TERRA NOSTRA

Schriften der Alfred-Wegener-Stiftung 2003/4

9th International Symposium on Antarctic Earth Sciences

Antarctic Contributions to Global Earth Science

September 8 – 12, 2003
Potsdam, Germany

Programme and Abstracts

IMPRESSUM

Terra Nostra

Heft 2003/4: 9th International Symposium on Antarctic Earth Sciences (ISAES IX)
Antarctic Contributions to Global Earth Sciences
September 8 – 12, 2003 - Potsdam, Germany
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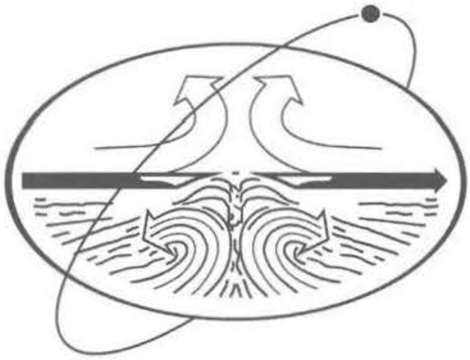

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9th International Symposium on Antarctic Earth Sciences

8-12 September 2003

Hosted by:
University of Potsdam and
Alfred Wegener Institute for Polar and Marine Research

Antarctic Contributions to Global Earth Science

Programme & Abstracts

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Contents

GENERAL INFORMATION

INTRODUCTION

The call for papers for the various symposium themes resulted in a total number of 176 oral papers to be presented and 200 posters as well as about 20 maps. Due to this large number of contributions it was necessary to organize three parallel oral sessions during the five days of the symposium and three poster sessions.
From Monday to Thursday, the program will start at 08.00 a.m., on Friday at 08.30 a.m., with plenary talks presenting scientific highlights of Antarctic Geoscience. The detailed program is shown right after this general information. Please consult the notice board in the symposiums office for alterations of the program and for technical information.
Members of the organizing committee and local staff are identified by blue badge colours. If you have questions, please do not hesitate to ask them.

REGISTRATION AND SYMPOSIUM OFFICE

The registration desk will be open on Sunday, September 7, in the Science Park "Albert Einstein" on the Telegrafenberg, from 16.00 to 19.00 p.m. in building H, and from Monday through Friday in the symposium office in the lobby of the AudiMax at Potsdam University. The symposium office will be open from Monday to Friday from 08.00 a.m. to 18.00 p.m.. Please ask the secretariat staff for any help you need. The secretariat is equipped with telephone, telefax and photocopier.

ON-SITE REGISTRATION FEE

Full participant..€ 350
Student..€ 140
Accompanying person..................................€ 140

Single day registration (without icebreaker, boat trip, conference dinner)
1 day (including abstract volume)..................€ 50
other days (per day).......................................€ 30

BADGES

Badges must be worn for identification and access to all activities of the symposium.

TRAVEL GRANTS

Participants who have been awarded travel grants will receive them in the symposium office. Please ask the staff for information.

INTERNET ACCESS

Internet access is available in the Internet Café located close to the symposium office during working hours of the office.

INFORMATION AND MESSAGES

A message board will be available in the registration area. Please stop by periodically to check the messages.
An information board will also be placed in the same area for posting and receiving information pertinent to ISAES attendees.

BANKING

There is no bank inside the university campus. Numerous banks can be found in the center of Potsdam, i.e. on the ways to your hotels, with normal working hours from 09.00 to 17.00. Bank automats are also located at many places and banks where money can be taken with credit cards after closing time.

POSTAL SERVICES

Postal services are available in the main post office "Am Kanal 16-18" in the eastern part of the town center. A special official postal stamp will be in use on September 8 dedicated to the opening of the ISAES conference. Please contact the symposium office if you are interested to obtain such a stamp.

COMMUNICATIONS

Pay telephones are located at some places in the university campus and in town.
Germanys international code is 49; Potsdam's area code is 0331 for domestic calls.
Messages received by the symposiums office will be posted on the message board.

FIELD TRIPS AND EXCURSIONS

See pages 13 to 17 of the 2nd circular for the field trips. As some field trips haven been cancelled due to low interest, please inform yourself on the actual state of the field trips in the updates of our ISAES website. For additional information, please contact the symposium office.

PARKING

There are several parking facilities around the university campus where free places should be available because students are on summer break.

MEALS

An arrangement has been made for the conference participants to have lunch at the university canteen (Mensa). Please inform yourself in the symposium office. There are also some cafés, kiosks and small restaurants in and around the campus area; there will be a list of selected restaurants in your conference bag.

COFFEE AND TEA

Coffee and tea will be available during the coffee brakes indicated in the program in the lobby area of the AudiMax and outside lecture hall B. Beer and mineral water will be served during the poster sessions.

WORKING GROUPS, SPECIALISTS GROUPS AND OTHER MEETINGS

Several meetings are planned before and after the conference. Time and locations are available at our web site and can be found on the information board at the symposium office. If room is needed for ad hoc meetings, please contact the secretariat.

SYMPOSIUM DINNER

The symposium dinner will take place as an informal dinner at the "Krongut Bornstedt" on Thursday, September 11 starting at 19.00. The Krongut is a historical place which has been rebuild after a catastrophic fire in the middle of the 19^{th} century by the Prussian King Friedrich Wilhelm IV who wanted to see it as his "Italian village". In the last years it has been completely restored and provides several traditional stores and some restaurants. In one of these restaurants, having its own beer brewery, the conference dinner will take place. As the Krongut is in short distance from the conference site, it is planned to walk there after the poster session. For those being interested a guided tour to the Bornstedt church and cemetery will be offered. At 23.00 you will be brought to your hotels by buses. The conference dinner is included in the registration fee. Additional tickets can be purchased at the symposium office for € 50.

BOAT TRIP

A boat trip through lakes, rivers and channels surrounding Potsdam is organized for all participants and accompanying persons in the afternoon of Wednesday, September 10. This trip will give you the opportunity to get an impression of the scenic (glacially formed) landscape as well as castles, villages and other historic buildings. The boat trip starts exactly at 14.30 from the pier at the "Lange Brücke" (river side of Hotel Mercure). Everybody being interested should go there on foot or use public or private transports. The boat trip is included in the registration fee. Snacks and beverages are on your own charge. The trip will end at approx. 19:00.

ORAL PRESENTATIONS

Every oral presentation is scheduled for 20 minutes, 5 minutes discussion included. This will be strictly adhered to by the session chairs. Succeeding speakers are kindly asked to be ready to mount the podium right after the preceding speaker.
Three venues will be used for the oral sessions. These are designated as AudiMax and Hall B in building 8, and as Hall C in building 11. For orientation the lecture halls and building numbers are marked in the plan printed in this volume and will be marked at the campus area with special signs.

Each venue will have one 35 mm slide projector, one overhead projector and a PowerPoint presentation facility. All presenters and chairpersons are asked to familiarize themselves with the operation of the projectors and lights prior to their presentation sessions. An orientation will be given by technical staff starting 15 minutes before each session.

All oral session speakers must check-in at the preparation room (room No 0.64 in building 8 located close to the symposiums office) 24 hours prior to their presentations. All PowerPoint presentations must be submitted in the preparation room to be downloaded to a main computer and transferred to the lecture hall where speakers will give their talks. Technical staff will have each single presentation cued up and ready to go when speakers arrive to the lecture hall. Speakers may not use their own laptops in technical sessions.

Overhead projectors, 35 mm slide projectors, slide trays (straight magazines, no carousels), and computers are available in the preparation room to practice preparation.
The preparation room will be open from Monday to Thursday from 07.30 to 17.00 on Friday from 07.30 to 12.00.
Important: The preparation room will be reserved on Monday from 07.30 to 14.00 hours for speakers having a plenary or oral talk on Monday.

POSTER PRESENTATIONS

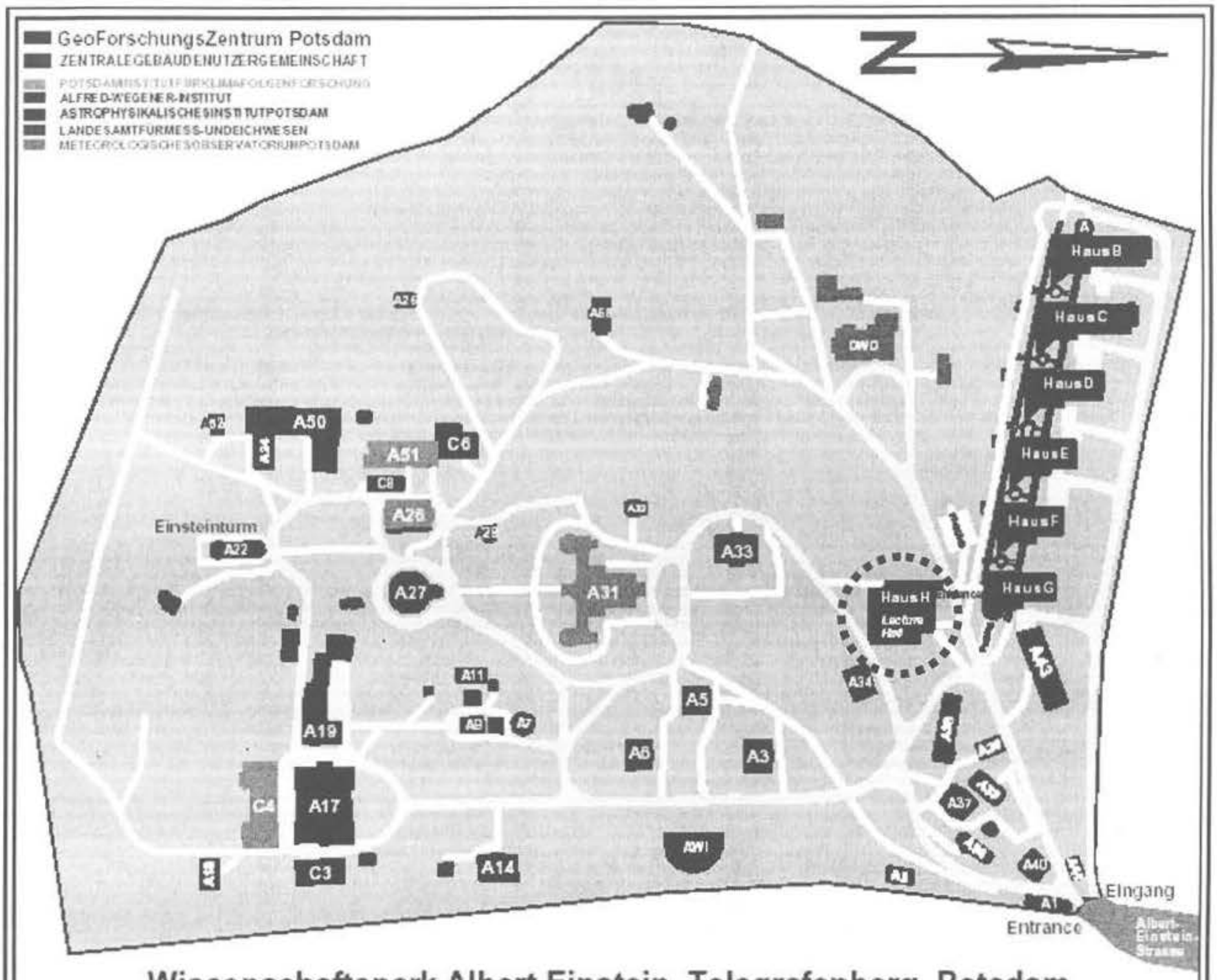
Posters thematically grouped, and clearly identified by numbers in both, the program and the display, in order to facilitate easy location. Authors are expected to be present during the respective sessions to answer questions. Posters should not exceed 120 cm heights and 85 cm widths. Please note that only magnets are allowed for fixing the posters which will be available on the sessions. Please don't use any other fittings like pins or tape! For every poster session the posters should be fixed till 15.00 h and taken off till the first coffee break next morning.

MAP EXPOSITION

A permanent exposition of new Antarctic maps related to the earth sciences will be shown in the poster presentation room

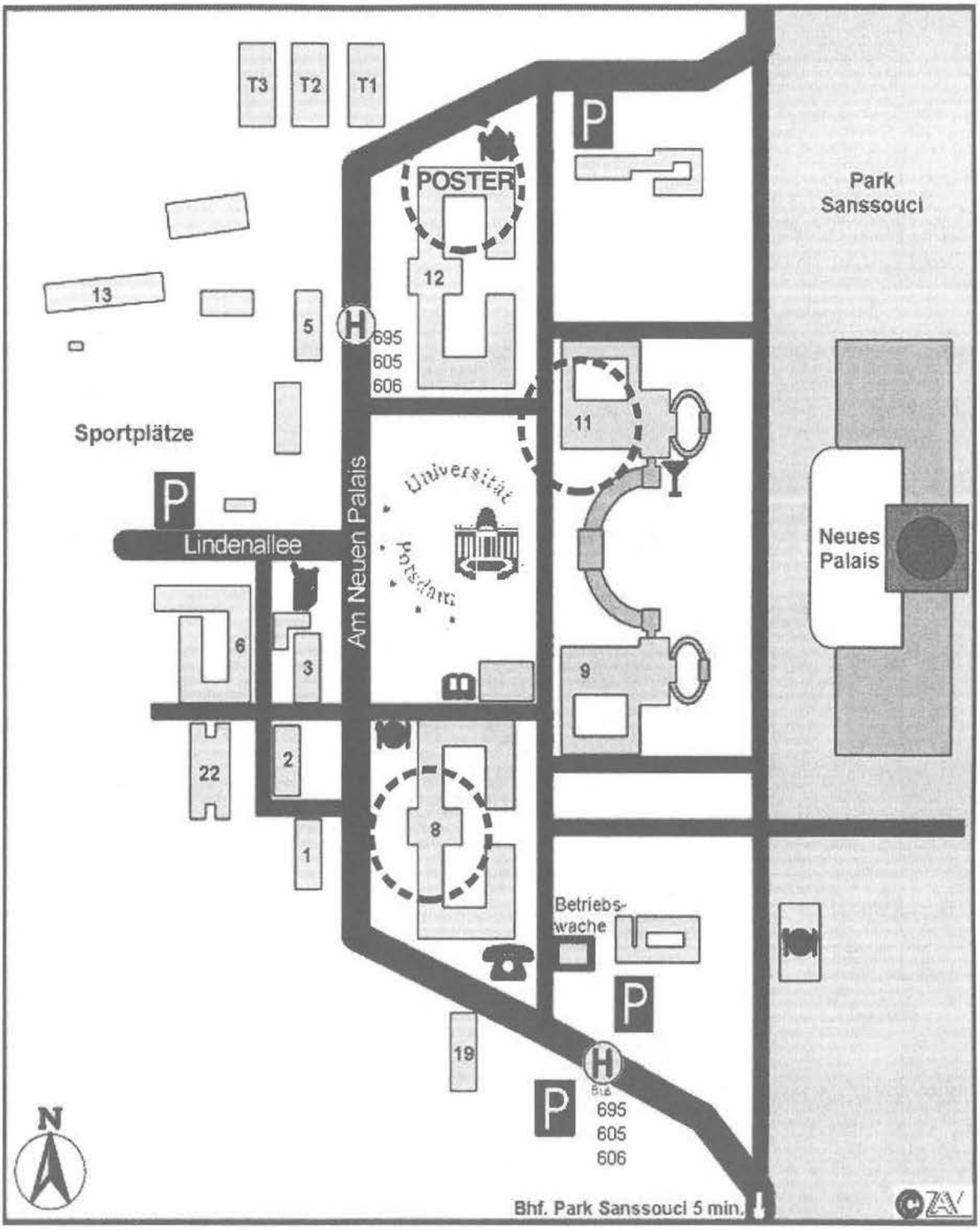
PROCEEDINGS

Dieter Fütterer will be the scientific editor for the proceedings volume. Perspective authors will find information and instructions for publication and format of the manuscripts in the conference bag.



Wissenschaftspark Albert Einstein, Telegrafenberg, Potsdam

Map of Potsdam University



Symposium Timetable

Time	Sunday 7. Sept.	Monday 8. Sept.	Tuesday 9. Sept.	Wednesday 10. Sept.
08.00-09.10	ANTEC-Workshop (08.00-16.00)	Opening Ceremony (08.30)	Plenaries	Plenaries
09.10-10.10.	SDLS-Workshop		Oral P.	Oral P.
10.10-10.40	(09.00-13.00)	Coffee Break Plenaries	Coffee Break	Coffee Break
10.40-12.20	SCAR-GSG (09.00-16.00 ?)	(11.00-12.10)	Oral P.	Oral P.
12.20-13.30		Lunch Break	Lunch Break	Lunch Break and End of Session
13.30-15.10		Oral P.	Oral P.	Boat Trip on River Havel (14.30-19.00)
15.10-15.40		Coffee Break	Coffee Break	
15.40-17.00		Oral P.	Oral P.	
17.00-20.00		Postersession I	Postersession II	
		ACC/IODP (20.00-22.00)	ANDRILL (20.00-22.00)	
			APAG (20.00-22.00)	

Time	Thursday 11. Sept.	Friday 12. Sept.	Saturday 13. Sept.	Sunday 14. Sept.
08.00-09.10	Plenaries	Plenary (08.30-09.10)	EANT-Workshop (09.00) (full day)	ANZAPF-Workshop (09.00) (full day)
09.10-10.10.	Oral P.	Oral P.		
10.10-10.40	Coffee Break	Coffee Break		
10.40-12.20	Oral P.	Oral P.		
12.20-13.30	Lunch Break	Lunch Break		
13.30-15.10	Oral P. (13.30-15.30)	Oral P. (13.30-14.50)		
15.10-15.40	Coffee Break	Coffee Break		
15.40-17.00	Postersession III (16:00-18.00)	Closing Session (15:00)		
19:00	Conference Dinner			

Timetable for oral presentations as of August 13th, 2003

Time	MONDAY 08th AudiMax – Building 8	MONDAY 08th Hall B – Building 8	MONDAY 08th Hall C– Building 11
8.30	**Opening Ceremony**		
10.00	Ford: The road to Gondwana via the early SCAR symposia.		
10.30	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK
	PLENARY-1 IN AUDIMAX		
11.00	Frimmel: Mesoproterozoic continental growth: The South Africa–East Antarctica connection.		
	1 RODINIA		
11.30	Yoshida et al.: The role of the circum-East Antarctic orogen in the east Gondwana assembly.		
11.50	Jacobs et al.: Major structural elements of the East African/Antarctic Orogen between the Grunehogna and Napier cratons and significance for the amalgamation of Gondwana.		
12.10	LUNCH BREAK	LUNCH BREAK	LUNCH BREAK
	1 RODINIA	7 OBSERVATORIES	5 GLACIAL PROCESSES
13.30	Mikhalsky & Grikurov: East Antarctica crust growth from isotopic data.	Eckstaller & Müller: Seismological network and geophysical observatory at Neumayer Base, Antarctica.	Bolshiyanov: Current glaciation of Bunger Hills as an indicator of Antarctic glacierization at the last glacial maximum.
13.50	Fitzsimons: Detrital zircon populations in metasedimentary rocks from DML and W Australia: is the 1.1 Ga Maud Province a collisional suture between southern Africa and Australia?	Bitelli et al.: Local geoid determination by gravimetric measurements in NVL.	Baroni et al.: Warm-based ice advance and continental chemical weathering documented by the "Ricker Hills Tillite", Victoria Land, Antarctica.
14.10	Jacobs et al.: New age constraints for Grenville-age metamorphism in W central DML, and implications for the palaeogeography of Kalahari in Rodinia.	Meloni et al.: Some recent characteristics of geomagnetic secular variation in Antarctica.	White & Gore: Ice marginal processes and landforms in the southern PCM, East Antarctica.
14.30	Bauer et al.: Late Mesoproterozoic arc and back-arc volcanism in the Heimefrontfjella and implications for the palaeogeography at the southern margin of the Kapvaal-Grunehogna craton.	Korepanov et al.: Vernadsky Antarctic Station geomagnetic observatory: recent upgrade and results.	Lloyd Davies et al.: Cold-based glacier advance in the Allan Hills, Antarctica: evidence and preservation potential.
14.50	Fanning et al.: Whither the Mawson Continent?		Atkins: Cold-based glacial erosion and deposition features in the Dry Valleys, Antarctica.
15.10	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK
	1 ENDERBY LAND	9 OTHERS	5 GLACIAL PROCESSES
15.40	Hokada et al.: Archaean–Early Proterozoic history of the Napier Complex: constraints from U-Th-Pb zircon and monazite chrono-Logy.	Hanfland & Geibert: Natural radioactive tracers between Africa and Antarctica: preliminary results from POLARSTERN expedition ANT-XX/2.	Csathó et al.: Geomorphologic mapping by airborne laser scanning in southern VL, Antarctica.
16.00	Harley & Kinny: The age of UHT metamorphism in the Napier Complex.	Nobes & Petterson: Non-invasive mapping of hydrocarbon-contaminated sites using near-surface geophysical methods in the McMurdo Sound region.	Sletten & Hallet: Surface stability and contraction crack development on various forms of ground ice in the Dry Valleys, Antarctica.
16.20	Kelly & Harley: Metamorphic events in the Napier Complex revisited: a re-interpretation of U-Pb SHRIMP data.		Schaefer et al.: Landform and cryogenic features of volcanic-rock landscape of Keller Peninsula, Admiralty Bay, Antarctica.
16.40	Kawasaki & Motoyoshi: High-pressure and high-temperature phase relations of a sillimanite-cordierite-sapphirine granulite from Rundvågshetta, Lützow-Holm Complex.		del Valle & Inbar: Middle Holocene raised beaches from Potter Peninsula, King George Island, South Shetland Islands, Antarctica.
17.00	POSTER SESSION I AND BEER AT THE "OBERE MENSA" / BUILDING 12		
20.00	END OF SESSION	END OF SESSION	END OF SESSION

	TUESDAY 09th AudiMax – Building 8	TUESDAY 09th Hall B – Bulding 8	TUESDAY 09th Hall C– Building 11
	PLENARY-2 IN AUDIMAX		
08.00	Leitchenkov et al.: Identification of continent-to-ocean boundary on the Antarctic passiv margin.		
	PLENARY-3 IN AUDIMAX		
08.30	Crame: Polar biodiversity: an historical perspective.		
	1 PRINCE CHARLES MTS.	5 JAMES ROSS-SEYMOUR ISL.	2 BREAK UP
09.10	Laiba et al.: Main geological features of the PCM region by results of Soviet (Russian) Geological investigations (1970-2000).	Strelin et al.: New data related to Holocene landform development and climate change in James Ross Island.	Ghidella: Crustal ages in the western Weddell Sea between break-up and Chron 34: their relationship with the opening of the South Atlantic Ocean.
09.30	Phillips et al.: Structure of Cumpston Massif, southern PCM, Mac. Robertson Land.	Pirrie et al.: High resolution stratigraphy of The Gustav Group, James Ross Island.	König & Jokat: When and how did the early Weddell Sea develop?
09.50	Corvino & Boger: Structural evolution of the northern Mawson Escarpment southern PCM.	Kriwet: Post-Jurassic Antarctic fish diversity pattern.	Gohl & Eagles: Tectonic and magmatic evolution of conjugate continental margins: a multi-stage Rift event between New Zealand and W Antarctica.
10.10	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK
10.40	Boger: Barrovian-type metamorphism from the Archaean Ruker Terrane southern PCM.	Martin: Biostratigraphy of the Mosasauridae (Reptilia) from Antarctica.	Eagles & Gohl: Animated reconstruction of gridded gravity anomalies in the SE Pacific.
11.00	Belton et al.: Post Pan-African cooling and exhumation of the S Mawson Escarpment.	Crame et al.: Maastrichtian paleoenvironments of Antarctica.	Larter: What caused Late Cretaceous rifting between New Zealand and West Antarctica?
11.20	Wilson et al.: A regional structural interpretation of the southern PCM, East Antarctica.	Hara: Bryozoen growth-forms as palaeoenvironment indicators of the La Meseta Formation (Eocene), Seymour Island, West Antarctica.	Cande & Stock: Tertiary seafloor spreading between East and West Antarctica and implications for Antarctic lithosphere structure.
11.40	Wang et al.: Advances in SHRIMP geochronology and their constraints on understanding the tectonic evolution of the Larsemann Hills, East Antarctica.	Case: The Late Eocene, terrestrial, vertebrate fauna from Seymour Island: the tails of the Eocene Patagonian size distribution.	Lawver & Gahagan: Antarctic Marginal Gravity Highs AMGH and the tectonic evolution of the East Antarctic margin.
12.00	Zhao et al.: Neoproterozoic accretionary tectonics of the Prydz Belt: implications for the assembly of the EAC and Gondwana.	Smellie et al.: Eruptive setting of the Miocene-Recent James Ross Island Volcanic Group.	Dalziel et al.: Bransfield Basin and Cordilleran Orogenesis.
12.20	LUNCH BREAK	LUNCH BREAK	LUNCH BREAK
	1 DRONNING MAUD LAND		3 PLUME-LITHOSPHERE INTERACTION
13.30	Bisnath et al.: Structural geology and geochronology of the Gjelsvikfjella area, northern Maud Belt, East Antarctica.	Hambrey et al.: Neogene glacial deposits in the James Ross Island Volcanic Group.	Brown et al.: Break-up and seafloor spreading between Antarctica, Greater India and Australia.
13.50	D'Souza et al.: Characterization of A-type granitoids occuring in east Mühlig-Hoffmannfjella ranges, central DML.	Francis et al.: Biodiversity and climate change in Antarctic Paleogene floras.	Direen et al.: Integrated potential field modelling and deep seismic interpretation: examples from the East Antarctic margin.
14.10	Baba et al.: Sapphirine granulite from Schirmacher Hills, central DML.	Cantrill & Poole: Vegetation composition of Cretaceous and Tertiary floras of the Antarctic Peninsula as evidenced by the fossil wood record.	Stagg & Colwell: The deep-water East Antarctic continental margin from 38-152°E: overview of a new integrated geophysical data set.
14.30	Engvik et al.: Magma-driven hydraulic fracturing and infiltration of CO_2-H_2O fluids into high-grade crytaslline rocks, DML.	Dutra & Fallgatter: Additional paleofloristic evidence of dry and warm climate in the Early Tertiary of northern Antarctic Peninsula.	Boger & Wilson: Strike-slip faulting related to the rifting of Gondwana, evidence from the Lambert drainage basin, East Antarctica.
14.50	Keshava et al.: Fluid inclusion characteristics of charnockite-granite suite in Mühlig-Hoffmannfjella, central DML.	Ashworth et al.: The Neogene terrestrial biota of Antarctica.	Lisker et al.: The Vestfold Hills between Lambert rifting and Gondwana break-up: evidence from apatite fission track dating.
15.10	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK
	1 NVL-TAM-ELLSWORTH MTS.	5 STRATIGRAPHY TAM / KING GEORGE ISL.	
15.40	Henjes-Kunst et al.: SHRIMP-dating of high-grade metamorphic and igneous rocks from Oats Land at the Pacific margin of TAM.	Collinson et al.: Permian-Triassic boundary in the central Transantarctic Mountains.	Sutherland: Late Cretaceous-Cenozoic Antarctic deformation predictions from the South Pacific and global plate reconstructions.
16.00	Weaver et al.: Accretion of the Cambrian Bowers Terrane arc to the Gondwana margin: evidence from conglomerate provenance.	Wilson et al.: Integrated chronostratigraphic calibration of the Oligocene-Miocene boundary at 24 ±0.1 Ma from the CRP-2A drill core, Ross Sea.	Finn et al.: Definition of a Cenozoic alkaline magmatic province in the SW Pacific without rift or plume origin.
16.20	Goodge et al.: Rift- to active-margin sedimentation in the Neoproterozoic and lower Paleozoic siliciclastic rocks, central Ross Orogen.	del Pilar et al.: Volcanism and taphoflora of the Cretaceous-Tertiary interval, King George Island, Antarctica.	Fielding et al.: Stratigraphic architecture of W Victoria Land Basin re-interpreted from stratigraphic and seismic reflection data, Cape Roberts.
16.40	Fernandez et al.: New geological survey at Patriot Hill (80°S), Ellsworth Mts.	Santana & Dumont: Geology around the Ecuadorian Station Pedro Vicente Maldonado.	Kleinschmidt & Läufer: The Matusevich Fracture Zone, Oates Land.
17.00	POSTER SESSION II AND BEER AT THE "OBERE MENSA" / BUILDING 12		
20.00	END OF SESSION	END OF SESSION	END OF SESSION

WEDNESDAY 10th AudiMax – Building 8	WEDNESDAY 10th Hall B – Bulding 8	WEDNESDAY 10th Hall C– Building 11

PLENARY-4 IN AUDIMAX

08.00 Palmeri et al.: Ultra-high-pressure metamorphism at the paleo-Pacific margin of Gondwana: the Lantermann Range in Antarctica.

PLENARY-5 IN AUDIMAX

08.30 Hervé et al.: Patagonia – Antarctica connections before Gondwana break-up.

AudiMax – Building 8	Hall B – Bulding 8	Hall C– Building 11
2 ROSS OROGEN **09.10** Gootee & Stump: Depositional environment of the Byrd Group, Byrd Glacier area: a Cambrian record of sedimentation, tectonism, and magmatism on the paleo-Pacific continental margin of Gondwana	8 DATA BASES AND MAPS **09.10** Klenke & Schenke: A new bathymetric model for the Southern Ocean.	3 PLUME-LITHOSPHERE INTERACTION **09.10** Fitzgerald & Baldwin: Tracking the West Antarctic rift flank.
09.30 Stump et al.: Geological investigation of the Byrd Glacier discontinuity: progress report and working hypothesis	**09.30** Kamenev: The real minerogenic provinces of Antarctica.	**09.30** Hanemann & Viereck-Götte: New geochemical aspects to the petrogenesis of the Jurassic Ferrar igneous rocks from NVL.
09.50 Skinner: Geochemical variation in Robertson Bay Group, NVL, and correlation with Greenland Group of West Coast, South Island, New Zealand	**09.50** Vogt et al.: Metadata for Antarctic spatial data: towards ISO 19115 compliance.	**09.50** Mukasa et al.: Myth of the Dufek Plume: Nd, Sr, Pb, and Os isotopic and trace element data in support of a subduction origin.
10.10 COFFEE BREAK	**10.10** COFFEE BREAK	**10.10** COFFEE BREAK
10.40 Rocchi et al.: Mafic rocks at the Wilson-Bowers Terrane boundary and within the Bowers Terrane: clues to the Ross geodynamics in NVL, Antarctica	**10.40** Manning: Evolution of the SCAR GIANT programme.	**10.40** Elliot et al.: Beacon-Mawson field relations at Coombs and Allan Hills, south Victoria Land.
11.00 Bomparola et al.: Chemical response of zircon to fluid infiltration and high-T deformation: Howard Peaks Intrusive Complex, NVL, a case study.	**11.00** Berrocoso et al.: Geodetic research in Deception Island.	**11.00** Ferraccioli et. al.: Aerogeophysical investigations in the Jutulstraumen rift area, East Antarctica.
11.20 Läufer et al.: Late-orogenic structures in the Wilson Terrane and the western front of the Ross Orogen, NVL.	**11.20** Greku et al.: Argentine Island archipelago topography, bathymetry and geodetic GPS survey.	**11.20** Smith Siddoway: Structural evolution of the Ford Ranges, Marie Byrd Land, from kinematic analysis of brittle minor structures.
11.40 Bell: Planning for the International Polar Year (IPY) – 2007: an opportunity for earth sciences	**11.40** Aleshkova et al.: Free-air gravity anomaly map of the Antarctic (sector 60°W-90°E) and crustal models of the Antarctic continental margin	4 RECENT KINEMATICS **11.40** Armadillo et al.: Draped aeromagnetic survey over Mt. Melbourne volcano.
		12.00 Paulsen & Wilson: Volcanic cone alignments and the intra-plate stress field in the Mt. Morning Region, south Victoria Land, Antarctica.
13:00 END OF SESSION	**12.00** END OF SESSION	**12:20** END OF SESSION
LUNCH BREAK	LUNCH BREAK	LUNCH BREAK

14.30 – 19.00 BOAT TRIP ON HAVEL LAKES

	THURSDAY 11th AudiMax – Building 8	THURSDAY 11th Hall B – Bulding 8	THURSDAY 11th Hall C– Building 11

PLENARY-6 IN AUDIMAX

08.00 Bell et al.: Lake Vostok: ancient system, dynamic processes.

PLENARY-7 IN AUDIMAX

08.30 Gersonde: Neogene-Quaternary Antarctic cryosphere evolution – The view from Southern Ocean sediment archives.

Time	AudiMax – Building 8	Hall B – Bulding 8	Hall C– Building 11
	5 SOUTHERN OCEAN	6 GEOPHYSICAL DATA AND SUBGLACIAL GEOLOGY	4 RECENT KINEMATICS
09.10	Barker & Thomas: The onset and development of the Antarctic Circumpolar Current.	**09.10** Wilson et al.: Using flexural modelling and Geophysical data to define Neogene stratigraphic drilling targets in moat basins beneath McMurdo Ice Shelf.	**09.10** Adams: Pattern of uplift of Paleozoic terranes in NVL, Antarctica: evidence from K-Ar age profiles.
09.30	Maldonado et al.: Intensified northern Weddell Gyre flow and splitting of flow pathways since the Middle Miocene.	**09.30** Yamashita et al.: Reflection imaging of the crustal structure beneath the Mizuho Plateau, East Antarctica: SEAL 2000-2002.	**09.30** Bitelli et al.: NVL crustal deformation control: advances of VLNDEF programme.
09.50	Abelmann et al.: Palaeobiological evidence for iron-induced high productivity in the glacial Southern Ocean.	**09.50** Toda et al.: Multidisciplinary surveys for the crustal structure of the Lützow-Holm-Complex, Enderby Land, East Antarctica, SEAL 2000-2002.	**09.50** Bohoyo et al.: Development of Jane Basin by crustal fragmentation: southern margin of the South Orkney Microcontinent, Antarctica.
10.10	COFFEE BREAK	**10.10** COFFEE BREAK	**10.10** COFFEE BREAK
	5 SOUTHERN OCEAN		
10.40	O'Brien et al.: Sediment composition changes and recycled palynomorphs as guides to past ice volume changes in the Amery Ice Shelf drainage system: results from ODP Leg 188.	**10.40** Behrendt et al.: Shallow source aeromagnetic anomalies observed over the WAIS compared with coincident bed topography from radar ice sounding: new evidence for glacial "removal" of subglacially Erupted Late Cenozoic volcanic edifices.	**10.40** Mayer & Heck: Evaluation of an appropriate estimation strategy for the highly precise regional deformation network Antarctic Peninsula.
			4 SEISMICITY AND TECTONICS
11.00	Grützner et al.: Evidence for orbitally controlled size variations of the East Antarctic Ice Sheet during the Late Miocene.	**11.00** Davis & Blankenship: Subglacial morphology and structural geology along 150°W between the TAM front and the South Pole: new data from an airborne ice-penetrating radar survey.	**11.00** Galindo-Zaldívar et al.: Elephant Island recent tectonics in the framework of the Scotia-Antarctic-South Shetland block tripple junction, NE Antarctic Peninsula.
11.20	Kuvaas et al.: Seismic expression of deep-marine deposits attributed to glacial sediment flux in the Riiser Larsen Sea, East Antarctica	**11.20** Cianfarra et al.: Modelling the tectonic origin of the Aurora and Concordia trenches, Dome C area, East Antarctica.	**11.20** Fitzgerald et al.: Episodic Cenozoic denudation in the Shackleton Glacier area of the TAM: a record of changing stress regime?
11.40	Gore et al.: Multiple post-Miocene deglaciations and marine transgressions at Vestfold Hills, East Antarctica.	**11.40** Studinger et al.: Sub-ice geology inland of the TAM in light of new aerogeophysical data.	**11.40** Reading: East Antarctica: seismic structure and seismicity.
12.00	Webb: Integration of Antarctic Pliocene marine and low-mid lattitude sequence stratigraphic-stable isotopic data.		**12.00** Salvini & Storti: Do transform faults propagate and terminate in East Antarctic continental lithosphere?
12.20	LUNCH BREAK	**12.20** LUNCH BREAK	**12.20** LUNCH BREAK
	5 SOUTHERN OCEAN	6 SUBGLACIAL LAKES	4 SEISMICITY AND TECTONICS
13.30	Ramsey & Bartek: Determination of oldest extensive Antarctic glaciation and seismic facies classification, Ross Sea, Antarctica.	**13.30** Masolov et al.: Main results of the Russian ground-based geophysical research of the subglacial Lake Vostock, central East Antarctica.	**13.30** Kanao et al.: Lithospheric shear velocity models beneath continental margins in Antarctica inferred from genetic algorithm inversion for teleseismic receiver functions.
13.50	Brancolini et al.: Recent investigations of the George Vth Land continental margin, East Antarctica – WEGA project.	**13.50** Richter et al.: Acquisition ans analysis of aerogravity over subglacial lakes in East Antarctica.	**13.50** Müller & Eckstaller: Local seismicity detected by the Neumayer seismological network, DML: tectonic earthquakes and ice-related phenomena.
14.10	Scheuer & Gohl: Sedimentation processes on the continental rise of the western Bellingshausen Sea, West Antarctica.	**14.10** Wendt et al.: Geodetic observations to study ice surface deformation in the area of the Vostok core location.	**14.10** Wiens et al.: Preliminary results from the TAM seismic experiment – TAMSEIS.
14.30	Hernández-Molina et al.: Pliocene and Quaternary stratigraphic evolution of the Pacific margin of the Antarctic Peninsula offshore from Adelaide Island.	**14.30** Pötsch et al.: Response of subglacial Lake Vostok, Antarctica, to tidal forcing.	**14.30** Fischer et al.: Preliminary crust and upper mantle seismological model of TAM from TAMSEIS.
14.50	Hillenbrand et al.: Sediment drift formation on the Pacific margin of the Antarctic Peninsula: implications from ANTDRIFT project.		**14.50** Rosetti et al.: Cenozoic right-lateral strike-slip faultin in NVL: an integrated structural, AFT and $^{40}Ar/^{39}Ar$ study.
15.10	Volpi et al.: The effects of biogenic silica on sediment compaction on the Pacific margin of the Antarctic Peninsula.		**15.10** Greku et al.: Geodynamic features and density structure of the Earth's interior within the Scotia Arc with geoid and altimetric data.
15.30	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK
16.00	POSTER SESSION III AND BEER AT THE "OBERE MENSA" / BUILDING 12		
18.00	END OF SESSION	END OF SESSION	END OF SESSION

FRIDAY 12th
AudiMax – Building 8

PLENARY-8 IN AUDIMAX

08.30 Wilson: The SCAR ANTEC initiative: exploring neotectonic processes in Antarctica.

2 ROSS OROGEN

09.10 Roland & Damaske: Structural trends and plate boundaries at the Pacific margin of Antarctica.

09.30 Glen & Percival: Convergent and transform boundaries along the SE Australian sector of the proto-Pacific Gondwana margin in the Ordovician.

09.50 Tessensohn: Active margins of Antarctica and Gondwana: evidence for the existence of the Pacific convection cell since the Cambrian.

10.10 COFFEE BREAK

2 ANTARCTIC PENINSULA

10.40 Trouw et al.: Tectonic evolution of the Trinity Peninsula Group and correlatives.

11.00 Bradshaw et al.: The View Point Conglomerates: a probable upper fan deposit in the accretionary wedge of the Triassic Trinity Peninsula Group, N Antarctic Peninsula.

11.20 Vaughan et al.: A new tract-based interpretation and evidence for accretion during sinistral transpression of the Trinity Peninsula Group, Antarctic Peninsula.

11.40 Millar et al.: Provenance of the Trinity Peninsula Group, northern Antarctic Peninsula.

12.00 Flowerdew et al.: Provenance and tectonic setting of Pre-Jurassic rocks at the English Coast, eastern Ellsworth Land.

12.20 LUNCH BREAK

2 ANTARCTIC PENINSULA

13.30 Wendt et al.: Petrology, textures and geochronology of metamorphic rocks from the Antarctic Peninsula – a compilation.

13.50 Kraus & Miller: Subduction related dyke systems of the South Shetland Islands, West Antarctica,- tracing geodynamic history combining structural, geochemical and isotopic data.

14.10 Grad et al.: Seismic crustal structure of West Antarctica between Elephant Island and Marguerite Bay.

14.30 Menichetti et al.: Tectonic evolution of the Fueginan Andes and the Magellan fold-and-thrust belt (Tierra del Fuego Island) since Mesozoic.

14.50 COFFEE BREAK

15.00 CLOSING SESSION IN AUDIMAX

FRIDAY 12th
Hall B – Bulding 8

4 GLACIAL ISOSTASY

09.10 Ivins et al.: Mass balance and present-day Antarctic rebound and gravity change.

09.30 Bentley et. al.: Relative sea-level curves and ice-sheet history from the Antarctic Peninsula.

09.50 Manning: Vertical motion from Antarctic GPS base stations.

10.10 COFFEE BREAK

4 GLACIAL ISOSTASY

10.40 Scheinert et al.: Vertical crustal deformations in DML. Antarctica: observations versus model predictions.

11.00 Willis et al.: Horizontal crustal motions in the Antarctic interior: comparison of GPS measurements and post-glacial rebound model predictions.

11.20 Shibuya et al.: Ten years progress of Syowa Station, Antarctica, as a global geodesy network site.

5 METHODS

11.40 Damiani: Quartz grain surface textures as indicators of transport and depositional mechanisms in glacial marine sediments under the McMurdo / Ross Ice Shelf – Windless Bight.

12.00 Marinoni et al.: Grain size, mineralogy and geochemistry in Late Quaternary sediments from the western Ross Sea outer slope: proxies for climate change.

12.20 LUNCH BREAK

14.50 COFFEE BREAK

FRIDAY 12th
Hall C– Building 11

5 SIRIUS GROUP

09.10 Harwood et al.: Glacial stratigraphy and sea-ice diatom history suggest Late Neogene paleoenvironmental shift from polythermal to cold polar Antarctic Ice Sheet.

09.30 Paschier: Chemistry of diamicts and glacial Muds of the Sirius Group of the TAM: a longterm continental record of East Antarctic climate and glaciation.

09.50 Dickinson et al.: Preliminary ages from atmospheric ^{10}Be and nitrate for the Sirius Group, Dry Valleys, Antarctica.

10.10 COFFEE BREAK

5 ANTARCTIC PENINSULA MARINE

10.40 Anderson et al.: Do ice streams self-destruct?

11.00 Amblas et al.: Establishing the links between continental shelf glacial troughs and continental rise development west of the N Antarctic Peninsula.

11.20 Serrano & López-Martínez: The periglacial morphodynamic system in the South Shetland Islands, western Antarctica.

11.40 Greku: Topography and dynamics of the ice cover for the Graham Land between 65-66°S with the ERS SAR interferometry.

12.00 Mori et al.: Surface movement of stone-banked lobes and terraces on Ring Crag, James Ross Island, Antarctic Peninsula.

12.20 LUNCH BREAK

5 WEST ANTARCTIC ICE SHEET

13.30 Bentley et al.: Holocene history of George VI ice shelf, Antarctic Peninsula: inferences from lake sediments.

13.50 Scherer: Past (and future) collapse of the West Antarctic Ice Sheet: redux.

14.10 LeMasurier et al.: Anomalies in the erosion of Marie Byrd Land volcanoes over the past 35 Ma: implications for the history of the West Antarctic Ice Sheet.

14.50 COFFEE BREAK

Overview and Plan of Poster Sessions as of July 28th
Posters will be presented by first authors if not differently marked

Poster Session I
Monday 08th September 2003, 17.00 to 20.00

Symposium Theme 1:
Mechanisms of Continental Growth

Regional Comparisons

1 C. Rolf & F. Henjes-Kunst: A Cambrian paleomagnetic pole for Antarctica – improving the poor paleomagnetic database for Gondwana during the Paleozoic.

2 N.W. Roland: 500 Ma granitoids in East and West Antarctica: key to different plate tectonic settings.

3 I.C.W. Fitzsimons: Correlation of the 1.1 Ga Maud Province with its Gondwana neighbours and the continuation of the East African Orogen into Antarctica.

4 I.C.W. Fitzsimons & J. Jacobs: IGCP 440 Geodynamic map of Rodinia – draft map of Antarctica.

Western Dronning Maud Land

5 W. Bauer, W. Fielitz, J. Jacobs, C.M. Fanning & G. Spaeth: Mafic Dykes from Heimefrontfjella and implications for the post-Grenvillian to pre-Pan-African geological evolution of western Dronning Maud Land.

6 J. Jacobs, W. Bauer & R. Schmidt: Magnetic susceptibilities of the different tectono-stratigraphic terranes of Heimefrontfjella, western Dronning Maud Land, East Antarctica.

Central Dronning Maud Land

7 S. Baba, M. Owada, A.L. Läufer, S. Elvevold, K. Shiraishi & J. Jacobs: Geology of Filchnerfjella in Dronning Maud Land, East Antarctica: a preliminary report of Japan-Norway-Germany joint geological investigation.

8 S. Elvevold, A.K. Engvik, S. Baba, M. Owada & A.L. Läufer: Decompressional evolution of granulites from Dronning Maud Land, East Antarctica.

9 A.L. Läufer, M. Owada, S. Baba, S. Elvevold, K. Shiraishi & J. Jacobs: Structural geology of Filchnerfjella and adjacent areas in central Dronning Maud Land (East Antarctica): preliminary results.

10 V. Ravikant: Tectono-metamorphic history recorded in high-grade rocks from Filchnerfjella: implications for the transition between Grenvillian- and Pan-African-aged mobile belts in central Dronning Maud Land, East Antarctica.

11 E.V. Mikhalsky, K. Hahne, H.-U. Wetzel, F. Henjes-Kunst & B.V. Beliatsky: Geological evolution of the Schirmacher Hills from U-Pb zircon dating and a comparison with the Wohlthat Massive, central Dronning Maud Land.

12 O. Shulyatin & A. Laiba: Tourmaline pegmatites in Schirmacher Oasis (East Antarctica).

Enderby Land and Kemp Land / East Antarctica

13 M. Funaki, P. Dolinsky, N. Ishikawa & A. Yamazaki: Why does large magnetic anomalies appear in Archean crust of the Mt. Riiser Larsen area, Amundsen Bay, Enderby Land, Antarctica?

14 T. Tsunogae, M. Santosh, Y. Osanai, T. Toyoshima, M. Owada, T. Hokada & W.A. Crowe: Carbonic fluid inclusions in osumilite- and sapphirine-bearing ultrahigh-temperature granulites from Bunt Island in the Napier Complex, East Antarctica.

15 K. Sato, T. Miyamoto & T. Kawasaki: Experimental study of Fe-Mg exchange reactions between orthopyroxene and spinel and its application to a geothermometer.

16 F.C. Schröter, C.L. Clarke & N.J. Pearson: Trace and REE fractionation in medium-P intermediate to mafic migmatites: effects of mineral composition and Pand T on trace and REE distribution.

Prince Charles Mountains

17 B.V. Belyatsky, E.N. Kamenev, A.A. Laiba & E.V. Mikhalsky: Sm-Nd ages of metamorphosed volcanic and plutonic rocks from Mount Ruker, southern Prince Charles Mountains, East Antarctica.

18 A.V. Golynsky, V.N. Masolov, V.S. Volnukhin & D.A. Golynsky: Crustal provinces of the Prince Charles Mountains region and surrounding areas in the light of aeromagnetic data.

19 A.V. Golynsky, V.N. Masolov, V.S. Volnukhin & D.A. Golynsky: Magnetic anomaly pattern of the Grove Mountains region: implications for tectonic correlations.

20 A.A. Laiba, B.V. Beliatsky, D.M. Vorobiev, N.A. Gonzhurov & A.Yu. Melnik: Subalcaline polyphase pluton of Mount Collins (Prince Charles Mountains): results from latest studies.

East Antarctic 80°E – 120°E

21 S.L. Harley: The impact of 530-510 Ma Prydz Belt tectonism on the Archaean of the Rauer Islands: constraints from zircon-garnet-pyroxene REE relationships.

22 T. Hokada, S.L. Harley & K. Yokoyama: Peak and post-peak development of UHT metamorphism at Mather Peninsula, Rauer Islands: monazite U-Th-Pb and REE chemistry constraints.

23 I.C.W. Fitzsimons: Evidence for a continuation of the late Neoproterozoic Darling Fault Zone of western Australia to the Pacific margin of East Antarctica.

George V Land to North Victoria Land / Ellsworth Mountains

24 F. Talarico, G. Kleinschmidt & G. Di Vicenzo: The Mertz Shear Zone (George V Land): implications for Australia/Antarctica correlations and East Antarctic Craton/Ross Orogen relationships.

25 D. Perugini & G. Poli: Development of viscous fingering patterns during mingling/mixing processes between mafic and felsic magmas: evidence from late Ross intrusives in northern Victoria Land (Antarctica).

26 F. Henjes-Kunst: Single-crystal Ar-Ar laser dating of detrital micas from metasedimentary rocks of the Ross orogenic belt at the Pacific margin of the Transantarctic Mountains, Antarctica.

27 A.M. Fioretti, L.P. Black, F. Henjes-Kunst & D. Visona: Detrital zircon age patterns from a lage gneissic xenolith from Cape Phillips granite and from Robertson Bay Group metasediments, northern Victoria Land, Antarctica.

28 C. Perinelli & P. Armienti: The origin of pyroxenites and megacrysts in alkaline basaltic magmas from northern Victoria Land (Antarctica).

29 F. Hervé, J.P. Lacassie, R. Fernández & C.M. Fanning: SHRIMP U-Pb detrital zircon ages from the Liberty Hills Formation, Ellsworth Mountains, Patriot Hill area, Antarctica.

Symposium Theme 5:
Paleo-Environment of Antarctica: Causes and Effects of Climate Change

East Antarctic Oasis

30 K. Franke, D. Rößler, M. Melles, B. Wagner & H. Kupsch: Comparative studies of rare earth element and heavy metal loads and the corresponding natural organic matter fractions in sediments from three lakes of Amery Oasis, East Antarctica.

31 M. Melles, S.R. Verkulich, Z.V. Pushina & H.-W. Hubberten: Holocene sea-level and climate fluctuations in Bunger Hills, East Antarctica, reflected by the sedimentary diatom succession in Rybiy Khvost Bay.

32 S.R. Verkulich, M. Melles, Z.V. Pushina & H.-W. Hubberten: Holocene sea-level changes in Bunger Oasis, East Antarctica, as inferred from diatom assemblages in four sediment cores from modern bays and inlets.

33 B. Wagner, M. Melles, N. Hultzsch, H.-W., Hubberten, D. Gore & P. Doran: Late Quaternary environmental histories of the Amery Oasis, East Antarctica, and Taylor Valley, southern Victoria Land.

34 W.-D. Hermichen & U. Wand: On the late Quaternary history of ice sheet and climate in Dronning Maud Land, Antarctica,: a compilation of records on land.

Methods and Models

35 C. Baroni & G. Giorgetti: Electron microscopic characterization of "rock varnishes" from northern Victoria Land.

36 B. Hagedorn, R.S. Sletten, B. Hallet & E.J. Steig: Formation and characterization of ice-cemented soils in Victoria Valley, Antarctica.

37 D. Schulte & H.W. Schenke: Modelling of atmospheric water vapour in Antarctica using GPS.

38 H. Matsuoka, T. Sato & M. Funaki: Paleomagnetic and rock magnetic study of deep-sea sediments in central Wilkes Land margin.

Symposium Theme 7:
Antarctic Earth Sciences Observatories

39 M.J. Willis & L. Hothem: Construction of low power continuous operating remote GPS stations in southern Victoria Land.

40 F.J. Davey, C.R. Hutt & L. Tomlinson: An update on geophysical observatory operations at Scott Base and Vanda, McMurdo Sound.

41 P.R. Kyle, R. Aster, J. Crain, N. Dunbar, R. Esser, W.C. McIntosh, M. Richmond, M. Ruiz & L.J. Wardell: Monitoring volcanic activity at Mount Erebus, Antarctica.

A. Morelli, A. Delladio, R. Laterza & M. Russi: Italian seismographic observatories in Antarctica.

42 L. Cafarella, A. Zirizzotti, D. Di Mauro & A. Meloni: A new geomagnetic observatory at Dome C.

43 J. Manning: The status of continuous GPS stations in Antarctica and their contribution to global networks.

44 M. Kanao, H. Negishi, Y. Tono & K. Shibuya: Broadband seismic array deployment around the Lützow-Holm bay area, East Antarctica.

45 R.Kh. Greku, G.P. Milinevsky, Yu. Ladanovsky & P.V. Bahmach: Topographic and geodetic GPS survey on islands and in aquatoria of the Argentine Archipelago.

Symposium Theme 8:
Antarctic Data Bases and Maps

46 A.M. Reading: AnSWeR: the Antarctic Seismic Web Resource: http://rses.anu.edu.au/seismology/answer

47 J.R. Childs, N. Wardell, A.K. Cooper & G. Brancolini: The Antarctic Seismic Data Library System for Cooperative Research.

48 A.V. Golynsky, M. Chiappini, D. Damaske, F. Ferraccioli, C. Finn, T. Ishihara, V.N. Masolov, P. Morris Y. Nogi & R.R.B. von Frese: ADMAP – a digital magnetic anomaly map of the Antarctic.

49 A.M. Grunow: The Antarctic Rock Magnetic Database: an overview.

50 R.A. Askin & A.M. Grunow: The United States polar rock repository and Antarctic geologic database.

51 E.N. Kamenev: A new map of metamorphic facies of Antarctica 1 : 5 000 000.

52 A. Macario, D. Olbers, J. Thiede, G. König-Langlo, M. Reinke & H. Pfeiffenberger: Research platforms in polar regions – a portal approach.

53 R.Kh. Greku & G. Milinevsky: Topography and dynamics of the ice cover of Graham Land between 65-66°S from ERS SAR interferometry.

54 G. Milinevsky, V. Glotov, S. Kovalenok & K. Tretjak: Detailed Argentina Islands small ice cap geomorphology.

55 T.R. Greku: Bathymetric map and geomorphological features of the Argentine archipelago's sea-bed from Ukrainian (1998-2003) and British (1964-1965) soundings.

56 M. Berrocoso, C. Torrecillas, R. Páez, J.M. Enríquez-Salamanca, E. Ramírez, A. Fernández-Ros, A. Pérez-Peña & M.J. Gonzáles: Multidisciplinary scientific information support system (SIMAC) for Deception Island (South Shetland Islands, Antarctica).

57 M. Berrocoso, A. García, J. Martín-Davila, M. Catalán-Morollón, M. Astiz, E. Ramírez, C. Torrecillas & J.M. Enríquez-Salamanca: DEVCOL and GEODEC projects.

58 H.-J. Paech: Mapping results obtained in central Dronning Maud Land, East Antarctica.

59 M. Almavict: Absolute gravity measurements and collocated geodetic positioning techniques in Antarctica: a review. Implications for the polar cap.

60 F.J. Davey & V. Stagpoole: Bathymetry of the Ross Sea region.

61 H. Grobe, M. Diepenbroek, M. Reinke & R. Sieger: Archiving and distributing earth-science data with the information system PANGAEA.

62 P. Pulsifer & D.R. Fraser Taylor: Cybercartography in support of Antarctic earth sciences.

63 M. Alberti, N. Rastelli, R. Palmeri & C.A. Ricci: The Italian geological database and GIS of Antarctic rock samples.

Poster Session II
Tuesday 09th September 2003, 17.00 to 20.00

Symposium Theme 3: Plume-Lithosphere Interactions and Intra-Plate Rifting

Continent - Ocean Boundary

64 R.Kh. Greku, V.P. Usenko, K.M. Bondar & T.R. Greku: Earth's interior geodynamic features and density structure of the Scotia Arc with geoid and altimetric data.

65 D. Close & A. Watts: A geophysical study of the Wilkes Land margin, Antarctica.

66 J.B. Colwell, H.M.J. Stagg & N.G. Direen: Geology of the deep-water margin of East Antarctica between Queen Mary and George V lands.

67 V. Gandyukhin, G. Leitchenkov, Yu. Gouseva, G.A. Kudryavtsev, L. Kuznetsova, S.V. Alyavdin, S.V. Ivanov & A. Kazankov: Crustal structure, seismic stratigraphy and tectonic evolution of the Enderby Land and MacRobertson Land continental margin (southern Indian Ocean).

68 Yu. Gouseva, G.A. Kudryavtsev, V. Gandyukhin, G. Leitchenkov, S.V. Ivanov, A. Kazankov & A. Kuznetsov: Crustal characteristics and seismic stratigraphy of the Riiser Larsen Sea basin.

69 G.A. Kudryavtsev, A. Kuznetsova, S.V. Alyavdin & S.V. Ivanov: Geophysical investigation on the Princess Elisabeth margin (new data from 2003 season).

Central Rift - Geophysics / Tectonics

70 S. Danesi, A. Morelli & N. Pagliuca: The mantle signature of the Antarctic rift system imaged by seismic waves.

71 R.E. Bell, M. Studinger, G. Karner, C. Finn & D. Blankenship: Defining multiple stages of extension in central West Antarctica.

72 R. Buck, M. Studinger & R. Bell: Transantarctic uplift or Ross Sea collapse? Implications of new aerogeophysical data.

73 F. Davey & L. De Santis: A rifting model for the Victoria Land Basin in the McMurdo region.

74 M. Busetti & R. Geletti: Extension and inversion tectonic in the Victoria Land Basin (Ross Sea).

Prince Charles Mountains / Marie Byrd Land / Dronning Maud Land

75 F. Lisker & R. Brown: A Cretaceous cooling episode in the Beaver Lake area, northern Prince Charles Mountains.

76 A.L. Läufer & G. Phillips: Brittle structural architecture of the Lambert Glacier area (southern Prince Charles Mountains, Antarctica): a preliminary report.

77 V.S. Kamenetsky, E.V. Mikhalsky, G.M. Yaxley & G.T. Nichols: First results on carbonate-bearing picrites and olivine-phyric carbonite from East Antarctica.

78 W.E. LeMasurier: What supports the Marie Byrd Land dome?

79 M.L. Curtis, T.R. Riley, P.T. Leat & F. Ferraccioli: Tectonic inferences from Jurassic dyke swarms and alkaline pluton emplacement in western Dronning Maud Land.

Volcanism and Tectonics in Victoria Land

80 I. Nardini, P. Armienti, S. Rocchi, S. Tonarini & D. Harrison: Cenozoic volcanism of the western Ross embayment: any evidence for a mantle plume from isotope systematics?

81 E. Bozzo, F. Ferraccioli, E. Armadillo, G. Caneval, P. Armienti & S. Rocchi: An aeromagnetic hunt for Cenozoic alkaline intrusions north of Mariner Glacier, Victoria Land (Antarctica).

82 F. Ferraccioli & E. Bozzo: Is there a link between Cenozoic strike-slip faulting of the Transantarctic Mountains / Ross Sea Rift and the eastern margin of the Wilkes Subglacial Basin?

83 F. Ferraccioli, E. Armadillo, G. Tabellario, E. Bozzo, N. Agostinetti, D. Damaske & G. Reimayr: Geophysical modelling across the Rennick Graben structure, northern Victoria Land.

84 P.-S. Ross & J.D.L. White: Within-vent processes of explosive basaltic eruptions in the Ferrar Group, South Victoria Land.

Symposium Theme 4: Antarctic Neotectonic – The ANTEC Programme of SCAR

85 T. Wilson, S. Henrys, P. Barrett, M. Hannah, Chr. Fielding, R. Jarrard & T. Paulsen: New rift history of the southwestern Ross Sea, Antarctica.

86 S. Pondrelli, S. Danesi, S. Bannister & A. Morelli: The D-GOALS project, David Glacier: an outlook on Antarctic low seismicity.

87 A.M. Reading: The SSCUA broadband seismic deployment, East Antarctica.

88 R. Kobayashi & D. Zhao: Rayleigh wave group velocity distribution in the Antarctic region.

89 M. Hoffmann: Investigations of crustal structures beneath Dronning Maud Land, Antarctica.

90 K. Kaminuma & M. Kanao: Local seismic activity around Syowa Station, East Antarctica.

91 S. Tsuboi, E.R. Ivins, T.S. James & M. Kanao: Lithospheric stress due to ice-mass change and its implication to the March 25, 1998 Balleny Island earthquake.

92 Y. Nogi & K. Koizumi: Seafloor structure around the epicenter of the great Antarctic earth quake.

93 S. Pondrelli, L. Margheriti & S. Danesi: What does seismic anisotropy say about northern Victoria Land geodynamics?

94 Tassone, D. Yagupsky, E. Lodolo, A. Cominguez, M. Menichetti, J.F. Vilas, R. Geletti & H. Lippai: Seismic study of the northwestern boundary of the Scotia Plate on the Argentinean continental margin.

95 J. Galindo-Zaldívar, J.C. Balanyá, F. Bohoyo, A. Jabaloy, A. Maldonado, J.M. Martínez-Martínez, J. Rodríguez-Fernández & E. Suriñach: Crustal thinning and the development of deep depressions at the Scotia-Antarctic plate boundary (southern margin of Discovery Bank, Antarctica).

96 E.L. Flores-Márquez, E. Suriñach, J. Galindo-Zaldívar & A. Maldonado: Deep crustal structure of the central Drake Passage from 3-D gravity inversion (Shackleton Fracture Zone and west Scotia Ridge, Antarctica).

97 Maestro, L. Somoza, J. Rey, J. Martínez-Frías, J. López-Martínez, J. Galindo-Zaldívar, C. Sanz-de-Galdeano & J.J. Durán: Tectonic evolution of Deception Island (Bransfield ridge, western Antarctica).

98 J. López-Martínez, R.A.J. Trouw, J. Galindo-Zaldívar, A. Maestro, L.S.A. Simoes, F.F. Medeiros & C.C. Trouw: Tectonics and geomorphology of Elephant Island, South Shetland Islands.

99 M. Mayer & B. Heck: Activities to achieve an appropriate estimation strategy for the highly precise regional deformation network, Antarctic Peninsula.

100 J. Manning, G. Johnston, P.Digney & J. Dawson: Geodetic results from PCMEGA.

101 E. Armadillo, E. Bozzo, G. Caneva & G. Tabellario: Crustal features of the Rennick Graben structure and southern continuation of the Meso-Cenozoic fault system from GDS investigation and other geophysical constraints.

102 M. Amalvict, M.-N. Bouin, J. Hinderer & B. Luck: Absolute gravity and GPS measurements as constraints on the post-glacial rebound and present-day ice melting in the French sub-Antarctic Territories.

103 Bartel, P.R. Kyle, E. Desmarais, C. Meertens, C. Kurnik & B. Johns: Campaign and continuous GPS measurements of deformation at Mt. Erebus, Antarctica.

104 M. Hideki, O. Junnichi, N. Masao, M. Hideaki, T. Masashi, A. Igarashi, S. Koji & M. Kiichi: Late Quaternary relative sea-level change and reconstructed Antarctic ice history.

105 T. Janik: Seismic modelling of the Hero Fracture Zone, West Antarctica.

106 P.G. Fitzgerald, S.L. Baldwin, J.R. Pettinga, P.B. O'Sullivan & S.K. Kline: Thermochronologic and structural constraints on the evolution of the Transantarctic Mountains in the Reedy Glacier region.

107 Sasgen, J. Hagedoorn, V. Klemann, Z. Martinec & D. Wolf: Temporal variations of the geoid due to present and past glacial changes in Antarctica.

Symposium Theme 5:
Paleo-Environment of Antarctica: Causes and Effects of Climate Change

Stratigraphy and Paleoenvironment of James Ross and Seymour Islands

108 S.A. Marenssi: Eustatic sea-level changes in the northern Antarctic Peninsula during the Eocene.

109 S.A. Marenssi & S.N. Santillana: $^{87}Sr/^{86}Sr$ derived ages from the lower Sobral Formation (Paleocene), Seymour Island, Antarctic Peninsula.

110 D. Pirrie, S.A. Lomas, J.A. Crame & J.D. Marshall: Thyasira mounds from the Maastrichtian of Antarctica.

111 P. Jadwiszczak: Eocene penguins of Seymour Island: systematics, evolution and paleoecology.

112 J. Greenhalgh, D.J. Cantrill & J. Powell: Paleoenvironmental change in the Paleocene and Eocene of Seymour Island based on quantitative palynological analysis.

113 J.E. Martin & J.A. Crame: British Antarctic Survey vertebrate fossils from the Late Cretaceous Lopez de Bertodano Formation, Antarctic Peninsula area.

114 D. Lazarus: Evolution of Cenozoic Antarctic plankton biotas.

115 H. Griffiths: Using a GIS to analyse marine mollusc distribution in the Southern Ocean.

South Shetland Islands

116 S.B. Kim, Y.K. Sohn & M.Y. Choe: Volcanology and sedimentology of the Paleocene-Eocene Sejong Formation, Barton Peninsula, King George Island, Antarctica.

117 Gazdzicki: Stromatolites from the Oligocene of King George Island, West Antarctica.

118 E. Santana & J.F. Dumont: Coastal morphology of the fast uplifting coast: characteristics and implications. Antarctic Peninsula, Greenwich Island, South Shetland Islands.

119 Navas, J. López-Martínez, J. Casas, J. Machín, J.J. Durán, E. Serrano & J.A. Cuchi: Soil characteristics in Byers Peninsula, Livingstone Island, South Shetland Islands.

120 C.E.R. Schaefer, F.N.B. Simas, L.M. Costa, M.R. Albuquerque Filho, L.E. Dias, R.M. Michel & A. Tatur: Nutrients bioavailability of ornithogenic cryosols on volcanic rocks from Admiralty Bay, King George Island, Antarctica.

Cenozoic Sequences in the Prydz Bay Region

121 A.K. Cooper & P.E. O'Brien: ODP drilling in Prydz Bay – clues to East Antarctic Cenozoic glacial transitions.

122 P.E. O'Brien: Cainozoic continental slope and rise sediments from 38°E to 164°E, East Antarctica.

Sedimentary Sequences of the Ross Sea

123 M. Siegert, R. Dunbar & R. DeConto: ACE: Antarctic Climate Evolution.

124 ANDRILL Steering Committee & ANDRILL Science Management Office: ANDRILL - stratigraphic drilling for climate and tectonic history in Antarctica.

125 Bücker, R. Jarrard, W. Ehrmann, F. Niessen & T. Wonik: Downhole measurements and their use for stratigraphic correlations in the Ross Sea (Antarctica).

126 W. Ehrmann: The clay mineral signature of the sediments off Cape Roberts, Victoria Land Basin, Antarctica.

127 G. Salvi, C. Salvi, R. Tolotti, M. Testa, G. Cortese & A. Brambati: Late Quaternary climate variability recorded by micropalaeontological and geochemical data from the western Ross Sea slope.

128 R.D. Powell: Significance of a Transantarctic Mountain ice sheet on the Victoria Land Basin rift succession, Ross Sea, Antarctica.

129 N. Corradi, G. Fierro, F. Finocchiaro, R. Invaldi & A. Pittà: Late Quaternary sedimentation in the northern Western Basin (Ross Sea, Antarctica): seismostratigraphic features and sedimentary properties of calibrated cores.

130 N. Corradi, F. Finocchiaro, R. Invaldi & A. Pittà: Seismostratigraphic signature of the West Antarctic Ice Sheet advance during the Late Quaternary on the Little America Bassin (eastern Ross Sea, Antarctica).

131 P.J. Bart, A. Maas, K. Rotondo, D. Egan, S. Ghoshal & J. Holloman: Seismic-stratigraphic analysis of Ross Bank (central Ross Sea) suggests west-directed advance of the West Antarctic Ice Sheet from Marie Byrd Land.

Poster Session III
Thursday 11th September 2003, 16.00 to 18.00

Symposium Theme 2:
Changing Gondwana Margins through Accretion, Break-up and Dispersion

Ross Orogen

132 M. Olesch & F. Lisker: Phanerozoic denudation of George V Land, Antarctica, based on apatite fission track data.

133 L. Federico, L. Crispini & G. Capponi: The Ross orogeny in northern Victoria Land: geodynamic evolution and possible analogues.

134 G. Roghi, A.M. Fioretti & G. Capponi: Achritarchs in a thermo-metamorphosed sedimentary xenolith within Surgeon Island Granite (northern Victoria Land, Antarctica).

135 G. Capponi, L. Crispini, G. Di Vicenzo & R. Palmeri: Contrasting metamorphic evolution at the contact between terranes: microtextural and petrological evidence from shear zones in the Lanterman Range (northern Victoria Land, Antarctica).

136 F. Giacomini, R.M. Bomparola, L. Dallai & M. Tiepolo: Emplacement ages and interaction evidence from the mafic-felsic complex of Teall Nunatak (northern Victoria Land, Antarctica).

137 R.M. Bomparola: U-PB geochronology of the Granite Harbour Intrusives from the Wilson Terrane (northern Victoria Land – Antarctica.

138 S. Rocchi, G. Di Vicenzo, A.M. Fioretti & C. Ghezzo: Igneous activity during the waning stage of the Ross Orogeny in Victoria Land.

139 F. Ferracciolo, D. Damaske, E. Bozzo & F. Talarico: Aeromagnetic evidence for accreted(?) arc crust in the western Wilson Terrane.

140 F. Talarico, E. Armadillo, F. Ferraccioli & N. Rastelli: Magnetic petrology of the Ross Orogen in Oates Land (East Antarctica).

141 F. Talarico, R. Palmeri, E. Stump, B. Gootee & C.A. Ricci: Metamorphic evolution of the Selborne Group, and implications for the Byrd Glacier discontinuity, central Transantarctic Mountains, Antarctica).

Antarctic Peninsula

142 Jabaloy, J.C. Balanyá, A. Barnolas, J. Galindo-Zaldívar, F.J. Hernández-Molina, A. Maldonado, J.M. Martínez-Martínez, J. Rodríguez-Fernández, C. Sanz de Galdeano, L. Somoza, E. Suriñach & T. Vázquez: The transition from the active margin of the SW end of the South Shetland Trench to the passive Pacific margin of the Antarctic Peninsula.

143 Guterch, M. Grad, T. Janik & P. Sroda: Deep crustal seismic models along the Antarctic Peninsula, West Antarctica.

144 Y.K. Jin, S.H. Nam & Y. Kim: Estimates of heat flow from gas hydrate BSRs on the South Shetland margin, Antarctic Peninsula

145 J. Galindo-Zaldívar, L. Gamboa, A. Maldonado, S. Nakao & Y. Bochu: Bransfield Basin tectonic evolution during the separation of the South Shetland Block from the Antarctic Peninsula.

146 R. Keller, S. Fretzdorff & P. Stoffers: Submarine volcanic geology of Bransfield Strait, Antarctica.

147 Chr. Pimpirev, D. Dimov & M. Ivanov: The Miers Bluff Formation, Livingston Island, South Shetland Islands – part of the Upper Jurassic-Cretaceous depositional history of the Antarctic Peninsula.

148 E. Puga, F. Bohoyo, A. Díaz de Federico, J. Galindo-Zaldívar & A. Maldonado: Petrological and geochemical study of Linvingston, King George and Deception islands (South Shetland Islands, Antarctica): geodynamic evolution and magmatism.

149 N. Petkov & L. Klayn: Distribution of some elements in the rocks from Hurd Peninsula, Livingston Island.

150 S.D. Hur, J.J. Lee, M.Y. Choe & Y. Kim: Geochemical and isotopic constraints on the generation of the Hesperides Point Intrusions from Hurd Peninsula, Livingston Island, Antarctica.

151 Machado, F. Chemale Jr., E. Fernandes de Lima, A.M. Graciano Figueiredo, D. del Pilar Montecinos de Almeida, D. Morata Céspedes & J. Lobato: Geochemical data of Meso-Cenozoic calc-alkaline magmatism in the South Shetland Arc.

152 A.A. Dean, P.T. Leat & A.P.M. Vaughan: Defining tectono-stratigraphic terranes in the Antarctic Peninsula using primitive basalt dykes as lithospheric probes.

153 F. Ferraccioli, P. Jones, A.P.M. Vaughan & P.T. Leat: Testing terrane accretion models for Palmer Land, Antarctic Peninsula, with new airborne remote sensing data.

154 M.A. Hunter: A new regional stratigraphy for eastern Ellsworth Land.

155 T.S. Laudon & C.M. Fanning: SHRIMP U-Pb age characteristics of detrital and magmatic zircons, eastern Ellsworth Land.

156 L.S.A. Simões, R.A.J. Trouw, C.M. Valerino & E.S.O. Matsuo: Inclusion patterns in porphyroblasts of a subduction complex at Elephant Island, West Antarctia.

Antarctic Peninsula / Ross Sea

157 St.C. Cande & J. Stock: Tertiary seafloor spreading between East and West Antarctica and implications for Antarctic lithospheric structure.

158 R.C. Decesari, B.P. Luyendyk, L.R. Bartek, J.B. Diebold & Chr.C. Sorlien: Tectonic evolution of the east flank of the Victoria Land Basin along the Ross Ice Shelf, southwestern Ross Sea, Antarctica

Symposium Theme 5:
Paleo-Environment of Antarctica: Causes and Effects of Climate Change

Paleoenvironment of the Southern Ocean / Atlantic Sector

159 S. Schumacher & D. Lazarus: The influence of Antarctic isolation on productivity patterns at the Eocene-Oligocene transition.

160 D.C. Leuschner, G. Schmiedl, W. Ehrmann, A. Mackensen, B. Diekmann, H. Grobe, G. Kuhn, P. Morgenstern & F. Niessen: Quaternary deep-water exchange between the South Atlantic, Southern and Indian oceans.

161 T. Wittling & R. Gersonde: A semi-circum Antarctic view (40°E–120°W) of the past 30 ka Southern Ocean development.

162 M. Kunz-Pirrung, C. Bianchi & R. Gersonde: Pleistocene millennial-scale climate variability from the Atlantic sector of the Southern Ocean based on diatoms.

163 Z. Pushina, G. Leitchenkov & I. Andreeva: Biostratigraphy of Holocene deposits in the southern part of Cosmonaut Sea, Antarctica.

164 G. Kuhn & B., Diekmann: Patterns of biogenic and terrigenous sedimentation: a record of late Quaternary climate and environmental changes in the Antarctic zone of the South Atlantic.

165 Bianchi & R. Gersonde: Climate changes over the last two glacial-interglacial cycles: sea surface temperature and sea-ice records from the Southern Ocean.

166 H.I. Yoon, B.K. Park, Y. Kim & C.Y. Kang: Holocene diatom ooze deposits from mass sedimentation of Weddell Sea ice-edge blooms along the Antarctic Slope Front.

167 S.H. Bae, H.I. Yoon, B.-K. Park & Y. Kim: Meltwater discharge anomalies in Marine Isotope Stage 3 from a sediment core in the south of the Atlantic Polar Front, Drake Passage.
168 K.-C. Yoo, H.I. Yoon & C.Y. Kang: Seasonal water column properties at Marian Cove, West Antarctica: regional warming in the Antarctic Peninsula.

Sediments at the Antarctic Peninsula Continental Margin
169 V. Helm, W. Jokat & M. König: The structure of the continental slope in the area of the Larsen Shelf, eastern margin of the Antarctic Peninsula.
170 P. Diviacco, M. Rebesco, A. Camerlenghi & N. Wardell: Advancement in understanding the sedimentary process of the Antarctic Peninsula margin from re-processing of formerly collected seismic data.
171 F.J. Hernández-Molina, R.D. Larter & A. Maldonado: The Pacific slope offshore from Adelaide Island, Antarctic Peninsula: glacial processes and growth pattern.
172 F.J. Hernández-Molina, R.D. Larter, M. Rebesco & A. Maldonado: Evidence of Miocene bottom water flow reversal from a fossil patch drift plastered on seamounts on the continental rise west of the Antarctic Peninsula.
173 R. Geletti, A. Camerlenghi, M. Rebesco, M. Canals, A.M. Calafat, M. De Batist & R. Urgeles: The development of the continental margin of the northern Antarctic Peninsula from high resolution multichannel seismic reflection profiles.
174 E. Domack, M. Canals, A. Camerlenghi, R. Gilbert, D. Amblas, A.M. Calafat, R. Urgeles, M. De Batist, J.L. Casamor & M. Rebesco: Complete swath map coverage of the Gerlache-Boyd Strait paleo ice stream: an example of collaborative seafloor mapping in the Antarctic Peninsula.
175 Y. Imbo, M. De Batist & M. Canals: Evidence for instability events in the central Bransfield Basin since the last glaciation.
176 V. Willmott, M. Canals & J.L. Casamor: Ultra-high resolution acoustic study of the deglacial and post-glacial sediment drape in the western Bransfield Basin, northern Antarctic Peninsula: implications for ice retreat.
177 U. Tinivella, F. Accaino, R. Geletti & A. Camerlenghi: Seismic evidences of gas hydrate in the South Shetland margin (Antarctica).
178 J.T. Vázquez, F.J. Hernández-Molina, A. Jabaloy, A. Maldonado, J. Galindo-Zaldívar, L. Somoza & H. Nelson: Morphologic and stratigraphy stacking pattern from an active to passive margin at the end of the SW extreme of the South Shetland Trench (Antarctic Peninsula).

Symposium Theme 6:
The Land Beneath the Ice: 99 % of Antarctica

Geophysical Data and Subglacial Geology
179 D. Danesi, A. Morelli & N. Pagliuca: The lithosphere beneath the ice: seismic tomography of the Antarctic upper mantle.
180 U. Nixdorf, R. Dietrich, W. Jokat, M. Wiehl, M. Scheinert & H. Miller: VISA – Validation, densification and Interpretation of Satellite data for the determination of magnetic field, gravity field, ice mass balance and structure of the earth crust in Antarctica using airborne and terrestrial measurements: concept and first results of a new project.
181 A.M. Smith, D. Vaughan, P. Jones, H. Corr, F. Ferraccioli & E. King: Aerogeophysical survey over the drainage basin of the Rutford Ice Stream, West Antarctica.
182 M. Kanao, H. Miyamachi, S. Toda, H. Murakami, T. Tsutsui, T. Matsushima, M. Takada, A. Watanabe, M. Yamashita, K. Yoshii & SEAL Geotransect Group: Multidisciplinary surveys by "Structure and Evolution of the East Antarctic Lithosphere": SEAL-2000, - 2003.
183 M. Yamashita, T. Tsutsui & M. Kanao: Seismological characteristics of the Moho beneath the Mizuho Plateau, East Antarctica: SEAL-2000.
184 M. Yamashita, T. Matsushima, M. Kanao & K. Shibuya: In-situ tests of the Antarctic penetrator on the Mizuho Plateau, East Antarctica.
185 K. Kitamura, M. Ishikawa, M. Arima & K. Shiraishi: Elastic wave velocities and anisotropy of high-grade metamorphic rocks from Lützow-Holm Complex, East Antarctica.
186 S.Toda, H. Miyamachi, M. Kanao, H. Murakami, T. Tsutsui, T. Matsuhima, M. Takada, A. Watanabe, M. Yamashita, Y. Fukuda & SEAL Geotransect Group: Gravimetric survey for the crustal density structure of the Lützow-Holm Complex, Enderby Land, East Antarctica: SEAL 2000 and 2002.
187 S.V. Popov, A. Ruddell, I. Allison & V.N. Masolov: Ice sheet, bed relief and morphological aspects of MacRobertson and Princess Elizabeth Lands, East Antarctica: a synthetis of Russian and Australian data.
188 M. McLean & D. Damaske: An aeromagnetic survey south of Prince Charles Mountains, East Antarctica.
189 G. Reitmayr & G. Caneva: Gravity survey at the Oates Coast, East Antarctica, in 1999/2000.
190 V. Damm, D. Eisenburger, M. Jenett & J. Winkelmann: The subice topography of the Matusevich Glacier area (Oates Coast, East Antarctica).
191 D. Damaske, E. Bozzo & F. Ferraccioli: Aeromagnetic anomaly investigation over East Antarctica from northern Victoria Land to George V Land.
192 Finn, J. Goodge, D. Damaske & N. Roland: Aeromagnetic and gravity survey of shield basement along the central Ross margin of East Antarctica.
193 D.S. Wilson, B.P. Luyendyk & C.C. Sorlien: Formation of bedrock plateaus within the Ross Sea embayment, Antarctica, by marine erosion in Late Tertiary time.

Subglacial Lakes / Ice Shelves / Ice Sheets
194 A.M. Popkov, S.V. Popov, V.N. Masolov & V.V. Lukin: Russian reflection seismic investigations in subglacial Lake Vostok region: methodical features and principle results.
195 M. Studinger, R.E. Bell, G.D. Karner & V. Levin: Geophysical models for the tectonic framework of the Lake Vostok region, East Antarctica.
196 S.V. Popov, A.N. Lastochkin, A.M. Popkov & V.N. Masolov: Morphology of the Lake Vostok basin area (central East Antarctica).
197 M. Studinger, R.E. Bell & G.D. Karner: Ice flow, landscape setting, and geological framework of subglacial Lake Vostok, East Antarctica.
198 E.F. Davis & D.C. Nobes: Non-invasive mapping and monitoring of a fold system located on the McMurdo Ice Shelf near Scott Base, Antarctica.
199 A.F. Corvino & C.J.L. Wilson: Crevasse propagation along the Sørsdal Glacier margin, East Antarctica.

Permanent Exposition of Geological and Other Thematic Maps/Posters

1 J.-C. Thomas: LANDSAT thematic mapper satellite image mapping in the Transantarctic Range from the Nimrod Glacier to northern Victoria Land at the U.S. Antarctic research center.
4 "image maps" of Taylor Valley and eastern part of Wright Valley (1:25 000; 186 x 220)
4 "image maps" of both sides of Byrd Glacier (1:100 000; 170 x 200)

2 G. Capponi, R. Casnedi, D. Castelli, T. Flöttmann, H. Jordan, G. Kleinschmidt, B. Lombardo, M. Meccheri, G. Oggiano, P.C. Pertusati, C.A. Ricci, M. Schmidt-Thomé, D.N.B. Skinner, F. Tessensohn & F. Thiedig: Geological and structural map of the area between Aviator Glacier and Victory Mountains, northern Victoria Land – Antarctica.

3 G. Capponi, M. Meccheri & P.C. Pertusati: Antarctic Geological 1 : 250 000 Map Series – Mount Murchison Quadrangle (Victoria Land).

4 G. Capponi, M. Meccheri &G. Oggiano: Antarctic Geological 1 : 250 000 Map Series – Coulman Island Quadrangle (Victoria Land).

5 G. Capponi, L. Crispini, M. Meccheri, G. Musumeci & P.C. Pertusati: Antarctic Geological 1 : 250 000 Map Series – Mount Joyce Quadrangle (Victoria Land).

6 G. Capponi, L. Crispini, M. Meccheri, G. Musumeci & P.C. Pertusati: Antarctic Geological 1 : 250 000 Map Series – Relief Inlet Quadrangle (Victoria Land).

7 G. Capponi, M. Meccheri & P.C. Pertusati: Antarctic Geological 1 : 250 000 Map Series – Freyberg Mountains.

8 M. Meccheri, G. Musumeci & P.C. Pertusati: Antarctic Geological 1 : 250 000 Map Series – Sequence Hills Quadrangle (Victoria Land).

9 R. Casnedi, P.C. Pertusati & F. Salvini: Antarctic Geological 1 : 250 000 Map Series – Reeves Névé Quadrangle (Victoria Land).

10 N.W. Roland, C.J. Adams, T. Flöttmann, G. Kleinschmidt, M. Olesch, P.C. Pertusati, U. Schüssler, D.N.B. Skinner & F. Henjes-Kunst (2001): Geological map of the Matusevich Glacier Quadrangle, Victoria Land, Antarctica – 1 : 250 000.- GIGAMAP Ser., Expl. Note 15 p., BGR, Hannover.

11 N.W. Roland, C.J. Adams, T. Flöttmann, G. Kleinschmidt, M. Olesch, U. Schüssler, D.N.B. Skinner, & G. Wörner (1996): Geological map of the Suvorov Glacier Quadrangle, Victoria Land, Antarctica, 1 : 250 000.- GIGAMAP Ser., BGR, Hannover.

12 U. Schüssler, G. Fenn, T. Flöttmann, G. Kleinschmidt, M. Olesch, N.W. Roland, W. Schubert & D.N.B. Skinner (1998): Geological map of the Pomerantz Tableland Quadrangle, Victoria, Antarctica, 1 : 250 000.- GIGASSMAP Ser., BGR, Hannover.

13 H. Jordan, S. Estrada, F. Henjes-Kunst & G. Kleinschmidt (1999): Geological map of the Ob Bay Quadrangle, Victoria Land, Antarctica, 1 : 250 000.- GIGAMAP Ser., BGR, Hannover.

14 F. Tessensohn, H. Kreuzer, F. Henjes-Kunst, G. Kleinschmidt & U. Vetter (1996): Geological map of the Yule Bay Quadrangle, Victoria Land, Antarctica, 1 : 250 000.- GIGAMAP Ser., BGR, Hannover.

15 S. Rocchi, G. Di Vincenzo & C. Ghezzo: Geopetrographic map of the Terra Nova Intrusive Complex, North Victoria Land, 1 : 50000.

16 C. Lüdecke: Exploring the unknow: history of the first German south polar expedition 1901-1903.

17 P. Mixa & D. Nyvlt: Initiation of the Antarctic geological research programme of the Czech Republic.

General Information for the Workshop
"East-West Antarctic Tectonics and Gondwana Breakup 60W to 60E"
13. September 2003, Potsdam

Dear Colleagues,
as conveners we are glad to announce this work shop to all participants of the ISAES meeting. From the contributions it is obvious that the work shop will give an excellent overview on the current geophysical data base in this area. We hope that also people will visit the work shop, who have not applied for a talk. Some general information to the speakers and other participants:

Location

AWI-Potsdam, Telegrafenberg, Building A43, Lecture Room (Vortragsraum). For details see the attached maps.

Technical facilities for the presentations

1xBeamer, 1x Overhead, 1xDia Projector; if you need additional technical support please contact Mathias Hoffmann (mhoffmann@awi-bremerhaven.de) in time.

Powerpoint presentations

There will be a Windows2000 computer available for the presentations. We prefer to have your ppt-files on CD-ROM just in the morning of September 13th (responsible persons: Mathias Hoffmann/Matthias König). MAC users should test their presentation also on a Windows computer to avoid any problems. If possible you can email your powerpoint presentation to Mathias Hoffmann (mhoffmann@awi-bremerhaven.de) . He will then check if there are any problems and will have your presentation available on the computer. However, sending the file via email should be done before 8th September 2003.

Poster

The session has no official poster presentations. However, just in case we can arrange in addition up to 5 poster walls for discussions during the coffee breaks. Again inform us (karl.hinz@br.de, mhoffmann@awi-bremerhaven.de) , if you want to present in addition a poster.

Registration

Registration is only required for the speakers. Please use your name tag from ISAES meeting to identify yourself.

Costs

There will no extra costs/fee for the work shop. We might just ask for a small contribution for the coffee and you have to pay lunch on your own. Currently we are trying to arrange lunch in the nearby Mensa of GFZ. Details on this issue will be given by the conveners during the work shop.

Publication

It is intended to publish all presentations fast in an international journal/book. Thus, we request your contribution earliest at the work shop. For the layout of the article please orientate on Marine Geophysical Researches-style. The final deadline is November 30th for any submission. We would like to receive your contribution on paper and electronically (jokat@awi-bremerhaven.de) . Images please in JPEG Format.

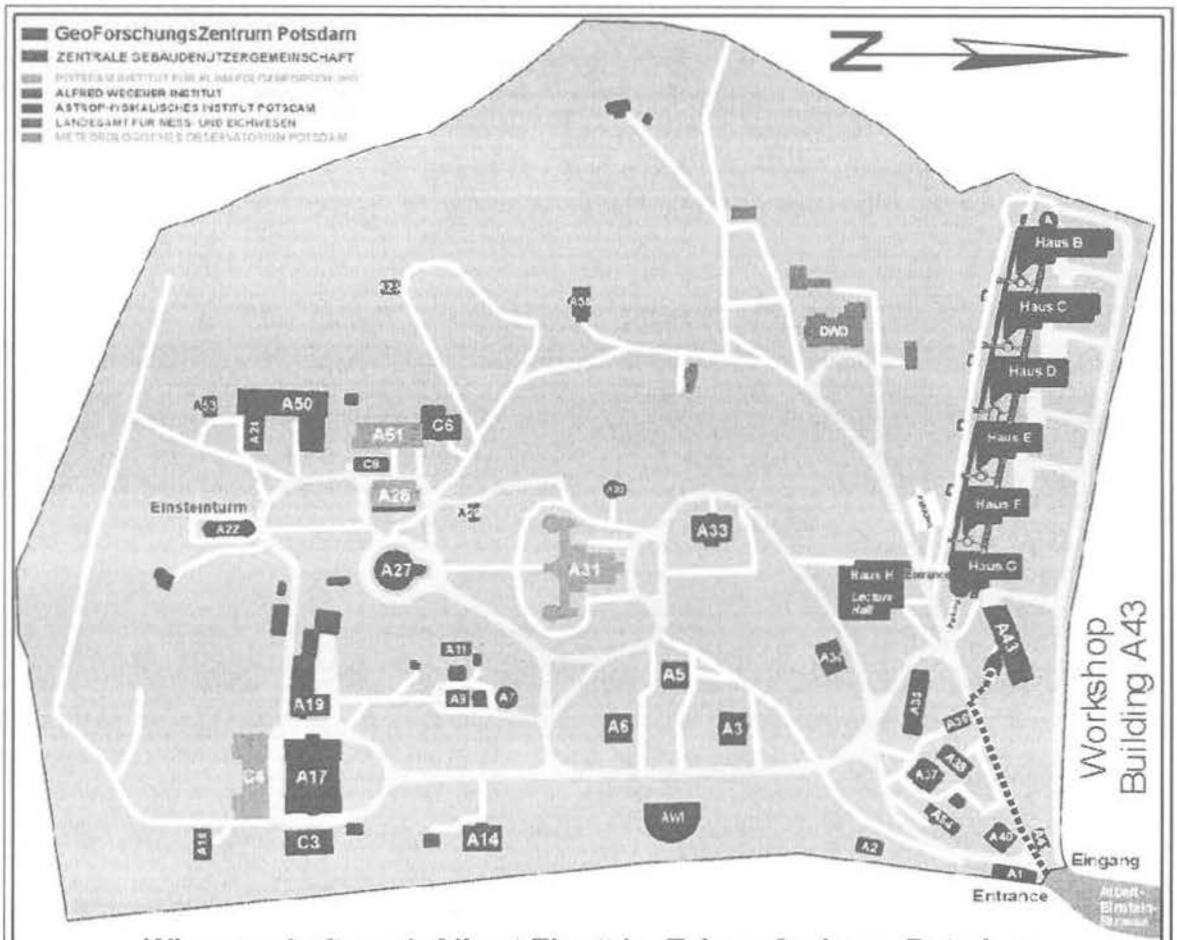
Conveners

The work shop will be guided by Karl Hinz and German Leitchenkov. Unfortunately Wilfried Jokat will not be able to attend, since he has to join an expedition to East Greenland at the same time. Sorry for this.

Problems/Contact

In case of any problems or if you have still question feel free to contact one of the following persons:
Karl Hinz (karl.hinz@bgr.de)
Wilfried Jokat (wjokat@awi-polarstern.de after August 10th)
German Leitchenkov (german_leitchenkov@hotmail.com)
Mathias Hoffmann (mhoffmann@awi-bremerhaven.de)
Matthias König (mkoenig@awi-bremerhaven.de)

We hope to see you soon on the workshop
Wilfried Jokat, Karl Hinz, German Leitchenkov



Wissenschaftspark Albert Einstein, Telegrafenberg, Potsdam

Time schedule for the Workshop
"East-West Antarctic Tectonics and Gondwana Breakup 60W to 60E"
13. September 2003, Potsdam

Conveners: W. Jokat, G. Leitchenkov and Karl Hinz

Talks: 15 Minutes plus 5 minutes discussions
Speakers underlined

09:00 G.Uenzelmann-Neben and K. Gohl
Agulhas Ridge, South Atlantic: the peculiar structure of a transform fault

09:20 B. Schreckenberger, S. Neben and D. Franke
The early opening history of the South Atlantic: Breakup, volcanism, and seafloor spreading in the light of new seismic and magnetic data

09:40 M. E. Ghidella
Crustal ages in the Western Weddell Sea between break up and Chron 34: their relationship with the opening of the South Atlantic Ocean

10:00 M. König
Geodynamic model for the Weddell Sea using aeromagnetic and palaeomagnetic data

10:20 Coffee Break

11:00 A. Golynsky
Major crustal provinces of eastern Dronning Maud Land and Enderby Land and their aeromagnetic signature

11:20 M. Hoffmann, W. Jokat and A. Eckstaller
3-D Crustal Model in the Western Dronning Maud Land Region, Antarctica, from the interpretation of different geophysical data sets

11:40 J. Rogenhagen, W. Jokat and K. Hinz
New seismic stratigraphy for the Weddell Sea

12:00 S. Neben, K.Hinz, Y. B. Gouseva and G. A. Kudryavtsev
A Compilation of Geophysical Data from the Lazarev Sea and the Riiser-Larsen Sea, Antarctica

12:20 B. Kuvaas, Y. Kristoffersen, G. Leitchenkov, J. Guseva and V. Gandjukhin
Regional interpretation of glaciomarine sediments along the East Antarctic continental margin.

12:40 Yu. Gouseva., G. Leitchenkov., V. Gandyukhin, G. Kudryavtsev., L. Kuznetsova, S. Alyavdin, S. Ivanov, A. Kazankov, M. Sand M., and H. Brekke

Crustal Structure, Seismic Stratigraphy and Tectonic Evolution of the Southeastern Indian Ocean between 0 E and 60 E.

13:00 Lunch Break

14:00 J.B. Colwell, H.M.J. Stagg and N.G. Direen
Structure and sediment distribution of the deep continental margin of Enderby and Mac Robertson Lands, East Antarctica

14:20 G. Leitchenkov, S. Ivanov, Yu. Gouseva, V. Gandyukhin, G. Kudryavtsev and M. Sand
New identifications of seafloor spreading magnetic anomalies in the southwestern Indian Ocean. Early history of East Gondwana break-up.

14:40 Y. Nogi, K. Nishi and Y. Fukuda
Seafloor spreading in the West Enderby Basin during initial breakup of Gondwana.

15:00 B. Brown, B.J. Brown, R.D. Müller, C. Gaina, S. Cande and T. Ishihara
Newly integrated potential field data off the Enderby Land margin: New seafloor spreading and plate tectonic models

15:20 Y. Wang, D. Liu, L. Ren and S. Tang
Advances in SHRIMP geochronology and their constrains on understanding the tectonic evolution of Larsemann Hills, East Antarctica

15:40 L. D. Brown, M. Kanao, A. Kroner, P. R. Reddy and B. F. Windley
Lithospheric Evolution of Gondwana East from Interdisciplinary Deep Surveys (LEGENDS)

16:00 Coffee Break

16:30 Summary and Final discussions

Closing of the Workshop

Palaeobiological evidence for iron-induced high productivity in the glacial Southern Ocean (oral p.)
Andrea Abelmann, Rainer Gersonde, Giuseppe Cortese, Uli Zielinski & Victor Smetacek

Pattern of uplift of Paleozoic terranes in northern Victoria Land, Antarctica: evidence from K-Ar age profiles (oral p.)
C.J. Adams

The Italian geological database and GIS of Antarctic rock samples (poster p.)
M. Alberti, N. Rastelli, R. Palmeri & C.A. Ricci

Absolute gravity measurements and collocated geodetic positioning techniques in Antarctica: a review. Implications for the polar cap (poster p.)
Martine Amalvict

Absolute gravity and GPS measurements as constraints on the post-glacial rebound and present-day ice melting in the French sub-Antarctic Territories (poster p.)
Martine Amalvict, Marie-Noëlle Bouin, Jacques Hinderer & Bernard Luck

Establishing the links between continental shelf glacial troughs and continental rise development west of the North Antarctic Peninsula (oral p.)
D. Amblas, M. Canals, A.M. Calafat, R. Urgeles, A. Camerlenghi, M. De Batist, E. Domack, J.L. Casamor & M. Rebesco

Do ice streams self-destruct? (oral p.)
John Anderson, David Heroy, Amanda Mosala, Lisa Oakes & Julia Wellner

ANDRILL: Stratigraphic drilling for climatic and tectonic history in Antarctica (poster p.)
ANDRILL Steering Committee and ANDRILL Science Management Office

Crustal features of the Rennick Graben structure and southern continuation of the Meso-Cenozoic fault system from GDS investigation and other geophysical constraints (poster p.)
E. Armadillo, E. Bozzo, G. Caneva & G. Tabellario

Draped aeromagnetic survey over Mt. Melbourne volcano (oral p.)
E. Armadillo, E. Bozzo, G. Caneva, F. Ferraccioli, G. Tabellario & S. Urbini

The Neogene terrestrial biota of Antarctica (oral p.)
Allan C. Ashworth, Rosemary Askin, David Cantrill, Guillermo Kuschel, Richard Preece & F. Christian Thompson

The United States polar rock repository and Antarctic geologic database (poster p.)
Rosemary A. Askin & Anne M. Grunow

Cold-based glacial erosion and deposition features, Dry Valleys, Antarctica (oral p.)
Cliff Atkins

Sapphirine granulite from Schirmacher Hills, Central Dronning Maud Land (oral p.)
S. Baba, M. Owada & K. Shiraishi

Geology of Filchnerfjella in Dronning Maud Land, East Antarctica; A preliminary report of Japan-Norway-Germany joint geological investigation (poster p.)
S. Baba , M. Owada , A. Läufer, S. Elvevold, K. Shiraishi & J. Jacobs

Meltwater discharge anomalies in Marine Isotope Stage 3 from a sediment core south of Antarctic Polar Front, Drake Passage (poster p.)
Sung Ho Bae, Ho Il Yoon, Byong-Kwon Park & Yeadong Kim

The onset and development of the Antarctic Circumpolar Current (oral p.)
P F Barker & E Thomas

Electron microscopic characterization of „rock varnishes" from northern Victoria Land (poster p.)
Carlo Baroni & Giovanna Giorgetti

Warm-based ice advance and continental chemical weathering documented by the "Ricker Hills Tillite", Victoria Land, Antarctica (oral p.)
Carlo Baroni, Francesco Fasano, Giovanna Giorgetti & Maria Cristina Salvatore

Seismic-stratigraphic analysis of Ross Bank (central Ross Sea) suggests west-directed advance of the West Antarctic Ice Sheet from Marie Byrd Land (poster p.)
Philip J. Bart, Andrew Maas, Kristina Rotondo, Dave Egan, Swati Ghoshal & Jason Holloman

Campaign and continuous GPS measurements of deformation at Mt. Erebus, Antarctica (poster p.)
Beth Bartel, Philip R. Kyle, E. Desmarais, C. Meertens, C. Kurnik & B. Johns

Late Mesoproterozoic arc and back-arc volcanism in the Heimefrontfjella and implications for the palaeogeography at the southeastern margin of the Kaapvaal-Grunehogna Craton (oral p.)
W. Bauer, J. Jacobs & C.M. Fanning

Mafic dykes from Heimefrontfjella and implications for the post-Grenvillian to pre-Pan-African geological evolution of western Dronning Maud Land (poster p.)
W. Bauer, W. Fielitz, J. Jacobs, C.M. Fanning & G. Spaeth

Shallow source aeromagnetic anomalies observed over the West Antarctic Ice Sheet compared with coincident bed topography from radar ice sounding – new evidence for glacial "removal" of subglacially erupted late Cenozoic rift related volcanic edifices (oral p.)
J.C. Behrendt, D.D. Blankenship, D. L.Morse & R.E. Bell

Defining multiple stages of extension in central West Antarctica (poster p.)
R. E. Bell, M. Studinger, G. Karner, C. Finn & D. Blankenship

Lake Vostok: ancient system, dynamic processes (oral p.)
Robin E. Bell, Michael Studinger, Ani Tikku & Garry Karner

Post pan-African cooling and exhumation of the southern Mawson Escarpment, Prince Charles Mountains, Antarctica (oral p.)
D.X. Belton, F. Lisker, H.J. Gibson & C.J.L. Wilson

Sm-Nd ages of metamorphosed volcanic and plutonic rocks from Mount Ruker, the southern Prince Charles Mountains, East Antarctica (poster p.)
B.V. Belyatsky, E.N. Kamenev, a.A. Laiba & E.V. Mikhalsky

Holocene history of George VI ice shelf, Antarctic Peninsula: inferences from lake sediments (oral p.)
M. Bentley, J.A. Smith, D. Hodgson, S. Roberts, M. Barrett, C. Bryant, M. Leng, P. Noon, D. Sugden & E. Verleyen

Relative sea level curves and ice sheet history from the Antarctic Peninsula (oral p.)
M.J. Bentley, G. Milne, D.A. Hodgson & J.A. Smith

Geodetic research in Deception Island (oral p.)
M. Berrocoso, A. Fernández-Ros, C. Torrecillas, J. M. Enríquez-Salamanca, M.E. Ramírez, A. Pérez-Peña, R. Páez, M. J. González, M. Tárraga, F. García.

Multidisciplinary scientific information support system (SIMAC) for Deception Island, South Shetland Islands, Antarctica (poster p.)
M. Berrocoso, C. Torrecillas, R. Páez, J.M. Enríquez-Salamanca, E. Ramírez, A. Fernández-Ros, A. Pérez-Peña & M.J. González

DECVOL and GEODEC projects (poster p.)
M. Berrocoso, A. García, J. Martín-Davila, M. Catalán-Morollón, M. Astiz, E. Ramírez, C. Torrecillas & J.M. Enríquez-Salamanca.

Climate changes over the last two glacial-interglacial cycles: sea surface temperature and sea-ice records from the Southern Ocean (poster p.)
C. Bianchi & R. Gersonde

Structural geology and geochronology of the Gjesvikfjella area, northern Maud Belt, East Antarctica (oral p.)
A. Bisnath, H.E.Frimmel & R.A. Armstrong

Local geoid determination by gravimetric measurements in northern Victoria Land (oral p.)
G. Bitelli, A. Capra, F. Coren, S. Gandolfi & P.Sterzai

Northern Victoria Land crustal deformation control: advances of VLNDEF program (oral p.)
G. Bitelli, A. Capra, S. Gandolfi, F. Mancini, P. Sarti, L. Vittuari & A. Zanutta

Strike-slip faulting related to the rifting of Gondwana, evidence from the Lambert drainage basin, East Antarctica (oral p.)
S.D. Boger & C.J.L. Wilson

Barrovian-type metamorphism from the Archaean Ruker Terrane, southern Prince Charles Mountains, East Antarctica (oral p.)
S.D. Boger

Development of Jane Basin by crustal fragmentation: southern margin of the South Orkney Microcontinent, Antarctica (oral p.)
F. Bohoyo, J. Galindo-Zaldívar, A. Jabaloy, A. Maldonado, J.M. Martínez-Martínez', J. Rodríguez-Fernández, A.A. Schreider & E. Suriñach

Current glaciation of Bunger Hills as an indicator of the Antarctic glacierization at the Last Glacial Maximum (oral p.)
D. Bolshiyanov

Chemical response of zircon to fluid infiltration and high-T deformation: Howard Peaks Intrusive Complex (northern Victoria Land – Antarctica), a case study (poster p.)
R.M. Bomparola, C. Ghezzo, E. Belousova, L. Dallai, W.L. Griffin & S.Y.O'Reilly

U-Pb geochronology of the Granite Harbour Intrusives from the Wilson Terrane, northern Victoria Land, Antarctica (oral p.)
R.M. Bomparola

An aeromagnetic hunt for Cenozoic alkaline intrusions north of Mariner Glacier, Victoria Land, Antarctica (poster p.)
E. Bozzo, F. Ferraccioli, E. Armadillo, G. Caneva, P. Armienti & S. Rocchi

The View Point Conglomerates: a probable upper fan deposits in the accretionary wedge of the Triassic Trinity Peninsula Group, northern Antarctic Peninsula (oral p.)
J.D. Bradshaw, A.P.M. Vaughan & R.A.J. Trouw

Recent investigations of the George Vth Land continental margin, East Antarctica – WEGA (Wilkes Basin Glacial history) project (oral p.)
Giuliano Brancolini , Laura De Santis & Peter T. Harris and the WEGA team

Breakup and seafloor spreading between Antarctica, greater India and Australia (oral p.)
B.J. Brown, T. Ishihara & R.D. Muller

Newly integrated potential field data off the Enderby Land margin: New seafloor spreading and plate tectonic models (workshop p.)
B.J. Brown, R.D. Muller, C. Gaina, S. Cande & T. Ishihara

Lithospheric evolution of Gondwana east from interdisciplinary deep surveys (LEGENDS) (workshop p.)
Larry D.Brown, Masaki Kanao, Alfred Kroner, P. Ramchandra Reddy & Brian F. Windley

Transantarctic uplift or Ross Sea collapse? Implications of new aerogeophysical data (poster p.)
Roger Buck, Michael Studinger & Robin Bell

Downhole measurements and their use for stratigraphic correlations in the Ross Sea, Antarctica (poster p.)
C. Bücker, R. Jarrard, W. Ehrmann, F. Niessen & T. Wonik

Extension and inversion tectonic in the Victoria Land Basin, Ross Sea (poster p.)
Martina Busetti & Riccardo Geletti

A new geomagnetic observatory at Dome C (poster p.)
L. Cafarella, A. Zirizzotti, D. Di Mauro, A. Meloni, J.J. Schott, A. Peres & M. Cantin

Tertiary seafloor spreading between east and West Antarctica (oral p.)
Steven C. Cande & Joann Stock

Vegetation composition of Cretaceous and Tertiary floras of the Antarctic Peninsula as evidenced by the fossil wood record (oral p.)
David J. Cantrill & Imogen Poole

Contrasting metamorphic evolution at the contact between terranes: microtextural and petrological evidences from shear zones in the Lanterman Range, northern Victoria Land, Antarctica (poster p.)
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The late Eocene, terrestrial, vertebrate fauna from Seymour Island: The tails of the Eocene patagonian size distribution (oral p.)
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Structural evolution of the northern Mawson Escarpment, southern Prince Charles Mountains, East Antarctica (oral p.)
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Crevasse propagation along the Sørsdal Glacier margin, East Antarctica (poster p.)
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Polar biodiversity: an historical perspective (oral p.)
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Geomorphologic mapping by airborne laser scanning in southern Victoria Land, Antarctica (oral p.)
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Tectonic inferences from Jurassic dyke swarms and alkaline pluton emplacement in western Dronning Maud Land (poster p.)
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Quartz grain surface textures as indicators of transport and depositional mechanisms in glacial marine sediments under the McMurdo/Ross Ice Shelf, Windless Bight (oral p.)
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The mantle signature of the Antarctic rift system imaged by seismic waves (poster p.)
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Beacon-Mawson field relations at Coombs and Allan Hills, South Victoria Land (oral p.)
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Whither the Mawson Continent? (oral p.)
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The Ross Orogeny in northern Victoria Land, Antarctica: geodynamic evolution and possible analogues (poster p.)
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New geological survey at Patriot Hills (80°S) , Ellsworth Mountains, West Antarctica (oral p.)
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Aerogeophysical investigation in the Jutulstraumen Rift area, East Antarctica (oral p.)
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Aeromagnetic evidence for accreted(?) arc crust in the western Wilson Terrane (poster p.)
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Testing terrane accretion models for Palmer Land, Antarctic Peninsula, with new airborne remote-sensing data (poster p.)
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Geophysical modelling across the Rennick Graben structure, northern Victoria Land (poster p.)
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Is there a link between Cenozoic strike-slip faulting of the Transantarctic Mountains / Ross Sea Rift and the eastern margin of the Wilkes Subglacial Basin? (poster p.)
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Stratigraphic architecture of the western Victoria Land Basin re-interpreted from stratigraphic and seismic reflection data, Cape Roberts, McMurdo Sound (oral p.)
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Definition of a Cenozoic alkaline magmatic province in the southwest Pacific without rift or plume origin (oral p.)
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Aeromagnetic and gravity survey of shield basement along the central Ross margin of East Antarctica (poster p.)
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Detrital zircon age patterns from a large gneissic xenolith from Cape Phillips granite and from Robertson Bay Group metasediments, northern Victoria Land, Antarctica (poster p.)
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Tracking the West Antarctic rift flank (oral p.)
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Episodic Cenozoic denudation in the Shackleton Glacier area of the Transantarctic Mountains: a record of changing stress regimes? (oral p.)
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Evidence for a continuation of the late Neoproterozoic Darling Fault Zone of Western Australia to the Pacific margin of East Antarctica (poster p.)
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Detrital zircon populations in metasedimentary rocks from Dronning Maud Land and western Australia: is the 1.1 Ga Maud Province a collisional suture between southern Africa and Australia? (oral p.)
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Correlation of the . Ga Maud Province with its Gondwana neighbours and the continuation of the East African Orogen into Antarctica (poster p.)
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IGCP 440 geodynamic map of Rodinia - draft map of Antarctica (poster p.)
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Deep crustal structure of the central Drake Passage from 3 D gravity inversion (Shackleton Fracture Zone and West Scotia Ridge, Antarctica) (poster p.)
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The road to Gondwana via the early SCAR symposia (oral p.)
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Biodiversity and climate change in Arctic Paleogene floras (oral p.)
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Comparative studies of rare earth element and heavy metal loads and the corresponding natural organic matter fractions in sediments from three lakes ofAmery Oasis, East Antarctica (poster p.)
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Mesoproterozoic continental growth: The South Africa-East Antarctica connection (oral p.)
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Why does large magnetic anomalies appear in Archean crust of the Mt. Riiser Larsen area, Amundsen Bay, Enderby Land, Antarctica? magnetic and chemical properties of metamorphosed banded iron formation (poster p.)
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Crustal thinning and the development of deep depressions at the Scotia-Antarctic plate boundary, southern margin of Discovery Bank, Antarctica (poster p.)
J. Galindo-Zaldívar, J.C. Balanyá, F. Bohoyo, A. Jabaloy, A. Maldonado, J.M. Martínez-Martínez, J. Rodríguez-Fernández & E. Suriñach

Bransfield Basin tectonic evolution during the separation of the South Shetland Block from the Antarctic Peninsula (poster p.)
J. Galindo-Zaldívar, L. Gamboa, A. Maldonado, S. Nakao, Y. Bochu

Elephant Island recent tectonics in the framework of the Scotia-Antarctic-South Shetland Block triple junction, NE Antarctic Peninsula (oral p.)
J. Galindo-Zaldivar, A. Maestro, J. López-Martínez & C. Sanz de Galdeano

Stromatolites from the Oligocene of King George Island, West Antarctica (poster p.)
Andrzej Gazdzicki

Crustal structure, seismic stratigraphy and tectonic evolution of the Enderby Land and MacRobertson Land continental margin, southern Indian Ocean (poster p.)
V. Gandyukhin, G. Leitchenkov, Yu. Gouseva, G. Kudryavtsev, L. Kuznetsova S. Alyavdin, S. Ivanov & A. Kazankov

The development of the continental margin of the northern Antarctic Peninsula from high resolution multichannel seismic reflection profiles (poster p.)
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Neogene-Quaternary Antarctic cryosphere evolution –The view from Southern Ocean sediment archives (oral p.)
Rainer Gersonde

Crustal ages in the western Weddell Sea between break-up and Chron : their relationship with the opening of the South Atlantic Ocean (workshop p.)
Marta E. Ghidella

Emplacement ages and interaction evidence from the mafic-felsic complex of Teall Nunatak, northern Victoria Land, Antarctica (poster p.)
F. Giacomini, R.M. Bomparola, L. Dallai & M. Tiepolo

Convergent and transform boundaries along the SE Australian sector of the proto-Pacific Gondwana margin in the Ordovician (oral p.)
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Tectonic and magmatic evolution of conjugate continental margins: a multi-stage rift event between New Zealand and West Antarctica (oral p.)
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Crustal provinces of the Prince Charles Mountains region and surrounding areas in the light of aeromagnetic data (poster p.)
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ADMAP – a Digital Magnetic Anomaly Map of the Antarctic (poster p.)
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Major crustal provinces of eastern Dronning Maud Land and Enderby Land and their aeromagnetic signature (workshop p.)
A.V. Golynsky

Rift- to active-margin sedimentation in Neoproterozoic and lower Paleozoic siliciclastic rocks of the central Ross Orogen, Antarctica: detrital record of provenance and orogenic denudation rates (oral p.)
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Depositional environment of the Byrd Group, Byrd Glacier area: A Cambrian record of sedimentation, tectonism, and magmatism on the Paleo-Pacific continental margin of Gondwana (oral p.)
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Multiple post-Miocene deglaciations and marine transgressions at Vestfold Hills, East Antarctica (oral p.)
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Crustal characteristics and seismic stratigraphy of the Riiser-Larsen Sea basin (poster p.)
Yu. Gouseva, G. Kudryavtsev, V. Gandyukhin, G. Leitchenkov, S. Ivanov, A. Kazankov, A. Kuznetsov

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Seismic crustal structure of West Antarctica between the Elephant Island and Marguerite Bay (oral p.)
Marek Grad, Alexander Guterch, Tomasz Janik & Piotr Sroda

Palaeoenvironmental change in the Paleocene and Eocene of Seymour Island based on quantitative palynological analysis (poster p.)
Jenny Greenhalgh & David J Cantrill & Jamie Powell

Topography and dynamics of the ice cover for the Graham Land between 65-66°S with ERS SAR interferometry (oral p.)
R.Kh. Greku

Geodynamic features and density structure of the earth's interior within the Scotia Arc with the geoid and altimetric data (oral p.)
R. Kh. Greku, V.P. Usenko, K.M. Bondar & T.R. Greku

Topographic and geodetic GPS survey on islands and in aquatoria of the Argentine Archipelago (poster p.)
R.Kh. Greku, G.P. Milinevsky, Yu.V. Ladanovsky & P.V.Bahmach

Bathymetric map and geomorphological features of the Argentine Archipelago's sea-bed with Ukrainian (1998-2003) and British (1964-1965) soundings (poster p.)
T.R. Greku

Argentine Island archipelago topography, bathymetry and geodetic GPS survey (oral p.)
R. Greku, G. Milinevsky, Yu. Ladanovsky & P. Bahmach

Earth's interior geodynamic features and density structure of the Scotia Arc with geoid and altimetric data (poster p.)
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Using a GIS to analyse marine mollusc distribution in the Southern Ocean (poster p.)
Huw Griffiths

Archiving and distributing earth-science data with the information system PANGAEA (poster p.)
H. Grobe', M. Diepenbroek', M. Reinke & R. Sieger

Evidence for orbitally controlled size variations of the East Antarctic Ice Sheet during the Late Miocene (oral p.)
J. Grützner, M. Rebesco, A.K. Cooper, C.F. Forsberg, K.A. Kryc & G.Wefer

The Pacific slope offshore from Adelaide Island, Antarctic Peninsula: glacial processes and growth pattern (poster p.)
F.J. Hernández-Molina, R.D. Larter & A. Maldonado

SHRIMP U-Pb detrital zircon ages from the Liberty Hills Formation, Ellsworth Mountains, Patriot Hills area, Antarctica (poster p.)
F.Hervé, J.P. Lacassie, R. Fernández & C.M. Fanning

Late Quaternary relative sea-level change and reconstructed Antarctic ice history (poster p.)
Miura Hideki, Okuno Junnichi, Nakada Masao, Maemoku Hideaki, Takada Masashi, Atsuo Igarashi, Seto Koji & Moriwaki Kiichi

Sediment drift formation on the Pacific margin of the Antarctic Peninsula: implications from project ANTDRIFT (oral p.)
C.-D. Hillenbrand, G. Uenzelmann-Neben & M. Rebesco

Investigations of crustal structures beneath Dronning Maud Land, Antarctica (poster p.)
Mathias Hoffmann

3-D Crustal Model in the western Dronning Maud Land region, Antarctica, from the interpretation of different geophysical data sets (workshop p.)
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Palaeobiological evidence for iron-induced high productivity in the glacial Southern Ocean

(oral p.)

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Continental ice-core investigation has documented that during glacials the atmospheric CO_2 concentrations have been substantially lower by ca. 80 parts per million and that there is a close link between the atmospheric CO_2 concentration and Southern Hemisphere temperature change (PETIT et al. 1999). This points to a Southern Hemisphere origin for the glacial/interglacial CO_2 change. The contemporary Antarctic Circum Polar Current (ACC) is a weak CO_2 sink despite high nutrient levels because productivity is limited by iron availability. During glacial periods much greater iron availability should have significantly enhanced productivity and CO_2 drawdown (MARTIN 1990). However, there is ongoing debate on the physical and biological mechanisms in the Southern Ocean causing the lowering of the glacial CO_2 concentrations (SIGMAN & BOYLE 2000). Most palaeochemical proxies indicate a latitudinal shift in the zone of enhanced glacial primary productivity and intensified CO_2 drawdown but no overall increase in biogenic export (e.g. ANDERSON et al. 2002, FRANK et al. 2000). Other lines of explanation involve physical mechanisms restricting the Southern Ocean / atmosphere communication and thus reducing the ocean's CO_2 release (STEPHENS & KEELING 2000, FRANCOIS et al. 1997). However, the validity of such hypotheses, considering the establishment of strong surface water stratification (FRANCOIS et al. 1997) and expansion of the sea ice field (STEPHENS & KEELING 2000), has been questioned, based on theoretical grounds (KEELING & VISBECK 2001) and numerical modeling (MAQUEDA & RAHMSDORF 2002), respectively. Here we present evidence for last glacial Southern Ocean conditions from biological proxies (resting spores of the diatom genus *Chaetoceros* and skeletons of the radiolarian *Cycladophora davisiana*). The areal and downcore distribution patterns of these primary producer and phytodetritus feeding, deep living protozoan indicate the occurrence of extensive diatom blooms across the entire Atlantic sector of the ACC, particularly in the seasonal sea-ice zone, during the last glacial. These robust ecological proxies of a strong, glacial biological carbon pump support the iron hypothesis of MARTIN (1999) and indicates that the biological system in the last glacial Southern Ocean had a substantial impact on the deep ocean CO_2 drawdown.

Petit, J.R. et al. (1999): Nature 399: 429-436.
Martin, J.H. (1990): Paleoceanography 5: 1-13.
Sigman, D. & Boyle, E.A.(2000): Nature 407: 859-869.
Anderson, R.F. et al. (2002): Deep Sea Research II 49: 1909-1938.
Frank, M. et al. (2000): Paleoceanography 15(6):642-658.
Stephens, B. & Keeling, R. (2000): Nature 404: 171-174.
Francois et al. (1997): Nature 389. 929-935.
Keeling, R.F.,Visbek, M., Sigman, D. & Boyle, E.A. (2001): Nature 412: 605-607.
Morales Maqueda M.A. & Rahmsdorf S. (2002): Geophys. Res.Lett. 29:111-113.

Pattern of uplift of Paleozoic terranes in northern Victoria Land, Antarctica: evidence from K-Ar age profiles
(oral p.)

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K-Ar mineral and total rock ages from Paleozoic igneous and metamorphic rocks of the Wilson, Bowers and Robertson Bay Terranes in northern Victoria Land fall in the following ranges: (1) for a northern profile, along the Oates Coast (Pacific Ocean), 460-515 Ma, and (2) for a southern profile, near Terra Nova Bay (Ross Sea), 468-558 Ma. There is, in part, a pattern of decreasing K-Ar age with depth within the present terrane structure (i.e. present-day altitude), but more importantly, there is an additional symmetrical variation about a NNW-SSE axis adjacent to the eastern margin of the Wilson Terrane. This latter feature corresponds to a proposed tectonic ("pop-up") uplift structure (FLÖTTMAN & KLEINSCHMIDT 1991), as defined by major opposing thrust systems within the terrane. The younger ages are confined to the internal wedge-shaped portion of the structure, which thus indicates that its formation is not older than 460-470 Ma, and probably younger than 413 ±10 Ma.

Flöttman, T. & Kleinschmidt, G. (1991): Geology 19: 45-47.

The Italian geological database and GIS of Antarctic rock samples
(poster p.)

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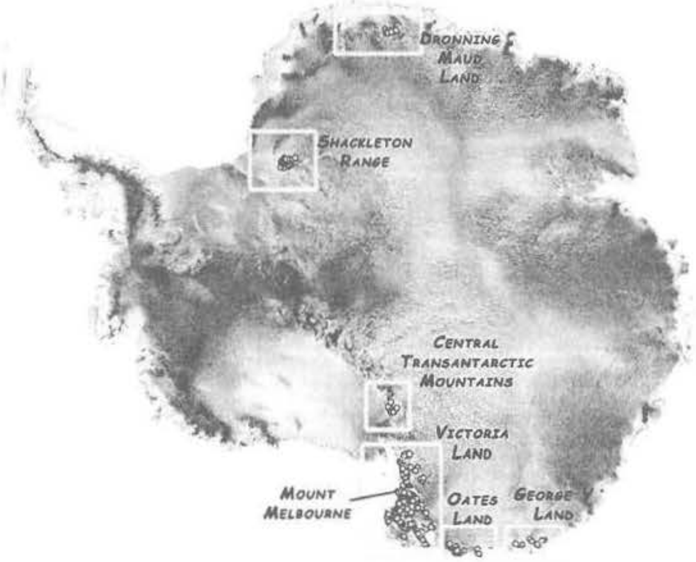

Fig. 1: The rock-sampling location theme (circles) superposed on the RAMP image (source NSIDC).

Since the second half of the 80's Italian geological research in Antarctica has generated a great amount of geological data and samples, collected in George V and Oates Land, Victoria Land, central Transantarctic Mountains, Shackleton Range and Dronning Maud Land. In order to preserve and study the geological samples, a unified repository has been established within the framework of

PNRA (Programma Nazionale di Ricerca in Antartide), at the Italian Museo Nazionale dell'Antartide which collects 16,000 samples and their related data. Rock sample study is focused on the recognition of their mineralogical and petrographical features. These data, together with those derived from field observations and maps, enabled the establishment of a geological database and GIS (Fig. 1). The database has been maintained with MS Access and is made up of a set of interrelated tables that store field data, as well as the results of petrographic analyses and magnetic susceptibility values.

At present, the GIS contains 2400 sampling location data which correspond to 9700 samples, in a series of regional and local projections (Polar Stereographic, Lambert Conformal Conic), and also the attribute tables derived from the database. Using GIS softwares such as ArcView and Arc/Info, it is possible to project, visualize, query and analyze the data. Moreover, these softwares allow the development of new personalized tools with programming languages. Using Avenue, ArcView's language, an ad-hoc customization permits the selection of rock samples based on user-defined mineral assemblages. This customization has been successfully tested with data from the Mt. Melbourne Quadrangle. Further improvements will permit the selection of samples, based on the choice of predefined metamorphic parageneses and geochemical characteristics. For this purpose, the database will be populated with mineral chemistry and geochronological data of metamorphic rocks.

Examples of the current database structure and contents, as well as downloadable versions of the GIS themes are accessible in Internet http://www.mna.it/english/Collections/collezioni_set.htm.

Absolute gravity measurements and collocated geodetic positioning techniques in Antarctica: a review. Implications for the polar cap

(poster p.)

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Due to the difficulty to reach Antarctic stations, only a few Absolute Gravity (AG) measurements have been performed in Antarctica. The first one was in the late 50s, using pendulum instrument while nowadays the FG5 ballistic gravimeter is the most largely used. We make a review of these measurements, and present the different resulting values of gravity, including some repetitions. For similar reasons, GPS data are restricted to permanent receivers installed at the permanent basis (remote stations are limited to austral summer time, since the solar panels are usable only during this period of the year). We present a review of available data and results.

Measurements of AG collocated with precise positioning systems are very useful in order to constrain the vertical displacement and consequently provide priceless information on the time evolution of the Antarctic polar cap. In particular, they will help separating the Post-Glacial Rebound (PGR) visco-elastic component from the elastic component due to present day ice melting.

Absolute gravity and GPS measurements as constraints on the post-glacial rebound and present-day ice melting in the French sub-Antarctic Territories

(poster p.)

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Absolute gravity (AG) measurements in the French sub-Antarctic Territories are performed with FG5#206 AG meter, in the framework of a 5-year program supported by the French Polar Institute. This program started in 2000 with an AG measurement in Terre Adélie, Antarctica; and this measurement will be repeated in 2005.

In 2001, we measured for the first time in Kerguelen Island and in La Réunion Island. These two stations will be measured again in March-April 2003, leading to the first repetition of AG measurements in this region.

A permanent GPS station is operating in Kerguelen since 1994 in collocation with a DORIS beacon. Both type positions and velocities have been included in the current ITRF2000 solution. An uplift rate between 3 (8 year GPS estimation) and 5 mm/year (ITRF2000) is obtained. In a two-year duration (2001-2003) the induced displacement leads, if we convert it into gravity change using the free-air gradient, to a small value of 1 to 3 μGal.

Despite that this value is close to the AG meter accuracy, we will compare it to our gravity measurement. We will also compare the GPS uplift rate to the DORIS solution.

This type of collocated precise positioning and gravity investigation will help in constraining the crucial problem of separating PGR (Post-Glacial Rebound) and present-day ice melting contributions.

Establishing the links between continental shelf glacial troughs and continental rise development west of the North Antarctic Peninsula

(oral p.)

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The nature of the links between glacial troughs on the continental shelf and the development of canyon/channel systems and intervening large sediment mounds on the continental rise west of the North Antarctic Peninsula (NAP) is far from being obvious. Acquisition and integration of swath bathymetry data covering an area of 66,000 km^2 with the predicted seafloor topography of SMITH & SANDWELL (1997) bring new insight into the former question.

The continental margin west of the NAP between 63°S and 66°S consists of an up to 150 km wide shelf, which includes several southeast-northwest oriented, tens of kilometres wide glacial troughs.

The deepest inner segments of these troughs exceed 1000 m of water depth and they shallow towards a ~400 m deep lobate shelf edge. An up to 20° steep, gullied continental slope which lacks submarine canyons opens into a broad and smoother continental rise starting at water depths in excess of 2500 m. The continental rise is cut by canyon-channel systems that can be traced from ~2800 m to >3800 m of water depth. The development of tributary networks and the overall size of each of the individual canyon-channel systems varies largely. The distal parts of some of them merge forming up to 8 km wide channels that vanish into the abyssal plain. Intervening large sediment mounds with their crest hundreds or even more than one thousand meters above canyon-channel axes grade from strongly asymmetric to essentially symmetric. Shallow landslide scars are found in several of the mounds' flanks, either the steeper or the smoother. The largest scars, located on the mound named 4A, are 60 m to 120 m high and can be followed along 60 km.

The integration of multibeam and predicted seafloor topography data indisputably shows that the heads of all the canyon-channel systems develop off the mouth of the glacial troughs cut on the continental shelf. Most trough mouths locate at shelf edge reentrants while shelf edge lobes mostly correspond to inter-trough segments. This indicates that both the highest activity of the canyon-channel systems and the most efficient development of the sediment mounds would occur during glacial epochs, when the ice stream-filled troughs carried large amounts of sediment to the shelf edge where the ice was grounded (CANALS et al. 2003). Quickly accumulating sediment on the continental slope off trough mouths would easily become unstable thus leading to the development of the shelf edge reentrants and of the correlated canyon-channel systems. These would transport down to the abyssal shelf the coarsest fraction of the subglacially bulldozed sediments. Because of the combined action of (i) hydraulic jumps at the base of the slope, (ii) release of subglacial sediment-laden water flows along the grounding line at the shelf edge, and (iii) along-margin bottom currents, the finer sediments would accumulate out of the canyon-channels thus forming the continental rise sediment mounds. Contributions to mound development during glacial transitions could have been of relevance too since more suspensate-rich subglacial meltwater was available. Our data show that there is a straightforward relation between the inferred ice drainage area of individual glacial systems, spacing between neighbour valley systems and mound size. These factors also seem to relate with the asymmetric or symmetric character of the various mounds. Mound crests form off inter-troughs outer shelf shallow banks. Long term stability of the various physiographic and sedimentary elements on the continental margin west of the NAP would favour the development of large mounds.

Smith, W.H.F. & Sandwell, D.T. (1997): Science, 1956-1962.
Canals, M. et al. (002): Geology 30 (7): 603-606.

Do ice streams self-destruct?
(oral p.)

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Detailed seismic and swath bathymetry surveys were conducted on the West Antarctic continental shelf, from the Ross Sea to the Antarctic Peninsula, focusing on large glacial troughs where ice streams are believed to have been located during the last glacial maximum. Most of these troughs cut into crystalline bedrock on the inner shelf and off-lapping sedimentary strata on the outer shelf, allowing examination of how past ice stream behavior was influenced by bedrock geology and physiography. An offshore transition in geomorphic features from grooves and striations (crystalline bedrock) to highly attenuated drumlins (thin sediment cover) to mega-scale glacial lineations (thick sedimentary strata) typifies the troughs. The latter features indicate accelerating ice flow across a deforming bed. Data from Pine Island Bay and Marguerite Bay extend landward into former onset areas. The seascape in these areas includes spectacular subglacial meltwater drainage systems, which supplied needed water to the deforming bed.

Radiocarbon ages from sediment cores indicate a diachronous retreat history of different ice streams across West Antarctica. The timing of retreat from the shelf is best correlated to the geological setting of ancestral ice streams. The ice streams of the eastern Ross Sea extended hundreds of kilometers across the shelf to the shelf break, flowing across unconsolidated strata. These ice streams retreated first, long before the West Antarctic Ice Sheet retreated from the shelf off Marie Byrd Land and the Antarctic Peninsula region. It is suggested that overextension of ice streams flowing across sedimentary basins resulted in draw down of the ice sheet, causing it to decouple from the bed, even while global sea level was at a lowstand.

ANDRILL: Stratigraphic drilling for climatic and tectonic history in Antarctica
(poster p.)

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Limited exposures of Cenozoic strata in Antarctica (due to ice cover and erosion) and the low number of stratigraphic drillholes on the continental margin has led geoscientists to interpret ice sheet history from lower latitude proxy records. The resulting models and understanding of Antarctic glacial history has as yet little confirmation from Antarctica. The Antarctic margin is well place to record, directly, fluctuations in the Antarctic ice sheet and climate. Sedimentary archives recovered by the Cape Roberts Project (CRP) demonstrate that high-quality proximal records of past ice sheet behavior are obtainable. ANDRILL is an international initiative that will build on the success of the CRP through a new phase of stratigraphic drilling. ANDRILL plans to use fast-ice and ice shelves as a drilling platform to obtain high-resolution (0.1 to 100 k.y.) seismically-linked and chronologically well constrained stratigraphic records from key locations around the Antarctic continental margin. Key scientific questions and objectives will be addressed in a series of portfolios, the first being the *McMurdo Sound Portfolio* (MSP) in the western Ross Sea. In this region, accumulation of a thick pile of Cenozoic strata is accommodated within a subsiding half-graben basin of the West Antarctic Rift System and within flexural moat basins rimming volcanic centers within the basin.

Five themes with an overarching focus on climate and glacial history are at the core of ANDRILL's scientific plan and include: (1) Thresholds and stages in the development of the cryosphere; (2) Climatic optima and ice sheet stability – response to times of past warmth; (3) Ice sheet modulation of global climate and sea-level; (4) Origins and adaptations of polar biota; (5) Antarctic rift evolution and uplift of the TAM.

ANDRILL will achieve its scientific objectives of the MSP through an integrated three-phase approach involving geophysical surveys, stratigraphic drilling, and modeling. A geophysical survey program including gravity and magnetic surveys, and seismic acquisition from the sea-ice and ice shelf began in 2001 and will continue throughout the program with goals to document basin extent, architecture and to correlate drilling targets to existing drillcores. Four seasons of drilling will obtain stratigraphic sections from the Antarctic margin to link proxy climate records from lower latitudes to proximal pre-glacial and interglacial-glacial records. Four years of data analysis and integration into glaciological, climate, tectonic, and oceanographic models will determine global links and the role of the Antarctic cryosphere in global environmental change. A new Scientific Committee on Antarctic Research (SCAR) initiative is the ACE Working Group, which will address "Antarctic Climate Evolution" through the integration of geological data with model data. ANDRILL will provide vital new information to calibrate and test the new models.

The ANDRILL program must address unique logistical and drilling requirements to achieve its science goals. New drilling tools will be developed from proven technology that was employed during the CRP. The new ANDRILL drilling systems will have the potential for: (1) continuous wireline sea-riser coring (2) Greater than 95 % core recovery, (3) recovery of strata to a depth of 1000 m below sea-floor in water depths up to 1000 m, (4) recovery of sediment from sea-ice and ice-shelf platforms, and (5) recovery of soft sediment.

ACE Working Group <www.ace.scar.org>/ ANDRILL <www.andrill-server.unl.edu> / CRP <www.geo.vuw.ac.nz/croberts>.

Crustal features of the Rennick Graben structure and southern continuation of the Meso-Cenozoic fault system from GDS investigation and other geophysical constraints

(poster p.)

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The Cenozoic geologic history of North Victoria Land (NVL) shows evidence for close space-time link between magmatic activity, dextral strike-slip fault system, and Southern Ocean fracture zones (ROCCHI et al. 2002). The Rennick Graben (RG), the most important Cenozoic tectonic structure of NVL, can be adequately described in terms of a tectonic depression in a region of dominating NW-SE trending dextral-slip (ROSSETTI et al. 2003). An interpretation of the electrical conductivity structure beneath the RG, based on Geomagnetic Deep Sounding (GDS), was carried out during the 1999/2000 BACKTAM project (BOZZO & DAMASKE 2001). The GDS transect is composed by nine stations located perpendicularly to the graben and the main structural lineaments (Leap Year Fault, Lanterman Fault, Wilson Thrust), from the Everett to the Daniels Ranges, with a spacing of about 20 km for a total lenght of 160 km.

The interpretation by induction arrows analysis and 2D inversion suggests a clear differentiation of the investigated area in three crustal sectors separated by the Daniels Range and the Bowers Mts., in close relation with main known structural lineaments. The analysis is based on the different thickness of the shallow resistivity layer (resistivity over 400 ohm m) and the resistivity pattern at depth greater than 15 km. The RG block shows also a different geometry affecting the shallow resistivity layers, it deepens at the east and west sides of the Morozumi Range (MR), suggesting two different interpretations: it can be related to the shear zone or the MR can be considered an inner horst (ARMADILLO et al. 2003).

During the recent 2002/2003 PNRA expedition, a new GDS investigation has ben carried out in the frame of the TIMM project (Tectonics and Interior of Mt. Melbourne area), together with aeromagnetic and ground geophysical survey. The investigated area is located between the Aviator and the Reeves Glaciers and crosses the Priestley and the Campbell glaciers. This new GDS transect is formed by 12 stations with a spacing of about 20 km. As known the Pristley and the Campbell Faults are marked by two NW magnetic lineaments; the Campbell Fault is interpreted to be the reactivated Wilson Thrust Fault zone and is an important isotopic discontinuity in the basement (FERRRACCIOLI & BOZZO 1999). The Mt. Melbourne area is located at the intersection of the Ross Sea and Rennick Graben Fault system (ROLAND & TESSENSOHN 1984) and is dominated by major NW-SE rigth-lateral strike-slip faults generating uplifted crustal blocks, namely Deep Freeze Range block and more subsided N-S graben-like structures such as the one in which MM volcano appears to be located (FERRACCIOLI et al. 2000). Comparing the model of the RG and the preliminar interpretation of the new GDS data collected in the Mt. Melbourne area, we have obtained further information on the southern continuation of the main structural lineaments related to the RG system. In this frame other potential field geophysical constraints have been used to model and identify possible correlations between major tectonic lineaments and the crustal structures.

Armadillo E., Bozzo E., Caneva G. (2003): Terra Antartica, submitted.
Armadillo E., Ferraccioli F., Bozzo E., Caneva G. & Caneva A. (2000): Annali di Geofisica 43, 2.
Bozzo E. & Damaske D. (2001): Terra Antartica Reports N. 5
Ferraccioli F., Armadillo E., Bozzo E. & Privitera E. (2000): Phys. Chem. Earth 25/4: 387-393.
Ferraccioli F., Bozzo E. (1999): JGR 104/B11: 25, 297-25,319.
Kleinschmidt, G. (1992: Polarforschung 60: 124-127.
Rocchi S., Armienti P., D'Orazio M., Tonarini S., Wijbrans J.R. & Di Vicenzo G. (2002): JGR 107/B9, 2195, doi: 10.1029/2001JO00515.
Roland W. & Tessensohn F. (1984): GANOVEX III Vol.II 1982/1983 Expedition.
Rossetti F., Laufer A. & Storti F. (2003): Terra Antartica, submitted.

Draped aeromagnetic survey over Mt. Melbourne volcano

(oral p.)

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Recent volcanic activity of Mt. Melbourne is revealed by blankets of pyroclastic pumice and scoria fall around the eastern and southern flanks and by pyroclastic layers interbedded with the summit snows (WÖRNER & VIERECK 1989). Geothermal activity in the crater area of Mt. Melbourne has been modelled by 30-m wide dykes intruded within the last 200 years (DELISLE & THIERBACH 1989). Geophysical networks deployed to monitor Mt. Melbourne in the 1990s suggest indeed that it is a quiescent volcano apparently characterized by slow internal dynamics (BONACCORSO et al. 1997, ARMADILLO et al. 2003). Hence the ANTEC international neotectonics programme of SCAR recognized that the Mt. Melbourne area is a stimulating target for high-resolution geophysical work addressing interplays between neotectonics and active(?) or at least recently active volcanic processes. The significance of this volcano is high because of its key location at the transition between the uplifted Transantarctic Mountains (TAM) and one of the largest, active(?) rift systems in the world, the West Antarctic Rift (WAR) system (BEHRENDT 1999). In this framework the TIMM (Tectonics and Interior of Mt. Melbourne area) project was initiated during the latest 2002-2003 Italian Antarctic campaign. New high-resolution aeromagnetic and ground-geophysical data including magnetovariational network monitoring were acquired.

We will present the first images obtained from the new high-resolution aeromagnetic survey. For this survey the line separation was in parts less than 500 m. A low-altitude draped (<305 m) survey flight configuration was adopted. This is a pioneering high-resolution draped survey over the Antarctic continent. Detailed geophysical imaging of Mt. Melbourne volcano area and adjacent tectonic structures was obtained demonstrating that such type of surveys is required to meet the enhanced requirements of ANTEC-related investigations. The previously available aeromagnetic (BOSUM et al. 1989), gravity (REITMAYR 1997), seismic refraction (O'CONNELL & STEPP 1993) and electromagnetic (ARMADILLO et al. 2000) studies already provided some regional perspective of crustal structure and tectonics of the area. The combined interpretation of these previous data has led to the suggestion that Mt. Melbourne volcano could be linked to a major intra-plate strike-slip fault system, namely the Campbell fault (FERRACCIOLI et al. 2000). Such an interpretation would be consistent with recent geodynamic models for Cenozoic magmatism of the TAM-WAR region (ROCCHI et al. 2002).

The detailed geophysical fieldwork performed in the TIMM project during the latest Italian Antarctic campaign is a new basis for high-resolution mapping and subsequent modelling of the Mount Melbourne volcano area. Hence, the new dataset provides a more accurate means of verifying any possible coupling between active(?) faulting along the western margin of the Rennick Graben and the Terror Rift and its effects on the interior of the quiescent Mount Melbourne volcano itself.

Armadillo E., Ferraccioli F., Bozzo E., Caneva G. & Caneva A. (2000): Annali di Geofisica 43: 279-288.
Armadillo E., Bonaccorso A. Bozzo E., Caneva G., Capra A., Falzone P., F. Ferraccioli F., Gandolfi S., Mancini F., Privitera E., & Vittuari L. (2003): Royal Soc. N. Zealand Bull. 35: 571-578.
Behrendt, J.C. (1999): Global and Planetary Change 23: 25-44.
Bonaccorso A., Gambino S. & Privitera E. (1997): Terra Antartica Pub. 531-538.
Bosum W., Damaske D., Roland, N.W., Behrendt, J.C. & Saltus, R. (1989): Geol. Jb. E38: 153-230.
Delisle G. & Thierbach (1989): Geol. Jb. E38: 435-453.
Ferraccioli, F., Armadillo E., Bozzo E., Privitera E. (2000): Phys. Chem. Earth 25(4): 387-393.
Reitmayr, G. 1997): (Terra Antartica Pub. 597-602.
Rocchi S., Armienti P., D'Orazio M., Tonarini S., Wijbrans J.R. & Di Vicenzo G. (2002): JGR 107/B9.
O'Connell, D.H. & Stepp, T.M. (1993): Geol. Jb. E47: 229-276.
Wörner, G. & Viereck L. (1989): Geol. Jb. E38: 369-394.

The Neogene terrestrial biota of Antarctica

(oral p.)

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Meyer Desert Formation fossils from the Oliver Bluffs at ~lat. 85°S on the Upper Beardmore Glacier, Transantarctic Mountains, indicate that a tundra-like environment persisted into the Neogene. Plant and algal fossils include wood and leaves of *Nothofagus* (HILL et al. 1996, FRANCIS & HILL 1996), abundant seeds of *Ranunculus* (buttercups) and other herbaceous taxa, an entire cushion plant, moss stems and leaves representing at least four species, a grass leaf, root casts, spores and pollen (ASKIN & MARKGRAF 1986, ASKIN & RAINE 2000). Animals are represented by insects, ostracods, freshwater molluscs, and a fish. Insects include the skeletal parts of two species of listroderine weevils (ASHWORTH & KUSCHEL 2003) and the puparium and a leg of a cyclorraphan fly (ASHWORTH & THOMPSON 2003). Freshwater mollusc shells are those of a species of sphaeriid bivalve, *Pisidium* and a lymnaeid gastropod (ASHWORTH & PREECE 2003). The fish tooth and pharyngeal bones lack sufficient diagnostic features to enable them to be identified to the family level. The fossils accumulated in an ice-marginal environment, adjacent to the terminus of the glacier, at the head of wide fjord. The growth forms and low diversity of plant taxa indicate a mosaic tundra vegetation. The landscape was sufficiently stable for a lake, ice-free for long enough during the summers, to support algae, benthic invertebrates and a species of fish. Mean summer temperature is estimated to have been about 4-5°C for at least two months.

The site is of considerable biogeographical interest as it represents the southernmost distribution for terrestrial organisms with complex life histories. One of the major questions regarding the organisms is whether they had continuously inhabited Antarctica since the Mesozoic, or whether they migrated to the continent during a Neogene warm interval. The difficulties of dispersing across 1000 km of ocean make it more probable that *Nothofagus* and the flightless listroderine weevils were part of the Gondwana flora and fauna. Other organisms, however, may have been transported to the remote location by birds migrating from one of the southern continents, or even from the Arctic.

Cooling of the climate between 34-26 Ma associated with either the opening of the Drake Passage and the formation of the Circumpolar Current or a global decrease in atmospheric CO_2 levels (DECONTO & POLLARD 2003), is the most probable cause for the initial decline in species diversity of plants and animals. The East Antarctic Ice Sheet had formed by 10 Ma and the West Antarctic Ice Sheet by 6 Ma (ZACHOS et al. 2001). Increasingly, the climate became more arid and a shift from wet-based to cold-based glaciations occurred. We infer that ice-free areas, starved of moisture, became polar deserts resulting in the extinction of vascular plants, most cryptogams, arthropods other than a few species of mites and collembollans, and all aquatic organisms of the Neogene tundra biota.

Ashworth, A.C. & Kuschel, G. (2003): Palaeogeogr. Palaeoclimatol. Palaeoecol. 191: 191-202.
Ashworth, A.C. & Preece, R.C. (2003): J. Moll. Stud. 69: 89-92.
Ashworth, A.C. & Thompson, F.C. (2003 in press): Nature.
Askin, R.A. & Markgraf, V. (1986): Antarctic J. U.S. 21: 34-35.
Askin, R.A. & Raine, J.J. (2000): Terra Antartica 7: 493-501.
DeConto, R.M. & Pollard, D. (2003): Nature 421: 245-249.
Francis, J.E. & Hill, R.S. (1996): Palaios 11: 389–396.
Hill, R.S., Harwood, D.M. & Webb, P.-N. (1996): Rev. Palaeobot. Palynol. 94: 11-24.
Zachos, J., Pagani, M., Sloan, L., Thomas, E. & Billups, K.(2001): Science 292: 686-693.

The United States polar rock repository and Antarctic Geologic Database
(poster p.)

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The United States polar rock repository and the Antarctic geologic database provide a curated, easily accessible archive of collections of U.S. geologists obtained from the polar regions, primarily from Antarctica. This new national facility, completed in June 2003, houses rock collections along with associated materials such as field notes, annotated maps and air photos, raw analytic data, paleomagnetic cores, ground rock and mineral residues, thin sections, and microfossil mounts, microslides and residues. The repository includes storage space, along with a rock preparation room with rock saw, work and lay-out areas, office and conference areas, plus computer and microscope equipment. Additional laboratory facilities, if needed, are available in the adjacent Byrd Polar Research Center, as well as in the Department of Geological Sciences at Ohio State University (OSU). The repository is managed by the curator (Dr. Anne Grunow) with student assistance, and with an advisory U.S. National Steering Committee. Visitors are welcome to examine rock collections and associated materials, and splits of sample material (obtained within sampling guidelines) may be requested for analysis. Evaluation of sample collections may be carried out on site or via the online Antarctic Geologic Database (AGD).

Rock collections from Antarctica, with accompanying materials, have thus far been received from Drs. Campbell Craddock, Thomas Laudon, Timothy Vick (collection of Duncan Stewart, Carleton College), Warren Hamilton, Dwight Crowder and Don Coates. We have been promised or are discussing receipt of rock collections and/or other materials from Drs. Art Ford, Scott Borg, William Long, and Hal Borns. Collections from OSU being incorporated into the repository archives include those of Drs. James Collinson, David Elliot, Rosemary Askin, Anne Grunow, Terry Wilson, Peter Webb, Gary Wilson, William Long, and various collections of past OSU students such as Peter Barrett and John Lindsey, among others.

The Antarctic Geologic Database (http://bprc.mps.ohio-state.edu/agd) provides online searchable data for all samples held within the U.S. polar rock repository, as well as any samples stored elsewhere in the U.S. when the principal investigator has entered the relevant data. A user can search for rock samples by geographic area, geologic age, rock type, formation or unit, fossil or mineral content, collection purpose, and by whom and when the collection was made. It can inform the user what analyses have been carried out, where those results are published, and also of other possible unpublished results and their location and availability. It can provide a great variety of descriptive information, including anecdotal field observations, as well as visual images such as petrographic thin sections. The AGD records where the rocks are currently stored, and the name and contact details of the collector, curator or contact person.

Cold-based glacial erosion and deposition features, Dry Valleys, Antarctica
(oral p.)

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It is commonly assumed that cold-based glaciers are ineffective geomorphic agents and leave little imprint on the landscape. However, a recent study has documented a suite of features produced by cold-based on bedrock surfaces at high elevations (1600-2300 m.a.s.l.) in the Transantarctic Mountains (TAM). These consist of abrasion marks, subglacial deposits, glaciotectonically deformed substrate, isolated blocks, ice-cored debris mounds, and boulder trains and have been used to delineate a cold-based ice advance over 2 km into ice-free areas, overtopping landforms up to 100 m above the present ice limit (ATKINS et al. 2002).

Additional cold-based features have been observed from low elevations (600 m.a.s.l.) in the Pearse Valley where the cold-based margin of the Taylor Glacier rests on sediment covered surfaces. These features include abraded boulders, overturned cobbles and compacted ground. These observations confirm that abrasion can occur beneath cold-based glaciers on sediment covered surfaces, however, the preservation potential at lower elevations appears to be very low as they are easily removed by melt-water that erodes lateral channels along the margins of the glaciers.

The features on bedrock surfaces at high elevations have better preservation potential owing to the lack of melt-water. Thus, they provide criteria to recognise previously invisible cold-base glacier movements in other areas of Antarctica. This may also be true for interpreting the surface of Mars, where recent studies have suggested that cold-based glaciers may exist (HEAD & MARCHANT 2003). In the hyper-arid, Martian climate, cold-based glacier features as outlined above may have a even greater preservation potential and prove to be useful tools for understanding past climate conditions.

Atkins, C.B., Barrett, P.J. & Hicock, S.R. (2002): Geology 30/7: 659-662.
Head, J.W. & Marchant, D.R. (2003): Geophys. Res. Abstr. 5: 02770.

Sapphirine granulite from Schirmacher Hills, Central Dronning Maud Land

(oral p.)

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Numerous sapphirine-bearing metamorphic rocks were reported from various localities in East Antartica (e.g., Napier Complex, Rayner Complex). In central Dronning Maud Land (CDML), GREW (1983), ASAMI et al. (1994) and ISHIZUKA et al. (1995) reported different types of sapphirine-bearing rocks. However, none of them were coexisting with orthopyroxene. In this paper, we introduce new sapphirine locality in Schirmacher Hills, and propose UHT metamorphism evidenced by coexisting orthopyroxene compositions.

Schirmacher Hills is located on the Princess Astrid coast of CDML (11°20'-11°55' E, 70°45' S). The metamorphic rocks in Schirmacher Hills are divided into following lithologies from the lower to upper structural level, quartzofeldspathic gneiss (including charnokite, mafic granulite), augen gneiss, mixed zone (pelitic gneiss, calcsilicate, mafic granulite, charnokite etc.), Grt-Bt gneiss, Bt and Bt-Hbl gneiss (SENGUPTA 1993). These rocks were suffered granulite-facies metamorphism at early, and followed by amphibolite-facies metamorphism. GREW & MANTON (1983) reported 630 Ma metamorphic age (U-Th-Pb age) from the Bt and Bt-Hbl gneisses. VERMA et al (1987) shows 411-608 Ma K-Ar biotite age. Although there are no direct age datings, early granulite-facies metamorphism was considered to be 1000-1200 Ma Grenvillian event in light of neighbouring lithological unit of CDML.

Sapphirine-bearing granulite is exposed in a small outcrop in the eastern part of Schirmacher Hills. It lies adjacent to Hbl-Bt gneiss outcrop and surrounding bodies consisting of Bt gneiss and Bt-Hbl gneiss. Locally, Grt-bearing mafic gneiss and Grt-Sil gneiss can be seen in the surrounding body. Sapphirine-bearing granulite have distinctive domains of coarse-grained massive domains and fine-grained banded domain. The former consisting mainly of coarse-grained orthopyroxene, garnet and plagioclase, and the latter of cordierite, orthopyroxene, garnet, and biotite. Sapphirine occurs mainly as inclusions within garnet and rarely orthopyroxene, and as relict grains in secondary orthopyroxene and cordierite coronas. Garnet porphyroblasts have high pyrope contents (up to XMg 0.52). Orthopyroxene porphyroblasts have an Al_2O_3 content of up to 10 wt.% and XMg of 0.74. By using P-T grid with calculated XMg and XAl isopleths for garnet and orthopyroxne (HENSEN & HARLEY 1990), we obtained UHT condition of nearly ~1000 °C. Sapphirine, high-Mg garnet, high-Al orthopyroxene might be stable at the UHT condition, and secondary orthopyroxene and cordierite were formed during the subsequent decompressional stage.

According to the previous study, the UHT metamorphism should be coincident with Grenvillian granulite-facies metamorphism widely recognized in CDML. However, critical correlation between Schirmacher Hills and other CDML region are needed on the basis of recent geochronological dating and tectonothermal event involving UHT metamorphism.

Asami, M., Makimoto, H. & Grew, E.S. (1994): Proc. NIPR Symp. Antarct. Geosci. 7: 179
Grew, E.S. & Manton, W.I. (1983): Antarct. Jour. U.S. 18: 6-8
Grew, E.S. (1983): Antarct. Earth Sci., 40-43
Hensen, B.J. & Harley, S.L. (1990): High Temperature Metamorphism and Crustal Anatexis.- Unwin Hyman, London, 19-56
Ishizuka, H., Suzuki, S. & Kojima, H. (1995): Proc NIPR Symp. Antarct. Geosci. 8: 65-74

Sengupta, S. (1993): Prec. Res. 63: 273-291
Verma, S.K., Mittal, G.S. & Dayal, A.M. (1987): Dept. Ocean Develop., New Delhi, Tech. Publ 4:43-54

Geology of Filchnerfjella in Dronning Maud Land, East Antarctica; a preliminary report of Japan-Norway-Germany joint geological investigation

(poster p.)

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The nunataks of Mühlig-Hofmannfjella and western Orvinfjella, a hitherto poorly known part of the Dronning Maud Land (DML) mountain range, was mapped for the first time during the Norwegian Antarctic Research Expedition (NARE) 1996-97. The area was revisited during the austral summer of 2001/2002 by a Japanese-Norwegian-German joint geological expedition. Geological history is constructed from metamorphic, igneous petrology and structural investigation of Filchnerfjella and surrounding area, where the nunataks continuously crop out between 2°E to 8°E in central Dronning Maud Land. We report preliminary results of geological features in the Filchnerfjella region.

Filchnerfjella consists mainly of metamorphic rocks accompanied with intrusive rocks. The two-stage metamorphism can be divided in this area, where the earlier stage metamorphism is defined as porpyroblast stage (garnet, hornblende, and sillimanite stable), and the later one is recognized as symplacticte stage (orthopyroxene and cordierite stable). Clockwise P-T path is required involving high-P/medium-T at early stage followed by low-P and high-T stage, at which partial melting may take place, because probable melt of leucocratic gneiss contains cordierite.

The field relationship and petrography of the syenite on Filchnerfjella are similar to those of the post-tectonic plutons from central Dronning Maud Land, and most of the post-tectonic intrusive rocks indicate within plate geochemical characters. The structural history in Filchnerfjella and surrounding areas can be divided into the Pan-African stage and the Mesozoic to Cenozoic stage that relates to breakup of Gondwana.

Meltwater discharge anomalies in Marine Isotope Stage 3 from a sediment core south of Antarctic Polar Front, Drake Passage

(poster p.)

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Marine isotope stages (MIS) 1 to 5 were identified in the planktonic $\delta^{18}O$ record in sediment core DP00-02 just south of the Antarctic Polar Front within the Drake Passage, Antarctica. The oxygen isotope record based on *Neogloboquadrina pachyderma* sinistral is well correlated with the contemporaneous global $\delta^{18}O$ stratigraphy. Marked differences from the global climate curve suggest a local/regional overprint, particularly during the MIS 3, which is considered as a colder time period in the ocean record than the MIS 1 and MIS 5 interglacial periods. The comparison shows that negative $\delta^{18}O$ shifts in the core DP00-02 during the MIS 3 are larger than mean global changes that show a shift equal to or smaller than 0.5 ‰. The isotope shift, exceeding the glacial-interglacial ice volume effect, probably resulted from changes in the isotope composition of sea water which is linearly related to decreases in salinity rather than increases in sea-surface temperature. Increased ice-rafted debris (IRD) content during this period interval indicates strong influx of IRD from melting ice shelves and iceberg, which may be related to upwelling of warmer Circumpolar Deep Water.

The onset and development of the Antarctic Circumpolar Current

(oral p.)

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The strength of interaction between tectonics and climate, through changes in ocean circulation, is a major concern of palaeoclimate research, that must be addressed. For this reason, a thorough re-assessment is needed of the timing of onset and development of the Antarctic Circumpolar Current (ACC), and its likely effects on climate, particularly Antarctic glaciation. A causal relationship between glaciation and ACC onset was suggested many years ago (KENNETT 1977). Recent ocean drilling has confirmed the opening of a deep-water gateway between the Australian and Antarctic continents at around the Eocene-Oligocene boundary (EXON et al. 2001), the time of onset of significant Antarctic glaciation (eg. ZACHOS et al. 2001) and the time also of changes in Southern Ocean structure in the SE Indian/SW Pacific sector (eg. NELSON & COOKE 2001) that have been generally interpreted as marking ACC onset. However, there is compelling evidence that a deep gap was not created between South America and Antarctica, completing a circum-Antarctic deep-water path, until much later than the Eocene-Oligocene boundary (perhaps as recently as the early or middle Miocene: eg. BARKER 2001), although the precise timing of this development is unknown. Recently also, numerical modelling of Antarctic glaciation (DE CONTO & POLLARD 2003) has argued that glacial onset could have been caused by a decline through the Cenozoic in atmospheric carbon dioxide or related greenhouse gases, with or without a contribution from changes in Southern Ocean circulation caused by the creation of deep-water pathways.

The key questions are therefore revised:

- When was a complete deep-water circumpolar pathway created, and (thus) when did the ACC develop as we know it today?
- What was the Southern Ocean circulation in the period (Oligocene and early Miocene?) when Antarctica was glaciated, but before a complete circumpolar deep water pathway existed?
- were all the documented aspects of this circulation real? To what extent were they effects of Antarctic glaciation rather than its cause?

We can provide speculative answers to these questions, but our major objective is to suggest how they might be answered with greater confidence.

Barker, P.F. (2001): Earth Science Reviews 55: 1-39.
De Conto, R. & Pollard, D. (2003): Nature 421: 245-249.
Exon, N.F., Kennett, J.P. & Shipboard Scientific Party (2001): Proc. ODP, Init. Repts., 189 [CD-ROM].
Kennett, J.P. (1977): J. geophys. Res. 82: 3843-3860.
Nelson, C.S. & Cooke, P.J. (2001): N.Z. J. Geol. Geophys. 44: 535-553.
Zachos, J., Pagani, M., Sloan, L., Thomas, E. & Billups, K. (2001): Science 292: 686-693.

Electron microscopic characterization of „rock varnishes" from northern Victoria Land

(poster p.)

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Thin films that coat rock surfaces, known as rock varnishes, are ubiquitous in desert regions and they have also been pointed out in Antarctica. We sampled well evident erosional and depositional geomorphologic units of different age in northern Victoria Land. Varnished rocks have been accurately examined in the field and selected on the basis of optical microscopic observation of their surfaces. Thin polished sections have been prepared perpendicular to the external surface of the samples. Scanning and transmission electron microscopy (SEM and TEM), with energy dispersive analytical systems, and X-ray diffraction (XRD) techniques have been performed to characterize the varnishes.

Most of the varnish/rock boundaries are sharp with no gradational transition. A discontinuous, thin (>1μm), microgranular layer composed by Fe-oxides marks the boundary of a number of observed samples. The varnishes are patch-distributed and preferentially accumulated in small depressions on the rock surface. Their thickness is variable, from few μm up to 100 μm. This variability is due to lateral thinning of the coating but post-depositional erosion is also documented.

Most of the coatings are composed by sequences of parallel micro-laminae 1-5 μm thick. Several samples show micro-laminae mainly constituted by Si-Al with minor Mg, K, and Fe. The Fe content is variable and originates dark- to light-grey (in back-scattered electron images) micro layers. TEM observations indicate that the siliceous-aluminium laminae are amorphous with very few smectite crystallites up to 100 nm thick. White bright discontinuous and irregular thin layers often occur in the varnishes. The layers can be parallel intergrown with the amorphaus laminae but they can also truncate the silicate structures. They are composed by S-Fe-K-Al (+P+Si), Fe (+Si+Al), and Mn+Fe (+Si+Al). The proportion of the different elements varies. No specific minerals have been detected in these laminae by SEM, probably because the crystals eventually present have dimensions smaller than the spatial resolution of the analytical probe. TEM and XRD techniques have clarified the nature of the S-Fe-K-Allenses and layers: they are minerals of the alunite-jarosite series (i.e. hydrated Fe-AI-K sulphates). Fe- and Mn+Fe-rich layers are probably constituted of Fe- and Mn-oxides.

Chemical composition and varnish micromorphology are produced by different mechanisms and under several environments that in turn, depend on specific climatic conditions. For this reason, they are useful tools in paleoenvironmental studies, particularly if sampled on surfaces of well-known age.

Warm-based ice advance and continental chemical weathering documented by the "Ricker Hills Tillite", Victoria Land, Antarctica

(oral p.)

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The Ricker Hills are a nunatak emerging from the East Antarctic Ice Sheet at the southern margin of the David Glacier basin. A semi-lithified to lithified diamicton, informally named "Ricker Hills Tillite", outcrops in places under a discontinuous Late Pleistocene glacial drift. Detailed geomorphologic and glacial-geologic surveys have been carried out for reconstructing the geomorphologic evolution of the area, for analyzing the sedimentary facies, and for characterizing the fabric of glacial deposits. The newly discovered tillite has been accurately mapped, described, and sampled for investigating the dynamic of the glacier responsible of its deposition. Thin sections of impregnated samples have been prepared for micromorphological description and petrographic analysis. The mineralogical composition of the clay fraction (X-ray diffractometry) and the chemical analyses of the bulk rock (X-ray fluorescence spectrometry) have also been carried out.

Petrographic analyses allowed the distinction of lodgement, ablation, and flow tills as well as injection veins and glacio-tectonic structures. The diamictite is generally massive, with a porphyric-related distribution, low sorting, low rounding and medium to high angularity. Chemical analyses indicate that samples derive from mixing of the two lithologies outcropping in the area: the Ferrar Group dolerites and the Beacon Supergroup sandstones. As it regards the clay minerals composition, samples are characterized by high smectite and kaolinite contents (respectively from 47-78 % and from 16-34 %), and low illite and chlorite content. Deformation structures induced by glacial stress are visible in glacial deposits and in bedrock samples collected at the base of the tillite. Phyllosilicate reorientation patterns (plasmic fabrics) due to glacial stress are clearly visible. Post-depositional features such as clay and silt coatings are widespread. Furthermore, clues confirming secondary water circulation and slight pedological activity are documented by common calcite neoformation.

We conclude that an ice mass advanced on the Ricker Hills and deposited a glacial drift in climatic conditions warmer than present, with a diffused availability of water during deposition. This interpretation is sustained by several sedimentary structures linked to hydraulic transport and by the evidence of deformational structures typical of wet sediments. Finally, the tillite experienced a post-depositional continental weathering in wet condition with percolating water, as testified by illuviation features, by calcite infillings, and by the formation of clay minerals typical of temperate climates.

Seismic-stratigraphic analysis of Ross Bank (central Ross Sea) suggests west-directed advance of the West Antarctic Ice Sheet from Marie Byrd Land

(poster p.)

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The large-scale trough and bank morphology of the Ross-Sea continental shelf and the semi-continuous alignment with similar topographic features within the adjacent inland (i.e., subglacial) areas of the West Antarctic Rift provide strong evidence that 1) at least five paleo-ice streams existed before grounded ice retreated from the continental shelf edge and that 2) West-Antarctic-Ice-Sheet (WAIS) flow was directed northward (e.g., HUGHES et al. 1981). At a finer scale, sea-floor lineations within trough axes also indicate north-directed ice flow (SHIPP et al. 1999) at least for the period of time immediately prior to ice-sheet retreat (STOKES & CLARK 2001). Within the constraints of this framework, sea-floor banks may have evolved in at least two ways: 1) as erosional features formed as distinct ice streams (zones of fast-flowing ice) deeply eroded into pre-existing strata; or 2) as depositional features (ice-stream boundary ridges) created as till accreted below zones of slow-moving ice between adjacent ice streams (i.e., via processes somewhat analogous to deep-sea drift evolution). Our seismic-stratigraphic analysis of the strata below Ross Bank (central Ross Sea outer continental shelf) supports neither of these two views. Despite its overall morphology, the internal stratigraphy suggests that Ross Bank was associated with westward drainage of the WAIS. Across and along the N-S oriented axis of Ross Bank, low-angle foreset stratal surfaces prograde to the west and downlap onto an underlying erosional surface. In our ongoing study of Ross Bank, we tentatively propose that prior to the establishment of the modern drainage pattern (i.e., north-directed flow with several ice streams), there was a period of time when the WAIS advanced from Marie Byrd Land (i.e., west-directed flow). If this hypothesis is correct, Ross Bank - and presumably the semi-continuous ridge within the inland areas of the West Antarctic Rift basin - evolved as a terminal moraine of an ancient WAIS expansion across Eastern Basin.

Campaign and continuous GPS measurements of deformation at Mt. Erebus, Antarctica

(poster p.)

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Mt. Erebus, Antarctica, the southernmost active volcano in the world, displays continuous eruptive activity. Small strombolian eruptions occur from the actively convecting phonolite lava lake and adjacent vents within the centrally-located summit crater. The activity of Erebus makes it an ideal laboratory for studying eruption dynamics. A 17-station campaign GPS network and an 8-station continuous GPS network monitor deformation to examine the timing, magnitude, and location of magma movement within and below Erebus. The continuous GPS network contains both dual- and single-frequency GPS systems. Sites range in distance from 0.5 to 10 km from the volcano's summit, at a variety of azimuths. The sites are part of a broader geophysical monitoring network including seismometers, microphones, tiltmeters and meteorological instruments.

Data from four yearly campaigns (1999/2000-2002/03) and three years of continuous data have been analyzed to date. Bernese 4.2 software was used to estimate 3-dimensional coordinates for all the GPS data. 3-dimensional site velocities and corresponding 95 % confidence estimates were subsequently calculated using a standard weighted least-squares method with the full data covariance. Velocities were calculated relative to MCM4 at McMurdo Station, which is assumed to be stable relative to volcanic motions. Maximum average site motions for the four-year time period are 3 ±0.2 mm/yr horizontal and 5 ±0.3 mm/yr vertical. Both the continuous and campaign data show small-scale time-variance in motions. Motions of the sites are, with the exception of the site closest to the summit crater (E1GP), directed radially outward from the volcano. Most sites have consistent downward motion relative to MCM4.

Motions may result from volcano/magmatic and tectonic mechanisms. The downward motion of sites relative to MCM4 suggests the volcano is settling under its own weight. As the deformation signal is time-varying and directed radially from the center of the volcano, horizontal motion is probably due to changes within the volcanic system. This horizontal motion can be approximated using a Mogi point source at shallow depths centered roughly beneath the volcano's summit. Significant motions from outer sites suggest a source around 5 km depth. Residual motions indicate the deformation source is likely more complicated than a single 'spherical' pressure source, possibly the result of multiple magma bodies or an elongate magma body; alternatively, the deformation pattern may be complicated by the influence of local or regional tectonics.

The small motions observed over four years indicate little change in the magma reservoir within Erebus. Assuming a magmatic source is responsible for the deformation, we suggest four explanations for the small motions: 1) upward migration of magma feeding Erebus is near-constant but low-volume; 2) single intrusions are able to feed the volcano for a period of at least several years with no significant replenishment; 3) significant influxes of magma occurred during the winter months when the continuous GPS systems had lost power, and the magma reservoir was returned through eruptions and degassing to its previous pressure before measurements resumed; and/or 4) pressurization from intrusions occurred either too deep or too shallow to be measured by our network. In the 2003/04 field season we will add a campaign and a continuous GPS site on the crater rim to help resolve very shallow sources of deformation.

Late Mesoproterozoic arc and back-arc volcanism in the Heimefrontfjella and implications for the palaeogeography at the southeastern margin of the Kaapvaal-Grunehogna Craton

(oral p.)

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The Heimefrontfjella is situated approximately 400 km inland of the eastern margin of the Weddell Sea in western Dronning Maud Land. The nunataks are dominantly composed of juvenile Late Mesoproterozoic rocks that were metamorphosed and deformed at about 1080 and 500 Ma. Heimefrontfjella is part of the Late Mesoproterozoic Maud belt, adjacent to the southeastern margin of the Archean Kaapvaal Craton, which has an Antarctic fragment, the Grunehogna Craton. Three discontinuity-bound terranes have been identified in Heimefrontfjella, namely the Kottas, Sivorg and Vardeklettane terranes. In the Sivorg Terrane the basement is mainly made up of fine-grained banded felsic and mafic gneisses, representing a metamorphosed bimodal volcanic sequence. In contrast, the basement in the Kottas Terrane is composed of banded gneisses of tonalitic to dioritic composition and calc-alkaline metaplutonic rocks. The metamorphic rocks of the Vardeklettane Terrane are granulites of supra- to infracrustal origin.

Geochemical data characterize the protoliths of the bimodal sequence in the Sivorg Terrane as tholeiitic basalts with low LREE/HREE enrichment, indicated by $(La/Yb)_n$ ratios between 5.69 and 1.19, and lacking Eu anomalies (Eu/Eu* 0.91-1.15), typical for oceanic tholeiites. These mafic rocks alternate with metamorphosed high K-rhyolites, derived from a highly fractionated granitic magma. A moderate LREE/HREE enrichment, indicated by $(La/Yb)_n$ ratios between 15.68 and 3.18, and pronounced negative Eu anomalies (Eu/Eu* 0.30-0.63), are common features for these samples. Four U-Pb zircon SHRIMP ages prove a magmatic activity in the Sivorg Terrane at least from ~1160 to 1090 Ma. In the Kottas Terrane orthogneisses of tonalitic, trondhjemitic, dioritic and granitic composition are exposed. Geochemically they follow a calc-alkaline trend and using multielement discrimination diagrams they plot in the field of volcanic arc granites. A relatively high enrichment of light

REE relative to heavy REE is documented by $(La/Yb)_n$ ratios of 18.66 and 5.03, whereas weak positive Eu anomalies (Eu/Eu* 1.12 and 1.28) reflect the absence of feldspar fractionation and/or high oxygen activity. Protoliths of these may be derived from a calc-alkaline magmatic suite along a subduction-related volcanic arc.

According to recent reconstructions of the Kalahari continent the basement of the Kottas Terrane is an Antarctic counterpart of the Mzumbe Terrane in Natal. Our data allow a reconstruction of a subduction-related volcanic arc (Kottas Arc) along a southerly directed subduction zone which existed from ~1200 to 1100 Ma, finally colliding with the southeastern margin of the Kaapvaal-Grunehogna Craton. South of the volcanic arc, a back-arc basin (Sivorg Terrane) developed during latest Meso-proterozoic times. Undeformed calc-alkaline granites in the northernmost Heimefrontfjella point to a final northward directed subduction of the oceanic lithosphere of the back-arc basin which led to the collision of the Coats Land block with the Kaapvaal-Grunehogna Craton.

Mafic dykes from Heimefrontfjella and implications for the post-Grenvillian to pre-Pan-African geological evolution of western Dronning Maud Land

(poster p.)

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Two groups of geochemically different mafic dykes have been identified in the Grenville-aged basement of Heimefrontfjella. During the Pan-African orogeny both dyke groups underwent metamorphism and tectonism at different grades: up to amphibolite-facies in the eastern and southern Heimefrontfjella, and at greenschist-facies in the western and northern Heimefrontfjella. This study was carried out to question whether these metamorphosed dykes are part of a greater magmatic province, i.e. are there possible correlatives in adjacent areas, and whether a Rodinia break-up is documented by mafic dykes in western Dronning Maud Land.

The first group comprises dykes of continental tholeiite basalt composition. One dyke of this group yielded an U-Pb zircon SHRIMP age of 1033 ±7 Ma. This group of dykes postdates the high-grade metamorphism of the basement by c 30 Ma.. According to JACOBS et al. (1993) the Kaapvaal-Grunehogna Craton and the Grenville-aged orogen at the southern margin underwent a prolonged phase of SW-NE directed convergence. The shape of the craton and the geometry of the major shear zones point to indentation tectonics. The mafic dykes of group I are oriented perpendicular to the main (Grenvillian) structural trend of the orogen and parallel to the implied $\sigma 1$ direction of the indenter. This is a preferred orientation of late-tectonic mafic dykes swarms in indentation regimes (FAHRIG 1987). The composition of the group I dykes with moderate REE profiles suggest a derivation from the lithospheric mantle either by assimilation of felsic crustal material or partial melting of an enriched source.

The second group has an E-type MORB composition and one dyke gave a preliminary U-Pb SHRIMP age of 586 ±7 Ma. It predates the oldest Pan-African metamorphic zircon ages at c 555 Ma (JACOBS et al. in press). At that time the Mozambique Ocean between West and East Gondwana was still existing, but assumed that present palaeogeographic reconstructions for the Late Neoproterozoic are correct, this ocean was already closing (e.g. DALZIEL 1997, GOSE et al. 1997). A (failed?) rift setting would be a possible explanation for the younger dykes.

The older dykes may be correlated with the Equeefa suite of southern Natal whereas the younger dyke group is not correlatable with any mafic intrusions or lava flows in adjacent regions. Neither the geochemistry of Heimefrontfjella mafic dykes nor their age is related to known Rodinia break-up dykes (WINGATE et al. 1998).

Arndt, N.T. et al. (1991): Geol. Rundsch. 80: 759-777.
Dalziel, I.W.D.(1997): Bull. Geol. Soc. America 109: 16-42.
Fahrig, W.F. (1987): Geol. Ass. Canada Spec. Pap. 34: 331-348.
Gose, W. et al. (1997): J. Geophys. Res. 102: 7887-7902.
Jacobs, J., Thomas, R.J. & Weber, K. (1993): Geology 21: 203-206.
Jacobs, J., Fanning, M. & Bauer, W. in press. Precamb. Res.
Wingate, M.T.D. et al. (1998): Precamb. Res. 87: 135-159.

Shallow source aeromagnetic anomalies observed over the West Antarctic Ice Sheet compared with coincident bed topography from radar ice sounding – new evidence for glacial "removal" of subglacially erupted late Cenozoic rift related volcanic edifices

(oral p.)

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Aeromagnetic and radar ice sounding results from the 1991-1997 central West Antarctica (CWA) aerogeophysical survey over part of the West Antarctic IceSheet (WAIS) and subglacial area of the volcanic West Antarctic Rift System have enabled detailed examination of specific anomaly sources. These anomalies previously interpreted as caused by late Cenozoic subglacial volcanic centers, are compared to bedrock topography. A great deal of technical effort by the CASERTZ and SOAR operation was needed during the 1990s to produce magnetic datahaving the observed accuracies of a few nT. As a result, the data contoured at 2 and 10 nT contour interval proved quite valuable in resolving subtlefeatures. Considering the approximately 1-km flight elevation over the snowsurface and the 2-3-km ice thickness of the WAIS, anomaly amplitudes aresurprisingly high (100->1000 nT) over most of the CWA area. In contrast, is the essentially non-magnetic, interpreted non-volcanic terrane at the southeast part of the survey (the Ellsworth-Whitmore crustal block comprising part of the rift shoulder) which was originally recognized in the 1960s from magnetic profiles, as geologically quite different from the magnetic, volcanic area.

Using 1/250 000 scale, 2- and 10-nT-contour interval magnetic and 20-m bedrock elevation maps we examined about 1000 shallow source magnetic anomalies for bedrock topographic expression. Using very conservative criteria we found over 400 specific anomalies which correlate with bed topography. We interpret these anomalies as indicative of the relative abundance of volcanic anomalies having shallow magnetic sources. Of course, deeper source magnetic anomalies are present, but these have longer wavelengths, lower gradients and mostly lower amplitudes from those caused by the highly magnetic late Cenozoic volcanic centers.

The great bulk of these >400 (40-1200-nT) anomaly sources at the base of theice have low bed relief (60-600 m, with about 70 % <200 m) which we interpret as indication of glacial removal of volcanic edifices comprising hyaloclastite, pillow breccia, and other volcanic debris injected into the moving ice during eruption since the iniation of the WAIS >10 m.y. ago. About 20 of the anomalies examined, about half concentrated in the area of the WAIS divide, have high topographic expression up to 1500 m. All of these high topographic relief anomaly sources at the base of the ice would isostatically rebound to elevations above sea level were the ice removed. We interpret these approximately 20 anomaly sources as evidence of subaerial eruption of volcanoes whose topography was protected from erosion by competent volcanic flows similar to prominent volcanic peaks that are exposed above the surface of the WAIS. Further, we infer these volcanoes as erupted at a time when the WAIS was absent. In contrast, at the other extreme, the bed topography in the survey area surrounding Ice Stream D is very smooth; the glacial bed probably comprises unconsolidated sediments. Yet, there are a number of shallow source, volcanic appearing magnetic anomalies in this area. These shallow subglacial volcanic sources may be overlain by glacially deposited sediments too thin to resolve from the magnetic survey. Probably the volcanic edifices were removed at a more rapid rate here because of fast glacial flow. Other deep source magnetic anomalies in the Ice Stream D area partially define a sedimentary basin.

Although late Cenozoic volcanic activity may have had a significant influenceon the behavior of the WAIS in the past, any Holocene influence is highly uncertain despite the presence of at least one active subglacial volcano (BLANKENSHIP et al. 1993) and sparse active volcanism throughout the area ofthe WAIS. Because the WAIS and the volcanic rocks are roughly of similar age it is critical that datable samples from subglacial volcanic centers be obtained when new ice drilling technology comes on line in the near future (e.g. CLOW et al.2002).

Planning for The International Polar Year – 2007: an opportunity for earth sciences

(oral p. & discussion)

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Planning is underway to hold an International Polar Year in 2007-2008. IPY 2007-2008 stands to be a significant research opportunity. It also has the potential to capture the public's imagination and convey the crucial role that the polar regions play in the global systems. IPY 2007-2008 is envisioned to be an intense, international campaign of coordinated polar observations and analysis; it will be bipolar in focus, multidisciplinary in scope, and truly international in participation. The Planning Group's vision is for many nations to work together to gain holistic insights into planetary processes, targeted at exploring and increasing our understanding of the poles and their roles in the global system.

The concept of an International Polar year 2007-2008 has been endorsed and advanced by a broad range of polar and global research groups. Earlier this year, the International Council for Science (ICSU) formed an International Polar Year Planning Group (IPY-PG) which met for the first time at the end of July. Planning Group discussed ways to create an open process that encourages broad input from the international community. We began to describe the desired goasls of IPY 2007-2008, which we believe should address compelling science issues through multi-national programs, enable scientific programs which would not otherwise occur, attract and develop next generation of polar scientists, and engage the public. The Planning group has identified three overarching themes that we hope can serve as the foundation for IPY 2007-2008:

Exploring the Earth's Icy Domains,
Decoding the Role of the Poles in Global Change,
Understanding Polar Processes.

The Planning Group envisions focused research activities under each of these major themes. For example, a program to explore sube-ice environment of East antarctica would fit under the theme

Exploring the Earth's Icy Domains, a program of Integrated Polar Observing Networks including GPS and seismic instrumentationm would fit under *Decoding the Role of the Poles in Global Change*, and a collaborative effort to study the stability of the cryosphere would fit under *Understanding Polar Processes*.

The goal of this discussion session is to bringe the Earth Science Community up to date on to the ICSU planning process and provide an open forum of discussion of key Earth Science Opportunities for the International Polar Year.

Defining multiple stages of extension in central West Antarctica

(poster p.)

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Detailed gravity and magnetic data over central West Antarctica provide an insight to its tectonic history (BELL et al 2002). Werner deconvolution solutions of the aeromagnetic data were used to estimate the depth to magnetic basement and the sediment thickness in the basins while the Bouguer anomalies were used to define the infilling history and thus age of the basins. We are able to use the Bouguer anomalies to distinguish large Mesozoic basins with positive gravity anomalies similar to the major Ross Sea basins from more recent basins with negative anomalies. The Interior Ross Embayment contains three distinct groups of sedimentary basins. One group of basins, ~100 km long and parallel to the southern Transantarctic Mountains and the Whitmore Mountains, is characterized by 30 km wide gravity lows and sediment thicknesses of ~5 km. These basins have no simple equivalent in the Ross Sea. The second set of basins including the Bentley Subglacial Trench and a basin north of Siple Dome, are 100 km wide and up to 200 km long, and oriented NW/SE. These wide basins are associated with Bouguer gravity highs, contain a minimum of 5 km sediment and are similar to the major basins in the Ross Sea. Adjacent to these basins are features with Bouguer lows and magnetically shallow basement. The third group of sedimentary basins are oriented NNW/SSE, are associated with Bouguer lows and deep magnetic basement. These basins include the elongate Trunk D Basin, the seismically mapped Onset Basin and several small basins west of Byrd Station. No evidence of these structures exists east of Byrd Station.

We have linked these three groups of basins to the three periods of West Antarctic extension. We suggest that those basins parallel to the mountains formed during the Jurassic. The larger basins, including the Bentley Subglacial Basin and the Siple Dome Basin, show positive Bouguer gravity anomalies and probably resulted from the Late Cretaceous extension event that also produced the Victoria Land Basin, the Central Trough and the Eastern Basin as well as the basins on the Campbell Plateau. Cenozoic reactivation produced the elongate Siple Dome Basin, the Onset Basin and the minor faulting in the western Ross Sea.

Bell, R.E., Studinger, M.E., Tikku, A.A., Clarke, G.K.C., Gutner, M.M. & Meertens, C. (2002): Nature 416: 307-310.

Lake Vostok: ancient system, dynamic processes
(oral p.)

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To date over 70 sub-glacial lakes have been identified beneath the Antarctic ice sheets with the majority in East Antarctica. Lake Vostok is the largest system with a surface area of 14,000 km^2 and a volume of 5200 km^3. Like many of the subglacial lakes, Lake Vostok is formed in a deep valley created along a major tectonic boundary with recent minor tectonic activation. The ice sheet flows over the lake at ~3 m/year, with a transit time of 16-20,000 years. The flux of water into Lake Vostok is from melting at rates of ~5 cm/year over a 1440 km^2 region close to the northwestern shoreline. Although melting has been identified over 10 % of the lake, freezing of water onto the base of the ice sheet is evident over 60 % of the lake at average rates 0.7 cm/year. The material frozen to the base of the ice sheet is removed by the regional ice flow along the eastern shoreline. The influx of the water in the north and the removal of water in the south yields a present estimated residence time for the lake water of ~36,000 years. Inversion of the gravity anomaly confirmed by the seismic measurements has documented a clear two basin system. The southern basin is 1400m below sea level and the northern basin is 1200 m below sea level. Since the overlying ice sheet ranges from 4200 m thick in the north to 3750 m in the south the maximum water depths are ~1000 m in the southern basin and ~500 m in the northern basin. The sloping ceiling and the two-basin shape of the lake bed will be fundamental controls on the circulation in the lake. Calcualtion of velocities based on simple lake bathymetry produce very slow velocities on the order of 0.3 mm/sec with vertical convection on the order of five days and horizontal advection on the order 45 years. The two primary targets for Lake Vostok exploration are the characterization of the subglacial lake ecosystem and the recovery of paleoclimatic records from the lake sediments. The steps in exploration are site selection, in situ observatories, recovery of water and shallow sediments and finally recovery of deeper cores for paleoclimatic studies.

Post Pan-African cooling and exhumation of the southern Mawson Escarpment, Prince Charles Mountains, Antarctica
(oral p.)

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The Phanerozoic to recent crustal evolution of the southern Prince Charles Mountains has until now been shrouded in mystery. Unlike similar basement exposures in the nPCMs, the sPCMs lack any recognised sedimentary deposits young enough to have provided some insight into the regions recent geological development. In the absence of traditional lithological and (bio)stratigraphic markers, thermochronological techniques provide an unparalleled opportunity to extract information on the Phanerozoic burial and/or exhumation phases of often very old basement rocks. Because of their low temperature sensitivity, shallow crustal thicknesses of up to ~4 km are best characterised by the complimentary techniques of apatite fission track analysis and apatite (U/Th)/He analysis.

Here we report on a series of samples based on material collected during ASAC Project 2137, as a preliminary to the recent PCMEGA program. While initial sampling was restricted to three vertical profiles retrieved from the southern Mawson Escarpment, the work, however, provided a framework for a far more extensive sampling program during PCMEGA. This recent expedition focussed on key topographic and structural features and their likely relationship to currently exposed regional landforms as well as geophysical anomalies detected beneath the present ice cover.

The East Antarctic Shield has long been considered to be a key lithospheric block in the former Rodinia and Gondwana. It formed the nucleus for growth and subsequent dispersion of both supercontinents. In the southern PCM, the shield terrain is dominated by Archaean rocks consisting of a gneissic basement complex overlain by a number supercrustal sediments and volcanic units. The rocks are characterized by pervasive ductile deformation and metamorphic grades up to amphibolite facies. These overprints are attributed to episodes of orogenesis related to the suturing of the proto-Indian and proto-Antarctic continents occurred during the Mesoproterozoic. Deep-seated tectono-metamorphic activity appears to have ceased with the conclusion of the Pan-African event. In contrast, the Phanerozoic history of the sPCMs is characterised by a series of rifting/denudation phases, most of was associated with the development of the Lambert Graben and the break-up of Gondwana.

Fission track analysis of samples from the southern PCM suggests a Phanerozoic history dominated by a Late Paleozoic initial rifting of the Lambert, Triassic to Early Cretaceous subsidence, followed by a Late Cretaceous to recent(?) rifting. The period of Late Cretaceous exhumation is particularly constrained by the presence of a remarkably widespread (pre-glacial – early Tertiary?) erosion surface that extends virtually the entire length of the Mawson Escarpment. Many of the massifs and smaller nunataks bordering the Lambert Graben preserve a similar palaeosurface at their summits. Results suggest that during the Permo-Triassic cooling (early rifting phase), the southern PCM experienced denudation of ~3-4.5 km, while Cretaceous cooling (reactivation of the Lambert Graben?) generated ~1.7-2.5 km of exhumation. The timing of these events duplicates the style of cooling histories previously interpreted for the northern PCM, however the overall magnitudes of section removed appear more modest in the southern PCM.

Sm-Nd ages of metamorphosed volcanic and plutonic rocks from Mount Ruker, the southern Prince Charles Mountains, East Antarctica

(poster p.)

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Low grade metamorphic volcanic-sedimentary sequence at Mount Ruker includes presumably meta-volcanic members and layers of green schist (fine-grained rocks composed of chlorite, actinolite, hornblende, mica, carbonate, quartz, plagioclase in varying proportions; the color index is mostly between 40 and 80) of basaltic to dacitic composition (bimodal distribution from available data) and voluminous metasedimentary slate, schist, and quartzite. The sequence was intruded by mafic sills composed of meta-gabbro-dolerite (compared with the metavolcanics, it is essentially coarser-grained metamorphic rock with commonly preserved magmatic textures). Metavolcanics predominate in the southern, poorly exposed slopes, while metasediments make up most of the northern, steeper and much better exposed slopes. Later metadolerite and dolerite dykes (partly altered due to autometa-morphic processes) of tholeiitic composition and larger gabbroic bodies cut across the sequence, and dykes were also found to cut easterly located granite pluton dated at ca 3000 Ma..

Three rock groups were studied for Sm-Nd isotope composition: metavolcanics, metagabbro-dolerites, and unmetamorphosed gabbro and dolerite. Metavolcanic rocks (two metabasalts, metaandesite, and metadacite) define an isochron with an age of 2917 ±82 Ma (MSWD = 0.33; Nd_i = 0.508446 ±0.000080). Three metagabbro-dolerite samples define an isochron with similar age of 2832 ±140 Ma (MSWD = 0.25) but with somewhat lower Nd_i = 0.50801 ±0.00014. Mineral separates (plagioclase, biotite) from one metagabbro-dolerite plot exactly along this reference line, which changes the isochron age to 2878 ±65 Ma (MSWD = 0.639; Nd_i = 0.507985). Both plagioclase and biotite are thought to be metamorphic minerals, thus the constrained age of c 2900 Ma is most likely to reflect the age of metamorphism, though low Nd_i value precludes long premetamorphic crustal residence time. The metavolcanics are likely to be roughly co-eval with the metagabbro-dolerites, but their slightly higher Nd_i value suggests that they originated from somewhat different mantle source or experienced more pronounced crustal contamination.. Granophyric gabbro collected in the southern slopes of Mount Ruker is one of only a few unaltered rocks. Its whole rock and mineral separates compositions (plagioclase, clinopyroxene) define a three-point reference line corresponding to an age of 2365 ±65 Ma (MSWD = 1.8; Nd_i = 0.508951 ±0.000062). Two dyke dolerite samples plot roughly along this line, putting five-point isochron age to 2400 ±200 Ma (MSWD = 4.33; Nd_i = 0.508934). The initial Nd ratio is somewhat higher than in other measured rock types, providing evidence that these plutonic rocks derived from different (less enriched) mantle source. The age of these mafic plutonic rocks correspond to the Rb-Sr ages of high-Mg dykes in the Vestfold Hills (c 2400 Ma, COLLERSON & SHERATON 1986) and Enderby Land (c 2350 Ma, SHERATON & BLACK 1981), though later U-Pb studies showed younger age of the Vestfold Hills dykes (2240 Ma, LANYON et al. 1993).

Individual rock samples have rather low $\varepsilon_{Nd}(T = 2.9\ Ga)$ values (-8-9 for metavolcanic and fresh plutonic rocks, -18 for matagabbro-dolerites), which is significantly lower than ε_{Nd} values for granites and granite/plagiogranite gneisses in the southern Mawson Escarpment and Mount Ruker (0- -5) (MIKHALSKY et al. 2001), which implies that these rocks are not likely to contribute to the studied rocks isotopic compositions. The studied rocks were probably derived from variously enriched mantle sources with no significant crustal contamination, unless essentially older and yet undiscovered crustal protolith is involved.

Collerson, K.D. & Sheraton, J.W. (1986): J. Petrol. 27: 853-886.
Lanyon, R., Black, L.P. & Seitz, H.M. (1993): Contr. Mineral. Petrol. 115:184-203.
Mikhalsky, E.V., Sheraton, J.W., Laiba, A.A. et al. (2001): AGSO Bulletin 247.
Sheraton, J.W. & Black, L.P. (1981): Contr. Mineral. Petrol. 78: 305-317.

Holocene history of George VI ice shelf, Antarctic Peninsula: inferences from lake sediments

(oral p.)

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The recent collapse of several Antarctic Peninsula ice shelves has highlighted the need for a long-term perspective on ice shelf stability. An opportunity to obtain a highly detailed late-Quaternary history of one ice shelf is provided by Moutonnée Lake (ML). ML is a large, 50 m deep epishelf lake impounded on the eastern side of Alexander Isl. by George VI Ice Shelf, which flows across George VI Sound from the Antarctic Peninsula. Detailed water chemistry measurements have shown ML to be clearly stratified. A distinct halocline occurs at 30 m, where modern freshwater overlies marine water. Our hypothesis is that any changes in the stability of the ice shelf should leave distinct biological, chemical and lithological signatures in the lake sedimentary record. Biologically, ice shelf loss would see the present stratified water column replaced by a purely marine one. Significant changes in sedimentation are also likely to follow any change in the configuration of George VI Ice Shelf. Outcrops of igneous and metamorphic rocks with distinctive chemical and isotopic signatures are found on the western coast of the Antarctic Peninsula. These differ from the rocks of Alexander Isl., which are predominantly sedimentary in origin. Restricted ranges of igneous and metamorphic clasts, transported through George VI Ice Shelf to Alexander Isl., and deposited with locally derived sedimentary clasts, would be replaced, during periods of ice shelf loss, by a wide lithological assemblage dominated by ice-rafted debris and locally derived sedimentary clasts.

To test this hypothesis, high-resolution studies have been performed on two sediment cores extracted from ML. Analyses have included physical (MS, LOI and $CaCO_3$), biological (diatom and foraminifera) and isotopic measurements performed on both bulk sediment samples and individual foraminifera. Results demonstrate the existence of two distinct zones, where marine organisms (foraminifera and marine diatoms) and local sedimentary clasts dominate. Both zones coincide with elevated $\delta^{13}C$ values, interpreted here as enhanced marine activity. Taken together these data imply that George VI Sound has been free of the ice shelf on at least one occasion during the Holocene. Chronological control will be provided by AMS ^{14}C dates performed on individual foraminifera.

Relative sea level curves and ice sheet history from the Antarctic Peninsula
(oral p.)

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The configuration of the Last Glacial Maximum (LGM) Antarctic Peninsula ice sheet is not yet well-constrained. We present here new relative sea level curves from sites in both the southern and northern Antarctic Peninsula, which help constrain both the size and post-LGM history of the ice sheet. The southern curve is from the Marguerite Bay region (c 67°S), and has been derived from dating penguin remains within beaches, and marine-freshwater transitions in isolation basins. The curve shows dominant uplift since formation of the marine limit in the Early Holocene. The northern curve is from the South Shetlands region (c 62°S) and is derived from isolation basins and dated material within beaches. The curve is more complex and shows initial uplift was followed by a period of mid-Holocene relative submergence until uplift again dominated in the Late Holocene.

We will present sea-level predictions for this region based on a recently published glaciological model (HUYBRECHTS 2002) and a suite of plausible earth models. These predictions will be used to make a first interpretation of both the new and existing sea-level observations. We also suggest that analysis of the raised beaches around Marguerite Bay curve can be used to infer the extent of sea ice through the mid- to late-Holocene.

Huybrechts, P. (2002): Quat. Sci. Rev.,21: 203-231.

Geodetic research in Deception Island

(oral p.)

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Geodetic researches carried out in Deception Island have been aimed to control the deformation the island suffers as the result of its volcanic activity. During the continuous Spanish campaigns in the Antarctica a geodetic network has been designed and improved, with the main objetive of studying the deformation ocurring there from GPS observations. Nowadays, the network consits of twelve points around Port Foster which are provided with WGS-84 geodetic coordinates. Time analysis of these coordinates will lead us to the horizontal deformation model.

To obtain the vertical deformation model a levelling network has been developed. This network is denser in those areas where the volcanic activity is stronger, as in the Fumarole Bay and in the Hill of Obsidians. Also, GPS, levelling and gravimetric measurements have been collected in secondary points to obtain an experimental geoid model which make possible an adequate reference frame for physical applications.

Multidisciplinary scientific information support system (SIMAC) for Deception Island, South Shetland Islands, Antarctica

(poster p.)

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The desribed information support system can be defined as a set of interrelated components that collect, process, store and distribute information to the basis for decision-making and control in an organization (STAR 1992).

Geographical Information Systems (GIS) are information systems designed for working with georeferenced data. GIS are of great value where the variable or attribute has great geographical influence. Among the advantages offered by GIS, is an environment for the analysis, creation and study of topological relations, as well as comparitive spatial, proximity or adjacency studies. It also allows for two-dimensional spatial indexating and multi-user editing of data and versions.

Since the Spanish Antarctic campaigns began in 1987 on Deception Island, South Shetland Islands we have obtained a large amount of cartographic data and graphic output on numerous projections, referenced to several geodetic systems. There is now a need to compile this multidisciplinary data and integrate it into a geographic information system. This would make the information on Deception Island more accessible to the scientific world, avoid duplicating information and enhance collaboration among research groups through the exchange of data and transfer of results.

DECVOL and GEODEC projects

(poster p.)

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In the presented paper it is shown the main objetives and results obtained in DECVOL project as well as the objetives and activities carried out in GEODEC project. The information resulting from continuous studies from 1987 has shown a scientifically interesting situation in the geodynamical aspect. Three of the most active groups which have been working in Deception Island will gather to provide a current an projected status of the volcanic complex by means of high resolution models.

In December 1999, DECVOL project consisted of the realization of a short campaign set aside for a geodetic and geophysical monitoring, with the aim of determining the activity situation in the island resulting from the seismic crisis during the austral summer in 1998-1999. During this campaign, a great deal of measurements were collected, as GPS observations and gravimetric and magnetic measurements, among others.

In the GEODEC project the network REGID has been reobserved, and it has been improved with new points, determined from the recent activity. The extension of the network and the use of a permanent station in Livingston Island will allow a centrimetric resolution required for volcano monitoring. A marine geophysical campaign sequel to a previous campaign (DECVOL 99) will allow a superficial definition of Deception Volcano structure. The existence and delimitation of the latest eruptions' magmatic chamber and an evaluation of possible short and medium term eruptions. The use of geographical information systems has revealed itself as imperious in the making of risks maps, integrating all available data (geological, geochemical, geodetical, geophysical, etc.) a map of Deception Island may be produced. These maps are required to develop models of lava flows, products emission, etc. In others words, the effects of an eruptive process. In a parallel way, statistical methods will be use to evaluate return period and deterministic models reconstructing pasted events and forecasting future eruptions. The final deliverable will be the creation of volcanic hazard and risk maps for Deception Island.

Climate changes over the last two glacial-interglacial cycles: sea surface temperature and sea-ice records from the Southern Ocean

(poster p.)

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Opal-rich sediment sequences from two high latitude locations of the Atlantic sector (ODP Sites 1093 and 1094) in the southern Polar Front Zone and the Antarctic Zone respectively, allowed us to reconstruct the Southern Ocean climate development over the past 180 ka. Here we present records of summer sea surface temperature (SSST), obtained by means of a transfer function, and records of sea-ice extent, inferred from abundance fluctuations of sea-ice diatoms (*Fragilariopsis curta, F. cylindrus, F. obliquecostata*).

During glacial times the maximum extent of the sea-ice edge reaches c 3° latitude to the north relative to present and sea-ice seasonality appears reduced. The diatom assemblage shows high abundances of *Eucampia antarctica*, *Chaetoceros* spp. and sea-ice algae (*Fragilariopsis curta* and *F. cylindrus*). The southward retreat of the sea-ice edge and surface water warming at the onset of the deglaciations results in dramatic changes of the environmental conditions, as indicated by the drastical increases in sedimentation rates and marked changes in the composition of the diatom assemblage, which becomes dominated by the open water species *Fragilariopsis kerguelensis*.

The warming along Terminations I and II occurs in two steps separated by a temperature rebound, resembling the structure of the Antarctic Cold Reversal. While during Termination I the major environmental changes occur during the first step of deglaciation (18-14 ky BP), at Termination II these take place during the second step, which is concluded at c 128 ka.

The southward retreat of the sea-ice and SSST development at Terminations I and II well correlates with the timing and shape of the increases in atmospheric CO_2, as recorded by ice cores, supporting the idea that the Antarctic winter sea-ice, Southern Ocean temperature and/or water column structure exert a primary control on the atmospheric-ocean CO_2 exchanges and hence on global climate.

Structural geology and geochronology of the Gjesvikfjella area, northern Maud Belt, East Antarctica

(oral p.)

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The Maud Belt of western Dronning Maud Land (DML) represents the western extension of the East Antarctic Shield that preserves a polymetamorphic history with two orogenic episodes of "Grenvillian", i.e. 1.2-1.0 Ga age and secondly "Pan-African", i.e. 0.6-0.5 Ga age. Gjelsvikfjella forms the north-easternmost portion of the high-grade polydeformed metamorphic terrane, known as the Maud Belt in western DML, East Antarctica.

Studies by JACKSON (1999) in the Kirwanveggen, western DML suggests that the existence of regional pervasive tectonic structures of Pan-African age in the northeast trending Maud Belt is unclear, because of the possibility of co-linearity of Grenvillian and Pan-African structures. JACOBS et al. (1998) and SHIRAISHI et al. (1994) emphasized the Pan-African event for east-west trending central DML and eastern DML respectively, thereby casting doubt on the presumed continuity of Grenvillian-age crust within the East Antarctic Shield. In support, recent studies by BOARD (2001) suggest that the regional pervasive tectonic structures present in Sverdrupfjella area of western Dronning Maud Land formed during Pan-African times, implying that the earlier orogenic event has been completely overprinted.

This study concentrates on the Gjelsvikfjella area, which provides a unique opportunity to address the above problem as two structural trends intersect there. This paper aims at highlighting new structural and geochronological data. Field relationships show that the oldest unit present is a metasupracrustal sequence of continuous to discontinuous metatuff, metabasalt and metagabbro. Remnants of eclogite might be present in the form of stretched and rotated boudins of garnet-clinopyroxene rock. The supracrustal rocks were intruded by a megacrystic, granitic augen gneiss with a single zircon SHRIMP age of 1104.4 ±8.3 Ma.

Three stages of granitic intrusions have been observed. The first is a medium to coarse-grained variety that intruded at 1130 ±19 Ma prior to the regional deformation. The second are granitic veinlets that possibly formed as a product of partial melting at approximately 1030 Ma, and finally the youngest intrusion being aplite dykes (497.6 ±5.3 Ma) that cut across the regional foliation and a major shear zone.

Five deformation events are recorded in the rocks. D_2 and D_3 appear to be a continuous deformation event. The D_1 event is represented by (F_1) fold axes that have been rotated parallel to sub-parallel into the dip direction of the regional pervasive foliation (S_2). The older D_1 event is interpreted to represent the Grenvillian deformation event that has been overprinted by the D_2-D_3 events in certain areas providing support for the data published by BOARD & FRIMMEL (2001) suggesting a top to the northwest shearing event that occurred during Pan-African deformation. D_3 folds the regional fabric and D_4 is seen as a broad open type of folding or warping event. D_5 is expressed as fractures related to Gondwana break-up.

Board, W.S.] Frimmel, H.E. (2001): SANAP Final Project Report. Department of Environmental Affairs and Tourism, Pretoria, 16 pp.
Jacobs, J., Fanning, C.M., Henjes-Kunst, F., Olesch, M. & Paech, H.S. (1998): J. Geol. 106: 385-406.
Jackson, C. (1999): SANAP Final Project Report. Department of Environmental Affairs and Tourism, Pretoria, 80 pp.
Shiraishi, K., Ellis, D.J., Horoi, Y., Fanning, C.M., Motoyoshi, Y. & Nakai, Y. (1994): J. Geol. 102: 47-65.

Local geoid determination by gravimetric measurements in northern Victoria Land
(oral p.)

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Gravimetric measurements in Antarctica have been generally devoted to geophysical purposes; in those application high level accuracy for the three-dimensional stations positioning is not required. A program for local geoid determination through gravimetric measurements was started in Victoria Land, in an area located around the Italian base Terra Nova Bay. The program started an activity planned on a more extended area, with the aim to evaluate an high accuracy geoid for all northern Victoria Land.

Points distributed on a regular grid of 3.75' latitude and 15' longitude, corresponding to an average distance of 10 km, were measured in Mt. Melbourne and Mt. Murchison area. Moreover sparse points were measured around the planned grid. The positioning of gravimetric stations has been made by precise GPS method in order to obtain a decimeter accuracy in coordinate determination. This accuracy, overall for the height, is fundamental for high accuracy geoid estimation. The gravimetric closure has been made on IRGS (Italian Relative Gravity Station) located at Terra Nova Bay. Gravimetric data will be reduced using the DTM from BEDMAP project for the interior and using the DEM generated by INSAR surveying along the coast. Preliminary results of local geoid estimation are presented.

Northern Victoria Land crustal deformation control: advances of VLNDEF program
(oral p.)

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VLNDEF (Victoria Land Network for DEFormationn control) Geodetic Program addresses the crustal deformation control of northern Victoria Land (Antarctica) by using geodetic GPS measurements. VLNDEF project is within the activity of GIANT (Geodetic Infrastructure of Antarctica) SCAR Program. GIANT is devoted to the analysis of different geophysical and geodetic data, GPS (SCAR GPS Epoch campaigns), Gravimetry, VLBI, remote sensing applications, for geodynamics investigations in Antarctica. Moreover the geodetic activities are established within the actions of ANTEC (ANTarctic NeoTECtonics) run by a SCAR Group of Specialists.

During 1999-2000 and 2000-2001 Italian expeditions was established and completely surveyed a network of 27 stations, over an area of 700 km northward and 300 km westward. The average distance between vertexes is in a range of 70-80 km and covering the area from TNB (Terra Nova Bay; Italian base) to the Oates Coast (CAPRA et al 2001, 2002). In 2002-03 campaign the repetition of the whole network has been made.

The stations location was planned using knowledge about regional tectonic features as reported by (SALVINI et al 1997) and on the basis of geological characteristics and distribution of outcrops. Due to the long connections involved, session duration of about 48 hours was initially planned; this duration was recently increased and, in agreement with Scientific International Community guidelines and thanks to the increasing storage capabilities, time series of about 20-50 days were also collected on selected vertexes.

The analysis of the first network was constrained to the ITRF97 solution provided for TNB1 GPS permanent station. Some aspects in the use of ITRF2000 as reference frame for the last campaign and some solution inconsistencies are discussed in the paper. Data were processed using Bernese and Gipsy software packages. Some results of data processing and deformation analysis are presented.

Capra A., Gandolfi S., Mancini F., Sarti P. & Vittuari L. (2001): VLNDEF project: geodetic contribution to geodynamics study of Victoria Land, Antarctica.- Proc. Gravity, Geoid and Geodynamics GG2000 IAG symposium, 379-385.
Capra A., Gandolfi S., Mancini F.,Sarti P. & Vittuari L . (2002): VLNDEF project for crustal deformation control of northern Victoria Land.- Antarctic Geodesy Sympos., St. Petersburg, SCAR Report 21: 8-10.
Salvini F., Brancolini G., Busetti M., Storti F., Mazzarini F. & Coren F. (1997): Cenozoic geodynamics of the Ross Sea region, Antarctica: crustal extension, intraplate strike-slip faulting, and tectonic inheritance.- J. geophys. Res. 02/B11: 24669-24696.

Strike-slip faulting related to the rifting of Gondwana, evidence from the Lambert drainage basin, East Antarctica
(oral p.)

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The Lambert Glacier - Amery Ice Shelf occupies a narrow NNE-SSW orientated fault bound depression referred to as the Lambert Graben. Seismic reflection surveys have recognised deep faults associated with this structure and these data suggest that faulting associated with the Lambert Graben may extend at least 700 km inland from the Antarctic coast. These faults are interpreted to have initially developed during the Carboniferous and Permian, and are thought to have formed the depression into which the Permo-Triassic Amery Group were deposited. Resent geological investigations from the Lambert Glacier - Amery Ice Shelf region has identified quartz- and calcite-bearing faults, inferred to represent the surface expression of the larger structures recognised geophysically. Kinematic and palaeostress data from the exposed faults suggest that the majority of the preserved offset occurred in response to NW-SE directed extension, oblique to the axis of the graben. This resulted in predominantly dextral strike slip fault movement, accommodating components of both normal and reverse offset. Although the age of these structures is unconstrained, faults with this offset in the northern Prince Charles Mountains disrupt the Permo-Triassic Amery Group and juxtapose it against Proterozoic basement. Equivalent strike-slip faults in the southern Prince Charles Mountains produce dextrally offset tectonic boundaries and metamorphic isograds across the Lambert Glacier. These observations imply both a post-Triassic timing and regional significance for this period of faulting. Given the implied post-Triassic timing of deformation, we suggest that these faults are related to the Cretaceous rifting of Gondwana. The remarkable similarity in orientation between the palaeostress field calculated for these faults and the Cretaceous divergence vector between India and Antarctica supports this inference. Although these results do not preclude an earlier phase (Carboniferous?) of failed rifting, they suggest the Cretaceous overprint was significant. The results of which now dominate the observed brittle structures and preserved fault offsets.

Barrovian-type metamorphism from the Archaean Ruker Terrane, southern Prince Charles Mountains, East Antarctica

(oral p.)

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Mineral textures coupled with thermodynamic modeling in the K_2O-FeO-MgO-Al_2O_3-SiO_2-H_2O (KFMASH) model system of amphibolite facies metapelites from the Ruker Terrane, southern Prince Charles Mountains, point to the preservation of an up-temperature prograde metamorphic path, followed by rapid decompression (i.e. a clockwise P-T path). Textural evidence for the up-temperature path is given by the sequential growth of garnet, staurolite and kyanite in a number of rocks of different composition. The peak mineral assemblage consisted of garnet + kyanite ± biotite ± muscovite that formed at P-T conditions of approximately 700 °C and 9 kbar. The subsequent growth of sillimanite, then cordierite (± K-feldspar), is interpreted to reflect close to 5 kbar of near isothermal decompression. In less aluminous assemblages, decompression resulted in the formation of partial melts. The observed mineral assemblages, P-T path, and inferred peak pressures and temperatures are typical of Barrovian metamorphic terranes. During the Phanerozoic, these types of belts are commonly inferred to reflect convergent collisional orogens, the result plate tectonics. However, orogenesis in the Ruker terrane occurred during the late-Archaean (2870 Ma), a period in the Earths history when heat production and crustal heat flow were considerably higher, and the role of plate tectonics remains debated.

Development of Jane Basin by crustal fragmentation: southern margin of the South Orkney Microcontinent, Antarctica

(oral p.)

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Jane Bank and Basin system is located along the southern margin of the South Orkney Microcontinent (SOM). This region constitutes the eastern seaward prolongation of the Antarctic Peninsula. Geophysical data (magnetic, gravity, swath bathymetry and multichannel seismic profiles-MCS) along three profiles orthogonal to the main tectonic and bathymetric trends of the system were recorded during the SCAN97 cruise by the Spanish BIO "Hespérides". The new MCS profiles and gravity modelling reveal that these structures extend westwards beyond it was previously proposed.

We show, for the first time, linear sea floor magnetic anomalies in Jane Basin, which allow to date the oceanic crust. Spreading of Jane Basin began around 17.6 Ma, which is the age of the oldest magnetic anomaly. (chron C5Dn), and ended at about 14.4 Ma (chron C5ADn). Chron C6n (19.5 Ma) was identified as the youngest oceanic crust of the northern Weddell Sea, whose northern spreading branch was totally subducted. Magnetic anomalies of high intensities (over 400 nT) were detected, moreover, along the S-SE margin of the SOM, which may be attributed to basic plutonic rocks intruded during Mesozoic in the Pacific margin of the Antarctic Peninsula, and that form the Pacific margin anomaly belt.

The MCS profiles and gravity models show heterogeneous thinning of the continental crust at the SE margin of the SOM. Taking into account the probable continental nature of Jane Bank, the drifting of this bank to the southeast from the SOM was probably due to the same type of processes of continental fragmentation. MCS profile SM04 shows a good image of a spreading centre near the axis of Jane Basin, although this ridge is not well represented in the other sections. Important reversal faults in the oceanic crust of the Weddell Sea and Jane Basin were detected in the MCS profiles. These structures are younger than the age of development of Jane Basin, and they probably mark the end of Jane Basin spreading due to a change of the tectonic regime in the area. A thrusting of the SOM over the oceanic crust of the Jane Basin and duplication of this oceanic crust are detected in the gravity modeling, which emphasizes the importance of these reverse faults.

The analysis of the different set of data and mainly the distribution of the magnetic anomalies, suggest that subduction of the spreading centre of Weddell Sea below the SE margin of the SOM plays an important control for the development of Jane Basin. An important change in tectonic regime occurs at the Scotia-Antarctic plate boundary near 14.4 Ma being the responsible of the end of the Jane Basin spreading.

Current glaciation of Bunger Hills as an indicator of the Antarctic glacierization at the Last Glacial Maximum

(oral p.)

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The Bunger Hills are surrounded from all sides by ice of different type, ice shelf from the north, outlet glacier from the south and west, ice sheet from the east and passive glaciers from the south. This is in fact an island contacting the sea basin in the west and north with glaciers overlying the seabed from the east and south. The modern glacial regime provides the ice discharge at which the entire mass of discharged ice passes round the oasis.

The most widespread type of glaciers and firn fields directly in the territory of the oasis is the snow-ice dam forming at snow redistribution as a result of action of prevailing easterly winds. Snow fields and glaciers form in the wind shade of hillocks and ridges in the form of dams elongated in the western direction with a length up to several hundreds of meters and a thickness of tens of meters. Due to cyclic oscillations of climatic parameters in the oasis, dams appear and disappear with periodicities of 5, 11 and 23 years, which was determined from the occurrence of sand and gravel interlayers in the sections of bottom deposits of near-glacial lakes. Disappearance of dams leads to catastrophic events in the form of drain of the water basins embanked by them. The best examples of the dead ice dams are the ice bodies developed along the southern boundary of the oasis. They dam there the perennially ice-covered Lakes of White Smoke and Polyanskogo.

An analysis of spreading and the age of the stomach fat accumulations of Snow petrels (the so-called Antarctic "mumiye") in the Bunger Oasis (VERLKULICH et al. 1999) indicates the thickest and most ancient deposits of this substance in the center of the oasis. This means that the retreat of glaciers in the Bunger Oasis in the Late Pleistocene was in the direction from the center to the margins. The largest size of crustaceous lichen *Buellia frigida* and hence its most ancient age is observed in the central part of the Oasis. It is obvious that the age of lichens cannot be the same as the age of mumiye (up to 10 ka). Their age comprises merely tens and hundreds of years. However, the spatial regular features of the location of lichens suggests that after the oasis became free from glaciers in the early Holocene, the next glaciation stages were of the same character - accumulation and melting of latitudinally oriented passive glaciers. The last glaciation stage of the oasis also ended in the oasis becoming ice-free from its center. In addition, the largest lichen individuals are confined to the tope of the hills. At the slopes, they regularly decrease with moving downward. Thus, the tops of the hills were the first to become free of the ice and the snow cover.

These facts along with the revealed typical features about the structure and spreading of modern glacial bodies suggest that the Bunger Oasis was not occupied by the ice sheet in the Late Pleistocene contrary to modern concepts (INGOLFSSON et al. 1998). It had its own local glaciation in the form of dead glacial and firn fields. The last datings of the deposits in the Bunger Oasis by the OSL method (GORE et al. 2001) also showed that during the Last Glacial Maximum, the Antarctic ice sheet did not occupy the territory of the Oasis. In the Late Pleistocene, ice of the Antarctic ice sheet similar to the present time moved around the Bunger hills in the form of outlet glaciers. The Antarctic ice sheet dimensions could not be greater than the current ones. The east-western orientation of periodically accumulating local passive glaciers of the oasis was preserved over the last 10 ka. Hence, the wind regime above this territory in the Holocene was more or less stable.

Gore, D.B. et al. (2001): Geology .29/12: 1103-1106.
Ingolfsson, O. et al. (1998): Antarctic Science 10/3: 326-344.
Verkulich, S.R. et al. (1999): Inform. Bul. of Russian Ant. Exp. 119: 92-104.

Chemical response of zircon to fluid infiltration and high-T deformation: Howard Peaks Intrusive Complex (northern Victoria Land, Antarctica), a case study

(poster p.)

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The use of zircon U-Pb geochronology has proved indispensable in constraining the age, origin and thermal history of crustal rocks. However the high complexity of zircon's internal structures, associated to a frequent disturbance of the U-Pb system in many zircons of metamorphic and igneous rocks, makes often the interpretation of the radiometric data ambiguous. The application of high-precision in-situ laser ablation tecniques to obtain trace-element, U-Pb and Lu-Hf compositions in the same zircon grains, combined with a detailed study of the zircon's internal structures, is indispensable to discriminate between different types of zircon growth and alteration mechanisms and to attribute them to different geological processes. This approach has been applied to zircons extracted from six samples collected from foliated metaluminous, high-K monzogranites, granodiorites and tonalites of the Howard Peaks Intrusive Complex (Deep Freeze Range, Antarctica) emplaced during the Late Cambrian-Early Ordovician Ross Orogenesis and deformed under high-temperature solid-state conditions (MUSUMECI & PERTUSATI 2000). The aim of the present study is to define the emplacement age of the Howard Peaks Intrusive Complex and to constrain the source and subsequent evolution of the parent magmas.

The analyzed zircons show a complex pattern of internal structures with inherited components, euhedral concentric zonations, convoluted zones and patches of unzoned zircons sometimes retaining ghost zones. Ignoring the inherited components, a wide scatter in concordant and discordant ages between 518 and 440 Ma is observed, and two or three main age populations are found in all the analyzed samples. Discordant ages are often exhibited by domains characterized by the occurrence of bright zones in BSE images, while grains with convoluted zones, weak zoning or no zoning at all may show a wide range of concordant ages. A wide spread of trace-element compositions in the analyzed zircons is also observed, with large variations in U, Th, Y and LREE contents, and limited variability in HREE. Light REE enrichment is often related to the occurrence of bright domains and/or relatively younger ages in zircon. The observed trace-element variations cannot be related to fractional crystallization processes as indicated by the lack of a positive correlation between Yb and Th/U. Moreover, the observed variations in trivalent and tetravalent cations caanot be explained by a simple volume diffusion, as it should produce larger variations in HREE relative to LREE and, a higher mobility of Hf than of U and Th, which is not observed. Lu-Hf analyses define, on the contrary, a relatively narrow range of mean $^{176}Hf/^{177}Hf$ around 0.2823 in distinct age and structural groups within each sample, suggesting that the Lu-Hf system was left relatively undisturbed. Similar low $^{176}Hf/^{177}Hf$ ratios in all the analyzed samples support a common parental derivation from old recycled crust for the different selected intrusives. The limited scatter in $^{176}Hf/^{177}Hf$ could be related to different crustal components involved in the melting events. Less radiogenic ratios in old inherited cores, not related to the young population by a simple crustal evolution, are a confirmation of the composite nature of the crust.

The wide spread in zircon age signatures, internal structures and trace-element compositions is here related to post-crystallization alteration mechanisms that produced a strong modification of the trace-element distribution and the U-Pb system. The mobility of elements during the secondary processes was variable and probably related to different degree of fluid access during the high-temperature ductile deformation related to the NE-SW dextral strike-slip shear zone in this area.

Musumeci G. & Pertusati P.C. (2000): Antarctic Sci. 12: 89-104

U-Pb geochronology of the Granite Harbour Intrusives from the Wilson Terrane, northern Victoria Land, Antarctica

(oral p.)

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Zircon crystals from intrusive rocks from the Wilson Terrane in northern Victoria Land (Antarctica), along a transect nearly orthogonal to the orogenic belt over a lenght of about 200 km, have been analyzed. The selected plutons cover a wide compositional range, from metaluminous and peraluminous granitoids to minor mafic rocks of gabbro-dioritic composition. Emplaced during the Late Cambrian-Early Ordovician Ross Orogenesis (TONARINI & ROCCHI 1994), they belong to the Granite Harbour Intrusives. Zircons have been used to estimate the emplacement age of crustal and mantle melts and the nature of the deep continental crust involved in the melting events. High-precision in-situ laser ablation tecniques have been used to obtain trace-element, U-Pb and Lu-Hf compositions in the same zircon grains.

Preliminary results obtained on 23 selected samples of the largest plutons (with the exception of minor intrusions and of the late orogenic stocks and dikes) allow to recognize the following regional distribution of U-Pb isotopic data for the Granite Harbour Intrusives of northern Victoria Land:

- The oldest felsic magmatic pulses are represented by the metaluminous monzogranitic-granodioritic intrusions of the Mt. Baxter in the Eisenhower Range and Mt. Jiracek in the Southern Cross Mountains and by some quartz-monzonite intrusions of the shoshonitic suite from the Terra Nova Intrusive Complex (Teall Nunatak), with mean ages around 512 Ma;
- The metaluminous shoshonitic monzogranites and quartz-monzonites cropping out in the Deep Freeze Range and northern Foothills display emplacement ages in the interval between 503 and 492 Ma;
- The foliated amph-bearing tonalitic intrusions occurring in the same area show slightly older emplacement ages in the range 506-502 Ma; the mafic intrusions of gabbroic and dioritic composition show relatively younger ages spanning from 495 to 489 Ma;
- The peraluminous intrusions of the Tinker Glacier area in the Southern Cross Mountains emplaced between 494 and 488 Ma;
- The metaluminous monzogranitic intrusions of the Mountaineer Range show an age spectrum similar to the peraluminous granites of the Tinker Glacier area, between 495 and 490 Ma;
- The Keinath pluton, in the Deep Freeze Range, with a mean age of 485 Ma, represents the youngest large granitic intrusion in the studied area.

The geochronological data presented above indicate that during the Ross Orogenesis, in the studied area, the emplacement of the main intrusive complexes covered a time span of at least 25 Ma. Results obtained on the peraluminous granites of the Tinker Glacier area indicate their coeval generation and emplacement with the main metaluminous intrusive sequences.

Moreover, a wide range of inherited cores is present in some samples of both peraluminous and metaluminous granitoids with the following main age clusters: 2.2 Ga; 0.9-1.1 Ga; 800 Ma; 700 Ma; 570-610 Ma; a major peak in the interval between 0.9 and 1.1 Ga. Some of the observed ages match known events documented in the Proterozoic crust of the East Antarctic Craton. Few Lower Archean cores are also present showing usually discordant ages.

Tonarini, S. & Rocchi, S. (1994): Terra Antarctica 1: 46-50

An aeromagnetic hunt for Cenozoic alkaline intrusions north of Mariner Glacier, Victoria Land, Antarctica
(poster p.)

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Major continental rifts are often associated with either short-lived large igneous provinces of continental flood basalts, or long-lasting alkaline magmatic provinces. Northern Victoria Land (Antarctica) provides a prime example of long-lasting alkaline Cenozoic magmatism associated with a continental-scale rift, namely the West Antarctic Rift System (BEHRENDT 1999). Over an area of about 200 x 80 km in northern Victoria Land, plutons, dyke swarms, and volcanoes are exposed. Aeromagnetic evidence indicates that this area may correspond to a major tectonic block of the Transantarctic Mountains (TAM), namely the Southern Cross Block (FERRACCIOLI & BOZZO 1999). Within this block intrusive-subvolcanic rocks are known as the Meander Intrusive Group, while the volcanics are part of the McMurdo Volcanic Group (TONARINI et al. 1997). These large alkaline intrusions are marked by discrete and high-amplitude near-circular aeromagnetic anomalies (BOSUM et al. 1989). Anomalies of this character have not been imaged over the TAM south of Campbell Glacier, suggesting that the inferred Campbell Fault may mark the southern boundary of this Cenozoic alkaline intrusive province (FERRACCIOLI et al. 2000). Similar anomalies have however been imaged to the south beneath the Ross Ice Shelf, presumably within the West Antarctic Rift itself (BEHRENDT et al. 1996). The northernmost Cenozoic intrusion recognized so far is the Cape Crossfire Igneous Complex between Mariner Glacier and Borchgrevink Glacier (ROCCHI et al. 2002a).

An aeromagnetic survey was performed during the 2001-2002 Italian Antarctic campaign north of Mariner Glacier to assess if these alkaline intrusions extend also over the Tucker Glacier-Admiralty Mountains region. The main exploration method was aeromagnetics, which was complemented by a single ground-based gravity and geomagnetic depth sounding transect across the Tucker Glacier itself. Layout and set-up of the new MAGANTER helicopter-borne aeromagnetic survey closely resembled the one adopted for adjoining GITARA and GANOVEX surveys to ensure the maximum compatibility between the datasets. Line spacing was, therefore, set to 4.4 km with tie lines 22 km apart. More detailed, 2.2 km line-interval sections were also flown over selected areas. Nominal survey flight altitude was 2700 m. Some areas were flown at higher altitude (3000 and 3500 m), owing to the high elevations of the Admiralty Mountains. Overall 10947 km of usable line data were collected over an area of 32000 km^2.

Standard processing procedures were implemented with microlevelling techniques in frequency domain (FERRACCIOLI et al. 1998). We present new aeromagnetic maps for the region. By discussing selected magnetic signatures and comparing them with those observed over adjacent areas we address the northern extent of the Cenozoic alkaline plutons and volcanics. In particular we focus upon the spatial distribution of these rocks in relation to inferred intra-plate strike-slip fault belts, which have recently been proposed to control magma genesis and emplacement (ROCCHI et al. 2002b).

Behrendt, J.C., Saltus R., Damaske D., McCafferty A., Finn C.A., Blankenship D.D. & Bell R.E. (1996): Tectonics 15(2): 660-676.
Behrendt, J.C. (1999): Global Planet. Change 23: 25-44.
Bosum W., Damaske D., Roland, N.W., Behrendt, J.C. & Saltus, R. (1989): Geol. Jb. E38: 153-230.
Ferraccioli, F., Gambetta, M. & Bozzo, E. (1998): Geophys. Prospect. 46: 177-196.
Ferraccioli, F. & Bozzo E. (1999): J. Geophys. Res. 104: 25, 297-25,319.
Ferraccioli, F., Armadillo, E., Bozzo, E. & Privitera, E. (2000): Phys. Chem. Earth 25/4: 387-393.

Rocchi, S., Fioretti A.M. & Cavazzini, G. (2002a): Royal Soc. New Zealand Bull. 35: 215-225.
Rocchi, S., Armienti, P., D'Orazio, M., Tonarini, S., Wijbrans, J.R. & Di Vicenzo, G. (2002b): J. Geophys. Res. 107/B9.
Tonarini, S., Rocchi, S., Armienti, P. & Innocenti, F. (1997): Terra Antartica Spec. Pub: 511-521.

The View Point Conglomerates: a probable upper fan deposit in the accretionary wedge of the Triassic Trinity Peninsula Group, northern Antarctic Peninsula

(oral p.)

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Rocks of the Trinity Peninsula Group (TPG) occur widely in the northern Antarctic Peninsula, South Shetland and South Orkney archipelagos and are generally interpreted as parts of a Permo-Triassic accretionary complex. Turbidite successions dominate and reports concur in placing them in middle and lower submarine fan settings.

In the peninsula to the west of View Point (around 63-33°S, 057-23°W), the TPG is made up of two facies. The more voluminous facies is thinly bedded or laminated very fine-grained sandstone and siltstone with subsidiary mudstone interbeds. Some of the thicker beds (2-5 cm) show graded bedding with 'Bouma' Tbcd and Tcd patterns. This facies encloses a second, comprising thick beds (1-10 m) of sandstone and conglomerate. Both normal and reverse graded bedding is seen in these rocks and 'rip-up' clasts of the fine-grained facies are abundant at some horizons. Sandstone and conglomerate units exceed 100 m in thickness. Mapped distribution and lateral variation within the sandstone bodies suggests that they are lenticular. The dark, fine-grained, thinly bedded rocks are considered to be the deposits of low energy, dilute low density turbidity currents and to be the background sedimentation. The sandstone and conglomerate are interpreted as the deposits of high-concentration turbidity currents in upper-fan channels.

View Point succession differs strikingly from other TPG rocks in the abundance and coarseness of conglomerates (boulders of 50 cm to 1 m are common) which suggests that these rocks were deposited near a major submarine canyon mouth. The clasts are well rounded and comprise ~50% quartzite, ~25% granitoids and the remainder a mixture of acid to intermediate volcanics, quartzo-feldspathic sandstone, fossiliferous sandstone, and gabbro. The matrix of the conglomerates is quartzose and the associated micro-conglomerates have abundant quartz granules. The assemblage points to a diverse source of continental character and rugged relief that included of Archean to Paleozoic rocks. The prevalence of clasts of continental origin, absence of material from a contemporaneous magmatic arc, and the evidence of sinistral transpression in syn- and post-accretion structures, suggests a sinistral re-entrant in the plate margin. Such a re-entrant would allow access to the fan of course material, either eroded directly from the continent, or from the re-working of Permian glacial deposits.

Recent investigations of the George Vth Land continental margin, East Antarctica; WEGA (Wilkes Basin Glacial history) project

(oral p.)

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A geophysical and geological expedition was carried out in the George Vth Land continental margin in the frame of the WEGA (Wilkes Basin Glacial history) project, funded by the Australian National Antarctic Research Expeditions (ANARE) and the Italian Programma Nazionale Ricerche in Antartide (PNRA). The results of this successful expedition, which involved Australian, Italian and USA scientists provide new and interesting insights in the tectonic and stratigraphic evolution of this key sector of the Antarctic margin.

The George Vth Land continental margin represents the seaward termination of a large subglacial basin (Wilkes Basin) of the East Antarctic ice sheet. The base of this ice is mostly below sea level and for this reason it is sensitive to eustatic fluctuations. The thick sedimentary strata that form the passive margin sequence off George Vth Land therefore retain a record of Antarctic glacial dynamics which in turn is linked to the global climate signal. High resolution seismic profile data collected along the George Vth Land continental margin reveal a wide spatial and temporal variability in the dominant depositional processes. Asymmetric sediment ridges, orthogonal to the margin, formed on the continental rise by downslope sedimentary processes. Seismic facies from the ridges are characterized by channel-levee and sediment waves depositionsince the early Cenozoic (?Oligocene-?Early Miocene). The relief of these features decreases from older to younger sequences, possibly indicating a decrease in bottom current activity and/or sedimentation rate through time. The development of the ridges on the rise pre-dates the most significant glacially-driven shelf margin prograding wedge, that pinches out at the base of the slope. This demonstrates that most of the Late Neogene glacial sediment, did not reach the rise area, where sediment rates are interpreted to have been low. The ridges in the continental rise formed mainly under polythermal glacial conditions, when wet based ice was present on the margin; instead, the progressive upward attenuation of wavy geometries, with filling and draping of the preexisting forms, may be related to a change in the Eastern Antarctic Ice Sheet to polar conditions starting from the late Miocene. This led to the present condition of starvation of the continental margin.

Sediment cores collected from the most recent deposit across the rise ridges reveal alternation of Massive Mud and Laminated facies. The former facies was deposited by hemipelagic sedimentation. The presence of coarse to fine IRD and well preserved open-ocean diatoms in the Massive Mud facies indicate deposition during a period of retreat of sea ice and of good conditions for life, that we related to interglacial times. Silty laminae observed in the Laminated Mud facies are associated with traction currents and\or distal turbidities. The absence or few poorly preserved diatoms and the rare clasts related to IRD suggest a deposition during stable sea ice covering and sporadic iceberg formation, that has been associated to glacial periods.

The George Vth basin is also an important source of Antarctic bottom water that drives the earth's thermohaline circulation system. The analysis of seismic data and sediment cores indicates that sub ice-shelf and open marine conditions persisted for more than one glacial stage, up to the present time and bottom currents, which nowadays are related to the formation and the flow of HSSW, played an important role in shaping a 35 m thick drift sequence. The Holocene history of sedimentation on the George Vth basin in particular occurred in response to a progressively changing bottom current regime. The close spaced grid of high resolution seismic data and sediment cores revealed that the most extensive ice grounding event over the George Vth Basin up to the shelf edge occurred earlier than the Last Glacial Maximum.

Breakup and seafloor spreading between Antarctica, greater India and Australia
(oral p.)

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In addition to existing open-file data along the East Antarctic margin, several more offshore survey programs from Japan ("TH" surveys), France ("Marion Dufresne" surveys), Russia ("SaeRae" surveys) and Australia (see STAGG & COLWELL 2003) have vastly improved potential field data coverage, particularly in the area conjugate to the Greater Indian and Australian margins. The integration of these data sets, in conjunction with new high-quality Australian seismic data (STAGG & COLWELL 2003), offers the opportunity to add to the general tectonic framework of margin evolution including: the transition from continental to oceanic crust, breakup and seafloor spreading history, and plate tectonic reconstructions. In particular, the improved coverage of magnetic anomaly data has allowed gridding techniques to augment the identification of magnetic anomaly lineations, trends and sequences along the margin segments conjugate to Greater India and Australia.

In the Enderby Basin, from around 35°E-75°E, we observe magnetic anomalies trending roughly ENE, which are consistent with observed spreading between India and Australia. A Mesozoic magnetic anomaly sequence has been identified offshore from Kemp and MacRobertson Land, from M2 (~124 Ma) to at least M10 (~130 Ma) (GRADSTEIN et al. 1994 timescale). The seismic character of oceanic crust in this area is similar to that of the Cuvier Abyssal Plain off Western Australia (COLWELL et al. 2003), and this is broadly consistent with the age (Valanginian) and half-spreading rate (20-30 mm/yr) of seafloor identified in this area.

In the eastern Enderby Basin (approximately 60°E-73°E), the southern limit of identified seafloor spreading anomalies is marked by a prominent series of high-amplitude magnetic anomalies, followed by a magnetic anomaly low, which forms a large arcuate lineation that trends approximately E-W, somewhat oblique to the seafloor spreading lineations. This anomaly (named the MacRobertson Coast Anomaly, or MCA), coincides with a landwards step-down in basement that is observed in the Japanese and Australian seismic data (JOSHIMA et al. 2001, COLWELL et al. 2003), and is interpreted to mark a major crustal boundary, probably the continent-ocean boundary.

The sector between the southeast Kerguelen Plateau and Bruce Rise comprises a complex zone of oceanic crust that was formerly adjacent to the Cretaceous triple junction between Antarctica, Greater India and Australia. The crust abutting the Antarctic margin is characterised by a truncated sequence of ENE-trending Mesozoic anomalies, and was probably produced during the phase of India-Antarctica spreading that also formed the Enderby Basin. This crust is terminated oceanwards by the sharp transition to the E-W trending anomalies of the fast-spreading Australia-Antarctica crust.

Gridded magnetic anomaly lineations off the Wilkes Land margin reflect the change in spreading rate between Australia and Antarctica from early slow spreading (broad, poorly-defined lineations) to fast spreading (well defined, parallel lineations) at about Cenozoic anomaly 19 (43 Ma).

Colwell, J.B., Stagg H.M.J & Direen N.G. (2003): this volume.
Gradstein, F.M., Agterberg F.P., Ogg J.G., Hardenbol J., Van Veen P., Thierny J. & Huong Z. (1994): J. Geophys. Res. 99: 24051-24074.

Joshima, M., Ishihara T., Nakajima T., Sugiyama K., Tsuchida K., Kato A., Murakami F. & Brown B.J. (2001): Polar Geoscience 14: 244-263.
Stagg, H.M.J. & Colwell J.B. (2003): this volume.

Newly integrated potential field data off the Enderby Land margin: new seafloor spreading and plate tectonic models
(EANT workshop p.)

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The breakup and seafloor spreading history of the East Antarctic margin has been poorly constrained in many areas due to limited data coverage. This in turn has added uncertainty to plate reconstruction models including the breakup of Gondwana. In addition to existing open-file data along the East Antarctic margin, several more offshore survey programs from Japan ("TH" surveys), France ("Marion Dufresne" surveys), Russia ("Sae/Rae" surveys) and Australia have vastly improved potential field data coverage.

This is particularly the case in the area west of 60°E, in the Enderby Basin, where previously there were only a few widely spaced and randomly crossing shiptrack data. For the first time, there has been an opportunity to integrate virtually all the potential field data collected in the Enderby Basin. The improved coverage of magnetic anomaly data, in particular from the Russian and Australian surveys, has allowed gridding techniques to augment the identification of magnetic anomaly lineations, trends and sequences. The integration of these data sets offers the opportunity to look at the breakup and seafloor spreading history in this region, and add to plate tectonic reconstructions for the breakup of Gondwanaland, including Africa, Madagascar, Sri Lanka, India and Australia.

Transantarctic uplift or Ross Sea collapse? Implications of new aerogeophysical data
(poster p.)

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The Transantarctic Mountains (TAM) are often described as the highest "rift related" mountains in the world. The rift to which they are related is the West Antarctic rift system. These areas make up a very broad continental margin where the crust has been rifted and thinned. Most models assume that the TAM were uplifted when the Ross Sea was rifted in late Cretaceous time with the possibility of some early Miocene rifting. Previous quantitative models have mostly been kinematic, in that a geometry of deformation or loading is specified and the resultant local or regional isostatic response is computed. Different versions of such models include: mainly thermal uplift of the mountains; a combination of thermal and mechanical uplift related to rifting, or just mechanical effects of rifting thick lithosphere.

We suggest the alternative possibility that TAM were not uplifted in the rifting that formed the Ross Sea Shelf and Embayment, but that the Ross Sea region subsided during continental extension. The Ross Sea structure, geologic history and heat flow may be consistent with the collapse of a high plateau of thick crust. In the context of this idea the TAM would be a region on the edge of that plateau that was already high when the plateau extended and collapsed. To illustrate this idea we will use a dynamical model to simulate the mechanical and thermal behavior of the lithosphere by an explicit finite-element method. Using this model we can show conditions that can lead to extensional collapse of a plateau leaving behind already high mountains at the edges of the area of rifting. Erosion of the thick crust that did not collapse may contribute to the uplift of the uneroded parts of the mountains.

Two newly acquired and analyzed aerogeophysical transects help constrain the support of the Transantarctic Mountains. One survey goes between McMurdo and Dome C while the other goes between the Ross Ice Shelf and the South Pole. Gravity data along the transects does not support the flexural uplift model, and is consistent with thickening of the crust below the mountains. The data favors the Ross Sea collapse model in that much of the long wavelength elevation of the TAM may be supported by crustal thickness variations. We are investigating the possibility that some of the elevation of highest parts of the mountains are related to erosion of crust between the high mountains and the Ross Sea that was thick are the end of the collapse/rifting phase.

Downhole measurements and their use for stratigraphic correlations in the Ross Sea, Antarctica

(poster p.)

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Drillholes CRP-l to CRP-3 ofthe Cape Roberts Project (CRP) in the Northem McMurdo Sound (Ross Sea, Antarctica) targeted the western margin ofthe Victoria Land Basin to investigate Neogene to Paleogene climatic and tectonic history. Drilling on fast sea ice resulted in coring a stratigraphic succession with a composite thickness of 1500 rn and an age range of 17-34 Ma. Well logging of CRP-3 has provided a complete and comprehensive dataset of in situ geophysical measurements down to 939 meters below sea floor (mbsf).

By cluster analysis of the downhole logging data, it was possible to divide the borehole into three rnain sections. The upper section down to 230 mbsf is dorninated by mudstones with clearly different physical properties from the mudstones occurring below this depth. Beneath 230 mbsf sandstones are dorninating the lithology. Two types of sandstones could be characterized, with the lower sandstone being dorninant below 630 mbsf down to a brecciated shear zone at 790 mbsf. These two types of sandstones, which are differentiated rnainly by their magnetic properties, can be correlated to the detrital mode provenance analysis. The boundary rnarks the Eocene/Oligocene boundary.

Comparison of these results with the seisrnic stratigraphy shows that the rnajor change in sediment source from Victoria to Taylor Group is not seen by seisrnic sequence analysis. This finding wil1 have consequences for the entire Ross Sea seisrnic stratigraphy.

Extension and inversion tectonic in the Victoria Land Basin, Ross Sea
(poster p.)

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The Ross Sea tectonic structures (highs and basins) were formed by two main phases of deformation: the regional extension, mainly amagmatic, related to the late Cretaceous break-up, and the post-Oligocene transpressional phase localised in the western Ross Sea with magmatic activity. The second phase affected also the northern Victoria Land with right-lateral slip component reactivation of the Paleozoic North-West/South-East faults inherited by the Ross Orogeny (SALVINI et al. 1997).

One of the most intriguing feature in the Ross Sea is the Victoria Land Basin, a key area for understanding the evolution of the Ross Sea rifting, Transantarctic Mountains (TAM) uplift, and the transition between East and West Antarctica. Initial phase of formation was supposed to be late Mesozoic, for similarities with other Ross Sea basins formed during the break up, but recent data from Cape Roberts suggested that first extension could be Early Cenozoic. The subsequent phase of deformation produced the deepening of the western side of the Basin, the Discovery Graben, and inversion on the eastern side, building the Lee Arch.

Geophysical investigation conducted by Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS) from 1988 to 1990, acquired about 10,000 km of mainly multichannel seismic data in the whole Ross Sea, but more than half concentrated in the western Ross Sea. Furthermore, in the winter season 2001-2002, about 1700 km of single channel high resolution seismic were acquired in the western part of the Ross Sea, focussing on recent tectonic activity possibly connected to the onland main structures.

Analysis of new and older data, some of them reprocessed to enlighted structures in highly faulted zones, evidences that the transpressional activity subdivided the Victoria Land Basin in distinct areas each one characterised by different tectonic deformation:

a) In the southern part the basin is subdivided by two half graben separated by the Lee Arch, whose structure here is influenced by the tectonic and magmatic activity of the Ross Island;
b) In the middle part the basin has been partly deepened during the reactivation, and partly inverted in the Lee arch, a right transpressional structures;
c) In the northern part the Discovery Graben is very small, as the basin is almost completed inverted by two different transpressional features close each other, related to the Lee Arch.

Salvini F., Brancolini G., Busetti M., Storti F., Mazzarini F. & Coren F. (1997): J. Geophys. Res. 102/B11: 24669-24696.
Spadini G., Ben-Avraham Z. & Busetti M. (1998): Rend. Fis. Acc. Lincei, 9/9: 257-269.

A new geomagnetic observatory at Dome C
(poster p.)

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In 1994 France and Italy started a program for building a permanent scientific station on the high east Antarctic craton, at Dome C (latitude 75°06'S, longitude 123°23' E, about 3300 m above sea level and 950 km away from the coast). As a result of the French-Italian agreement the national Antarctic

Programs (IPEV and PNRA respectively) started logistic, technical and scientific activities that were initiated with the realization of a summer camp. A permanent base, intended to provide support to a growing number of scientific researches, is under construction and will be reasonably open in the year 2004. The base, that will be called "Concordia", is located 560 km from "Vostok" (Russia), 1100 km from "Dumont D'Urville" (France) and 1200 km from "Terra Nova Bay" (Italy).

During the 1999-2000 and 2001-2002 expeditions in Antarctica, some preliminary tests were carried out to evaluate if "Concordia" could also be a good site for a permanent geomagnetic observatory. Two independent data acquisition systems, each equipped with overhauser and flux-gate magnetometers, were installed in two shelters at about 300 m from the base camp. After some experiments and tests, the site was considered a good one for geomagnetic investigations. The instrumentation and the acquisition systems are being prepared now in France and in Italy for final installation that will take place during the 2004-2005 expedition, after additional tests that will be performed during the next 2003-3004 campaign.

Tertiary seafloor spreading between east and West Antarctica

(oral p.)

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Motion between East and West Antarctica, which is proposed to have occurred in Cretaceous and/or Tertiary time, has long been a concern for Antarctic tectonics. The amount and direction of any such motion has important implications for global plate motion problems such as hotspot fixity and reference frames of plate motion, as well as for any plate circuits that go through the Antarctic plate. It also has important implications for the lithospheric structure of the Antarctic continent. Marine geophysical studies of the seafloor of the Ross Sea region (cruise NBP9702), along with studies of the conjugate region on the Australia plate, showed that Antarctica acted as two independently moving plates separated by a slow oceanic spreading center along the Adare Trough during part of the Tertiary, from at least chron 20 time to chron 9 time (40 to 28 Ma; CANDE et al. 2000). This spreading produced a 150 km width of new seafloor that is identified in the Adare Basin (surrounding the Adare Trough) with conjugate magnetic anomalies on both sides. Recently, on cruise NBP0209, additional geophysical measurements were collected at the southern end of the Adare Trough. These results show that some of the linear magnetic anomalies associated with the Adare Trough, as well as the gravity low that is one of the defining characteristics of the Trough, continue southward into shallower regions of the Ross Sea without any apparent offset or termination. This result thus rules out some previous models that invoked NW-striking strike-slip faults here as a means for the extension to have been transferred laterally away from the southern Ross Sea. The 150 km of Tertiary ocean floor in the Adare Basin therefore projects along strike south-southeastward into the region between Cape Adare and the Iselin Bank. We hypothesize that the material now present between Cape Adare and the Iselin bank represents new crustal area formed during Tertiary extension between the East Antarctic plate and the West Antarctica plate. The nature of this crust is unknown but it may be oceanic (or transitional) crust, or highly extended continental crust. There was also some displacement between East and West Antarctica prior to chron 20 time, east of Iselin Bank; the net amount of this displacement is not yet well constrained. The continuation of the fossil E-W Antarctic plate boundary into the modern Antarctica plate, and where and how it would connect back out to the margins (i.e. west of the Antarctic Peninsula?) is not known. We do know, from Australia-Antarctica plate reconstructions, that since about chron 9 time (28 Ma) there is no resolvable relative motion between East and West Antarctica in the Adare Basin region.

Vegetation composition of Cretaceous and Tertiary floras of the Antarctic Peninsula as evidenced by the fossil wood record

(oral p.)

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An unparalleled Cretaceous through Paleogene record of forest growth in the high southern latitudes is contained within the sedimentary strata of the Larsen Basin. Much work has focused on the palynological record (DETTMANN & THOMSON 1987, ASKIN 1988, 1989), but in recent years good leaf assemblages (e.g. HAYES 1999) have provided additional information on patterns of floristic change (CANTRILL & POOLE 2002). Until recently relatively few taxonomic studies of the fossil wood record had been completed (GOTHAN 1908), but this deficiency has recently been redressed (e.g. TORRES et al. 1994, OTTONE & MEDINA 1998, POOLE & FRANCIS 1999, 2000, POOLE et al 2000, POOLE & GOTTWALD 2001). Elsewhere in the Antarctic Peninsula our knowledge of the taxonomic composition of wood floras has also improved (e.g. FALCON-LANG & CANTRILL 2000, 2001, POOLE & CANTRILL 2001, POOLE et al. 2001) so that it is now timely to synthesize this information based on fossil wood.

Fossil wood provides a different perspective from the palynological record of floristic change and vegetational composition, as it represents the tree stratum within these ecosystems rather than the whole regional flora. Based on the fossil wood record we can recognize five periods of floristic development: Aptian-Albian coniferous phase, ?Cenomanian to Santonian early angiosperm diversification phase, a Campanian to Maastrichtian modernization phase and an early Paleogene expansion of *Nothofagus* communities. However, the patterns seen are not simple, as evidenced by comparison with coeval floras from other basins. It is clear that climate change was a major factor affecting floristic composition but changing palaeoenvironments were equally important. Comparisons between the wood record and leaf and pollen record reveal important differences and strong parallels that further our understanding of these unique high latitude ecosystems.

Askin, R.A. (1988): Geol. Soc. America Memoir 169: 131-153.
Askin, R.A. (1989): Geol. Soc. London Spec. Publ. 47: 107-119.
Cantrill, D.J. & Poole, I.P. (2002): Geol. Soc. London Spec. Publ. 194: 141-152.
Dettmann, M.E. & Thomson, M.R.A. (1987): British Antarctic Surv. Bull. 77: 13-59.
Falcon-Lang, H.J. & Cantrill, D.J. (2000): Rev. Palaeobot. Palynol. 111: 1-17.
Falcon-Lang & Cantrill D.J. (2001): Cretaceous Res. 22: 277-293.
Gothan, W. (1908): Wissenschaftliche Ergbnisse der Schwedischen Sudpolar-Expedition 1901-1903 3(8): 1-33.
Hayes, P. (1999): Ph.D. Thesis, University of Leeds.
Ottone, E.G. & Medina, F.A. (1998): Ameghiniana 35: 291-298.
Poole, I. & Cantrill, D.J. (2001): Palaeontology 44: 1081-1112.
Poole, I. & Francis, J.E. (1999): Rev. Palaeobot. Palynol. 107: 97-107
Poole, I. & Francis J.E. (2000): Annals of Botany 85: 307-315.
Poole, I. & Gottwald, H. (2001): Australian Systematic Botayn 14: 207-230.
Poole, I., Hunt, R.H. & Cantrill, D.J. (2001): Annals of Botany 86: 421-432.
Torres T., Marenssi, S. & Santillana, S. (1994): Inst. Antarctico Chileno Serie Cientifica 44: 17-38.

Contrasting metamorphic evolution at the contact between terranes: microtextural and petrological evidences from shear zones in the Lanterman Range, northern Victoria Land, Antarctica

(poster p.)

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In northern Victoria Land, the boundary between the Wilson and the Bowers terranes is a first rank tectonic lineament, running from the coast of the Ross Sea to the Pacific ocean. The boundary is well exposed in the Lanterman Range where it is known as Lanterman fault zone (BRADSHAW et al. 1982). The Lanterman fault zone displays a poliphase structural evolution (CAPPONI et al. 2000): after a W over E thrusting under amphibolite facies metamorphism, it experienced shearing with a strike-slip movement. A microtextural and petrological study carried out on metabasic rocks sampled along the Lanterman fault zone, revealed a contrasting metamorphic evolution between samples from the boundary of the Wilson Terrane (WT) and those from the Bowers Terrane (BT). Samples from the WT display different degree of structural and metamorphic re-equilibration under the shear deformation. They vary from slightly retrogressed amphibolite (mainly high AlIV Mg-hornblende + oligoclase and rare actinolite) to mylonite schist where amphibole porphyroclasts are high AlIV pargasite/edenite and Mg-hornblende within a matrix composed of a new acicular Mg-hornblende with lower AlIV and K content, green biotite, chlorite, albite and rare oligoclase. Actinolite is rare and usually is present along porphyroclastic cleavages. Samples from the BT are fine-grained mylonite schists, mainly consisting of amphiboles of different size (from 6 up to 300 μm), which occur as large blades, equant subgrains or syn to post-kynematic needles. Amphiboles of every size are characterized by an actinolite core rimmed by high AlIV Mg-hornblende. Post-kynematic needles of a new actinolite have also been found. Plagioclase is both albite and oligoclase.The results indicate that along the Lanterman fault zone shear deformation on metabasites from the WT begun to develop under amphibolite facies metamorphic conditions and later evolved to transitional amphibolite/ greenschist facies conditions. At the boundary of the Bowers Terrane, on the other hand, temperature increased during shear deformation from greenschist to transitional amphibolite/greenschist facies, then retrogressed toward greenschist facies during the latest deformational stages.

Incremental laser heating ^{40}Ar-^{39}Ar analyses on amphibole separates of samples from both the Wilson and the Bowers terranes gave irregularly discordant age. ^{40}Ar-^{39}Ar age-steps, including the low-temperature region dominated by amphibole intergrown with other K-rich mineral phases (phyllosilicates), chiefly yielded ages >420-440 Ma and up to 490 Ma for the amphibole domains, thus suggesting a negligible influence of the Devonian- Carboniferous Borchgrevink Orogeny.

Bradshaw, J.D., Laird, M.G. & Wodzicki, A. (1982): In: C. Craddock (ed). Antarctic Geosciences, 809-816.
Capponi, G., Crispini, L. & Meccheri, M. (2002): In: J.A. Gamble, D.N.B. Skinner & S. Henrys (Eds). Antarctica at the Close of a Millennium, 105-112.

The late Eocene, terrestrial, vertebrate fauna from Seymour Island: The tails of the Eocene patagonian size distribution

(oral p.)

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The late Eocene, Antarctic, terrestrial vertebrate fauna from Seymour Island (= Isla Marambio), Antarctic Peninsula, exhibits a wide range of body sizes from small insectivorous, omnivorous and granivorous mammals (e.g. derorhynchid, prepidolopid, microbiotheriid and polydolopid marsupials along with a sudamericid gondwanathere) to moderate to large-sized ungulates (e.g. litopterns and astrapotheres), plus a large-sized sloth and large cursorial birds (a ratite and a phororhacoid). The fauna lacks medium-sized, mammals in the size range represented by rabbit- to deer-sized animals. Thus, the fauna has a bimodal distribution of body sizes in that it contains small mammals and large mammals and birds, but nothing in between.

In contrast to Antarctic fauna is the contemporaneous Eocene mammalian fauna from Patagonia, which has a reasonably normal distribution of body sizes and is most heavily represented by medium-sized ungulate herbivores. The body size distribution is directly opposite to that of the Antarctic fauna. A comparison of the late Eocene Antarctic fauna to the Eocene Patagonian fauna is appropriate, due to the taxonomic affinities between the two faunas. If the Patagonian fauna is the source for the Antarctic fauna, then the 13 Antarctic taxa could be expected to be distributed equally among the eight size classes present in the Patagonian fauna (at 1.62 taxa/size class). A Chi Square based G-test between the observed Antarctic body size data to this possible equal size class representation or to the "normal" distribution of the Patagonian fauna, shows that the Antarctic fauna is statistical different from either size class distribution.

The bimodal body size distribution is not an unusual pattern for a high latitude, homeothermic, vertebrate fauna, as it can also be seen in the modern boreal (i.e. higher latitudes, >45 degrees) mammalian fauna of North America. The modern boreal fauna also displays a low frequency of taxa in the medium-sized animals, which range in body size from 3-20 kilograms (i.e rabbit- to deer-sized mammals).

The bimodality of body sizes in these Antarctic terrestrial vertebrate fauna is an apparent derivation of Bergmann's Rule, where homeotherms in colder (= higher latitudes) climates are larger than related taxa in warmer climates (= lower latitudes) in order to conserve heat by creating smaller surface area to volume ratios. The small sized marsupials, would adapt to the cool climatic conditions through physiological means (e.g. torpor) and occupying small insulated nest sites. The larger mammals and birds have adapted to the climatic conditions by conserving heat by means of their larger body size. The absence of medium-sized mammals may be related to the fact that these animals could not utilize either physiological strategy of torpor or heat conservation exhibited by the tails of the body size distribution as they lack sufficient body size to conserve heat, nor are they small enough to occupy insulated nests or burrows and thus they would be at a selective disadvantage.

The Antarctic Seismic Data Library System for Cooperative Research

(poster p.)

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The Antarctic Seismic Data Library System for Cooperative Research (SDLS) was designed by members of the Antarctic geoscience community to facilitate open access to multichannel seismic reflection data, and to promote collaborative research based on those data. The SDLS was formally adopted in 1991 under the auspices of the Scientific Committee on Antarctic Research (SCAR) and mandates of Antarctic Treaty Consultative Meeting Recommendation XVI-12. Since that time, library branches have been established in countries worldwide, and more than 100,000 km of digital seismic reflection profile data have been provided to the SDLS by data collectors in 10 countries.

The library system is a dynamic library where data resides for use by all members of the research community in collaboration with data collectors. Data are available at the SDLS during the period between four and eight years following data collection, after which the data are sent to a World Data Center. The SDLS system protects intellectual property rights of data collectors and provides open access to data, as required by the Antarctic Treaty, to facilitate timely and multinational geoscience research products.

We present an updated design for the SDLS that incorporates a variety of new features and capabilities utilizing modern technology and current standards for the organization and dissemination of geospatial data, while retaining the basic tenets and guidelines upon which the library system was adopted. This updated design will be discussed in detail at an SDLS workshop during the ISAES IX symposium to ensure that it will meet the current and future needs of the Antarctic scientific community.

The prototype for the updated SDLS:

- includes not only the binary seismic datasets (SEG-Y), but also images of the profiles in standard formats (e.g. tiff) suitable for viewing and printing without specialized seismic processing software;
- is principally Web-based, allowing on-line access to digital datasets. Security and access to data will be controlled according to the terms of the original SDLS agreement. On-line access to sensitive data files (detailed shotpoint maps, SEG-Y data files and high-resolution images for data less than eight years old) will be protected by either password control or off-line storage (e.g. DVD) accessible only at the SDLS library locations;
- includes spatially referenced location figures at a standard projection and scale to enable the convenient production of location maps. The use of consistent map parameters and layered map elements facilitates the ease with which data from different datasets can be combined and interpreted;
- establishes a common set of descriptors about each dataset in order to provide more consistent and complete documentation about datasets in the library than now exists.

The updated SDLS, like its predecessor, will be a community research tool that relies on active data-input and use by data collectors and geoscientists to achieve ultimate success. Additional information about the SDLS is available at: http://walrus.wr.usgs.gov/sdls/

Modelling the tectonic origin of the Aurora and Concordia trenches, Dome C area, East Antarctica
(oral p.)

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The Aurora and Concordia trenches represent the major elongated depressions which characterize the bedrock below the ice cap in the Dome C area, East Antarctica. At these depressions the ice cap reaches a thickness of over 4000 m, leaving the possibility to have water deposits at their bottom. The relative young age of the Antarctic Ice Cap, about 38 Ma, compared with the old, Mesozoic age of the former, continental landscape constrains the age of these structures in Late Cenozoic time. The Aurora and Concordia trenches show a characteristic asymmetric shape, difficult to merely explain with erosional processes. On the other hand, this asymmetric shape is typical of morphologies resulting from fault activity, and specifically the presence of active normal faults with planes of variable dip. The bedrock morphologies at these trenches were compared with normal faulting processes by a series of numerical modelling to evaluate the possibility of a tectonic origin. Modelling of the bedrock morphology was simulated by the Hybrid Cellular Automata method (HCA) through the Forc2D software implementation. Within the Italian PNRA (Programma Nazionale Ricerche in Antartide) a series of airborne radar surveys was performed in the Lake Vostok - Dome C region in the last decade. A series of meaningful bedrock profiles were selected, to provide, as close as possible, across strike sections of the Aurora and Concordia trenches. The optimal orientation was then achieved by projecting the data along a perfectly across strike trajectory. In this way it was possible to simulate the faulting as a cylindrical deformation, suitable to be modelled by 2D software. The match was obtained by a forward modelling approach, in that the fault trace and the displacement were tuned until a satisfactory match was obtained. The obtained results confirmed the feasibility of the tectonic origin of both the Aurora and Concordia trenches and shows the presence of a more ductile zone at about 31km of depth in the continental litosphere below Dome C.

A geophysical study of the Wilkes Land margin, Antarctica
(poster p.)

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Multi-channel seismic (MCS) reflection, gravity and magnetic anomaly data acquired by the Australian-Antarctic Southern Ocean Profiling Project have been used to investigate the structure and development of the rifted continental margin of Wilkes Land, Antarctica. This margin formed by the separation of Antarctica and Australia in the Late Cretaceous, an event that marked the final stage in the development of extensional plate margins within Gondwana and completed its piecewise fragmentation.

Two regional unconformities have been identified on 12 deep MCS profiles between 105°E and 140°E. MCS data indicate that the deeper unconformity is associated with breakup in the Late Cretaceous at approximately 90 Ma. This unconformity typically marks the upper limit of heavily structured and intruded sequences, and generally terminates against the oldest oceanic crust. Comparison with the conjugate southern Australian margin suggests that the shallow unconformity is of early

Eocene age (approx. 50 Ma). The shallow unconformity dips oceanward beneath the lower rise on all except the westernmost MCS profiles and is a prominent onlap surface throughout the area.

Two-way-time (TWT) isopach maps for each of the two major sequences show a deep basin offshore of the Budd Coast (BC), with more than 5 s TWT (ca. 9 km) of sediment, overlying the Late Cretaceous unconformity in the west of the study area. In contrast, less than 1 s TWT (ca. 1 km) of sediment is typically observed in the east. On the easternmost profile, an interpreted gabbro-peridotite ridge underlies the seabed (STAGG et al. 2003; this volume). The majority of sediment deposition in the western Wilkes basin has occurred since the development of the upper unconformity, this is interpreted to be associated with the onset of continent-wide glaciation and the spread of glaciers capable of high-volume erosion and sediment transport. The locus of the thickest sediments occurs proximal to the termination of the Totten Glacier, one of the widest high-velocity glaciers in Antarctica. The basin geometry is distinctly asymmetric, sediment thickness is greater eastwards along the strike of the margin.

Rotated fault blocks, divergent bedding and distinct internal reflection patterns characterise continental basement beneath the continental slope. High-amplitude, discordant reflections within an overall low-reflective zone are interpreted to represent igneous intrusions in stretched and faulted continental crust and characterise transitional crust in the region. Oceanic crust is characterized by a rugged upper surface, the boundary with the transitional crust (continent-ocean boundary or COB) is often marked by a distinct basement ridge. Oceanic crust is characterised by a lack of coherent reflections, although some faulting of early oceanic crust is inferred.

A well developed, continuous free-air gravity "edge-effect" anomaly is associated with the East Antarctic margin. However, it is offset to the south in the region of the BC basin at 112°E. The less continuous edge effect gravity low is also cut at 115°E, by a gravity high that is located over BC basin. The COB interpreted on MCS profiles is typically located approximately 100-120 km northward of the edge effect low and correlates to a discontinuous "outer-low" anomaly.

Modelling of magnetic anomaly data is complicated by the very slow Australia-Antarctica spreading rates, following breakup, that resulted in limited anomaly continuity along strike. However, variable spreading rate modelling, using a magnetic 'block' model, allows the anomaly sequence from the present back to anomaly 21 (47 Ma) to be confidently identified. The sequence of anomalies older than anomaly 21 is less confidently identified. A characteristic, broad (approx. 100 km), dipolar anomaly can be confidently correlated on 8 of 19 observed profiles between 105-130°E. This observed anomaly matches closely anomaly 34n-33r in modelled profiles, suggesting the presence of remanently magnetised material formed approximately 90 Ma. However, this characteristic, if laterally inconsistent, magnetic anomaly ubiquitously overlies crust identified as continental or transitional on MCS profiles.

Permian-Triassic boundary in the central Transantarctic Mountains

(oral p.)

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The recent discovery of a typical Permian plant fossil, *Glossopteris*, in rocks previously thought to be Lower Triassic (MCMANUS et al. 2002), opens the possibility that complete stratigraphic sections across the Permian-Triassic boundary may be found within a terrestrial sequence in the central

Transantarctic Mountains. The boundary was previously assumed to be at the contact between Permian coal measures of the Buckley Formation and non-carbonaceous vertebrate-bearing sandstones of the Fremouw Formation. This contact was originally thought to represent a hiatus along a major disconformity (BARRETT 1969). With the occurrence of probable Permian fossils above the formational contact within the Fremouw Formation, the evidence for an unconformity representing a significant hiatus disappears. In the Shackleton Glacier area the base of the Fremouw Formation was placed below the lowest cycle with greenish-gray fine-grained beds and above the highest carbonaceous beds (COLLINSON & ELLIOT 1984). Permineralized fossil wood occurs in the lower Fremouw at several localities and was assumed to be Triassic in age. Now that *Glossopteris* has been found associated with the fossil wood, we believe that the fossil wood at other Fremouw localities along the Shackleton Glacier is also Permian. Vertebrate-bearing beds, where they occur, are 5 m to 30 m above the base of the Fremouw and have not been found to be associated with *Glossopteris* or fossil wood. A major negative $\delta^{13}C_{org}$ excursion has been reported from the top of the Buckley Formation at Graphite Peak (KRULL & RETALLACK 2000). This excursion has been interpreted as a chemostratigraphic marker for the Permian-Triassic boundary (ERWIN 1994). In the Shackleton Glacier area the Permian-Triassic boundary does not appear to coincide with the Fremouw-Buckley contact, but is within the lower Fremouw Formation between the highest occurrence of the Permian *Glossopteris* flora and the lowest occurrence of the *Lystrosaurus* Zone fauna.

Barrett, P.J. (1969): Ohio State Institute of Polar Studies Report 34: 1-132.
Collinson, J.W. & Elliot, D.H. (1984): Antarctic Research Series 36: 97-102.
Erwin, D.H. (1994): Nature 367: 231-236.
Krull, E.S. & Retallack, G.J. (2000): GSA Bull. 112: 1459-1472.
McManus, H.A., Taylor, E.L., Taylor, T.N. & Collinson, J.W. (2002): Rev. Palaeobot. Palynol. 120: 233-246

Geology of the deep-water margin of East Antarctica between Queen Mary and George V Lands

(poster p)

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In 2001 and 2002, Australia acquired an integrated geophysical data set over the deep-water continental margin from offshore Queen Mary Land to offshore George V Land, East Antarctica. The data comprise more than 12000 km of high-quality, 36-fold deep-seismic data with coincident gravity, magnetic and bathymetry data. Fifty single-ended refraction stations using expendable sonobuoys were also successfully recorded along the seismic profiles, with crustal velocities recorded at most stations and probable Moho arrivals recorded at 17 stations.

This part of the margin of East Antarctica was formed by the breakup of Australia and Antarctica, which culminated in the onset of seafloor spreading in the early Campanian (~83 Ma, anomaly A33), at about the same time as breakup of the eastern Australian margin in the Tasman Sea. The initial slow spreading phase continued until the Eocene, at which time the current North-South fast-spreading phase became established.Structurally, the margin can be divided into three distinct sectors separated by diffuse boundaries: the Queen Mary Land sector (west of 106°E); the Wilkes-Adélie Land sector (106-140°E); and the George V Land sector (east of about 140°E).

In the west, the Queen Mary Land sector is dominated by the generally 1500-2500 m deep Bruce Rise, one of the few marginal plateaus on the Antarctic margin, and the conjugate feature to the Naturaliste Plateau off southwest Australia. By analogy with the latter feature, Bruce Rise is probably comprised of Proterozoic to Cambrian basement rocks. A rift phase, of likely Late Jurassic to earliest

Cretaceous age has produced extensional half-graben containing 1-1.5 km of sedimentary rocks within the basement surface. The margins of Bruce Rise are steep and the contact with likely Early Cretaceous oceanic crust generated by India-Antarctica spreading is sharp.Margin breakup was highly asymmetric, and most of the highly extended continent-ocean transition (COT) crust remaining attached to the conjugate Australian margin.

The Wilkes-Adélie Land sector is dominated by a broad and highly structured COT. The COT underlies the inboard flank of the Australia-Antarctic Basin, between the zone of maximum thinning of continental crust and the continent-ocean boundary (COB) that separates the COT from slow-spreading oceanic crust to the north. The COB is located beneath the deep ocean basin, approximately 100 km outboard of where it hadbeen interpreted by previous workers.Integration of the seismic interpretation with potential field forward modelling shows that the 100 km-wide COT zone is characterised on its inboard edge by a ?peridotite ridge, similar to one in the conjugate Great Australian Bight, and analogous to that on the Galicia margin of the North Atlantic. Outboard of the ridge, a sedimentary basin has developed over highly-attenuated continental crust or altered mantle rocks.The overall structure of the COT zone is a near mirror image of the equivalent zone on the Australian margin, indicating that, at least in the central part of the rift, continental extension was almost symmetric across the margins.Geophysical data indicate that the structures of the COT extend for at least 1000 km along the margin.At the eastern end of this sector, crustal structures are influenced by the proximity of the major fracture zones that separate Tasmania from the Antarctic margin.This has resulted in the development of large-scale, (4-5 km amplitude; 20-40 km wavelength),pinch-and-swell structures of limited strike extent in the deep crust that indicate plastic deformation at this level.These structures are a major control on the distribution of sedimentary rocks, particularly in the post-rift section.

Structuring in the easternmost George V Land sector is dominated by the Tasmania-Antarctica fracture zones that offset the Southeast Indian Ridge in this area. The continental slope is steep and post-rift sedimentation, in particular is very thin.However, as with the Wilkes-Adélie Land sector, continental crust appears to underlie the deep ocean basin, well outboard of the continental slope.

Structure and sediment distribution of the deep continental margin of Enderby and MacRobertston Lands, East Antarctica

(EANT workshop p.)

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In 2001 and 2002, Australia acquired an integrated geophysical data set over the deep-water continental margin from west of Enderby Land to offshore from Prydz Bay, East Antarctica. The data include approximately 7700 km of high-quality, 36-fold deep-seismic data with coincident gravity, magnetic and bathymetry data. Thirty-seven single-ended refraction stations using expendable sonobuoys were also successfully recorded along the seismic profiles, with crustal velocities being recorded at 32 of the stations and probable Moho arrivals recorded at 13 stations.

This part of the margin of East Antarctica was formed during the breakup of Greater India and Antarctica, which culminated with the onset of seafloor spreading in the ?Valanginian (BROWN et al. 2003), at about the same time as breakup along much of the western Australian margin. However, the precise breakup history in the Enderby Basin is currently poorly defined, both temporally and spatially, with the pre-breakup positions of India and any continental fragments beneath the Kerguelen Plateau being largely speculative. The geology of this area can be divided into distinct east and west sectors by a major boundary at about 58-59°E. Across this boundary, the continent-ocean boundary (COB) steps outboard from west to east by about 100 km and the character of the oceanic crust changes markedly.

In the western sector, structuring in the interpreted continent-ocean transition (COT) zone and thinned continental crust landward of the COB is largely obscured by high-amplitude reflectors that probably represent extensive syn- and post-rift volcanics. Blocks of rift crust are inferred in the seismic data, and their presence is confirmed by gravity and magnetic modelling. Oceanic crust in this sector is variable in character, from rugged with a relief of more than 1 km over short distances, to rugose with low amplitude relief set on a long-wavelength undulating basement. Interpreted, non-reversed mantle velocities beneath this crust are probably low, averaging less than 7.8 km s^{-1} and the average depth to Moho is about 11 km. The variations in crustal character within this sector probably reflect a complex arrangement of seafloor spreading compartments. Post-rift sediments in the western sector are highly variable in thickness, ranging from about 4 km thick beneath the lower slope to around 1 km thick over oceanic crust.

In the eastern sector, structuring in the COT and adjacent thinned continental crust is also obscured by interpreted volcanics; however, here rift blocks are more apparent than they are to the west. The main crustal layer in this area has velocities of 6.1-6.2 km s^{-1}, which is consistent with the interpreted continental origin. The COB is the most prominent boundary in this sector, corresponding to a major oceanwards step-up in the basement level of as much as 1 km. This boundary is again confirmed by potential field modelling. North of the COB, oceanic crust is highly distinctive in character, with commonly 1) a smooth upper surface underlain by short, seaward-dipping volcanic flows; 2) a transparent upper crustal layer; 3) lower crust characterised by steeply dipping, high-amplitude reflectors; and 4) a strong Moho reflection coinciding with the base of the highly reflective layer. Moho velocities in this area determined by sonobuoys are markedly higher than to the west, averaging almost 8.3 km s^{-1} and Moho depths are deeper at an average of 13.6 km, again pointing to a major crustal boundary and the development of distinct spreading compartments. The ocean crust here is almost identical in character to the Early Cretaceous ocean crust in the Cuvier Abyssal Plain off northwest Australia.

In the eastern sector a large volume of sediments, primarily derived from the Lambert Glacier, Antarctica's largest outlet ice stream, have been deposited and reworked on the continental slope and in the Enderby Basin. These sediments are greater than 7 km thick beneath the lower slope and are at least 2 km thick more than 500 km oceanwards of the continental shelf.

Brown, B., Ishihara, T. & Müller, R.D. (2003): this volume.

ODP drilling in Prydz Bay - clues to East Antarctic Cenozoic glacial transitions
(poster p.)

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ODP drilling in Prydz Bay by Leg 119 (1988) and Leg 188 (2000) recovered cores that record transitions in Cenozoic paleoenvironments of the continental shelf slope and rise. The cores from the shelf reveal a pre-glacial alluvial plain system covering the Prydz Bay basin, a plain characterized by austral conifer woodland in Late Cretaceous that changed to *Nothofagus* rainforest scrub by mid to late Eocene time. Evidence of earliest nearby mountain glaciation in late Eocene time is seen in sand grain textures in the massive sands of the plain. Also at this time, interlayering of clays with channel sands and an increase in marine dinoflagellates signals a relative subsidence of the area to a near sea-level delta plain with tidal inlets.

In late Eocene to early Oligocene, Prydz Bay permanently shifts from being a fluvio-deltaic complex with rainforest scrub to an exclusively marine continental shelf environment. The transition is marked by a marine flooding surface later covered by overcompacted glacial sediments with subglacial sand grain textures that denote the first advance of the ice sheet onto the shelf. No core exists for early Oligocene to early Miocene times, and seismic data are the basis for inferring the transition from shallow to normal depth prograding continental shelf, with submarine canyons on the slope and channel/levys on the rise.

Cores from the continental rise provide evidence of Neogene long-term (m.y.) decrease in sedimentation rate and short-term (Milankovitch periods) cyclicity between principally biogenic and terrigenous sediment supply, due possibly to cyclic presence of onshore glaciers and related changes in ocean circulation. Transitions in mid Miocene time include more-rapid slowing of sedimentation rates, a shift to enhanced IRD, changes in clays and other minerals, and a period of regional erosion of the slope and rise. These transitions are believed due to enhanced glacial erosion of onshore and shelf source areas and reduced input from glacial meltwater as the ice became progressively colder. Further, seismic geometries illustrate that in mid Miocene time depocenters began to shift from the outer continental rise to the base of the continental slope coincident with the initial stages of the erosion and overdeepening (and foredeepening) of the continental shelf. These changes too reflect increasing glacial erosion and sediment distribution.

The transition to greater subglacial activity on the shelf in late Miocene and younger times is reflected in the overcompacted glacial diamictons, subglacial sand-grain textures and bank/trough morphologies of the shelf as well as the massive debris flows in the trough mouth fan of the continental slope. Isotope curves and interlayered diatomaceous sediments of Pliocene sections illustrate further short-term transitions, even during latest Neogene times of clear strong glaciation.

In summary, both short-term and long-term transitions characterize the Cenozoic evolution of the Prydz Bay region from non-glacial to full-glacial paleoenvironments. These transitions are known only from ODP cores. Further insights require additional drilling.

Late Quaternary sedimentation in the northern Western Basin, Ross Sea, Antarctica: seismostratigraphic features and sedimentary properties of calibrated cores

(poster p.)

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The northern Western Basin is a sector of the continental shelf of the western Ross Sea that is considered to be the natural northward extension of the Drygalski Basin by many authors. The literature provides a general model of the evolution of the basin and the recent papers of ANDERSON (1999) and BART et al. (2000) propose a seismic stratigraphy for the post-Miocene sedimentation. However, the sedimentary processes during the Late Quaternary and, in particular, the Last Glacial Maximum (LGM) are still little understood (BRAMBATI et al. 2001).

The preliminary results of the seismic survey (Huntec Deep Tow Boomer, Sub Bottom Profiler 3.5 kHz and 0.2-1 kJ Sparker multi-array 150 dip), calibrated with the on-board data of the sediment cores (magnetic susceptibility and physical properties), permitted us to delineate the morphological and seismostratigraphic features of the first few meters of sediment and to divide the basin into four sectors.

The longitudinal and cross sections of the southern sector of the basin show a morphological threshold at about 73°10'S characterized by several unconformities (up to four evident), and a wide lateral continuity that tapers toward the axes of the basin where a hummocky morphology prevails.

The Central sector has a very articulated morphology with accumulations of non-stratified sediment (diamicton) that rise for 10-20 m and whose widths vary between 100-1000 m. The sedimentary series shows at least three planar unconformities and aggrading deposits within a thickness of about 100 ms (TWT), typical of phases of glacial exaration.

On the outer shelf, starting from the shelf break, we recognized massive hummocky deposits formed by the reworking of the ice front during successive phases of advance and retreat, while the upper slope is characterized by prograding deposits related to successive advances and retreats of the sheet, which often involved consistent gravitative phenomena (ANDERSON 1999, BART et al. 2000, FANUCCI et al. 1993, SPEZIE et al. 1993).

The sequences of gravity cores principally show a constant scarcity of open-sea sediments (diatomaceous-mud) that are sometimes found mixed with diamicton deposits. This process could be imputed to winnowing by bottom currents that actually flow into the northern area.

There are still arguments over the position of the grounding line of the ice sheet in this sector during the LGM, which various authors have positioned at different latitudes and which could be resolved through consolidation tests and radiometric dating of the sediments sampled.

Anderson J.B. (1999): Cambridge University Press., Cambridge, 289 pp.
Bart P.J., Anderson J.B., Trincardi F. & Shipp S.S. (2000): Marine Geology 166: 31-50.
Brambati A., Corradi N., Finocchiaro F. & Giglio F. (2001): In: J.A. Gamble, D.N.B. Skinner, S. Henrys & R. Lynch (Eds.). Antarctic Earth Sciences at the Close of a Millennium, Royal Soc. New Zealand Bull. 35: 365-372.
Fanucci F., Firpo M. & Piccazzo M. (1993): Atti del Convegno "Verso una nuova geografia delle terre polari: sintesi e prospettive".- Mem. Soc. Geol. It., LI, 277-289.
Spezie G., Tucci S., Budillon G., Corradi N., Piccazzo M., Fanucci F., Firpo M., Mirabile L. & Ferrari M. (1993): Annali Facoltà Scienze Nautiche, Ist. Univ. Navale, Napoli, LX.

Seismostratigraphic signature of the West Antarctic Ice Sheet advance during the Late Quaternary on the Little America Basin, eastern Ross Sea, Antarctica

(poster p.)

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The Little America Basin (LAB), the easternmost basin of the Ross Sea, is a difficult area to access due to its sea ice cover. Even if there are models of the Late Quaternary evolution of the West Antarctic Ice Sheet (WAIS) that include this sector, the available data regarding the high- and very high-resolution seismic profiles and sampling are quantitatively inferior to those of other sectors of the Ross Sea. The seismic surveys (Sparker 400 J and Sub Bottom Profiler 3.5 kHz) and the preliminary data on the sediments (magnetic susceptibility) have permitted us to better define the evolution of the sheet in this sector.

Seismic data highlighted differences between the geometry of the deposits along the eastern and western flanks, and differences of internal structure in the northern and southern part of the basin. Seismic lines in the southern sector of the LAB show deposits as glacial till tongues, especially on the western flank, and several unconformities sub-outcropping under thin glacialmarine cover on the eastern flank. The northern sector shows several unconformities and glacial till tongues on the western flank; the outer shelf in this part is characterized by residual glacialmarine deposits.

A dip-oriented seismic profile shows a sedimentary ridge that divides the basin into two sectors, which could be interpreted on geomorphic features and seismic stratigraphy as a grounding zone wedge (ANDERSON 1999). On the outer shelf we recognized an analogous ridge with structures, internal geometry and sedimentary characteristics that could be referred to a more ancient cycle grounding line.

Magnetic susceptibility data confirm the differences between the northern and the southern sectors of the basin and show the increase of diatomaceous sediments (even with glacialmarine compound) to the south.

Anderson J.B., 1999. Cambridge University Press., Cambridge, 289 pp.

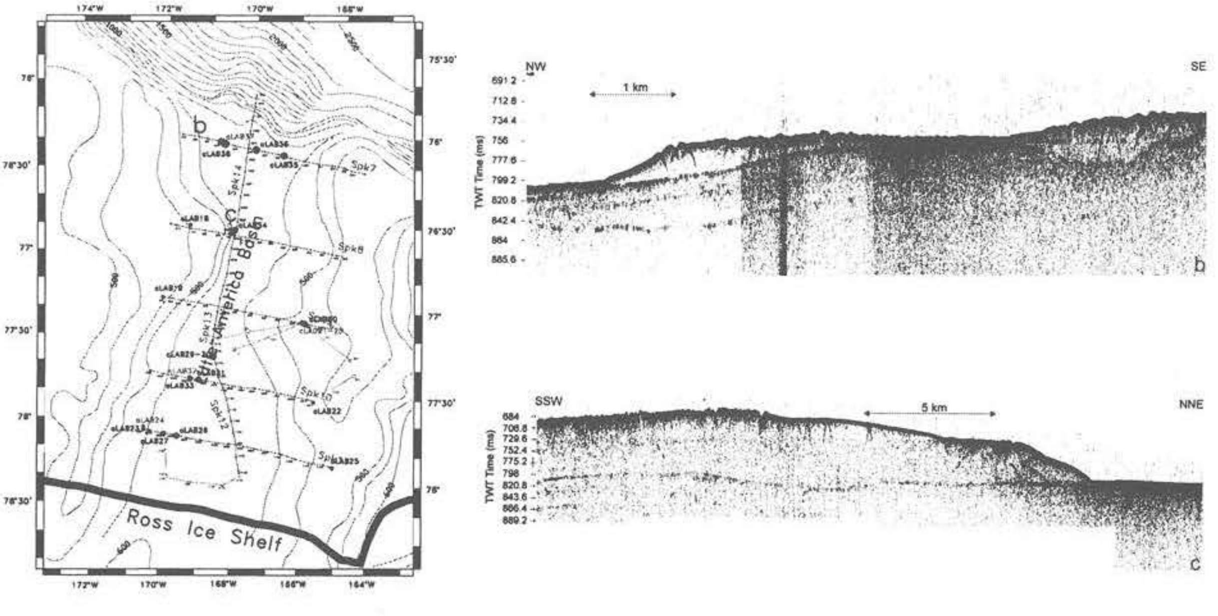

Fig. 1: (a) Bathymetric map of Little America Basin with location of high resolution seismic profiles and core sites; (b) seismic profile of the western flank showing two glacial till tongues; (c) dip-oriented seismic line showing the grounding zone wedge.

Structural evolution of the northern Mawson Escarpment, southern Prince Charles Mountains, East Antarctica

(oral p.)

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This paper presents a summary of key structural observations made along the northern Mawson Escarpment during the Prince Charles Mountains Expedition of Germany and Australia (PCMEGA) in the summer field season 2002-2003. Throughout the northern Mawson Escarpment there exists a strong co-planar relationship between the axial surfaces of F2 folds and the dominant metamorphic foliation (S2). There is also a spatially extensive co-linear relationship between the axes of F1 and F2 folds and a prevalent and marked lineation (L1). These structures are thought to be a sustained tectonic fabric. Between the Rofe Glacier and Lines Ridge there is a gradual and bulk ninety-degree rotation in the common structural trend, from east-west becoming north-south, occurring over a relatively short regional distance of (approx.) 20km. This observation represents a striking alteration to the predominant east-west structural trend that is found throughout the southern Mawson Escarpment (Boger, pers. com.) and Ruker Terrane in general (HOFMANN 1982). The most recently evolved structures are several generations of brittle faults that post-date metamorphism, folding and the youngest granites. They are potentially associated with recent activity of the Lambert Graben.

Hofmann, J. (1982): In: C. Craddock C. (ed.), Antarctic Geoscience. University of Wisconsin Press, Madison, 479-487.

Crevasse propagation along the Sørsdal Glacier margin, East Antarctica

(poster p.)

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Recent observations of crevasses, and crevasse traces, made along the northern Sørsdal Glacier margin provide a pragmatic groundwork for understanding their evolution. During three Antarctic summer field seasons, spanning 2000-2003, study sites amenable to conducting glaciology work were selected and annually monitored using high-precision GPS surveying. The determined velocity fields verify that the structures are propagating through a region of simple shear and that their ultimate trends, measured from the oldest crevasse traces, are parallel to this at any time. At the most evolved study site, and farthest upstream, the glacier surface is found to exhibit well-developed laminar flow traces with prominent microstructures and c-axis fabrics. Throughout, progressive shear flow is clearly marked by the vast stages of crevasse trace rotation and transposition. These observations, coupled with the workable positional data, allow the nature of infinite shear strain in a glacial environment to be scrutinised and offer a powerful analogue for understanding shear zone geometries in rock terranes. Results are presented and discussed.

Maastrichtian palaeoenvironments of Antarctica

(oral p.)

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Recent improvements in the quality of stratigraphic correlations have established that an extremely thick sequence of latest Cretaceous marine sedimentary rocks is exposed in the James Ross Basin, north-eastern Antarctic Peninsula. Indeed, this region has now become one of crucial importance within the Southern Hemisphere for the study of Late Cretaceous palaeoenvironments and the sequence of events leading up to the K-T mass extinction.

With the Campanian-Maastrichtian boundary established on the basis of strontium isotope stratigraphy, it can be demonstrated that the Antarctic Maastrichtian section is 1400 m thick. It comprises essentially fine-grained, volcaniclastic sediments but there is both lithological and faunal evidence to demonstrate a pronounced shallowing-upwards trend. Faunal assemblages preserved within both the Snow Hill Island and López de Bertodano formations are of high abundance but low taxonomic diversity. This may in part be a reflection of comparatively low palaeotemperatures, and an intriguing recent suggestion is that two basin-wide unconformities may be of glacioeustatic origin. There is also a combination of sedimentary and faunal evidence to indicate the periodic imposition of low benthic oxygen levels throughout the Maastrichtian. Our strontium isotope stratigraphy is helping to establish the exceptionally early extinction patterns shown by certain ammonite, belemnite and bivalve taxa. It is likely that they were progressively expelled from the relatively cool, shallow, high-latitude ocean into the warmer and deeper waters of the Tethyan Ocean. Nevertheless, it can be demonstrated that the stratigraphic ranges of a number of other marine invertebrate and vertebrate taxa were abruptly terminated at the K-T in Antarctica, where there was a small but pronounced mass extinction event. This unique locality is providing new insights into how biotas and environments changed in high palaeolatitudes at the end of the Mesozoic era.

Polar biodiversity: an historical perspective

(oral p.)

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The polar regions constitute one of the great biomes, or natural biogeographic regions, on the surface of the Earth. In comparison with the lower latitude or tropical regions they appear to be characterised by far fewer types of plants and animals, and we have grown used to the concept of a lush tropics in which life proliferates and comparatively barren poles in which it is in some way impeded. To many, there appear to be higher rates of evolution in the tropics than at the poles.

And yet as we have come to learn more about the polar regions this view has been significantly called into question. This is particularly so in the marine realm and in the Antarctic, where some rich assemblages of marine organisms have been reported from areas such as the Weddell and Ross Seas. Recent studies suggest that some assemblages of Antarctic marine invertebrates have just as many species as those from much lower latitude localities. Palaeobiologists have also started to ask how long the diversity imbalance between the tropics and the poles may have been in existence. Was there a latitudinal diversity gradient during periods of greenhouse warmth such as the Cretaceous, or is it a more recent feature associated with Cenozoic global climatic deterioration ?

As we attempt to solve such problems some intriguing patterns are coming to light. For many living groups of organisms there does indeed seem to be a gradient of decreasing taxonomic diversity with increasing latitude, but patterns in the Southern Hemisphere can be very different to those in the north. There are indications of latitudinal gradients from at least the Late Palaeozoic onwards but these are on nothing like the scale of those seen at the present day. At some time during the Cenozoic era, and possibly as recent as 10-15 m.y. ago, there was a pronounced pulse of global diversification.

Not all of the Cenozoic phase of global diversification was concentrated in the tropics. In the Antarctic a number of marine taxa appear to have radiated at comparatively high rates under the cold but constant environmental conditions; some major groups did indeed become extinct but this could just as well have been a gradual as rapid process. In comparison, the Arctic remained land-locked for much of the Cenozoic and has only recently become a met importer of taxa from the northern Pacific Ocean. The major patterns of life on Earth are not as simple as was once thought and the polar regions are providing key insights into macroevolutionary processes on the grandest of geographical scales.

Geomorphologic mapping by airborne laser scanning in southern Victoria Land, Antarctica

(oral p.)

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High-resolution, precise surface elevation data were mapped by NASA's Airborne Topographic Mapper (ATM) laser altimetry system over several sites in southern Victoria Land in December, 2001. The ATM surveys were conducted as part of a joint project of NASA and NSF to evaluate the potential of laser altimetry for topographic mapping in the Antarctica and to survey calibration/validation sites for the NASA ICESat (Ice, Cloud and Land Elevation Satellite) mission. Airborne laser altimetry (also called LIght Detection And Ranging or LIDAR) has been established as one of the most valuable tools in mapping surface topography and monitoring surface elevation changes of glaciers. Estimates of thickening and thinning rates measured by airborne lasers have been used to assess the mass balance of the Greenland and Antarctic ice sheets and alpine glaciers around the world. The main goal of the program presented here is to assess its potential for mapping glacial and tectonic geomorphology in the Antarctic polar environment.

The ATM system combines high-pulse laser ranging with a scanning capability. The laser is operated in the blue-green spectral region and its beam is directed toward the surface by a nutating mirror producing a set of overlapping spirals of data points as the aircraft moves forward. The data processing starts with combining the position and attitude of the platform with the laser range to compute the position of the laser footprints on the ground. After the removal of the outlier observations the irregularly distributed data set is interpolated into a regular grid with 2-4 meter resolution. This paper provides an overview of the Antarctic ATM mapping mission and the data processing, including questions of outlier detection, interpolation, feature extraction, data fusion and visualization of laser scanning data.

Results from the mapping of the Dry Valleys and the Cenozoic volcanoes around southern McMurdo Sound will be used to illustrate different geomorphic applications. Shaded relief DEMs depict micro-topography that reflects the processes shaping the Earth's surface. Information about the past history of glaciers can be inferred from surface topography. Glacio-geomorphologic features (e.g., trimlines, terminal moraines, meltwater channels) left behind as glaciers receded provide valuable, and often the only, information about past glacier extent. The shape of permafrost features, such as the striking circular, labyrinthine, polygonal and striped patterns of stone and soil, can reflect the presence, thickness and nature of subsurface ice. Linear fault traces, etched by erosion, can be mapped across bedrock terrain. In volcanic regions, the morphological shapes of volcanic cones can be used for structural mapping. Detailed information on the ellipticity, the symmetry of maximum/minimum elevation points, and the position of breaches on cone rims yield information on the geometry of underlying magmatic fissures and/or of faults that controlled ascent and emplacement of volcanic materials. Only locations and general cone shape are possible to map from imagery (aerial photos, Landsat, SPOT). The detailed topographic information from the LIDAR data makes it possible to quantify morphologic parameters of volcanic cones around Mt Discovery and Mt Morning and thus to obtain information on the structural kinematics and dynamics of the southern McMurdo Sound region in the late Cenozoic.

Tectonic inferences from Jurassic dyke swarms and alkaline pluton emplacement in western Dronning Maud Land

(poster p.)

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Western Dronning Maud exposes widespread hyperbyssal and local alkaline pluton rocks related to the initial break-up of Gondwana. We report on recent fieldwork (austral summers 2000/01 and 2002/03) in the Alhmannryggen and Straumsvola ranges, which lie to the west and east of the Jutulstraumen ice stream, which is considered to flow along a potential Jurassic age rift. Over 400 dykes were recorded throughout the region and fabrics within the Straumsvola nepheline syenite mapped.

Two alkaline plutons are exposed on the eastern margin of the Jutulstraumen ice stream where they intrude Neoproterozoic gneisses of the Jutulrøra Formation. Straumsvola and surrounding nunataks are the remnants of a 5 km diameter nepheline syenite complex (174 ±4 Ma, GRANTHAM et al. 1988), whilst Tvora is the centre of a smaller quartz syenite. Straumsvola pluton is formed of two significant units: a compositionally homogeneous outer zone syenite, and a layered inner zone, characterised by at least 66 layers of alternating abundances of alkali feldspar or mafic minerals (HARRIS & GRANTHAM 1993). Several examples of gravity-emplaced blocks of outer zone syenite were identified within the layered syenite, suggesting that the outer zone syenite unit formed the roof as well as the observed margins of the pluton. Our mapping revealed the presence of a generally ESE-trending, moderately inclined magmatic foliation within the outer zone syenite, with rare, locally developed pre-RCMP sinistral shear zones parallel to the southern pluton margin. Toward the centre of the pluton a zone of NE-SW trending, sub vertical, magmatic foliation was identified, with locally developed fabrics suggesting this foliation may be a product of extensional shear. At Tvora a NNW-trending magmatic fabric is variably developed parallel to the exposed and inferred pluton margins, with a strike swing to WNW-trend present within the centre of the pluton.

Both plutons, and the country rock within 20 km radius (study area), are intruded by a large number of dykes ranging in composition from dolerite to phonolite, microsyenite to lamprophyre. In exposures of the Jutulrøra Formation, the dyke swarm is dominated by NNW to N-trending dolerite dykes (90 % doleritic), that are crosscut by a subordinate suite of WNW-dykes, commonly pegmatitic but also doleritic in composition. Within the Straumsvola pluton dyke orientation and composition is more variable (dolerite 63 %, intermediate/felsic 20 %, phonolite 13 %, pegmatite 3 %), with a general NE-trending dyke suite dominating a NNW-trending dolerite dyke suite. Dyke population statistics reveal that mean dyke thickness decreases from Jutulrøra toward Straumsvola pluton (64-44 cm), suggesting that the dolerite dykes at least may not be sourced from Straumsvola.

Stepped dykes within the dyke suites were used to calculate mean dilation directions for the swarms. This technique revealed two distinct dilation directions: NW-SW (119-299°) and NE-SW (060-240°). The 119-299° dilation direction is very similar to that derived from dykes within the Alhmannryggen (133-313°), which is roughly perpendicular to the potential rift along the Jutulstraumen, as well as the steep zone of magmatic foliation within the nepheline syenite pluton, suggesting these magmatic bodies were emplaced during a regional extensional event consistent with potential two stage Gondwana break-up models (COX 1992, GRANTHAM 1996). The Straumsvola nepheline syenite may have been emplaced on the flanks of the Jutulstraumen rift within a releasing bend of a sinistral fault which acted as a transfer fault.

Cox, K.G. (1992): Magmatism and causes of Continental break-up.- In: B.C. Storey, A. Alabaster & R.J. Pankhurst (eds.). Geol. Soc. London Spec. Publ. 68: 165-184
Grantham, G.H., Groenewald, P.B. & Hunter, D.R. (1988): South African J. Antarct. Res. 18: 2-10.
Grantham, G.H. (1996): Weddell Sea Tectonics and Gondwana Break-up.- In: B.C. Storey, E.C. King & R.A. Livermore (eds.). Geol. Soc. London Spec. Publ. 108: 36-71
Harris, C. & Grantham, G.H. (1993): Geol. Mag. 130: 513-532.

Characterization of A-type granitoids occurring in east Mühlig-Hoffmannfjella ranges, central Dronning Maud Land, East Antarctica

(oral p.)

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The Mühlig-Hoffmann (MH) range is part of the continuous mountain chain exposed off the coast of central Dronning Maud Land (cDML), East Antarctica. cDML is characteristically a polydeformed and polymetamorphosed metamorphic and magmatic terrain. The post-tectonic Pan-African magmatic activity manifested by granite-syenite-charnockite-monzodiorite (granitoids) is the most dominant lithological unit exposed in the Wohlthat-Orvin-Mühlig-Hoffmann ranges of cDML. The granitoids exposed in the eastern part of MH form the basis for present studies.

A close association between granite and charnockite was observed in the area. A closely studied outcrop indicated visible textural continuity in the patches of granites and charnockites exposed on a single face. There is no structural plane like joints or pegmatite/aplite vein controlling the distribution of granite and charnockite on this face. Outcrops of granite and charnockite in other parts of the area are, however, segregated on a larger scale. Undigested rafts of migmatite gneiss, banded biotite gneiss and charnockitic gneiss are present along the north eastern and southern fringe of the area. The MH granitoids dominantly reflect subsolvus characteristics. Hypersolvus nature is indicated in two samples. The thin sections studied suggest compositional variety from granite-syenite-charnockite to monzodiorite. The felsic minerals present are mainly K-feldspar, perthite and plagioclase (antiperthite) with varying amount of quartz. Myrmekite intergrowth along rim of phenocrysts of K-feldspar and plagioclase is very common. Mafics are generally clustered together which are dominantly biotite, hornblende, magnetite and ilmenite in granitic part. Orthopyroxene with ferrosilite, fayalite and clino-pyroxene with biotite and hornblende are the ferromagnesian minerals present in charnockite along with magnetite and ilmenite. The monzodiorite is also very coarse-grained porphyritic containing plagioclase and K-feldspar phenocrysts associated with biotite. Zircon and apatite constitute dominant accessory phases present in all the units.

The SiO_2 wt.% varies between 60 to 70 % in the MH granitoids. The rocks are potassic to ultrapotassic and meta to peraluminous with Al_2O_3 content between 13 to 15 wt.%. Features like high total alkali, high FeO/FeO+MgO, low CaO and MgO, high TiO_2/MgO, high concentration of HFSE like Zn, Zr and Y are characteristics of A-type nature of these granitoids. These rocks are enriched in incompatible elements like Ba, Rb, Sr and also have some amount of Cl. The major and trace element characteristics of MH granitoids are also comparable with C-type granites. However, these granites have a high Fe/Mg ratio and contain fayalite and hence are grouped as A-type granitoids.

The proposed petrogenetic model for MH granitoid involves partial melting of charnockite-granodioritic upper mantle or lower crust under dehydrated condition. The magma generated was enriched with volatile F and Cl. The ascending magma was emplaced at mid crustal level where it also interacted partially with the resident crustal material introducing localized compositional ambiguity. The magma in the magma chamber subsequently became H_2O saturated. This liquid then enriched with volatiles invaded the crystallizing magma at mid crustal level altering selective parts of charnockite to granite.

The Bransfield Basin and Cordilleran orogennesis

(oral p.)

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Tectonic uplift of the Andean Cordillera was initiated in the mid-Cretaceous with inversion of a composite marginal basin along 7500 km of the continental margin of South America, from Peru to Tierra del Fuego and the North Scotia Ridge. In the southernmost Andes, from 50-56°S, the quasi-oceanic floor of this basin is preserved in the obducted ophiolitic rocks of the Rocas Verdes (Green Rocks) Basin. We suggest that the basin beneath Bransfield Strait, 61-64°S, separating the South Shetland Islands from the Antarctic Peninsula, constitutes a modern analog for the Rocas Verdes Basin.

Marine geophysical studies of Bransfield Basin have been undertaken over the past 12 years by the Institute for Geophysics, University of Texas at Austin, under the auspices of the Ocean Sciences Division and US Antarctic Program, National Science Foundation. These studies have elucidated the structure and evolution of Bransfield Basin for comparison with the Rocas Verdes Basin, with a view to eventual forward modeling of the evolution of a hypothetical cordilleran orogen by compression and inversion of the basin. These are the processes that can be observed in the tectonic transformation of the Rocas Verdes Basin into the southernmost Andean cordillera, as South America moved rapidly westward in an Atlantic-Indian ocean hot-spot reference frame during the mid-Cretaceous.

Multi-channel reflection seismic data from the Bransfield Basin reveal an asymmetric structural architecture characterized by steeply-dipping normal faults flanking the South Shetlands island arc and gently dipping listric normal faults along the Antarctic Peninsula margin. Normal fault polarity reversals appear to be related to distributed 10 ci of magmatic activity within the basin. This architecture is remarkably similar to that deduced from field structural studies of the Rocas Verdes Basin. Notably, the oceanward-dipping, low angle normal faults along the Antarctic Peninsula margin constitute ideally oriented surfaces for reactivation as thrust faults, leading to obduction of the basin floor rocks during any ensuing compressional event.

Seismic refraction studies of Bransfield Basin using Institute for Geophysics ocean bottom seismographs indicate along-strike northeastward thinning of the crust associated with southwestward rift propagation, comparable to that indicated for the Rocas Verdes Basin by the results of U-Pb zircon dating ofthe ophiolitic rocks. Cross-strike segmentation of Bransfield Basin also mirrors the isolated ophiolitic complexes of the inverted Rocas Basin in South America and on South Georgia Island.

The results of our geophysical studies of Bransfield Basin reveal close similarities in structure and evolution with the Cretaceous Rocas Verdes Basin, and therefore encourage the next step of forward modeling in an effort to help elucidate fundamental cordilleran orogenic processes.

Aeromagnetic anomaly investigation over East Antarctica from northern Victoria Land to George V Land

(poster p.)

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As part of the joint 1999-2000 German-Italian GANOVEX VIII-ITALIANTARTIDE XV Antarctic campaign, an integrated geophysical dataset including aeromagnetics, magnetic susceptibility, ground-based gravity, airborne radio-echo sounding, geomagnetic depth sounding and passive seismology was collected (BOZZO & DAMASKE 2001) over northern Victoria Land, Oates Land and George V Land. The aim was to provide new constraints upon crustal and lithospheric structure and tectonic evolution for this part of East Antarctica. This key region includes the northermost segment of the Transantarctic Mountains and, within its "backside", the northernmost edge of the enigmatic Wilkes Subglacial Basin.

Here we focus upon some results of the aeromagnetic survey. The complete coastal region from Mertz Glacier to Yule Bay spans a length of approximately 1000 km. It was surveyed for the first time using the "Polar Duke" vessel as a mobile base. The helicopter-borne survey was flown with a profile spacing of 4.4 km and tie lines 22 km apart. Survey altitude was at a constant barometric level within the individual sections. For the Lillie Glacier area the altitude was 2730 m; the Oates Coast section was flown at 1715 m. West of the Matusevich Glacier the survey level is 1425 m. Altogether 26,575 km of usable data on lines were collected over an area of 83,800 km^2. The aeromagnetic data were processed by applying base station corrections, differential GPS, IGRF removal, and statistical levelling procedures.

The magnetic anomalies over the Lillie Glacier, Oates Coast and George V Coast survey sections provide insight into geology of the region. Over the Robertson Bay Terrane or Zone (FINN et al. 1999), the Admiralty Intrusives of the Everett Range and of Yule Bay show contrasting magnetic signatures. Just offshore Yule Bay, a near-circular magnetic anomaly overlies Unger Island and Surgeon Island.

It reveals a mafic(?) intrusion beneath this enigmatic Ross-age crustal fragment (FIORETTI et al. 2002). Over the Wilson Terrane or Zone the most outstanding feature of the Oates Coast map, is a linear magnetic anomaly over the Matusevich Glacier. This anomaly might reflect Ross-age arc rocks emplaced along the Exiles Thrust Fault System (FLÖTTMANN & KLEINSCHMIDT 1991, FERRACCIOLI et al. 2002). Just west of the Matusevich Glacier, a high-amplitude circular anomaly shows the extent of the Archangel Nunataks gabbro. Two broad positive anomaly complexes are imaged in the George V Coast area, which is almost entirely devoid of outcrop. One is located along the inferred north-easternmost edge of the Wilkes Subglacial Basin, over the Mawson Peninsula, and SCAR Bluffs area. It may be caused by a buried Jurassic mafic intrusion, similar to the one interpreted from TAMARA aeromagnetics 1000 km further south (BEHRENDT et al. 2002). The second anomaly complex is located between Mertz and Ninnis Glacier. The trend of this anomaly is parallel to a major fault imaged from seismic data offshore (DE SANTIS et al. 2002). Along the northern edge of the Wilkes Subglacial Basin, high-frequency linear anomalies suggest that Ferrar sills and dykes may not be restricted to the Transantarctic Mountains. This new interpretation is consistent with magnetic modelling results along the ITASE traverse from Terra Nova Bay to Dome C (FERRACCIOLI et al. 2001).

Behrendt J.C., Damaske D., Finn C.A., Kyle P. & Wilson T.J. (2002): J. Geophys. Res. B8: 10.1029/2001JB000376.
Bozzo E. & Damaske, D. (2001): Terra Antartica Rep. 5: 109 pp.
De Santis L., B. Brown & G. Brancolini (2002): Workshop Scienze della Terra in Antartide, Siena: 47.
Ferraccioli F., Coren. F, Bozzo E., Zanolla C., Gandolfi S., Tabacco I. & Frezzotti M. (2001): EPSL 197: 407-421.
Ferraccioli, F., E. Bozzo & Capponi G. (2002): Geophys. Res. Lett. 29(10): 10.1029/2001GL014138.
Finn C., Moore D., Damaske D. & Mackey T. (1999): Geology 27: 1087-1090.
Fioretti A.M., Capponi G., Black L.P., Varne R. & Visona' D. (2002): Gondwana 11.
Flöttmann T. & Kleinschmidt, G. (1991): Geology 19: 45-47.

Quartz grain surface textures as indicators of transport and depositional mechanisms in glacial marine sediments under the McMurdo/Ross Ice Shelf, Windless Bight

(oral p.)

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Many studies on glacial marine sediments have established that provenance, processes of erosion and transport, and depositional environment all influence quartz grain morphoscopy and surface texture. With this in mind quartz grains sampled from recent marine sediments from beneath the McMurdo, Ross Ice Shelf in Windless Bight were analysed to extract information on provenance and sedimentary processes.

This study is part of a New Zealand, German, USA and Italian research program. During the 2003 Antarctic campaign two 60-cm-wide holes were drilled through the ice shelf (70.5 m thick at Site 1 and 143.7 m-thick at Site 2) using a hot water drilling system. Water depth was around 920 m at both sites and cores over 60 cm long were collected from each site.

Quartz grains have been sampled from Site 1, which probably represents the longest time interval based on lithology and preliminary smear slide observations. Different stratigraphic units have been recognized from visual description and each of them has been sampled. Abrasion and corrosion features on quartz grains have been observed at magnification obtainable with scanning electron microscope (SEM) in the secondary electron mode.

Quartz grains present a great variety of surface textures which reflect several transport and depositional mechanisms. Four typologies are recognised, representing aeolian, glacial, glacio-fluvial and marine environments. The top layer of the core is characterised by a low biogenic content and a high quartz content; quartz grains from aeolian environment are more abundant than quartz grains with characteristic of glacio-fluvial and marine transport. In the central part of the core, characterise by low biogenic and quartz content, quartz grains from a glacial environment are dominant. The lower part of the core is characterised by the absence of biogenic material and a low quartz content. Here quartz grains from glacial environment and, subordinately, from an aeolian environment are present. The bottom part of the core is characterised by the absence of biogenic material and a high quartz content. Here quartz grains with textures typical of glacio-fluvial and marine transports are dominant.

These preliminary results underline different sedimentary processes of transport and deposition under the McMurdo-Ross Ice Shelf. Further studies are needed to better constrain the past changes in the sedimentary environment linked to the ice shelf dynamic.

The subice topography of the Matusevich Glacier area, Oates Coast, East Antarctica

(poster p.)

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Ice sheet sensitivity to climate and sea level forcings and the associated changes in Antarctic ice volume are best investigated around the margins of the ice sheet. The circum Antarctic outlet glaciers are of special importance since their response time to any change of the climatic conditions is short compared to that of the ice sheet. Mass balance studies of major outlet glaciers allow to estimate past and future responses of the Antarctic ice sheet to environmental changes. The calculation of volume changes needs a comprehensive database about the glacier volume, i.e. ice thickness data, supplemented by flow velocity data and all input and output data (accumulation, ablation, basal melting etc.). A high resolution airborne ice thickness survey was done along the Oates Coast within the German expedition GANOVEX VIII in 2000. The target region in Oates Land is characterized by the drainage area of the Matusevich Glacier, which is one of the major outlet glaciers in the area. It follows the contact zone between the Ross Orogen and the East Antarctic Craton which is represented by a deep morphological structure extending far inland. The radar data were acquired with the helicopter operated pulse radar of BGR in a coastal strip of c 120 km width between 154-159°E. The polar plateau reaches altitudes of up to 1500 m in the south-west at 70°S. A dense survey grid with a line spacing of 20 km covers about 20,000 km^2 south of the Matusevich Glacier up to about 150 km inland. About 120,000 data points of ice thickness were acquired along flight tracks with a total length of 2500 km. The glacier thicknesses range from a few hundred meters to more than 2500 m. The ice thickness data provide the base for mapping the bedrock topography and mass balance analysis.

In February 2002 the 80 km long Matusevich Glacier tongue broke up and disintegrated forming the iceberg C-17 with an area of 150.84 km^2. A future increase in glacial surge is expected following this collapse according to the theory that ice shelves and glacier tongues act as dams preventing inland glaciers from slipping into the sea. The high resolution ice thickness data and additional flow velocities based on radar interferometry provide the base to verify this theory.

The lithosphere beneath the ice: seismic tomography of the Antarctic upper mantle
(poster p.)

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Tomographic analysis of seismic surface waves is a powerful tool for imaging the deep structure beneath continents and oceans. Lateral variations of Love and Rayleigh wave speed, at different periods, can be related to changes in S-wave velocity in the crust and the mantle, which in turn can be ascribed to the compositional or thermal structure. This approach is particularly valuable for Antarctica, not only because of the ice cover, but also because of the inaccessibility of the continental interior. Other seismic tomographic approaches, such as those based on body waves, need in fact a denser distribution of seismographic stations and earthquakes, and are not currently suitable to application to the Antarctic plate, where instead significant seismicity is concentrated on the plate boundary, and seismographic stations are located at the continental edge or on ocean islands.

We invert a composite dataset of fundamental mode surface wave dispersion measurements, composed by a global set of phase velocity measurements, taken from EKSTRÖM et al. (1997), and complemented for the Antarctic plate by our own regional-distance group velocity measurements for events and stations located at latitudes below 20°S. Our regional group velocity measurements are taken on shorter paths, and for additional Antarctic stations, than the global measurements, thus adding resolution in the region of our interest. Group velocity measurements are taken at different periods following a classical multifilter and phase matched filtering technique. Global phase dispersion curves are translated into group velocity dispersion curves, and then added to the database. The resulting set has a good global coverage, with increased path density in the Antarctic region. This data set is then inverted to compute dispersion maps at discrete periods, ranging from 30-150 s. Two dimensional group velocity maps are then nonlinearly inverted for the vertical velocity structure, to give the 3D shear-wave velocity field in the top few hundred km of the upper mantle (similarly to the study by DANESI & MORELLI 2001). The a priori crustal structure is taken from BASSIN et al. (2000).

The main features of the tomographic model can be related to surface geology. From the top of the upper mantle to at least 150 km depth, intense negative anomalies mark the oceanic ridges around the continent. They progressively decrease in amplitude, and vanish at about 180-200 km depth. Only few slow anomalies can be followed with confidence below 150 km in the Ross Sea Embayment and Marion Triple Junction. An extended area in West Antarctica is characterized by a broad low velocity pattern down to below 150 km, beneath the rift system and beneath active volcanic centers in Marie Byrd and Victoria Land. The East Antarctic Craton has deep, cold, roots evident in all maps, reaching a depth of 200 km: a sharp border marks the boundary between East and West Antarctica following the Transantarctic Mountains.

Danesi, S. & Morelli, A. (2001): Geophys. Res. Let. 28: 4395-4398.
Ekström, G., Tromp, J. & Larson, E.W.F. (1997): J. Geophys. Res. 102 (B4): 8137-8157.
Bassin, C., Laske, G. & Masters, G. (2000): EOS Trans 81: F897.

The mantle signature of the Antarctic rift system imaged by seismic waves
(poster p.)

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Surface waves provide important information on the structure of the Earth's upper mantle. Although they usually do not allow such high detail as body wave travel time studies, they sample the shallow part of the mantle along the whole path from the source to the seismograph, and can therefore be profitably employed to retrieve Earth structure in areas with low seismicity, and sparse coverage of stations, where body wave studies would not instead be very useful. The Antarctic Plate represents such an instance. The extremely low seismicity of Antarctica, besides being a limiting factor for tomographic studies, also presents a challenge to the understanding of the neotectonics of a continent, composed by a Precambrian craton and Cenozoic accreted terrains and crossed by the largest continental rift structure. This extensional structure, combined with the mostly spreading mid-ocean ridges bordering the plate, produce an apparent geodynamic paradox. We present and interpret results from measurements and inversion of a large dataset of fundamental model Rayleigh and Love wave group and phase dispersion curves (DANESI & MORELLI 2001, EKSTRÖM et al. 1997) resulting in a 3D model of shear-wave velocity in the upper mantle under the Antarctic Plate. Among other remarkable features, the Antarctic rift system has a clear signature in our tomographic maps.

Tomographic maps are usually displayed plotting lateral variation of seismic velocity, in our case: shear wave velocity, at different depths. Wave velocity is affected by several factors, such as chemical or mineralogical composition, temperature, water content, partial melt, but at mantle depths temperature is the main responsible for the lateral variations imaged on our maps. The broad low seismic velocity area that characterizes the upper mantle beneath West Antarctica may then be attributed to higher temperatures than the neighboring cold roots underlying East Antarctica. Although not so strong as the low velocity connected to mid-ocean ridges, where, in fact, presence of partial melt may significantly decrease S-wave velocity, a clearly defined slow anomaly expands to the (conventional) west of the Transantarctic Mountains (TAM). The lateral temperature gradient between East and West Antarctica, down to 150 km in the mantle, appears to be very strong. This sharp margin between colder and hotter rock is marked by the TAM shoulder. Beneath the Ross Sea and, more limitedly, Marie Byrd Land, the slow velocity feature shows stronger values, and reach the depth of 200 km, our data loose resolving power below. This warmer mantle, which we can estimate to be some 300°C hotter than average, should presumably be responsible for a high heat flow to the surface.

It is usually rather difficult to quantify the reliability of tomographic maps, because they are based on a number of simplifying assumptions, whose effect on a specific instance is very complex to test. Besides the formal error assessment of the inversion, based on calculation of an a posteriori covariance matrix, we also do a number of tests to ascertain the robustness of our results. Although the resolution achievable by the current seismic path distribution does not allow us to put full reliance on the finer details, we can nonetheless conclude on the confidence of the main features of the model. Use of a more general theoretical framework, currently under implementation, will presumably enable us to improve reliability of details.

Danesi, S. & Morelli, A. (2001): Geophys. Res. Let. 28: 4395-4398.
Ekström, G. , Tromp, J. & Larson, E.W.F. (1997): J. Geophys. Res. 102 (B4): 8137-8157.

A rifting model for the Victoria Land Basin in the McMurdo region
(poster p.)

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Seismic reflection data from the McMurdo Sound region and drill core data have been used to define the rifting history of the Victoria Land Basin (VLB). Angular unconformities within the seismic sequences demonstrate that several subsidence or uplift events have occurred during the formation of the VLB. As the VIB lies against the Transantarctic Mountains (TAM), the two tectonic features are usually considered to be related. However, there is a marked difference in timing between the onset of the two events, the TAM commenced its major uplift at 55 Ma, whereas drilling off Cape Roberts indicates that the VLB commenced subsiding at about 34 Ma.

The initial tectonic subsidence of the western margin of the VLB has been estimated from the physical properties and ages of the sediments in drillcore from the recent Cape Roberts Project. Between 34 Ma and the present, two main trends are detected, a fast subsidence of about 140 m/m.y. from about 34 Ma to 32.5 Ma, and a slower period of subsidence of about 23 m/m.y. from 32.5 Ma to 21 Ma. The seismic stratigraphy along several seismic reflection profiles further east across the VLB show that the sequences younger than about 20 Ma are also tilted and eroded, and that a significant amount of the sediments deposited into the basin is younger than 20 Ma. These data suggest that several episodes of fast extensional tectonics and associated subsidence also occurred in and after Miocene time. In the western part of the VLB, uplift events of the order of a kilometre as well as subsidence events of the order of several kilometres may have occurred. Back stripping modelling of a seismic profile across the basin has estimated the amount of stretching and the tectonic subsidence that occurred during this phase. Preliminary results indicate a pre-existing depressed region coincident with the VLB at the start of extension in about Eocene/Oligocene time.

Bathymetry of the Ross Sea region
(poster p.)

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A new bathymetric map of the Ross Sea region has been prepared based on multibeam and single channel bathymetric data. The multibeam data has given unprecedented detail of some of the features of the shelf and slope, allowing the detection of detailed, presumed volcanic features off Cape Adare, the definition of a complex array of small, presumed scour, channels over large areas of the shelf, and the development of submarine canyons down the continental slope. The map shows the main north to northeast trending broad ridges and channels across the Ross Sea shelf as has been delineated before (e.g. DAVEY 1995), however, the features and the consistency of structures, e.g. the very linear eastern margin of the ridge along 180°, are defined in more detail. There are still significant gaps in data coverage, particularly the lower continental slope and rise off eastern Ross Sea, where year round ice cover precludes detailed survey coverage and accurate satellite imaging.

Davey, F. J. (1995): Map 1a in Geology and Seismic Stratigraphy of the Antarctic Margin.- In: A.K. Cooper, P.F. Barker & G. Brancolini (eds.). Antarctic Res. Ser. 68, AGU, Washington D.C.

An update on geophysical observatory operations at Scott Base and Vanda, McMurdo Sound, Antarctica
(poster p.)

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Geophysical Observatories are operated at Scott Base (77°51'11"S, 166°45'22"E, elevation 38 m) and in the Lake Vanda region of the Dry Valleys (77°31'01"S, 161°51'11"E, elevation 151m). Tide gauge observations are made at Cape Roberts, western McMurdo Sound.

The present seismological instrumentation (3-component broad band and vertical short period borehole seismometers with high resolution digital data acquisition system) at Bull Pass near Lake Vanda (VNDA) is now operated by Ratheon Ltd on behalf of the Comprehensive Test Ban Treaty Organization in Vienna. Data are telemetered via Mount Newall direct to McMurdo Station and then through to the USA. VNDA is a CTBT primary station. The data are also archived by IRIS Data Management Center (DMC) and data windows are rapidly available via the IRIS SPYDER system. The instrumentation at Scott Base (SBA) comprises a broadband Streckeisen STS-2 seismometer operated by New Zealand for USGS. Digital data are also archived by, and available from, IRIS DMC. SBA is a Global Seismograph Network station.

The geomagnetics instrumentation at Scott Base comprise a 3-component digital fluxgate magnetometer, designed and constructed in New Zealand for GNS and predecessor organisation, with calibrating absolute measurements using a DIM and proton magnetometer. It is one of the INTER-MAGNET observatories delivering near real time 3-component variation data.

Continuous tidal gauge measurements are made at Cape Roberts for Land Information New Zealand (LINZ). A continuous recording GPS station is under consideration for deriving absolute tidal heights.

Subglacial morphology and structural geology along 150°W between the Transantarctic Mountain front and the South Pole, Antarctica: new data from an airborne ice-penetrating radar survey
(oral p.)

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The Transantarctic Mountains (TAM) form the high boundary between the subsided and extended crust in the Ross Sea Embayment known as the West Antarctic Rift System (WARS) and the East Antarctic Craton. The objectives of this study are to characterize the subglacial bedrock morphology of the southern TAM and to define the structural geology along the southern TAM front through analysis of airborne ice-penetrating radar data.

The airborne data were collected by the Institute for Geophysics. The survey was 850 km (N-S) x 130 km (E-W) and flown at a constant elevation of ~3400 m, extending from Ice Stream A to the South Pole along 150°W between the Scott and Reedy Glaciers. Approximately 15,000 line km were flown and data processed. Ice-penetrating radar antennae were mounted on the wings of a twin engine aircraft equipped with precise positioning and an interdisciplinary geophysical platform. The radar transmits a 250 ns pulse 12,500 times per second. Echoes from each transmission are digitized at a 16 ns sample interval with 2048 of these digitized sweeps stacked to form a single record. The resulting trackline sampling distance between these records is approximately 12 m.

Seismic migration processing methods were applied to incoherently detected and differentiated radar sounding records to correct the observed slope of the bed surface and preserve 'true' angular relationships for detailed morphological and structural analyses. Subsequently, the ice and bedrock surfaces were picked along each line and combined with the known geology, compiled from various sources, for structural interpretation.

Four distinct morphological provinces are identified along the length of the survey based on bed surface elevation analysis. These include: 1) a polar basin and plateau region with low relief features and thick (~3 km) ice cover; 2) an area of alpine glaciation with well-preserved U-shaped valleys that show a glaciation network that flowed opposite (southward) of contemporary glaciers; 3) the TAM massif, which includes three subglacial blocks and the subaerial part of the TAM; and 4) the TAM front, a normal fault zone forming the northern terminus of the TAM to Ice Stream A.

The southern TAM have a southward tilted block structure with maximum uplift in a region 30-50 km wide, bounded by low-angle normal faults on both the north and south sides of the massif. Down-to-the-north 20-50° normal faults north of the Watson Escarpment topographically downdrop the TAM from >3000 m to sea level over ~50 km and facilitate the development of valley glaciers and Ice Stream A. Primary faults are subparallel to the TAM (NW-SE) and to WARS rift fabric in the Interior Ross Embayment. Faults oriented obliquely to the TAM break the area of maximum uplift into three NNW-SSE trending blocks that appear offset ~10 km in a left lateral sense relative to each other with range-parallel horst and graben features superimposed. No evidence was found for high-angle transverse or oblique faulting in this area.

Non-invasive mapping and monitoring of a fold system located on the McMurdo Ice Shelf near Scott Base, Antarctica

(poster p.)

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High-frequency surface-based ground penetrating radar (GPR) profiling experiments on the pressure ridges of the McMurdo Ice Shelf near Scott Base, Antarctica, have yielded high-resolution images, which allow detailed analysis of the deformation caused by compressive forces as the ice shelf flows obliquely onto the coastline north east of Pram Point. Three-dimensional profiling of the ridges was undertaken to map and analyse the structure of the folded area. The radar profiles are interpreted with respect to two different antenna orientations obtained in surveying, which increases orientation control over the features. Fold wavelengths and interlimb angles of folds, including those that had no surface expression, were measured. Complexities in the fold train that could not be observed from the surface topography were recognised from the GPR profiles. Observations on the style of folding could be made from reflections from stratigraphic horizons. Defects in the brine layer were easily recognisable, while defects in the firn layers were more difficult to identify. Two possible crevasses were recognized from diffraction patterns. A three-dimensional image of the surface of the brine layer was developed, on which a possible diapiric feature was identified. Penetration of the radar waves beneath the brine layer did not occur, preventing mapping of the base of the ice shelf.

In addition to three-dimensional profiling of the pressure ridges, monitoring of selected GPR profiles over a six-week period give a time-lapse view of deformation in the subsurface. A number of areas where changes were identified were analyzed. These include: development of defects on the brine layer; changes in the subsurface near the transition, which are likely to be due to the effect of summer melt; apparent fold development between the two identified crevasses; and an apparent normal fault in the firn. The GPR profile monitoring is complemented by photographs, which allow analysis of progressive deformation of the pressure ridges over a longer timescale. Both the emergence and break-up of folds could be followed in photographs taken a few years apart. As the brine layer prevented access by radio waves to the base of the ice shelf the question of the basal profile of the ice shelf beneath the pressure ridges could not be solved. However the results suggest that the sinusoidal folding continues to the base of the ice shelf. Thrust faulting observed in synclines may be a secondary mechanism, which alters the sinusoidal shape, in order that the shelf profile can approach the equilibrium profile required by buoyancy forces.

Defining tectono-stratigraphic terranes in the Antarctic Peninsula using primitive basaltic dykes as lithospheric probes

(poster p.)

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Mafic dykes are common, albeit minor, components of continental magmatic arc terrains throughout the world. Provenance determination is generally hindered as most have undergone varying degrees of fractionation and assimilation prior to emplacement in the crust. However, some preserve a primitive chemical character that reflects their origins. Such dykes, derived from partial melts in the lithospheric, or rarely asthenospheric mantle, provide palpable evidence as to the nature of their enigmatic source regions.

The Antarctic Peninsula has conventionally been described as a Late Triassic to Miocene continental magmatic arc that formed by eastward-directed subduction of proto-Pacific and Pacific oceanic plate beneath a part of the pre-breakup margin of the former Gondwana supercontinent. Current theory suggests that while this basic premise holds, the tectonic history is complicated by recognition of several faulted crustal blocks (tectono-stratigraphic terranes) that could have allochthonous or exotic origins.

Mafic dykes with primitive signatures (MgO >8 wt.%), indicating a relatively unmodified composition, were intruded as swarms in the Antarctic Peninsula during a restricted interval between 110 and 90 Ma. Preliminary work identifies two distinct suites. Oscar II Coast, Graham Land dykes with low LREE/HREE ratios, low initial $^{87}Sr/^{86}Sr$ ratios, and high $^{143}Nd/^{144}Nd$ ratios, are interpreted as derived from partial melting of asthenospheric mantle wedge, and Black Coast, Palmer Land dykes with high LREE/HREE ratios, high $^{87}Sr/^{86}Sr$, and low initial $^{143}Nd/^{144}Nd$ ratios, are interpreted as derived from partial melting of sub-arc lithospheric mantle.

The later dykes of supposed lithospheric derivation, plus crustal and mantle xenoliths and xenocrysts they carry, are the focus of this study, and will provide a geochemical profile of crust/mantle architecture beneath the Antarctic Peninsula, refining the characterisation of terranes previously defined by structural, stratigraphic and geophysical means.

Initial results support a predominantly lithospheric source for Palmer Land basaltic dykes. Within this group identified sub-groups indicate fundamental differences in lithospheric character, which may imply allochthonous origins for some terranes.

Tectonic evolution of the east flank of the Victoria Land Basin along the Ross Ice Shelf, southwestern Ross Sea, Antarctica

(poster p.)

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In January of 2003, new geophysical data were collected on board RVIB "Nathaniel B. Palmer" cruise NBP03-01 along the Ross Ice Shelf front, Antarctica. The primary goal was to collect detailed grids of seismic data to select potential drill sites to further understand the glacial and tectonic history of the Ross Embayment. The survey sites were located in regions where large sections of the ice shelf have recently broken off, thus exposing previously covered and unexplored seafloor. Because the ice shelf is advancing at ~1 km/yr, drilling from the ice shelf into the survey area will be possible in 2-3 years. The C-19 survey site in the western Ross Sea was uncovered by the breaking off of the C-19 iceberg in March of 2002, and includes approximately 3600 km^2. It spans from the Victoria Land Basin (VLB) immediately west of the survey site to the Coulman High, over the Central Trough and onto the Central High. The seismic data collected from this survey site shows well defined normal separation faults extending from the basement into the overlying sedimentary layers, indicating that the basement has undergone extension, forming generally north-south trending horst and graben structures. Several faults are observed to offset the overlying sedimentary units, terminating approximately 15 m to 30 m below the sea floor. This may indicate of Quaternary extension of this sector of the VLB.

Seismic sequences identified in the C-19 survey may be equivalent to units observed in the Cape Roberts Ridge to the west, as well as off Cape Colbeck in the eastern Ross Sea. Eastern Ross Sea seismic sequences have not been correlated to sequences in the western Ross Sea because they pinch out at the Central High and cannot be carried west. DAVEY et al. (2001) revised the seismic stratigraphy interpretations compiled by COOPER et al. (1995) for the western Ross Sea. DAVEY et al. (2001) suggest, based on cores from the Cape Roberts Drilling Project, that Late Oligocene/Early Miocene and Early Oligocene seismic units in the western VLB correspond to units RSS-2 and RSS-1 respectively which are identified in the eastern Ross Sea. The Early Oligocene RSS-1 sequence can be further separated into RSS-1 upper and lower separated by unconformity RSU-7; RSS-1 lower is only observed in basement grabens (LUYENDYK et al., 2001). Both RSS-2 and RSS-1 lower have been tied to DSDP site 270. DAVEY et al. (2001) also suggest that the angular unconformity separating the Late Oligocene and Early Oligocene sequences on the Cape Roberts Ridge corresponds to the RSU-6 unconformity separating the RSS-1 and RSS-2 units in the eastern Ross Sea.

A reinterpretation of Antarctic Research Series (ARS) Vol. 68, seismic profile 5 has been tied to the C-19 site. We propose that the RSS-2 and RSS-1 upper/lower seismic units and the RSU-6 and RSU-7 unconformities are observed at the C-19 survey site, suggesting that they may occur across the entire

Ross Sea. Based on the tie to ARS Vol. 68, seismic profile 5 and the conclusions of DAVEY et al. (2001), we suggest the C-19 seismic units are not only identical to those of the Eastern Basin, but are also the same as those identified on the Cape Roberts Ridge. Also, we interpret the RSS-1 lower unit in the C-19 survey area to only exist in basement grabens, similar to the interpretations made in the eastern Ross Sea. At this time, we do not interpret any units older than the RSS-1 lower sequence in the C-19 site. We will test that seismic units from the C-19 site can be correlated to the Cape Roberts Ridge by using existing seismic reflection data to tie across the VLB.

Cooper, A.K., Barker, P.F. & Brancolini G. (1995): Antarctic Res. Ser. 68
Davey, F.J., Brancolini, G., Hamilton, R.J., Henrys, S.A., Sorlien, C.C. & Bartek, L.R. (2001): Terra Antarctica: 215-220
Luyendyk, B.P., Sorlien, C.C., Wilson, D.S., Bartek, L.R. & Siddoway, C.S. (2001): Tectonics 20: 933-958

Preliminary ages from atmospheric ^{10}Be and nitrate for the Sirius Group, Dry Valleys, Antarctica

(oral p.)

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The age of Sirius Group sediments in the Dry Valleys area is the centre of an intense debate on the past behaviour of the East Antarctic Ice Sheet (EAIS). We report a preliminary age for diagenetic minerals in the Sirius Group at Table Mountain of 11.5 ±1 Ma, determined from atmospherically derived ^{10}Be. This agrees well with the nitrate inventory age of 13.4 ±2 Ma for the same samples.

The Sirius Group at Table Mtn. consists primarily of glacial fluvial sands, which represent a proglacial facies of the subglacial dimicts further eastwards in the Transantarctic Mountains (TAM). The sands at Table Mountain are noted for their porous nature and the presence of authigenic minerals. Cores up to 9.5 m deep from this facies provided the samples used for dating. Previously, surface exposure dating of the Sirius Group, using ^{10}Be and other cosmogenic nuclides, have yielded only minimum ages (3-6 Ma) because of interpretative problems relating to variable erosion. Our approach to dating the Sirius Group uses ^{10}Be produced in the upper atmosphere, which, in Antarctica, accumulates in the salt components of the soil surface through snowmelt and evaporation. We analysed Be and nitrate from each sample in four components; stones (>1 mm), sands (1 mm to 62 μm), fines (<62 μm) and soluble salts. Included with the soluble salts is ice from the permafrost below 40 cm deep. Almost all of the nitrate was contained in the soluble salts while most of the Be was in the fines, which included diagenetic zeolite. The ^{10}Be/^{9}Be ratio of the fines decreased systematically with depth to yield a decay age. Total nitrate by volume, combined with a flux rate determined from ice core at Taylor Dome, yields an inventory age.

Diagenetic chabazite, a zeolite, is present (up to 18 %) in all samples and throughout the Sirius Group at Table Mtn. Our model suggests that as salt concentrations on the surface increase, a brine forms which seeps into the subsurface along thin films in subzero temperatures. Dissolution of framework grains and precipitation of diagenetic minerals suggests this brine is highly reactive even under frozen conditions. In this process, ^{10}Be derived from snowfall mixes completely with ^{9}Be released from the breakdown of silicate grains and is transported downward with brine. With increasing depth, the concentration of ^{10}Be decreases exponentially with respect to ^{9}Be which slowly accumulates with time. The decay curve for ^{10}Be/^{9}Be is thus independent of ^{10}Be deposition or infiltration rate.

Integrated potential field modelling and deep-seismic interpretation: examples from the East Antarctic margin

(oral p.)

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A major new deep-water geophysical data set from the margin of East Antarctica from 38-152°E, covering almost one-third of Antarctica's continental margin, has been acquired by the Australian Government since early 2000 (STAGG & COLWELL 2003). The data set covers two major, overlapping sectors of the East Antarctic margin: from 38-98°E, formed by the Early Cretaceous separation of Greater India from Antarctica, and from 90-152°E, formed during the Late Cretaceous separation of Australia and Antarctica. The western and eastern spreading histories are very different in age, azimuth and spreading rates, and these differences are strongly reflected both in the structures of the deep-water continental margin and in the character and structuring of the adjacent oceanic crust of the Enderby and Australia-Antarctic Basins. The western sector, from Enderby Land to Princess Elizabeth Land, is further divided into two distinct areas lying offshore from Enderby Land and offshore from Prydz Bay.

Twelve depth-converted interpretations from key deep-seismic lines have been used to generate three-dimensional, integrated free air gravity and magnetic intensity forward models, with the seismic interpretation providing geometric constraints. Constraints on body densities have been derived from conversion of modelled sonobuoy arrivals, and reflection stacking velocities using the Ludwig /Nafe /Drake relation. Magnetic properties are generally unconstrained, but remanence has been attributed to oceanic crustal blocks by matching the global geomagnetic reversal timescales (interpretation of BROWN et al. this volume). The integration of the modelling and the seismic interpretation shows that the two principal sectors on this margin are clearly differentiated on the basis of their structural style. The key features of each sector can be summarised as follows:

Wilkes Land Margin

- Strongly necked lower continental crust with megaboudinage and pinch and swell structuring of the whole crystalline crust;
- Major volcanic emplacement related to diapirism of the ductile mantle at the inner flank of the COT, adjacent to necked and thinned lower continental crust;
- Extreme thinning of lower crust in COT, exposing deep dense lower crustal rocks, and possible continental mantle peridotites;
- Mechanical extension of oceanic crust on listric faults that penetrate the upper mantle, and may sole into an intra-mantle decollement;
- Intra-oceanic crust alteration and serpentinisation on a large scale (hundreds of km^3).

Enderby Land - Prydz Bay Margin

- Rigid plate-like continental crust of the Proterozoic East Antarctic shield;
- Steep continent-ocean boundary;
- No clearly identifiable transition zone between thinned continental crust and oceanic crust on any profile;
- Highly structured and altered (serpentinised) sub-oceanic peridotites.

These examples show that an integrated approach utilising multiple, independent datasets generates more comprehensive and robustly constrained models for continental rifted margins.

Brown, B., Ishihara, T. & Müller, R.D. (2003): this volume.
Stagg, H.M.J. & Colwell, J.B. (2003): this volume.

Advancement in understanding the sedimentary process of the Antarctic Peninsula margin from reprocessing of formerly collected seismic data

(poster p.)

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A large amount of seismic data has been collected over the years in the Pacific margin of the Antarctic Peninsula. Such large data set was particularly valuable for reconstructing the ice sheet history, studying the glacial sedimentary process, and providing the bases for deep sea drilling (ODP Leg 178). Our understanding of the glacial sedimentary process improves over time, consequently requiring adequate new data acquisition or improved exploitation of the formerly collected data.

Among the issues that still need further investigations on the continental rise, two may be addressed with an improved exploitation of existing seismic data by means of new processing technologies:

1) the identification of the large debris flow deposits that should have developed at the onset of the glaciation of the margin, similarly to what successively happened during the Pleistocene in the northern hemisphere (e.g. the Norwegian margin that may presently correspond to an juvenile stage of development of a glacial margin with respect to the Antarctic ones);
2) the identification of any evidence of the impact of the Eltanin asteroid, which occurred at 2.15 Ma ~1300 km to the northwest. No definitive evidence was identified in ODP drilling 178.

To address both issues with a seismostratigraphic approach, the resolution of the data needs to be further improved. A deeper insight into the geology of the Antarctic continent could hence be attained from the reprocessing of the vast amounts of seismic lines already collected during previous surveys. New processing technologies combined with ever increasingly powerful computers allow much more detailed information to be extracted from seismic data. Within the RADA project funded by Programma Nazionale di Ricerche in Antartide (PNRA), a test subset of the available seismic lines was analysed to plan reprocessing flowcharts that can ensure the overall quality of the final seismic sections.

Strong efforts were devoted to the enhancement of both vertical and lateral resolution. In the former case, non conventional techniques for noise reduction and deterministic deconvolution were among the methods that were employed. The extreme weather conditions often found during data acquisition introduced strong noise components in the signal bandwidth. These have been successfully removed by means of spectral averaging techniques, which do not effect the useful signal content. The improved signal to noise ratio, allowed wavelet extraction to be performed with confidence, Subsequent source signature deconvolution of the records was able to provide a vertical resolution suitable to better analyse interpretation targets.

With regard to horizontal resolution, good results were obtained using pre-stack time migration, since the test area did not show the complex horizontal velocity variations that could be possibly found elsewhere in the area. Further tests are scheduled to plan processing flows for these zones. These will involve velocity model building using coherency inversion and pre-stack depth migration.

The results so far achieved, show that substantial improvements in the overall quality of the reprocessed data can be obtained by using modern processing methods. Reprocessed seismic profiles allow an improved characterisation of the gravity-flow deposits in the depressed areas between the sediment drifts and an enhanced correlation of seismostratigraphic events with ODP drilling results.

Complete swath map coverage of the Gerlache Boyd Strait Paleo Ice Stream: an example of collaborative seafloor mapping in the Antarctic Peninsula
(poster p.)

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As the use of swath mapping technology in Antarctica expands across several national marine programs it is imperative that co-operative efforts focus upon regional coverage of important tectonic and glacial geologic features of the seafloor. To that end the national programs of the US, Spain, and Italy have informally agreed to a collaborative effort in the Antarctic Peninsula region. We present the merged data sets from five cruises of the "N.B. Palmer" and "Hespirides" for the Gerlache Strait-Boyd Strait paleo ice stream (CANALS et al. 2000).

For the first time a complete and detailed image of a paleo ice stream bed has emerged. This view includes the ice catchment basins (fjords) of the Danco Coast and Brabant Island, the mid shelf transition from erosion to depositional bundles (Croker Passage to Boyd Strait) and the terminal zone of the ice stream at the shelf break. The total coverage of the map exceeds 8000 km^2 and the inferred flow path distance of the paleo ice stream is about 400 km. Total relief of the bed is nearly 3000 m; from the catchments to the terminus. All portions of the seafloor along the length of the system demonstrate streamlined erosion depositional character. In the catchement region of Gerlach Strait the streamlining takes on the pattern of small scale (km sized) "drumlins" that are arranged in an echelon pattern. Where the Croker Pasage and central Gerlache Striat meet major convergence of ice flow is indicated by extensive over-deepening (to more than 1200 m), the beginning of more elongate large scale (10's of km) bedforms, and a distinctive arcuate geometery to the bedforms. Here ice flowing from the northwest (Hughes Bay) merged with ice flowing from the southwest (Southern Gerlache). At this juncture ice was funnelled to the northeast via the Croker Passage. In the northern Croker Passage, near Hoseason Island, the first bundle type structures are recognized and these merge with the bundled seafloor of the mid shelf region through the Boyd Strait, between Smith and Snow islands. In general the glacial erosion/deposition of the paleo ice stream dominates the seafloor morphology. Yet small features indicative of post-glacial deposition and recessional processes can be recognized. In the Southern Gerlache Strait several valley-head kame deltas are recognized which likely were produced by subglacial meltwater efflux during a paused recession of the ice stream. There are also linear beaded ridges 100's of meters wide to km's long that trend across headland promontories, between fjord basins. Such ridges are interpreted as eskers or recessional moraines. Superimposed upon this glacial seafloor are sediment drifts that smooth the bathymetry along the Southern Gerlache Strait near Schollaert and Neumayer Channels. While underlying bedrock/structural control upon seafloor morphology is difficult to evaluate there do appear to be features indicative of incipient crustal extension within the southern Croker Passage. Here, symmetric basin shoulders lie on either side of the elongate central deep. In the central axis of the deep there are small symmetrical mounds that break though a thick post-glacial hemipelagic cover.

Canals, M. et al. (2000.): Geology 28: 31-34.

Additional paleofloristic evidences of dry and warm climate in the Early Tertiary of northern Antarctic Peninsula
(oral p.)

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New fossil plants found in the volcanic, pyroclastic and volcaniclastic rocks at the southwestern half of King George Island, during the expeditions of Brazilian Antarctic Program, give an additional support to the presence of warm temperate and dry seasonal conditions of the climate during Early Tertiary (Upper Paleocene? - Lower Eocene) at the north of Antarctic Peninsula.

The fossiliferous intervals are distributed both in Fildes Peninsula and Admiralty Bay between lavas with K-Ar ages of 58-59 Ma to 52 Ma (PARKHURST & SMELLIE, 1983, LI & LIU 1987, LI 1994) and 27 Ma to 24.5 Ma (SMELLIE et al. 1984, BIRKENMAJER et al. 1986). The taphoflora (leaves, wood and pollen) suggest a vegetation compound by Araucariaceae, Podocarpaceae and Cupressaceae conifers, angiosperms (macrophyllic leaves of *Nothofagus*, Rhamnaceae, Sterculiaceae, Sapindaceae, Anacardiaceae, Cunoniaceae, Myrtaceae sect. Mirtoidea, Lauraceae, Cochlospermaceae and Fabaceae) and show the first incursion of Myrtaceae sect. Leptospermoidea and monocotyledons (DUTRA 2001). All those elements are very similar to those found at New Zealand in sediments of the similar age and with those identified in the Middle Eocene of South America. They were preserved mainly in ash and tuffs layers produced by the effusive activity in the area and with low frequency, in the braided river systems established during the inter-eruption phases.

Birkenmajer, K., Delitala, M.C., Narebski, W., Nicoletti, M. & Petrucciani, C. (1986): Bull. Polish Acad. Sci., Earth Sci. 34: 243- 255.
Dutra, T.L. (2001): Revista de la Asociación Paleontológica Argentina, Publicación Especial, 8: 29-37
Li Haomin. (1994): (China) State Antarctic Comitte Monograph 3: 133-171.
Li Zh. & Liu X., (1987): In: M.R.A. Thomson et al. (eds.). Geological Evolution of Antarctica. Proc. Fifth Internat. Sympos. Antarctic Earth Sci., 487-491.
Parkhurst, R.J. & Smellie, J.L. (1983): Earth Planet. Sci. Lett. 66: 214 – 222
Smellie, J.L., Pankhurst, R.J., Thomson, M.R.A. & Davies, R.E.S. (1984): Sci. Rep. British Antarctic Survey 87: 1-85.

Animated reconstruction of gridded gravity anomalies in the SE Pacific
(oral p.)

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We present 90 gravity field reconstructions of the South Pacific Ocean using interpolated pole parameters between published and new finite rotation poles and combine them to form an animation. We present some new observations from the animation.

Asymmetric oblique spreading at the Bellingshausen-Pacific Ridge, and migration of the Pacific-Bellingshausen-Phoenix triple junction, produced a long-transform dominated northern margin to the Bellingshausen plate after chron C34. The plate's eastern margin underwent ~200 km of compression during collision with the Antarctic plate. Its southern margin was an extensional plate boundary, possibly distancing Thurston Island from Antarctica in its continental reaches.

Around chron C27 (61 Ma) plate motion directions altered and the Bellingshausen plate was incorporated into the Antarctic plate. The animation shows dramatically different adjustments to the motion change. Whereas the Amundsen Sea sector of the Pacific-Antarctic Ridge saw an increase in the number and a reversal in the offset of some transforms, the long-offset transforms of the former Bellingshausen-Pacific plate boundary sector remained largely unaltered, except for some possible mild compression across their axes.

After this, and until 49 Ma, the animation shows a very long-offset transform-like feature (sometimes referred to as "V") forming between the Pacific-Antarctic and Pacific-Phoenix ridges. "V" appears to have been affected by mild compression associated with migration of the Phoenix-Pacific-Antarctic triple-junction along it. This can explain rather rugged gravity anomalies produced just to the north. The offset was eventually by-passed and deactivated by a ridge-axis propagation event to the west.

If interpolated pole parameters are approximately correct, the reconstruction suggests that independent motion of the Bellingshausen plate may already have been underway by chron C34. A total-fit reconstruction suggests this may have involved stretching in the Bounty Trough, New Zealand, and Pine Island Bay, Antarctica. Alternatively, these stretched features may be older than C34, and a change in the strike of the Udintsev Fracture Zone may indicate that independent movement of the Bellingshausen plate begun during chron C33.

The seismological network and geophysical observatory at Neumayer base, Antarctica
(oral p.)

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The geophysical observatory at Neumayer Station and its predecessor station Georg-von-Neumayer is now operational for 21 years since its first installation in 1982. At beginning, the standard observations consisted mainly of classical geomagnetic measurements and seismological observations from a sparse network on the floating ice-shelf. Since that time, especially the seismological network was strongly extended.

Today, the seismological network consists of the four stations VNA1, VNA2, VNA3, and SNAA. VNA1 is a short-period, 3-component seismograph situated at the geophysical observatory near Neumayer base on the Ekström Ice-Shelf. VNA2 and VNA3 are intermediate period, 3-component sensors on grounded ice of the ice-rises Halvfar Ryggen and Søråsen, 45 km SE and 90 km SW of Neumayer. In addition, VNA2 is the central sensor of a 16-element short-period, small-aperture array. Array seismology provides a powerful tool for improving detection and localization capabilities for monitoring weak seismic events. Little is known about seismic activity of the Antarctic continent due to the sparse station deployment of the global network in this region. The array was installed in the austral summer season 1997 and has been operational almost continuously since that time. The design was adopted from the SPITS-array in Svalbard and consists of 15 short-period vertical seismometers arranged on three concentric rings around the 3-component intermediate-period seismometer in the center. Event detection and beamforming is done automatically using array processing software from NORSAR. The broadband seismograph SNAA at the neighbouring South African base Sanae IV complements the Neumayer seismograph network. With this seismic antenna the number of detected Antarctic earthquakes was increased significantly. In particular, two seismically active regions were identified along the Jutul-Penck-Graben and off Kapp Norvegia. The nature of this seismic activity is not yet fully understood. Especially, the Jutul-Penck-Graben region is of interest since the question arises if this is an active tectonic rift system or if the seismic activity originates from post-glacial rebound movements. Better knowledge of hypocentral depths and focal mechanisms will contribute to the understanding of these mechanisms. Phase readings of teleseismic and regional events are reported to NEIC (National Earthquake Information Center) and ISC (International Seismological Center) on a daily schedule.

The geomagnetic observatory of Neumayer is situated in a special woodden, non-magnetic container in the ice. It contains a 3-component, cardanic fluxgate-magnetometer and single-component flugate-magnetometer for manual measurements of declination and inclination values. The total magnetic field values are determined by two proton-precession magnetometers. Due to the movement of the ice-shelf, it is necessary to determine the true geographic north with means of a gyro inside the container. The values of hourly absolute mean values are delivered on a monthly schedule to the World Data Center for Geomagnetism in Copenhagen. They are used for the calculation of the International Geomagnetic Reference Field (IGRF). Due to the long time series of now 21 years, these registrations incorporate two complete solar cycles. In addition, these geomagnetic registrations are used as ground-truth values for satellite missions like Oerstedt or airborne geomagnetic surveys in this region.

In the austral summer season 2002/2003 an infrasound array was installed in the vicinity of Neumayer station. The array with station code IS27 was installed in cooperation with the Federal Institute for Geosciences and Natural Resources (BGR) in the frame of the International Monitoring System (IMS) of the Comprehensive Nuclear Test Ban Treaty Organisation (CTBTO). The array consists of nine microparograh sensors which are situated in a special array geometry with a diameter of 2 km. Each sensor is equipped with a noise-reducing pipe-array for suppressing incoherent wind-induced noise. Data are transmitted online via satellite link to the CTBTO in Vienna.

The clay mineral signature of the sediments off Cape Roberts, Victoria Land Basin, Antarctica

(poster p.)

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One of the main objectives of the Cape Roberts Project (CRP) was to reconstruct in detail the Cenozoic Antarctic climatic and glacial history. For this purpose, three cores were drilled on the continental shelf of McMurdo Sound in Ross Sea, Pacific sector of the Southern Ocean. In total, some 1600 m of Cenozoic sediments have been recovered. For this study, the sediments have been investigated by XRD for their clay mineral assemblages in order to define source areas and to reconstruct weathering conditions and therewith climate.

A complete and consistent set of clay mineral data can be presented for the first time for cores CRP-1, -2 and -3. The data comprise concentrations of the main clay mineral groups illite, chlorite, smectite and kaolinite. The ratios of peak areas of individual clay minerals to an internal standard give distribution patterns not influenced by dilution effects. Further XRD data describe the crystallinities of illite and smectite as well as the chemical composition of illite.

An almost monomineralic clay mineral assemblage characterizes the lowermost part of the early Oligocene sequence, below 625 mbsf in CRP-3. The assemblage is made of well-crystallized smectite with probably authigenic origin. This interval is followed by sediments that consist of moderately crystallized smectite that, at least in part, seem to be of detrital origin and thus indicate weathering under a relatively warm and wet climate. Within the next interval, still in the lower Oligocene, smectite concentrations fluctuate between 50 % and 100 % and probably document alternating phases of chemical weathering under warm and wet climate and physical weathering under relatively cool and dry climate.

The clay mineral pattern changes dramatically in the upper part of the lower Oligocene sequence. The younger clay mineral assemblages are dominated by illite (ca. 50 %). Smectite and chlorite are common (c 20 %, each), whereas kaolinite occurs in trace amounts only. This clay mineral composition indicates deposition of sediments during a time when physical weathering prevailed on a probably ice-covered continent. The assemblage is typical for a source consisting mainly of granitic and metamorphic rocks, such as are widespread in the Transantarctic Mountains and on the East Antarctic Craton. However, within the upper part of the lower Miocene and Quaternary sediments, three intervals with high smectite (more than 50 %) but low illite and chlorite concentrations document volcanic source rocks, as they are found in the region of the present-day Ross Ice Shelf. This implies that the main ice discharge was through the Transantarctic Mountains, but that an additional path existed in the more recent history.

Thus, the clay minerals in the sediments off Cape Roberts are useful tools for reconstructing both source areas and palaeoclimate.

Beacon-Mawson field relations at Coombs and Allan Hills, South Victoria Land
(oral p.)

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Eruption of Jurassic Kirkpatrick flood basalts of the Ferrar Large Igneous Province was preceded by an episode of phreatomagmatic activity which resulted in widespread accumulation of tuff breccia and lapilli tuff that contain variable amounts of sedimentary clasts and mineral grains. At Coombs Hills, contact relations between the pyroclastic rocks of the Mawson Formation and older Beacon strata have been interpreted as intrusive (WHITE & MCCLINTOCK 2002), but at Allan Hills as an unconformity with significant paleorelief (BALLANCE & WATTERS 1971). The contact in the latter region has been re-investigated and everywhere observed is interpreted as intrusive. West of Feistmantel Valley the contact with the Permian Weller Formation is marked by a narrow zone in which Weller strata are tilted, broken, and even folded; this disruption is attributed to phreatic activity that preceded emplacement of Mawson basaltic rocks. The Mawson rocks adjacent to the contact are intruded by sandstone breccia dikes, and are also cut by small diatremes of basaltic tuff breccia. Farther away from the contact, the Mawson tuff-breccias are intruded by diatreme-like bodies of tuff breccia and lapilli tuff, and by irregular dolerite bodies. East of Feistmantel Valley, the contact with the country rock, mainly the Triassic Feather Formation, is quite similar. Feather rocks exhibit in situ disaggregation of quartz sandstone to form a breccia with a sand matrix, and in the case of the upper Fleming Member boudinage-like extension of green micaceous sandstone lenses. Disaggregation is attributed to phreatic activity. This outer zone is followed inward by a zone of sedimentary megaclasts separated by screens of sandstone breccia. The megaclasts were derived principally from the coal-bearing Member C of the Lashly Formation, which does not crop out locally but would occur about 120 m stratigraphically above the in situ Feather Formation contact rocks. The brecciated Feather rocks and the megaclast unit are cut by a Ferrar dolerite dike, thus constraining the age of formation. The zone of megaclasts passes into generally massive basaltic tuff breccia and lapilli tuff. Here, Mawson rocks locally exhibit stratification, illustrated by a conspicuous basalt-sandstone debris-flow deposit and by large-scale changes in numbers and sizes of clasts; these Mawson rocks are cut by basaltic tuff-breccia and lapilli-tuff diatremes. At Coombs Hills, one locality shows Mawson rocks having a high angle intrusive contact with Lashly Member D strata that are 200+ m above the base of that Member, whereas at another locality contact relations are ambiguous and the contact rocks exhibit effects attributed to phreatic activity. Phreatic vents have also been identified in Lashly Member C at some distance from the Mawson-Beacon contact.

Re-interpretation of the contact at Allan Hills renders interpretations of the tectonic history, based on a pre-Ferrar episode of erosion creating significant paleotopography (500+ m), uncertain. At least the lower parts of the Mawson tuff-breccia deposits west of Feistmantel Valley could be, as proposed by WHITE & MCCLINTOCK (2001) for Coombs Hill, a caldera fill. However, the Mawson rocks on the southern arm of Allan Hills show stratification on km scales horizontally and 100+ m vertically, which suggests subaerial accumulation by mass-flow processes either in a caldera or as an outflow facies. East of Feistmantel Valley the stratified pyroclastic rocks and debris flow deposit likewise indicate subaerial processes. The great vertical extent of Mawson rocks at Coombs Hills (ca. 350 m) requires confining topography for the upper 150+ m of unstratified massive tuff-breccia which crops out at elevations higher than the youngest Lashly beds; some rocks below the Kirkpatrick Basalt on the south arm of Coombs Hills might be an outflow facies. Exposed Mawson rocks have estimated outcrop thicknesses of at least 300 m, and are clearly in part intrusive and in part stratified and extrusive. These results have implications for correlative strata in the central Transantarctic Mountains and north Victoria Land. Further, the exceptional thicknesses of tuff breccia and lapilli tuff may mark centers of Ferrar tholeiite emplacement and also topographic and structural lows in the inferred rift setting.

Ballance, P.F. & Watters, W.A. (1971): N. Zealand J. Geol. Geophys. 14: 512-527.
White, J.D.L. & McClintock, M.K. (2001): Geology 29: 935-938.

Decompressional evolution of granulites from Dronning Maud Land, East Antarctica
(poster p.)

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The nunataks of Mühlig-Hofmannfjella and Filchnerfjella (6-8°E), Dronning Maud Land, were mapped for the first time during the Norwegian Antarctic Research Expedition (NARE) 1996-97, and revisited in 2001-2002 by a Japanese-Norwegian-German joint expedition. The investigated area consists of a series of post-kinematic granitoid intrusives, which are emplaced into granulite facies metamorphic rocks. The igneous suite includes voluminous intrusions of charnockite, syenite, granite and several generations of dikes, whereas the metamorphic rocks comprise a layered sequence of mafic, intermediate and felsic gneisses, metapelites and migmatites.

The metamorphic evolution of the high-grade complex has been recovered through a study of mineral assemblages, mineral zoning and reaction textures. Orthopyroxene is present in rocks of basic to intermediate compositions, whereas spinel + quartz were part of the peak assemblage in pelitic granulite. Mineral equilibria indicate that peak metamorphic conditions were attained at ca. 850°C at intermediate pressures. The granulites contain abundant reaction textures recording partial re-equilibration to lower pressures. Garnet and amphibole porphyroblasts in mafic rocks are mantled or entirely replaced by orthopyroxene-plagioclase symplectites. In pelitic granulites, garnet-sillimanite-spinel-bearing assemblages break down to cordierite. Late, nebulous leucosomes in pelitic granulites contain large aggregates of cordierite, whereas biotite-amphibole gneisses contain melt patches with euhedral orthopyroxene. The late leucosomes are interpreted to have formed by decompression melting.

The high-temperature part of the P-T path is characterized by near-isothermal decompression. A high thermal budget is provided by the large-scale, regional emplacement of charnockitic and syenitic magma. A steep unloading P-T segment may also be explained by a stage of rapid uplift resulting from tectonic, rather than erosion controlled exhumation. Tectonic crustal thinning is supported by field observations of extensional shear zone development under ductile and progressively more brittle conditions. Melt-filled shear zones, which have an extensional geometry, suggest that the tectonic uplift started under high-temperature conditions. We relate the observed granulite facies metamorphism in Filchnerfjella to the Pan-African (c 500 Ma) thermal event.

Magma-driven hydraulic fracturing and infiltration of CO_2-H_2O fluids into high-grade crystalline rocks, Dronning Maud Land, Antarctica

(oral p.)

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The nunataks of Mühlig-Hofmannfjella and Filchnerfjella in Dronning Maud Land, East Antarctica, provide insight into large scale fluid infiltration and development of hydraulic fractures at a crustal level near the brittle-ductile transition zone. The originally metamorphic and plutonic rocks comprise granulite facies mineral assemblages including perthite, antiperthite, plagioclase, orthopyroxene, garnet and biotite. Peak metamorphic assemblages formed at conditions of T $\geq$850°C at intermediate pressures. Alteration of these rocks is restricted to the vicinity of widespread discordant granitic pegmatitic and aplitic veins, which form a dense network with variable orientation. The originally dark rocks are transformed into light rocks in sharply defined zones of nearly constant width, symmetrically paralleling the vein on both sides. The average ratio (d_{AZ}/d_{CV}) of the thickness of the alteration zone (d_{AZ}) to the thickness of the central vein (d_{CV}) is around 11. Microscopic examination reveals that the alteration is correlated with (1) hydration reactions including breakdown of orthopyroxene to biotite and sericitisation of plagioclase, (2) high density of healed and sealed microcracks in quartz and feldspar exceeding that observed in the unaltered host rock by an order of magnitude.

Abundant healed microcracks in quartz contain fluid inclusions rich in CO_2 or H_2O, or a mixture of both components, with minor N_2. Microthermometric analysis of the CO_2-rich fluid inclusions yields T_mCO_2 near -57°C. $T_{hom}CO_2$ between +15 and +30°C with homogenisation mostly into the liquid phase give CO_2-densities between 0.75 and 0.85 g/cm^3. T_mH_2O is typically about -2°C, indicating a low salinity of 3-4 wt.% NaCl equiv. $T_{hom}H_2O$ are mostly around 360°C. The fluid inclusion populations reveal evidence for phase separation during crack healing. The two-phase field in the system H_2O-CO_2 was entered during crack healing, which for low salinity fluids means cooling to below about 400°C within a short time span. Combined with the CO_2-densities, trapping pressures of 1.5-2.5 kbar for the temperature range of 300-400°C are suggested.

The granitic veins are interpreted to represent mode I hydraulic fractures driven by a volatile-rich melt with a minimum temperature of 650°C, emplaced in crustal level near the brittle-ductile transition zone with a far field host rock temperature of 300-400°C. The conspicuous alteration zones flanking the veins reflect the extent of microcrack-controlled infiltration of the CO_2-H_2O fluid phase liberated from the crystallising pegmatitic melt into the damaged host rock. We propose that (1) the extent of the symmetric alteration zones flanking the veins reflects the width of the damage zone defined by the radius of the process zone developed at the tip of the propagating fracture, (2) the damage zone was characterised by a transient state of high permeability which was short-lived due to rapid healing and sealing of microcracks, (3) infiltration and retrogression of the high-grade rocks can be considered as a single-stage quasi-instantaneous process on geologic time scales with a duration of hours to weeks.

The excellent exposure of the phenomenon in Dronning Maud Land provides an idea of how short term fracture-controlled fluid infiltration and related retrogression can affect extensive crustal volumes. The high volume percentage of light alteration zones observed throughout the mountain range over hundreds of kilometres, independent of lithological variations and with occasionally entire nunataks being altered, shows that such processes can be effective on a regional scale.

Whither the Mawson Continent?

(oral p.)

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In a Gondwana configuration the Terre Adélie Craton comprising Terre Adélie and George V Land is a key region linking the East Antarctic Craton and the various cratons of the Australian continent. Whilst the Mawson Continent hypothesis has received some consideration, clearly the continuation of the Gawler Craton of southern Australia into East Antarctica during Proterozoic (and Archaean) times requires more detailed examination. This is particularly the case for the evaluation of both subduction related and juvenile accretion tectonic models recently put forward for the assembly of the Australian continent and the Gawler Craton.

Studies of coastal outcrops Terre Adélie Craton have yielded a number of proposed direct Proterozoic geological links across the Southern Ocean. The c 1765 Ma phyllites at Cape Hunter and Coffin Bay Peninsular provide an important piercing point in continental reconstruction, as supported by correlations between c 2520 Ma granodiorites at Cape Denison with granitoids of the Dutton Suite in southern Eyre Peninsula and c 2420-2440 Ma garnet paragneisses of the Cape Gray-Stillwell Island region with the Carnot Gneisses. More recently the discovery of Ordovician granites in the Penguin Point-Cape Webb area has lead to ties with similar Delamerian (and Ross) age granites on the southern side of Kangaroo Island, extending the Palaeo-Pacific margin of Gondwana significantly westwards on this segment of the Antarctica coast.

As with most Antarctica geological problems, the major hurdle in evaluating the Mawson Continent theme is to determine the extent of the Terre Adélie Craton (and Mawson Continent) beneath the ice cap. Two important tools are available to evaluate such speculation. One is to examine the moraines from the Terre Adélie and George V Land Coast (PEUCAT et al. 2002), another is to use aeromagnetic images to trace inland known rock types from the coastal outcrops (for example FINN et al. 1999). In terms of the latter, detailed aeromagnetic images are not available for this section of the Antarctic continent, but preliminary investigations such as FINN et al. (1999) indicate a continuation of the Gawler and Terre Adélie cratons at least as far as the central Transantartic Mountains (c 1500 to 2000 km south from the coast).

From a preliminary study of coastal moraines in the Terre Adélie Craton, PEUCAT et al. (2002) report the presence of felsic volcanic rocks of similar age, chemistry and inferred petrogenesis to the 1590 Ma Gawler Range Volcanics (South Australia). Radar ice flow images indicate that such volcanic rocks may have been eroded off the Antarctic continent up to several hundred kilometres from the coast. Other rock types sampled from these moraines include c 1700-1720 Ma granites, and these can be correlated with Antarctic continent equivalents of the Moody Suite in southern Eyre Peninsula. Quartzo-feldspathic gneissic rocks are also a common moraine component and these are interpreted to have a similar age range and paragenesis to the rocks cropping out at Cape Denison and in the Port Martin area. Such gneisses may also provide further links to Middle Archaean material known to crop out in the Miller Range of the Central Transantarctic Mountains

The morainal studies indicate that the Mawson Continent extends significant distances into the Antarctic continent and a preliminary assessment of broad based aeromagnetic images further supports this contention. Tectonic models for southerly accretion of the Gawler Craton onto the North Australian Craton by subduction related processes are not supported, nor does there appear to be a continuation of the c 1850 Ma belt into the Terre Adélie Craton; that is easterly, juvenile crustal growth. The c 1710 Ma Kimban event is however widely recognised and in part reflects a westward juvenile crustal addition to the Terre Adélie Craton.

Finn, C., Moore, D., Damaske D. & Mackey, T. (1999): Geology 27: 1087-1090.
Peucat, J.J., Capdevila, R., Fanning, C.M., Ménot, R.P., Pécora, L. & Testut, L. (2002): Austr. J. Earth Sci. 49: 831-845.

The Ross Orogeny in northern Victoria Land, Antarctica: geodynamic evolution and possible analogues

(poster p.)

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Many tectonic reconstructions of northern Victoria Land (NVL), Antarctica, during the early Palaeozoic Ross orogeny have been so far proposed (e.g. KLEINSCHMIDT & TESSENSOHN 1987, FINDLAY et al. 1991, FERRACCIOLI et al. 2002). All these models deal with the amalgamation of the three "terranes" currently recognized in NVL (Wilson, Bowers and Robertson Bay terranes). Tectonic models have to reconcile the occurrence of an oceanic island arc sequence (Bowers Terrane) in close proximity with an "Andean type" active continental margin (Wilson Terrane). In many cases the problem has been solved claiming that the Bowers Terrane was an allochtonous element on a SW subducting plate, progressively brought closer to the continental margin of the Wilson Terrane until collision.

However, the Bowers Terrane shows more complex geochemical features than one could expect from an oceanic arc sequence, and could be better compared to a back-arc or a fore-arc sequence (ROCCHI et al. 2002). Recent models have thus been proposed which restore both the Bowers and the Wilson terranes in the upper plate; nevertheless, many features of these models are still debated.

These tectonic reconstructions are reviewed and tested against geological features of the Ross orogeny in NVL and in other continents which were adjacent before the Gondwana break-up (Tasmania, New Zealand and SE Australia). Possible modern and ancient analogues of the Ross orogeny are also discussed.

Ferraccioli F., Bozzo E. & Capponi G. (2002): Geophys. Res. Lett. 29: 10.1029/2001GLO14138.
Findlay R.H., Brown A.V. & McClenagham M.P. (1991): Mem. Soc. Geol. It., 46: 117-133.

Kleinschmidt G. & Tessensohn F. (1987): In: G.D. McKenzie (ed.). Gondwana Six: Structure, Tectonics, and Geophysics, 89-105.
Rocchi S., Capponi G., Crispini L., Di Vincenzo G., Ghezzo C., Meccheri M. & Palmeri R. (2002): Abstract Workshop "Scienze della Terra in Antartide" Certosa di Pontignano (Siena) 30/9-02/10/2002.

New geological survey at Patriot Hills (80°S), Ellsworth Mountains, West Antarctica
(oral p.)

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A geological study of the Middle to Late Cambrian Liberty Hills (LHF) and Minaret (MF) Formations, was carried out at Patriot Hills, the southernmost tip of the Ellsworth-Whitmore Mountains (EWM) crustal block.

The studied LHF stratigraphic succession comprises a siliciclastic and a carbonatic low and high energy marine litoral association, that is composed (top to bottom) of light grey clast-supported conglomerates, light grey monomictic matrix-supported conglomerates, red and green sandstones with locally preserved cross-beded stratification, syn-sedimentary folding and flutes, and light brown mudstones. The bed thickness varies from centimetres to meters. The mudstones constitute a previously non reported base for the stratigraphic column the area. However the entire thickness cannot be estimated because of the conglomerate´s discontinuos field relations. The described succession could represent a regression sequence.

The LHF is concordantly overlain in the area by the Late Cambrian limestones and sandstones of the MF. Only the base of MF crops out in the study area. These rocks are strongly folded showing a succession of three anticlinal-synclinal pairs. This is asociated to a main episode of deformation that produced a subvertical cleavage related to aproximately north-south compression. Highly altered basaltic dikes and hidrothermal breccia bodies cut the LHF succession. Mineral facies are of intermediate to low grade greenschist facies, mainly in the chlorite zone.

Three limestone samples from the base of the MF contain four different achritarcs (*Annulum squamaceum, Cristallinium cambriense, Saharidia fragilis* and *Leiosphaeridia* sp) that suggest a depositional age close to the Middle-Upper Cambrian limit, in a marine environment.

Seven LHF sandstones were selected for petrographic and geochemical analysis due to their low deformation and recrystallisation. Their petrographic and geochemical features characterise them as being derived from a cratonic source, and deposited in a basin located on a passive continental margin. This is in good agreement with the new tectonic scenarios proposed by CURTIS (2001), which account for the presence of rifting along a margin otherwise dominated by active subduction by Middle to Late Cambrian.

Fifty field drilled cores were analized for paleomagnetic studies. Natural remanent magnetism and susceptibility were measured. In order to study the magnetic components for paleopole estimations, these samples were demagnetized using the step by step thermal method. Very complex multicomponent and unstable magnetism was found; only one component of the magnetization was clearly identifiable, but it is of viscous type produced by the present geomagnetic field.

Curtis M.L. (2001): Tectonic history of the Ellsworth Mts., West Antarctica: Reconciling a Gondwana Enigma.- GSA Bull. 113: 939-958.

Aerogeophysical investigation in the Jutulstraumen Rift area, East Antarctica
(oral p.)

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During the 2001/2002 Antarctic campaign a combined aeromagnetic and aerogravity survey was performed by the British Antarctic Survey over the Jutulstraumen area in western Dronning Maud Land (East Antarctica). The aeromagnetic survey over the Jutulstraumen area was flown on a 1 km line spacing grid, with tie line interval of 8 km, at a constant nominal barometric altitude of about 2700 m. An area of approximately 15300 km^2 was covered. This is the first regional airborne aeromagnetic campaign over Antarctica with such detailed line spacing. Several long profiles were also flown to acquire coincident radio-echo and aerogravity data. These longer profiles allow us to image the longer wavelength features for aerogravity analysis.

This aerogeophysical survey is a component of the multi-disciplinary MAMOG (Magmatism as a Monitor of Gondwana Break-up) project. By investigating Mesozoic magmatic and tectonic events this project aims at understanding driving forces of Gondwana break-up as Africa rifted away from East Antarctica. Current Mesozoic break-up models are hampered by the lack of robust geophysical constraints on the magmatic and structural context of the Dronning Maud Land margin. However, it has been suggested that the region of the Jutulstraumen and Pencksökket glaciers could represent an early stage of rifting in Antarctica connected to the western branch of the East African Rift System (GRANTHAM & HUNTER 1991). Indeed the surface topography geometrically resembles a rift-rift-rift triple junction.

New bedrock elevation, free-air and Bouguer anomaly maps have been produced from the aerogeophysical survey data. The long-wavelength Bouguer anomalies now indicate that crustal thinning or possibly magmatic underplating is restricted to the northern branch of the Jutulstraumen Glacier area. Gravity modelling suggests that the amount of crustal thinning may be significant and comparable to that observed over modern continental rift systems. If such crustal extension were Jurassic in age, it may also account for the emplacement of Jurassic intrusions. To test this hypothesis we examined the newly produced 1:250,000 shaded relief aeromagnetic anomaly map of the region. Two discrete aeromagnetic anomalies reveal the extent of the Jurassic alkaline intrusions of Straumsvola and Tvora. Similar patterns are not detected beneath the inferred Jutulstraumen rift structure. Hence, similar Jurassic intrusions are highly unlikely beneath the rift itself. However, a very high-amplitude (1000 nT) anomaly at Straumsnutane, along the inferred western flank of the rift, may reveal a buried intrusion of poorly constrained age. The coincident Bouguer gravity high suggests that the intrusion has a mafic composition.

The Jutulstraumen rift exhibits a pattern of distinct magnetic highs and lows that suggest a hitherto unrecognised complexity of the rift itself. This may reflect pre-rift tectonics, complex rift kinematics or a combination of the two. The combined analysis of the aeromagnetic and aerogravity patterns suggests that the rift likely developed in response to reactivation of the inherited boundary between the Archean to Paleoproterozoic Grunehogna craton and the predominantly Grenvillian-age Dronning Maud Land microplate (Jacobs & Thomas 2002).

Grantham, G.H. & Hunter D. R. (1991): Geological Evolution of Antarctica, Cambridge Univ. Press: 47-51.
Jacobs J. & Thomas R. (2002): Royal Soc. N. Zealand Bull. 35: 3-18.

Aeromagnetic evidence for accreted(?) arc crust in the western Wilson Terrane

(poster p.)

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The Wilson Terrane, as currently exposed over the Transantarctic Mountains, provides a window over the Cambrian-Ordovician Ross Orogen. This continental-scale event relates chiefly to coeval subduction of the paleo-Pacific plate beneath East Antarctica and marks an important phase in the accretion of Gondwana. In Victoria Land, Ross-age subduction may have driven accretion and collision of the Robertson Bay Terrane and Bowers Terrane against the Wilson Terrane, although terrane accretion models have recently been questioned (FINN et al. 1999). In Oates Land, the Exiles Thrust may represent an important structural imprint of Ross-age subduction and possible terrane accretion outboard of the Wilson Terrane (FLÖTTMANN & KLEINSCHMIDT 1991). There is, however, only a small exposed segment of this fault zone, in the western Wilson Terrane, because it is located along the southern end of the Matusevich Glacier. Further south, an ice-covered aeromagnetic lineament, originally referred to as the "Matusevich line", also lies co-linear with the Matusevich Glacier (DAMASKE & BOSUM 1993). Recent aeromagnetic interpretations have attempted to correlate the Matusevich line with the buried southern prosecution of the Exiles Thrust (FERRACCIOLI & BOZZO 1999, FINN et al. 1999). However, it was not until the joint German-Italian Antarctic campaign (1999-2000) that the Matusevich Glacier area was surveyed with aeromagnetics to verify such correlations (DAMASKE et al. 2001).

New magnetic anomaly imaging over Oates Land reveals the prominent Matusevich Anomaly: a high-amplitude linear feature with amplitudes reaching 1000 nT. The sharp NNW trending gradient along the eastern flank of the anomaly corresponds to the inferred trace of the Eastern Exiles Thrust. A less pronounced gradient matches the inferred trace of the western Exiles Thrust. By comparing aeromagnetic signatures with ground susceptibility data and geology we investigate the potential sources for the Matusevich Anomaly. This comparison indicates that mylonitic hornblende-bearing Granite Harbour Intrusives or meta-ultramafic rocks and metabasites of the Wilson Metamorphic Complex could cause the anomaly. The magnetic bodies located beneath the Matusevich Glacier lack a prominent gravity signature. Hence, an intermediate rather than ultramafic bulk composition of the magnetic sources is reasonable. Modelling shows that magnetic intrusions, at least 5 km thick, and possibly as much as 20 km thick, are required to fit the main magnetic anomaly.

We propose that these thick magnetic intrusions of intermediate composition are the roots of a mostly buried magmatic arc emplaced directly along the Exiles Fault zone. This is consistent with geochemical evidence, which suggests that the hornblende-bearing granitoids exposed at Exiles Nunataks are island-arc or less likely continental-arc granitoids (OLESCH et al. 1996). The aeromagnetic evidence for buried magmatic arc crust emplaced along the Exiles fault zone is an important new element for geodynamic modelling of the Ross Orogen. The presence of other segments of magnetic arc crust within the Wilson Terrane suggests that Ross-age subduction occurred outboard of the Wilson Terrane itself (FINN et al. 1999, FERRACCIOLI et al., 2002). In this tectonic context, however, a new question is posed by the significance within the Wilson Metamorphic Complex of the mafic/ultramafic lenses of the Matusevich Glacier (ROLAND et al. 2001). These might represent scraps of oceanic crust. If so, the magmatic arc revealed from the magnetics in the western Wilson Terrane may have been accreted to the central Wilson Terrane and a former suture zone could be concealed beneath the Matusevich Glacier.

Damaske, D., Bozzo, E., Moeller, D., Ferraccioli, F. & Chiappini, M. (2001): Terra Antartica Rep. 5: 1-12.

Damaske D. & Bosum, W (1993): Geol. Jb. E47: 139-152.
Ferraccioli F. & Bozzo E. (1999): J. Geophys. Res. 104: 25, 297-25,319.
Ferraccioli, F., Bozzo, E. & Capponi G. (2002): Geophys. Res. Lett. 29(10): 10.1029/2001GL014138.
Finn C., Moore D., Damaske D. & Mackey T. (1999): Geology 27: 1087-1090.
Flöttmann T. & Kleinschmidt, G. (1991): Geology 19: 45-47.
Olesch, M., Roland, N.W., Fenn, G. & Krauss, U. (1996): Geol. Jb. B89: 195-245.
Roland N.W., Henjes-Kunst F., Kleinschmidt G. & Talarico F. (2001): Terra Antartica Rep. 5: 57-65.

Testing terrane accretion models for Palmer Land, Antarctic Peninsula, with new airborne remote-sensing data

(poster p.)

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Traditionally the Antarctic Peninsula has been considered as a complete Andean-type arc-trench system (STOREY & GARRETT 1985). The main elements of the system are accretion-subduction complexes on the Pacific margin of the Peninsula, a magmatic arc active from 240 to 10 Ma (LEAT et al. 1995), and the back-arc sequences of the eastern Weddell Sea side.

The subduction-related magmatic arc over the western side of the Antarctic Peninsula is marked by a prominent aeromagnetic anomaly, the Pacific Margin Anomaly (MASLANYI et al. 1991), similar to typical signatures observed over arcs in California and Japan. Magnetic modelling shows that the magmatic arc forms a significant proportion of the western Antarctic Peninsula crust (GARRETT 1990, JOHNSON 1999). Western Palmer Land crust has been interpreted as newly generated arc crust formed during Early Cretaceous extension (VAUGHAN et al. 1998). However, a recent tectonic model identifies western Palmer Land crust as a microcontinental allochthonous terrane, the Central Domain, with similarities with the Median Tectonic Zone of New Zealand. The other two proposed terranes for Palmer Land are the Eastern Domain and the Western Domain (VAUGHAN & STOREY 2000). The tectonic boundary between the Central and the Eastern domain is the Eastern Palmer Shear Zone, which was active in Early Cretaceous times (VAUGHAN et al. 2002).

During the 2002/2003 Antarctic campaign a combined aeromagnetic and aerogravity survey was performed by the British Antarctic Survey over Palmer Land. The survey will provide a remote-sensing tool to test terrane accretion models for Palmer Land by providing constraints upon crustal composition, structure and tectonics. Over 20,000 km of line data were acquired. Line spacing was 5 km for most of the survey area, with some regions at 10 km. Nominal flight altitude was 2800 m. Departures from the survey altitude to 3600 m were imposed by topography and weather conditions. This new aerogeophysical survey links previous BAS campaigns performed in the 90' with Russian surveys to the south. It also provides the first aerogravity dataset, which crosses the entire Antarctic Peninsula.
Aeromagnetic processing steps included magnetic compensation, IGRF removal, diurnal corrections by means of low-pass filtered base station data, levelling and microlevelling in frequency domain. The processed aeromagnetic data are gridded with a 1 km cell size, to produce new 1:250,000 total field aeromagnetic anomaly maps of the region. Preliminary in field data analysis suggest that a prominent magnetic anomaly break marks the boundary between the accretionary rocks of the Western Domain and the magmatic arc rocks of the Central Domain. More subtle signatures were generally identified over the Eastern Palmer Shear zone. However, the most evident aeromagnetic feature runs oblique to both the Eastern and the Western Domain terrane boundaries. Very high-amplitude anomalies within the Eastern Domain mark gabbroic plutons in the Black Coast area, as partly detected also by previous reconnaissance surveys (MCGIBBON & WEVER 1991).

Garrett, S.W. (1990): J. Geophys. Res. 95: 6759-6777.

Johnson, A.C. (1999): 104 B3: 5031-5046.
Leat P.T., Scarrow, J.H. & Millar I.L. (1995): Geol. Mag. 132: 399-412.
Maslanyj, M.P., Garrett, S.W., Johnson, A.C., Renner, R.G.B. & Smith, A.M. (1991): BAS GEOMAP Ser. Sheet 2, BAS, Cambridge, U.K., 37 pp.
McGibbon, K.J. & Wever H.E. (1991): Geological Evolution of Antarctica, Cambridge Univ. Press: 395-398.
Storey, B.C. & Garrett, S.W. (1985): Geol. Mag. 122: 5-14.
Vaughan, A.P.M., Warenham, C.D., Johnson, A.C. & Kelley, S.P. (1998): EPSL 158: 143-155.
Vaughan, A.P.M. & Storey, B.C. (2000): J. Geol. Soc. 157: 1243-1256.
Vaughan, A.P.M. Kelley S.M. &Storey B.C. (2002): Geol. Mag. 139: 465-471.

Geophysical modelling across the Rennick Graben structure, northern Victoria Land
(poster p.)

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During the joint German-Italian Antarctic campaign 1999-2000 geophysical investigations were performed over northern Victoria Land, Oates Land and George V Land (BOZZO & DAMASKE 2001). These included aeromagnetics, ground-based gravity surveys, airborne radar, geomagnetic depth soundings and seismological investigations. As part of these studies we present the first results derived from geophysical modelling across the Rennick Glacier area in northern Victoria Land.

Geological evidence suggests that the Rennick Glacier is underlain by a tectonic feature, namely the Rennick Graben structure (ROLAND & TESSENSOHN 1987). Geodynamic models predict that this graben could relate to Cretaceous (TESSENSOHN 1994) or alternatively to Cenozoic (SALVINI et al. 1997) transform shearing between the Australian and Antarctic plates. Just to the east of the Rennick structure, a fossil suture zone between the allocthonous Bowers Terrane and the autocthonous Wilson Terrane, known as the Lanterman Fault, is traditionally identified. However, recent brittle-fault studies confirm that this is not a fossil Early Paleozoic structure. Rather, Cenozoic reactivation of the inherited fault zone may have occurred and induced a component of strike-slip faulting along the margins of the Rennick Graben (ROSSETTI et al. 2002).

Prior to our study, no integrated geophysical investigations had been performed neither to test these geologic models nor to assess deeper crustal structure in the Rennick Graben area. Models of the longer wavelength aeromagnetic anomalies, suggests that the Ross-age magmatic arc basement, which floors the Rennick Graben, is indeed faulted. Modelling of higher-frequency anomalies indicates that Jurassic Ferrar sills and basalts are also faulted. The down-faulted Rennick Graben is clearly marked by a prominent Bouguer anomaly gravity low. In contrast, the adjacent uplifted Bowers Mts. block features a 100 mGal Bouguer high. Gravity modelling reveals that this anomaly relates to a buried high-density body, coupled with the effect of flanking graben structures. The body itself may be a remnant of Early Paleozoic oceanic crust. Uplift of this crust has been related to Early Paleozoic obduction (FERRACCIOLI et al. 2002). However, new apatite fission track data (LISKER 2001) suggest that Cenozoic uplift along the eastern flank of the Rennick structure also occurred. Deep electrical conductivity models show that the Rennick Graben is a resistive feature, formed by two sub-basins, separated by a structural high. There is no evidence for a prominent thermal anomaly in the lithosphere, which would be imaged as a major conductor beneath the Rennick structure. Seismologic models based upon receiver functions image the crust beneath the Rennick Graben as being only 26 km thick. Typically, the crust beneath the Transantarctic Mountains is about 35 km thick. Hence, the Rennick structure is a major continental rift structure, rather than a mere graben. The Rennick rift may be a passive rift reactivated in response to regional Cenozoic transtension between East and West Antarctica.

Bozzo E. & Damaske, D. (2001): Terra Antartica Rep. 5: 109 pp.
Ferraccioli, F., Bozzo, E. & Capponi G. (2002): Geophys. Res. Lett. 29(10): 10.1029/2001GL014138.
Lisker, F. (2001): Terra Antartica Rep.: 89-96.
Roland N.W. & Tessensohn, F. (1987): Geol. Jb. B66: 203-229.
Rossetti, F., Storti, F. & Läufer, A.L. (2002): J. Geol. Soc. London 159: 159-173.
Salvini, F., Brancolini G., Busetti M., Storti F., Mazzarini F. & Coren F. (1997): J. Geophys. Res. 102: 24669-24696.
Tessensohn, F. (1994): Terra Antartica 1(3): 553-558.

Is there a link between Cenozoic strike-slip faulting of the Transantarctic Mountains / Ross Sea Rift and the eastern margin of the Wilkes Subglacial Basin?

(poster p.)

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The Transantarctic Mountains (TAM) have been modelled as a flexural uplift of a half-graben-type extensional basin in the Ross Sea (STERN & TEN BRINK 1989). The Wilkes Subglacial Basin has been interpreted as a component of a flexural triad including the Ross Sea Rift (RSR), the TAM and the basin itself (TEN BRINK et al. 1997), or a rift basin within the East Antarctic Craton (DREWRY 1976), or a broader extended terrane (FERRACCIOLI et al. 2001). None of these models can be validated or rejected because extensive geophysical investigations are still lacking over the "backside" of the range. Recent geologic and seismic evidence suggests, however, that at least the tectonic setting of the RSR/TAM may be more complex than typically modelled: it may relate to Cenozoic reactivation of inherited Paleozoic boundaries as major right-lateral strike-slip fault belts (SALVINI et al. 1997, FERRACCIOLI & BOZZO 1999). These fault belts may link to south-western Pacific Ocean transform faults. Intense brittle deformations are kinematically compatible with this geodynamical model (STORTI et al. 2001, ROSSETTI et al. 2002).

A major open question is if Cenozoic strike-slip fault belts of the TAM/RSR region may extend also to the entirely ice–covered Wilkes Subglacial Basin region. We present an interpretation of aeromagnetic patterns and recently published structural data to address this question. Our combined analysis indeed hints to a connection between a major strike-slip fault system of the TAM and the eastern margin of the Wilkes Subglacial Basin (FERRACCIOLI & BOZZO in press). This connection, if true, implies that the Wilkes Subglacial Basin is not merely a flexural depression, neither a simple continental rift, nor a simple broad extended terrane. Since the strike-slip coupling we propose links the Wilkes Subglacial Basin to the RSR, the intervening TAM crustal block may not be a simple rift shoulder. Rather the range may result from more complex transform-fault phenomena (TEN BRINK et al. 1997) related to major transtension between East and West Antarctica. However, one of the weak aspects of our tectonic model is that it relies on the small aeromagnetic window presently available over the eastern margin of the Wilkes Subglacial Basin. Aerogeophysics coupled with seismological, deep electrical conductivity, GPS and geological investigations could link recent efforts along the Pacific Coast (BOZZO & DAMASKE 2001) with those over Victoria Land. This integrated approach would provide more robust constraints on the eastern margin of the Wilkes Subglacial Basin, which are required to test this new tectonic model.

Bozzo E. & Damaske, D. (2001): Terra Antartica Rep. 5: 109 pp.
Drewry, D.J. (1976): Tectonophysics 36: 301-314.
Ferraccioli F. & Bozzo E. (1999): J. Geophys. Res. 104: 25297-25319.
Ferraccioli F., Coren. F, Bozzo E., Zanolla C., Gandolfi S., Tabacco I. & Frezzotti M. (2001): EPSL 197: 407-421.
Ferraccioli F. & Bozzo E. (in press): Geol. Soc. London.

Rossetti, F., Storti, F. & Läufer, A.L. (2002): J. Geol. Soc. London 159: 159-173.
Salvini, F., Brancolini G., Busetti M., Storti F., Mazzarini F. & Coren F. (1997): J. Geophys. Res. 102: 24669-24696.
Stern,. T.A & ten Brink, U.S. (1989): J. Geophys. Res. 94: 10315-10330.
Storti F., Rossetti F. & Salvini F. (2001): Tectonophysics 341: 141-161.
ten Brink U.S., Hackney R.I., Bannister S., Stern T.A. & Makovsky Y. (1997): J. Geophys. Res. 102: 27603-27621.

Stratigraphic architecture of the western Victoria Land Basin re-interpreted from stratigraphic and seismic reflection data, Cape Roberts, McMurdo Sound
(oral p.)

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Core drilling by the Cape Roberts Project (CRP; 1997-1999) provided a complete, vertical stratigraphic transect through the western Victoria Land Basin (VLB) of McMurdo Sound, Antarctica. The core from CRP-1, -2/2A and -3 collectively records the period from c. 34 Ma (?late Eocene) to 17 Ma (Early Miocene) with a fragmentary Pliocene to Holocene record, and has been extensively interpreted in terms of evolving depositional environment and climate change. To date, however, correlation between the lithostratigraphy of the cores and seismic reflection data has been hampered by the presence of a shallow bottom-simulating reflector, such that local structural features have not been visible on seismic data. Consequently, the conventional interpretation of cross-sectional stratal geometry is of a gradually eastward-thickening wedge that extends into the centre of the VLB.

Recent reprocessing of USGS seismic line L2-84-403/404, a west to east (dip-oriented) transect that passes immediately north of the Cape Roberts drillholes, has facilitated a re-evaluation of Cape Roberts stratal architecture. We recognize a half-graben structure under the Roberts Ridge with a down-to-the west normal fault on its eastern margin, and at least one more similar feature downdip to the east. This suggests that rather than being a single, large depocentre with a slightly asymmetrical distribution of subsidence, the western VLB is in fact a complex of half-grabens. In turn, this allows a more geologically meaningful interpretation of stratal architecture in the Cape Roberts drillholes, and correlation of key surfaces with tectonic processes. Six tectonostratigraphic intervals can be recognized from the Cape Roberts cores, and are summarized below.

- 823.11 to 157.22 mbsf in CRP-3, coarse-grained, slope fan and apron deposits, c. 34 Ma, now interpreted to be synrift fill of the Roberts ridge half-graben. The top of this interval corresponds to the lowest seismic reflector that overlaps the basement high to the east of the Roberts Ridge half-graben.
- 157.22 mbsf in CRP-3 to 614.56 mbsf in CRP-2/2A, three relatively thick and complete transgressive-regressive glacimarine cycles (sequences), 32-31 Ma, and now interpreted to record a shift in the locus of rift sediment accumulation eastward into a new half-graben.
- 614.56 to 442.99 mbsf in CRP-2/2A, several relatively complete glacimarine sequences accumulated 31-29 Ma, and now interpreted as having accumulated during a period of decreasing though still rapid synrift subsidence.
- 442.99 to 306.65 mbsf in CRP-2/2A. numerous, relatively thin and incomplete sequences accumulated 29-24 Ma and now interpreted as recording a period of significantly slower, postrift subsidence.
- 306.65 to 130.27 mbsf in CRP-2/2A, three thick and complete glacimarine sequences, 24.1-23.7 Ma, interpreted as accumulating during a period of renewed synrift subsidence.

• 130.27 mbsf to top of Miocene section, numerous, relatively thin and incomplete sequences accumulated 23.7-17 Ma and now interpreted as recording re-establishment of the slower, postrift subsidence regime.

This reinterpretation allows a more meaningful correlation between subsidence curves for the Cape Roberts cores and cross-sectional stratal geometry, and discloses a complex rift history comprising more than one period of synrift subsidence driven perhaps by downdip migration of the locus of extensional subsidence with time. Examination of other seismic data in the region indicates that sediment accumulation probably continued for some time beyond 17 Ma. The subsidence pattern was modified further by flexural loading associated with the construction of the Ross Island volcanic edifices, and sediment accumulation was ultimately truncated by a major, regional angular unconformity. This unconformity is overlain only by a thin blanket of sediment, and is probably of Pliocene or Pleistocene age.

Definition of a Cenozoic alkaline magmatic province in the southwest Pacific without rift or plume origin

(oral p.)

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A Cenozoic (<50 Ma) bimodal, but largely basaltic, mostly alkaline igneous province covers a broad area of continental and oceanic lithosphere in the southwest Pacific has been conjecturally linked to rifting, mantle plumes, or hundreds of hot spots, but all of these associations have flaws. For example, plate reconstructions demonstrate that the last episode of major regional rifting in West Antarctica, eastern Australia and New Zealand occurred during the Mesozoic break-up of Gondwana. GPS and stress-field measurements show no extension in Australia, New Zealand and much of West Antarctica, suggesting that the widespread magmatism cannot be explained by rifting alone. Estimates of volumes of magmas erupted in West Antarctica and Australia, as well as magma production rates are low compared to areas associated with plumes. Uplift and doming typically associated with mantle plumes are also largely absent. Also, to explain the areal distribution of the volcanism, an unusually large plume would have to underlie the entire southwest Pacific, or there would have to be hundreds of hot spots, which are not observed. Clearly, new models for volcanism are required.

Comparison of the location of volcanoes and seismic shear wave perturbation models shows that this alkaline volcanic province is largely limited to regions with high-velocity lithospheric lids (velocity perturbations >~2 %) < 80 km thick. The exceptions to this are Peter I Island, the de Gerlach seamounts and young seamounts offshore Marie Byrd Land whose locations are controlled by trans-lithospheric structures. The province correlates with distinct low seismic velocity anomalies restricted to a zone in the mantle between ~60 and 200 km depth.

Geochemical studies show that for most of the region, the magmatism is a result of small degrees of melting (F = 1-3 %) of a source enriched in incompatible elements relative to primitive upper mantle. The enrichment may have involved the introduction of volatile-rich fluids or melts into pre-existing upper mantle. Metasomatic enrichment of the upper mantle by low degree melts, including infiltration of these melts into the overlying lithosphere, may explain regional geochemical signatures. In addition, metasomatized upper mantle can melt without excessive temperatures, implying that the low seismic velocities are primarily related to volatiles, in places, melt and perhaps slightly elevated temperatures.

The key to generating widespread, long-lived (~55 Ma), low volume alkaline magmatism is the combination of thin (<80 km) high-velocity lithospheric lids underlain by metasomatized, mostly Pacific mantle at only slightly elevated temperatures. The age of the metasomatism is not known but may be related to a combination of Paleozoic-Mesozoic subduction along the Pacific margin of Gondwana and possible plume-related activity in the Jurassic. During Cretaceous break-up of Gondwana, rifting in east Australia and West Antarctica did not result in voluminous magmatism despite thinning and regional extension of continental lithosphere containing metasomatized mantle. Although the magmatism has been linked broadly to tensional stress-fields, these are not requirements as evidenced by Australian volcansim in mildly compressional stress-fields for most of its history. Moderate extensional stress fields do seem to facilitate enhanced volcanic activity at places like Mt. Erebus, the site of active, low-level extension. All of these lines of evidence suggest that a regional heating event induced by a mantle upwelling event is required to allow alkaline magmatism.

Plate motion and seismic tomography studies propose that high density and velocity subducted slabs lying in the lower mantle beneath the region detached from the mantle transition zone in the late Cretaceous. Geodynamic model of the effects of an "avalanche" of detached slabs suggest that it is possible to generate vertical and lateral flow and high temperatures in the upper mantle. Although we do not call for a dramatic increase in temperature or mantle flow near the detached slabs, such a mechanism may induce slight heating, catalyzing melting of metasomatized mantle and eruption.

Aeromagnetic and gravity survey of shield basement along the central Ross margin of East Antarctica
(poster p.)

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The East Antarctic shield represents one of Earth's oldest and largest cratonic provinces, with a long-lived Archean to Proterozoic history. Long-standing interest in the geologic evolution of the East Antarctic shield has been rekindled by recent paleogeographic models linking East Antarctica to other Precambrian cratons as part of the Neoproterozoic Rodinia supercontinent. East Antarctica is also the central piece in the early Paleozoic East Gondwana mosaic, formed at a time of major changes in plate configurations, terrestrial surficial process, sea level, and marine geochemistry and biota. A clear understanding of the geological evolution of the East Antarctic shield therefore provides an essential foundation for studying early crustal evolution as well as subsequent resource distribution, biosphere evolution, and glacial and climate history. Due to nearly complete coverage by the polar ice cap, however, the interior of Antarctica remains the single most geologically unexplored continental shield. In the central Transantarctic Mountains in the vicinity of Nimrod Glacier, metamorphic and igneous rocks of the Archean-Proterozoic Nimrod Group provide a direct window into the Ross margin of the East Antarctic shield. To our knowledge, these rocks represent the only *bona fide* Archean crust exposed along the Transantarctic Mountains from northern Victoria Land to the Pensacola Mountains (>2500 km). As such, they provide an opportunity to directly compare geophysical signatures in the exposed part of the shield with those obtained over the adjacent polar plateau.

In the 2003-2004 austral summer, we will conduct a joint US-German airborne magnetic survey coupled with ground-based gravity measurements across the Ross margin of the East Antarctic shield in the Nimrod Glacier area. Our survey will be anchored at one end over the exposed basement rocks of the Nimrod Group, and extend in opposite directions across the polar plateau and the outboard Ross Orogen. Our major goals for this study are to determine the geophysical character of East Antarctic shield basement where it is exposed, define unique signatures that will help in exploration of ice-covered areas, examine crustal boundaries between the shield margin and deformed supracrustal rocks of the Ross Orogen, extend geophysical mapping of the shield basement as far as possible across the ice-covered plateau, and correlate crustal signatures and domains from our survey area with geologic provinces in other regions. This is an ideal area to conduct a geophysical study of this type, because: (a) crystalline rocks of the Nimrod Group consist of modified Archean and Paleoproterozoic protoliths representative of the East Antarctic shield; (b) these cratonic rocks are well-exposed, geologically well-characterized, and lie adjacent to deformed supracrustal rocks of the Ross Orogen; (c) recently compiled magnetic and gravity data from East Antarctica and Australia provide important datasets for comparison and correlation; and (d) data from surveys over the area between the Dry Valleys and Dome C show that the magnetic signatures of rocks beneath the polar plateau are distinct from Phanerozoic rocks in the Transantarctic Mountains.

We will collect high-resolution, airborne magnetic data along a transect extending from exposed rocks of the Nimrod Group across the adjacent polar ice cap. This survey will for the first time characterize the geologically well-known shield terrain in this sector using geophysical methods, providing an important baseline that will provide for better interpretation of future geophysical patterns in other ice-covered regions. We plan to collect about 30000 line-km of aeromagnetic data with a line spacing of 2.5 km, covering a corridor of about 70000 km^2. The portion of the corridor area over the Transantarctic Mountains will be flown as a "draped" helicopter survey, and the remainder of the corridor over the polar plateau will be flown by fixed-wing aircraft. Aeromagnetic data will be complemented by ground measurements of gravity over the exposed basement.

Detrital zircon age patterns from a large gneissic xenolith from Cape Phillips granite and from Robertson Bay Group metasediments, northern Victoria Land, Antarctica

(poster p.)

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A huge, contact-metamorphosed gneissic xenolith in the Devonian granite at Cape Phillips (GANOVEX TEAM 1987, FIORETTI et al. 1998), was tentatively interpreted as a possible klippe of the Wilson Terrane (KLEINSCHMIDT 1990), or as evidence of an older metamorphic basement below the Robertson Bay Group (VISONA' 2002). The detrital zircon age patterns of this xenolith and of two samples of the Robertson Bay Group (RBG) from the central and easternmost parts of the Robertson Bay Terrane (RBT) were investigated by SHRIMP analysis.

The zircon age spectra contain about 80 grains for each sample. $^{206}Pb/^{238}U$ ages were used for grains younger than 1100 Ma and $^{207}Pb/^{206}Pb$ ages for older grains. The latter were accepted only if they were > 90 % concordant.

The two RBG samples show similar spectra, with a dominant peak at 550-600 Ma and a series of three distinct peaks in the range 1000-1200 Ma, indicating the contribution of Grenville-age material; and smaller peaks of early Proterozoic to late Archean ages. The youngest grain of the easternmost sample is 481 Ma, followed by two grains at 515 and 518 Ma. The second RBG sample has one grain as young as 488 Ma, followed by a group of 4 grains at 496 Ma. The detrital zircon age spectrum of the gneissic xenolith closely resembles those of the two RBG samples, except for a dominant population at 498 Ma (mean of eight ages), represented by a peak as high as the two distinct signals within the 550-600 Ma range. There are also smaller Grenville peaks, early Proterozoic ages and indications of an Archean component. The youngest grain is 481 Ma old. The overall zircon age profile of these samples is similar to previous data on the RBG and is typical of Lower Palaeozoic sediments along the Gondwana margin (IRELAND et al. 1995). The youngest ages observed in both RBG samples would extend the Tremadocian or younger depositional age of the upper part (Handler Formation) of the RBG (BURRETT & FINDLEY 1984) to the "undivided lower RBG" (WRIGHT & BRODIE 1987). Regarding the youngest grains as possible outliers, the first age peak at approximately 495–500 Ma allows a maximum latest Cambrian to early Ordovician sedimentation age for the RBG, and places new constraints on the timing of the "Ross" metamorphic overprint in the RBT.

The strong similarity of the zircon age spectrum of the gneissic xenolith with those of the RBG suggests that this raft is not exotic to the RBG itself (possibly representing its unexposed deeper part), and appears to be inconsistent with both previously mentioned hypotheses. Alternatively, if the gneissic xenolith does represent the basement of the RBG, the similarity in the detrital zircon age spectra would be consistent with the RBG as a reworked sedimentary sequence derived from its basement.

Burrett, C.F., & Findlay, R.H. (1984): Nature, 307, 723-725.
Fioretti, A.M., Rocchi, S. & Balestrieri, M.L. (1998): Terra Antarctica Reports 2: 25-28.
GANOVEX Team (1987): Geol. Jb. B66: 7-79.
Kleinschmidt G. (1990): Polarforschung 60: 128-132.
Ireland T.R., Fanning C.M., Flöttmann T., Weaver S.D., Bradshaw J.D. & Adams C. (1995): 7th ISAES, Siena, Italy.
Visona' D. (2003): Terra Antartica Reports 9.
Wright T.O. & Brodie C. (1986): In: McKenzie (ed.). Gondwana 6th, Geophys. Monogr. Series. Washington DC, 40: 25-30.

Preliminary crust and upper mantle seismological model of Transantarctic Mountains from TAMSEIS

(oral p.)

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The large 2-D geometry of the Transantarctic Mountain Seismic Experiment (TAMSEIS) allows for characterizing the East Antarctic crust and upper mantle deep into the interior. This array consists of three sub-arrays that 1) traverse 370 km from McMurdo across the Transantarctic Mountains with 20 km spacing, 2) traverse perpendicular to the first sub-array with spacing of 80 km running 1400 km inland from Terra Nova, and 3) extend along the coastline at ~80 km spacing. The 43 seismic stations are used to examine the Antarctic lithosphere with better resolution and extent than any previous experiment.

Using a niching genetic algorithm (NGA is a guided search method) we are able to invert both receiver functions and surface wave phase velocities simultaneously. As the two data sets are complimentary they increase the uniqueness of the solutions and reduce need for a priori information. Additionally the NGA allows us to implement ice layers with known thickness and velocity without adversely affecting the inversion. This method produces a variety of 1-D models representing structures underlying TAMSEIS stations. By analyzing these 1-D structures together, we produce 2-D cross sections. From the 2-D cross sections we construct a 3-D model representing the crust and uppermost mantle from the Ross Sea to 1400 km within the East Antarctic plate.

We obtain preliminary crustal and upper mantle seismic velocity models using both surface wave and receiver function data from TAMSEIS broadband seismometers. These preliminary models indicate several structural variations from the Ross Sea to the East Antarctic Ice Plateau. 1) The East Antarctic crust thins through the Transantarctic Mountains from ~40 km to ~20 km at the Ross Sea, coinciding with uplift. 2) The Ross Sea crust and upper mantle are largely different from those observed beneath East Antarctica. The Ross Sea moho is not only more shallow than that of East Antarctica, but the underlying mantle is seismically much slower. 3) The East Antarctic crust is homogeneous for a large lateral extent. These observations may suggest a buoyant load underlying the West Antarctic Rift System, and a coincident response from the colder, older, and more brittle East Antarctic plate.

Thermochronologic and structural constraints on the evolution of the Transantarctic Mountains in the Reedy Glacier region

(poster p.)

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The Reedy Glacier outlets through the Transantarctic Mountains (TAM), the uplifted flank of the West Antarctic rift system (WARS), near the head of the Ross Embayment. Similar to elsewhere along the TAM, the geomorphology of the range front is characterized by relatively low relief nunataks within a zone of frontal piedmont glaciers 20-30 km wide, backed by an area of dissected ridges, leading up to an impressive escarpment of ~2000 m relief. The escarpment parallels the coast before curving around to follow the trace of the glacier. Fieldwork was undertaken to determine the timing and patterns of denudation and their relationship to the structural and geomorphic evolution of the TAM. Samples were collected for low temperature thermochronology, from low elevation near-coastal nunataks and from vertical profiles on dissected ridges near the escarpment. On the east side of the glacier, samples from Mt. Vito (1150-1900 m elevation) yielded apatite fission track (AFT) ages from 55 Ma to ~85 Ma. Confined track length distributions (CTLD) have means and standard deviations of 13.4 μm and 1.5 μm for the lowest elevation samples to 11.6 μm and 2.5 μm for the highest samples. These data record cooling as samples passed slowly through the apatite partial annealing zone (PAZ), as a result of slow denudation during the Late Cretaceous. The denudation rate decreased in the Late Cretaceous-Early Cenozoic, but was followed by a significant increase in rate of denudation (sometime after 55 Ma). At Christmas Eve Pass, also on the east side of the Reedy Glacier, four samples across an east-west trending fault zone yielded identical AFT ages (~150 Ma). Faults strike 086-110°, averaging ~090 and are near vertical (85°N) with associated crush zones. Slickenlines are mostly horizontal and indicative of oblique strike-slip. While no reliable sense of shear indicators were observed at Christmas Eve Pass, the sense of shear from nearby parallel fault zones indicate dextral slip. The lack of apparent offset of these AFT ages, plus the structural data indicate that there is no significant vertical displacement across these faults.

In contrast, on the west side of the Reedy Glacier AFT ages from Hendrickson Peak are all ~200 Ma with mean lengths of 11-12 μm and standard deviations of 1.9-2.6 μm. The lower elevation continuation of this profile, at the Colorado Glacier, ~3 km to the north, is more complex. The upper sample from the Colorado Glacier profile has an AFT age of 326 Ma, the oldest AFT age from the TAM, whereas the lower samples vary from 140-110 Ma, all with CTLDs indicative of considerable residence within an apatite PAZ. Our interpretation for this composite profile is that the upper sample from the Colorado Glacier has not been reset by the thermal event accompanying mid-Jurassic Ferrar magmatism, most likely due to the presence of more Cl-rich apatite grains (which are more resistant to annealing) than the Hendrickson Peak samples. The AFT ages of ~200 Ma at Hendricksons Peak are older than Ferrar magmatism (180 Ma). Considering that, the distribution of single grain ages and presence of very short tracks indicates that the thermal effects of Ferrar magmatism did not completely anneal tracks in these apatites. In contrast, other samples from the Colorado Glacier profile were all reset in the Jurassic, and the age-elevation profile suggests a period of denudation in the Late Jurassic-Early Cretaceous.

In summary, thermal effects due to Jurassic magmatism resulted in variable annealing of fission tracks, depending on their relative crustal depth and apatite chemistry. Thermal relaxation of isotherms was followed by a period of denudation in the Late Jurassic-Early Cretaceous, then an interval of relative tectonic and thermal stability until the Late Cretaceous when another period of slow denudation ensued. This was followed by yet another interval of relative tectonic and thermal stability until Cenozoic denudation, the timing of which is not directly constrained by this data. Cenozoic evolution of the rift flank was a result of escarpment retreat and erosion with no apparent normal faulting, followed by dextral transtension along east-west faults within the TAM Front. The marked difference in AFT ages from similar elevations from the west and east sides of the Reedy Glacier lead us to propose that a fault exists beneath the Reedy Glacier.

Tracking the West Antarctic rift flank
(oral p.)

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The West Antarctic rift system (WARS) is an intracontinental rift system, similar in size to the Basin and Range Province of southwestern USA, and includes the area under the Ross Sea, Ross Ice Shelf and a considerable portion of the West Antarctic Ice Sheet. The western edge (or inland flank) of the rift, ~3500 km long is defined by the Transantarctic Mountains (TAM) in the Ross Embayment and the northwest edge of the Ellsworth-Whitmore Mountains crustal block (EWM). These two parts of the rift flank have different architecture, geomorphic expression, geology and apparent lithospheric structure. The history of the WARS is poorly known because so much is covered by either ice shelf or ice sheet. The amount of extension is not well constrained, but plate reconstructions indicate that most extension occurred during the Cretaceous (105-85 Ma), and indeed mylonites of that age have now been dredged from the Ross Sea. Since the Eocene, extension has apparently been confined to the western side of the WARS in the Victoria Land Basin. Key questions remain about the WARS; for example; is information obtained in the Ross Sea representative of the entire rift system? Does seafloor spreading in the Adare Trough mark rupture in extended continental lithosphere along the west side of the WARS? How does the timing of extension vary within the rift and how is extension accommodated? Do plate boundary forces control the stress field? Pertinent to answering these questions is the geologic and tectonic evolution of the rift flank, especially as the oldest sediments cored in the WARS are Late Eocene. In this context we summarize results of low-temperature thermochronology from the western WAR flank, both in the TAM as well as in the EWM, aimed at determining the timing and patterns of denudation along the rift flank. The patterns of denudation along the WAR flank are striking in their consistency. Denudation events are recognized in the Late Jurassic-Early Cretaceous, Early Cretaceous, Late Cretaceous, Early Cenozoic (initiated in the Eocene and also in the Oligocene).

Jurassic tholeiitic magmatism associated with the initial stages of Gondwana break-up occurs along the TAM from the Pacific coast across Antarctica to the Dufek Massif. In nearly all locations studied to date along the TAM thermal effects accompanying Jurassic magmatism have completely annealed fission tracks in apatites and partially reset $^{40}Ar/^{39}Ar$ feldspar ages. The Late Jurassic-Early Cretaceous denudation event is recognized in the EWM, the Thiel Mountains and southern TAM. This event, particularly strong in the EWM may be related to translation of the EWM which did not reach its present location until ~110 Ma, about when this denudation event ceased. An Early Cretaceous denudation event recorded in northern Victoria Land is likely related to initial separation between Australia and Antarctica. Other Cretaceous denudation events along the TAM are most likely related to the main period of extension within the WARS, thought to be accommodated on low-angle detachment faults. The most pronounced rift-flank related phase of denudation recognized along the TAM begins in the Early Cenozoic and varies in magnitude at the front of the TAM from 4-9 km. Initiation of Early Cenozoic denudation youngs towards the south, and decreases in magnitude with distance away from WARS. In the Shackleton Glacier denudation initiated in the Oligocene may be related to the change in stress regime from orthogonal to dextral strike-slip that resulted in block tilting within the faulted TAM Front. A key question to address with respect to development of the rift flank is whether significant Cenozoic denudation along the TAM has occurred along the northwestern flank of the EWM. While, thermochronologic data from the EWM does permit a significant component of post-Early Cretaceous denudation, forward modeling permits both Late Cretaceous and Cenozoic events. The geomorphic contrasts between the TAM and the northwest flank of the EWM suggests however, that significant Cenozoic rift flank formation (as displayed by the TAM) ceases at the southern end of the Ross Embayment.

Fitzgerald, P.G. & Baldwin, S.L. (2003, this volume): Tracking the West Antarctic rift flank.-

Episodic Cenozoic denudation in the Shackleton Glacier area of the Transantarctic Mountains: a record of changing stress regimes?

(oral p.)

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The Transantarctic Mountains (TAM) define the western flank of the Mesozoic-Cenozoic West Antarctic rift system. The Shackleton Glacier in the central TAM is one of the major outlet glaciers through which ice of the East Antarctic Ice Sheet flows to join the Ross Ice Shelf. We present new apatite fission track (AFT) data from three vertical profiles on the western side of the Shackleton Glacier at Mts Speed (800 m relief), Wasko (800 m relief) and Franke (1250 m relief). With the exception of a few samples with retentive Cl-rich grains yielding older ages, all three profiles are characterized by AFT ages between ~40 and ~25 Ma. The AFT age versus elevation patterns are systematic, with older ages occurring at higher elevations. In general, samples with AFT ages >~30 Ma have confined track length distributions (CTLDs) with means <14 μm and standard deviations >1.5 μm indicative of a significant period of time spent within an apatite partial annealing zone (PAZ). In contrast AFT ages generally less than ~30 Ma have CTLDs with means >14 μm and small standard deviations indicative of more rapid cooling. Although these AFT data do not constrain the area's thermal history prior to 40 Ma, they do indicate a period of relative thermal stability prior to 30 Ma was replaced by more rapid cooling in the Oligocene. We can interpret these results in the context of previous work done east of the Shackleton Glacier. There, near Cape Surprise, AFT analyses on samples collected in a number of vertical profiles reveal the base of an exhumed apatite PAZ at ~40 Ma (MILLER et al. in prep.). Collectively, the AFT data from both sides of the Shackleton Glacier indicate the transition from a period of relative thermal and tectonic stability to a period of faster cooling at 40 Ma, most likely due to an increase in the rate of denudation. This was followed by another, shorter period of relative thermal and tectonic stability until another pulse of cooling and denudation began at ~30 Ma. We relate this episodic thermal and denudation history to the changing stress regime along the front of the TAM in the Eocene and Oligocene.

Geomorphic and structural studies near Cape Surprise (MILLER et al. 2001) indicate the presence of two fault sets, normal faults oriented generally parallel to the TAM Front and normal faults oriented at a high angle to the TAM Front. Kinematic analysis of lineated fault surfaces on these sets suggest orthogonal extension was followed by dextral transtension, consistent with data from elsewhere along the TAM. Asymmetric drainage patterns within the TAM Front between the Shackleton and Liv Glaciers suggest down-to-the-northwest block tilting and the formation of half-graben along faults striking nearly perpendicular to the range, and possibly related with the transition to dextral transtension. The onset of increased denudation at ~40 Ma is associated with orthogonal extension and faulting that accompanied Eocene rock uplift and base level change along the front of the TAM. On the west side of the Shackleton Glacier, Mts Speed, Wasko, and Franke appear to define the southeasterly flank of a now-dissected down-to-the-northwest tilted crustal block lying within the TAM Front. The AFT data from either side of the Shackleton Glacier indicates that a major transverse fault defines the path of the Shackleton Glacier, further evidence for segmentation along the TAM. We suggest that the onset of rapid denudation at ~30 Ma recorded on the west side of the glacier is a result of block tilting accompanying the transition from orthogonal extension to dextral transtension. This change in stress regime has been previously constrained as occurring at ~30 Ma by SALVINI et al. (1997) from studies in the Victoria Land Basin.

Miller, S.R., Fitzgerald, P.G. & Baldwin, S.L. (2001): Terra Antartica 8: 11-24.
Miller, S.R., Fitzgerald, P.G., Baldwin, S.L. & and O'Sullivan, P.B. (in prep.).
Salvini, F., Brancolini, G., Busetti, M., Storti, F., Mazzarini, F. & Coren, F. (1997): J. Geophys. Res. 102: 24669-24696.

Evidence for a continuation of the late Neoproterozoic Darling Fault Zone of western Australia to the Pacific margin of East Antarctica
(poster p.)

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The Darling Fault extends north-south for 1000 km along the western margin of the Australian craton and its curvilinear trace dominates magnetic and gravity images of the region. Its present morphology reflects Mesozoic rifting, but it reactivated an older structure known as the Darling Fault Zone developed during Neoproterozoic transcurrent movement. This movement juxtaposed the Archaean Yilgarn craton and Mesoproterozoic Albany-Fraser orogen with several late Mesoproterozoic to Neoproterozoic gneissic blocks exposed along the western edge of Australia, which are collectively called the Pinjarra Orogen (FITZSIMONS 2003). East of the fault zone, there was no pervasive tectonism or magmatism after 1130 Ma and rocks have TDM Nd model ages older than 1.8 Ga, but rocks to the west have evidence of magmatism and deformation at 1100-1000, 750-700 and 550-500 Ma and TDM Nd model ages of 2.2-1.1 Ga.

The extension of this structure into Antarctica is most likely marked by the Denman and Scott glaciers of the Queen Mary Land coast (HARRIS 1995). Mesoproterozoic gneiss in the Bunger Hills, immediately east of these glaciers, has TDM Nd model ages of 2.3-1.8 Ga, no evidence of pervasive tectonism or magmatism after 1130 Ma, and an identical history to the Albany-Fraser orogen, whereas rocks west of these glaciers include granitoid protoliths emplaced at 3000 and 550 Ma, evidence of metamorphism at 1050 and 500 Ma, and TDM Nd model ages of 3.2-1.6 Ga (SHERATON et al. 1995). Limited corridors of regional aeromagnetic data in Queen Maud Land are too widely spaced to identify any major crustal boundaries beneath the ice. GOLYNSKY et al. (2002) did suggest the existence of a "Bunger Anomaly" near the coast that appears to deviate sharply westwards away from the expected trace of the Darling Fault Zone, but its continuity is impossible to assess from the data available and its interpretation is uncertain. Given the consistent orientation of the Darling Fault Zone in Australia for 1000 km, it is likely to continue across Antarctica with a broadly north-south trend. This would take it through the Vostok region of the plateau, where a detailed geophysical survey has identified a north-south trending boundary between two regions of quite distinct gravity and magnetic characteristics (STUDINGER et al. 2003). The location and orientation of this boundary is consistent with it being a continuation of the Darling Fault Zone. This north-south trend would continue across Antarctica to the central Transantarctic Mountains, where there is yet more evidence of a major boundary in the Precambrian basement. This evidence is preserved by granite plutons of the Granite Harbour Intrusive suite, associated with the Cambro-Ordovician Ross orogeny. Isotope data for these plutons show a distinct jump in TDM Nd model age in the vicinity of the Shackleton Glacier, from 2.2-1.6 Ga for the northern and part of the central Transantarctic Mountains, to 1.5-1.1 Ga south of the Shackleton Glacier into the Queen Maud and Horlick Mountains (BORG et al. 1990, BORG & DE PAOLO 1994). These ages mirror those on either side of the Darling Fault Zone in Australia, and the identification of 1100-1000 Ma zircon xenocrysts in granites from the Pensacola and Queen Maud Mountains (VAN SCHMUS et al. 1997) allow further correlations with the Pinjarra Orogen. Traditionally this region of younger basement in the central Transantarctic Mountains has been interpreted as an allochthonous terrane accreted to the Ross margin, and older basement is inferred to lie inboard under the ice, but it is also possible that it represents the continuation of the Pinjarra Orogen from Queen Maud Land, via Vostok. More geophysical data are needed from the Antarctic plateau to demonstrate whether these features do indeed reflect a fundamental geological boundary or a coincidental alignment of unrelated structures.

Borg, S.G. & DePaolo, D.J. (1994): Geology 22: 307-310.
Borg, S.G., DePaolo, D.G. & Smith, B.M. (1990): J. Geophys. Res. 95(B5): 6647-6667.
Fitzsimons, I.C.W. (2003): In: Spec. Publ. Geol. Soc. London 206: in press.
Golynsky, A.V., Alyavdin, S.V., Masolov, V.N., et al. (2002): Tectonophysics 347: 109-120.
Harris, L.B. (1995): Geol. Soc. India. Mem. 34: 73-100.
Sheraton, J.W., Tingey, R.J., Oliver, R.L. & Black, L.P. (1995): Austral. Geol. Surv. Org. Bull. 244.
Studinger, M., Bell, R.E., Karner, G.D., Tikku, A.A. et al. (2003): Earth Planet. Sci. Lett. 205: 195-210.
Van Schmus, W. et al. (1997): In: The Antarctic Region: Geological Evolution and Processes: 187-200.

Detrital zircon populations in metasedimentary rocks from Dronning Maud Land and western Australia: is the 1.1 Ga Maud Province a collisional suture between southern Africa and Australia?

(oral p.)

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Grenville-age metamorphic belts are widespread in East Antarctica and its Gondwana neighbours of Australia, India and southern Africa. These belts preserve evidence for multiple tectonic events between 1350 and 900 Ma, and although previously regarded as a single continuous collisional orogen, they are now known to comprise a number of distinct provinces juxtaposed by 550 Ma tectonism. Three major Grenville-age domains exist in Antarctica, each with a different age for high-grade collisional tectonism: namely the Maud (1090-1030 Ma), Rayner (990-900 Ma) and Wilkes (1330-1130 Ma) provinces, which are closely related to similar rocks in southern Africa, the eastern Ghats of India and the Albany-Fraser Orogen of Western Australia, respectively. A fourth group of Grenville-age rocks occurs as displaced blocks in the Neoproterozoic Pinjarra Orogen of Western Australia, which preserve evidence for high-grade tectonism at 1090-1030 Ma. This age range corresponds closely with that of the Maud Province, raising the possibility that the two are related.

Grenville-age rocks in the Pinjarra Orogen comprise 1090 Ma granitic orthogneiss in the Leeuwin Complex and psammitic to pelitic paragneiss in the Northampton and Mullingarra complexes, deformed and metamorphosed to amphibolite or granulite facies at 1080-1030 Ma. This tectonism is traditionally believed to reflect collision of Australia with India at c. 1100 Ma, but this need not be the case given that East Gondwana is now known to have assembled at 550 Ma and it is quite likely that India and Australia only attained their Gondwana positions at this time. The Maud Province is interpreted as an 1150-1100 Ma magmatic arc and back-arc basin, developed at the margin of an unexposed craton that collided with the southeastern margin (present-day coordinates) of the Kaapvaal-Zimbabwe Craton of southern Africa at c 1100 Ma, resulting in pervasive deformation, granulite-facies metamorphism, and magmatism at 1090–1030 Ma. The unidentified craton is widely assumed to be the East Antarctic Shield, but again this need not be the case given widespread evidence that East Antarctica did not assemble until 550 Ma.

Evidence for the possible identity of the colliding cratons in both cases is provided by detrital zircon. Comparison of SHRIMP U-Pb zircon age data for three paragneiss samples from the Pinjarra Orogen (BRUGUIER et al. 1999, COBB 2000) and two samples from the Maud Province (ARNDT et al. 1991, HARRIS 1999) reveals a number of striking similarities. 2100-1110 Ma detrital grains dominate all samples, with a marked lack of c 1500 Ma grains. Although different samples are dominated by different populations within this range, significant detrital populations at 1100-1115, 1160-1220, 1280-1310, 1350-1390, and 1420-1440 Ma occur in samples from both regions. Age spectra from the Pinjarra Orogen and Maud Province are indistinguishable within the uncertainties of the data, and imply that paragneisses in both areas were part of the same sedimentary sequence eroded from the same source rocks; i.e. they are fragments of the same collisional orogen. Pre-1130 Ma detrital populations in both areas correspond to the ages of basement rocks in the Albany-Fraser Orogen and Wilkes Province, whereas 1130-1100 Ma grains were eroded from the magmatic arc exposed in the Maud Province, consistent with deposition at an active margin of an Australian–Antarctic Craton. The sedimentary rocks were then deformed and metamorphosed as the Kaapvaal-Zimbabwe Craton collided with this convergent margin at 1100 Ma.

Arndt, N.T., Todt, W., Chauvel, M., Tapfer, M. & Weber, K. (1991): Geol. Rundschau 80: 759-777.
Bruguier, O., Bosch, D., Pidgeon, R., Byrne, D. & Harris, L. (1999): Contrib. Miner. Petrol. 136: 258-272.
Cobb, M.M. (2000): unpubl. BSc (Hons) Thesis, Curtin University of Technology, Perth.
Harris, P.D. (1999): unpubl. PhD Thesis, Rand Afrikaans University, Johannesburg.

Correlation of the 1.1 Ga Maud Province with its Gondwana neighbours and the continuation of the East African Orogen into Antarctica

(poster p.)

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The East African Orogen has long been interpreted as a north-south trending continental collision zone resulting from late Neoproterozoic closure of the Mozambique ocean, but the continuation of this suture into Dronning Maud Land of Antarctica remains enigmatic (SHACKLETON 1996). The location of a collisional suture is commonly identified by rock types typical of the suture zone itself, such as ophiolites or eclogites, but such features may be poorly preserved in deeply eroded Precambrian orogens. Given that a major suture zone is unlikely to juxtapose crustal blocks with similar histories, another constraint on the location of a suture is that it should not pass through a region of apparently consistent geology.

The Maud Province of western Dronning Maud Land is characterized by high-grade gneiss with metamorphic ages of 1090-1030 Ma (ARNDT et al. 1991). Further east, in central Dronning Maud Land, magmatism and granulite-facies metamorphism at 650-500 Ma is attributed to closure of the Mozambique ocean, but this region still preserves protoliths with 1090-1030 Ma metamorphic ages (JACOBS et al. 1998). Similar ages have been retrieved from gneisses along the eastern edge of the Zimbabwe craton in western Mozambique (MANHICA et al. 2002) and in the Lurio Foreland of northeastern Mozambique (KRÖNER et al. 1997), which lie adjacent to Dronning Maud Land in Gondwana reconstructions. It is likely that these high-grade rocks represent dispersed fragments of an originally contiguous late Mesoproterozoic terrane. JACOBS & THOMAS (2002) suggested that these rocks formed the Lurio-Maud Microplate within the Mozambique ocean, and that the Mozambique suture had two strands passing either side of this microplate. However, lack of a pervasive Neoproterozoic overprint in western Dronning Maud Land and western Mozambique implies that late Mesoproterozoic rocks in these regions developed in situ adjacent to the eastern margin of the Archaean Kaapvaal-Zimbabwe craton. Indeed these rocks have been interpreted as a Mesoproterozoic collision zone between the Kaapvaal-Zimbabwe craton and another unidentified craton (GROENEWALD et al. 1995). It follows that the Lurio-Maud terrane is likely to lie on the southern African side of any Mozambique suture zone.

In fact there is some doubt whether a Mozambique suture extends into Antarctica at all. Dominant late Neoproterozoic structural trends in the Lurio Belt, central Dronning Maud Land and Sør Rondane Mountains are sub-parallel to the Antarctic coastline in Gondwana reconstructions, although transcurrent structures are developed at a higher angle to the coastline close to the margin of the Kaapvaal-Zimbabwe craton. These coast-parallel structures follow the trend of the Neoproterozoic Zambezi belt of south-central Africa, where there is new structural, petrological and isotopic evidence for Neoproterozoic ocean closure and continental collision (DE WAELE et al. 2003, JOHN et al. 2003). These data turn traditional models for the Neoproterozoic assembly of Gondwana on their head, and suggest that Neoproterozoic tectonism in Dronning Maud Land could have developed along the southern margin of an extension of an east-west "Zambezi" suture, rather than along a north-south "Mozambique" suture. If this suture passes into Antarctica it must do so in the Lützow Holm Bay region of eastern Dronning Maud Land.

Arndt, N.T., Todt, W., Chauvel, M., Tapfer, M. & Weber, K. (1991): Geol. Rundschau 80: 759-777.
De Waele, B., Wingate, M.T.D., Fitzsimons, I.C.W. & Mapani, B.S.E. (2003 in press): Geology.
Groenewald, P.B., Moyes, A.B., Grantham, G.H. & Krynauw, J.R. (1995): Precambrian Res. 75: 231-250.
Jacobs, J. & Thomas, R. (2002: In: Antarctica at the Close of the Millennium, R. Soc. N.Z. Bull. 35: 3-18.
Jacobs, J., Fanning, C.M., Henjes-Kunst, F., Olesch, M. & Paech, H.-J. (1998): J. Geol. 106: 385-406.
John, T., Schenk, V., Haase, K., Scherer, E. & Tembo, F. (2003): Geology 31: 243-246.
Kröner, A., Sacchi, R., Jaekel, P. & Costa, M. (1997): J. African Earth Sci. 25: 467-484.

Manhica, A., Grantham, G.H, Armstrong, R.A., et al. (2002): Spec. Publ. Geol. Soc. London 184: 303-322.
Shackleton, R.M. (1996): J. African Earth Sci. 23: 271-287.

IGCP 440 geodynamic map of Rodinia - draft map of Antarctica

(poster p.)

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One of the principal aims of IGCP 440 (Rodinia Breakup and Assembly) is to produce a set of maps depicting the tectonic evolution of Rodinia, the supercontinent believed to have assembled at the close of the Mesoproterozoic. Central to this endeavour will be a 1:10 million scale geodynamic map of Rodinia, and a number of regional compilers have been approached to draft maps for their areas of expertise, before these maps are combined into one or more possible Rodinia configurations.

The Rodinia Map Steering Committee has developed a legend, which classifies mappable units on the basis of tectonic setting and age. Map colours are based primarily on tectonic setting, with the following broad categories: intracratonic magmatic rocks, AMCG suite, continental arc rocks, island arc rocks, rift related rocks, foreland basin rocks, intracratonic basin rocks, passive margin rocks, and high-grade metamorphic rocks of unspecified or unknown tectonic setting. Each of these categories is subdivided into age ranges of 1600-1300 Ma, 1300-1100 Ma, 1100-900 Ma and 900-700 Ma. Rocks younger than 700 Ma will not be shown, since they did not exist in Rodinia times, and those older than 1600 Ma are depicted as cratonic blocks with some further subdivision into age ranges of greater than 2500 Ma, 2500-2200 Ma, 2200-2000 Ma, 2000-1800 Ma, and 1800-1600 Ma. There are means of depicting a later metamorphic overprint on units of a particular tectonic setting, and of showing protolith ages in regions of later high-grade metamorphism. Each unit will be linked to tables of geochronological data and relevant references.

The task of the regional compilers is to produce a map of their region using this legend. Antarctica presents a number of special problems in this regard. Most units within the age range of interest are deeply eroded metamorphic rocks whose regional context is clouded by sparse outcrop and minimal geophysical data, making tectonic interpretations problematic in many cases. Antarctica is, however, a critical component in many of the suggested reconstructions of Rodinia, and it is important that the Antarctic regional map is as complete and accurate as possible. We have compiled a preliminary map of the region, at greater detail than the final version to be incorporated into the Rodinia Map. The map is relatively simple, with poor exposure restricting the number of units that can be shown, but in some cases our interpretations have been based on limited and/or conflicting data and we seek feedback from the Antarctic Earth Science community. We would like comments on all aspects of the map including our choice of mappable units, the location and orientation of boundaries between them, and our interpretations of their tectonic setting.

An important outcome of the Antarctic map will be to identify priorities for future work. Problems already highlighted during our preliminary compilation include: limited knowledge of basement protolith ages in the Lützow Holm Bay and Sør Rondane area; almost no knowledge of the lateral extent, field relationships and tectonic setting of 750 Ma granitoid plutons reported from eastern Dronning Maud Land; little understanding of the age and relationships between different components of the southern Prince Charles Mountains, and a need for geophysical surveys to be focused around and inland from regions where the presence of a major crustal boundary is suspected, including

Lützow Holm Bay, the Denman Glacier region, the Shackleton Range, and the central Transantarctic Mountains.

Obviously Antarctica should not be considered in isolation, and some of our interpretations may be influenced significantly by data from better-exposed rocks in Africa, India, Australia and elsewhere, but at this stage we hope to derive a map that is at least compatible with available data from Antarctica. Regional maps will be combined and finalized early in 2004, with plans for a preprint of the final Rodinia Map to be presented at IGC in Florence in August later that year.

Deep crustal structure of the central Drake Passage from 3D gravity inversion - Shackleton Fracture Zone and West Scotia Ridge, Antarctica -

(poster p.)

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The tectonic evolution of the South Atlantic and the relationships with the Pacific Ocean in the Drake Passage are analyzed in the proximities of the boundary between the Scotia and Antarctic plates, which currently show a main sinistral displacement in the Scotia Arc region. The Scotia Plate, located between the two major Atlantic and Antarctic plates, has a complex internal structure formed by several spreading centers with different orientations. The western centers, of which the West Scotia Ridge (WSR) is the most important, ceased activity approximately between anomaly 5 and 3A. The Shackleton Fracture Zone (SFZ) is an active transpressive sinistral fault zone that delineates the western boundary of the Scotia Plate.

Gravity and bathymetric data from the ANTPAC97/98 cruise of the Spanish BIO Hespérides were collected in the area of interception between the SFZ and the WSR. The data were analyzed to determine by numerical inversion the 3D deep structure. Data from the Global Gravity Grid and Global Sea Floor Topography were also used to enlarge the cruise area. The analysis performed includes the integration of the two sets of data. Water layer contribution to the gravity anomaly was eliminated, taking into account the bathymetry. Spectral analysis of the reduced data yielded mean crust-mantle interface (CMI) depths of 10.5 ±1.2 km and 10.7 ±1.2 km for the cruise and combined data sets respectively. The 3D model obtained from this inversion generally agrees with the 2D models established along seismic profiles, where gravity and multichannel seismic data are available.

The SFZ and the WSR are linear structures that present an increase in the CMI depth. The SFZ is generally characterized by a positive relief with respect to the surrounding areas and a deep CMI, indicating a crustal thickening that is mainly related to the activity of reverse and transpressive faults. Local uplifts of the CMI are associated with the activity of a number of processes, including the development of transtensional and nodal basins associated with crustal thinning, and the westward propagation of the WSR into the SFZ. The WSR near the SFZ shows an asymmetric topography and a deep structure as a result of inversion tectonics, which induced a northwestward thrusting following the end of spreading. The tectonics of this structure forced greater CMI depths in the central valley and higher relieves on the SE margin than on the NW margin of the central valley. Minimum crustal thicknesses are observed towards the SE of the ridge. Along the WSR and towards the NE, the central valley has a thinner crust with shallow CMI depths, suggesting that the slip of the thrust may be discontinuous along the spreading center and may increase towards the SFZ. The WSR intersect the SFZ producing areas with high crustal thickness, related to the activity of the WSR valley thrust and generating areas of local CMI uplift. The WSR is an inactive structure that intersects the NE side of the SFZ. The active faults of the SFZ related to the Scotia-Antarctic plate boundary may be, in consequence, probably located along the axis or the SE slopes of the SFZ. The crust of the Antarctic plate is also intersected by the SFZ and seems to be affected, to some degree, by an extension of the NE-SW thickening of the Scotia plate. Finally, due to the presence of a volcanic edifice, a small local isometric crustal thickening is recognised, which could be attributed to the isostatic compensation effect.

The 3D gravity numerical inversion of the bathymetric and free air anomaly data from field data combined with the Global Gravity Grid and the Global Sea Floor Topography in areas with an approximately homogeneous oceanic crust, scarce sediments, and good coverage of ship data proved to be an useful tool to determine the deep tectonic structure of the crust.

Provenance and tectonic setting of Pre-Jurassic rocks at the English Coast, eastern Ellsworth Land

(oral p.)

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A recent model for the Antarctic Peninsula suggests accretion of allochthonous terranes onto the Gondwana margin (VAUGHAN & STOREY 2000) during the late Cretaceous Palmer Land event (VAUGHAN et al. 2001). In the southern part of the Antarctic Peninsula the junction between the Gondwana margin and allochthonous units is situated in the English Coast region of eastern Ellsworth Land.

Early Jurassic volcanics and sediments rest on Permian and possibly pre-Permian sedimentary and metasedimentary sequences in the English Coast region (LAUDON 1991). The Jurassic rocks are correlated with the Mount Poster and Latady formations present on the Gondwana margin in the southern Antarctic Peninsula. Thus, the pre-Jurassic rocks are thought to form the oldest known sediments of the Gondwana margin. However, correlations of the English Coast rocks with the Gondwana margin are poorly constrained and they could equally form part of an accreted terrane.

Despite the important tectonic and stratigraphic setting, rocks from the English Coast area remain largely unstudied, as the paucity of exposure has hindered detailed structural and sedimentological analysis. However, a new technique that couples SHRIMP U-Pb analyses with Laser ablation ICP isotope analyses for detrital zircons enables the provenance of sediments from the English Coast region to be better assessed than was previously possible. Such analyses, combined with Sm-Nd, Sr and Pb analyses for the sediments and plutonic rocks that cut the sediments, will be presented to enable a better assessment of the affinity of the English Coast rocks.

Laudon, T.S. (1991): In: M.R.A. Thomson, J.A. Crame & J.A. Thomson (eds). Geological evolution of Antarctica, 455-460.
Vaughan, A.P.M. & Storey, B.C. (2000): J. Geol. Soc. London 157: 1243-1256.
Vaughan, A.M.P., Pankhurst, R.J. & Fanning, C.M. (2002): J. Geol. Soc. London 159:113-116.

The road to Gondwana via the early SCAR symposia
(oral p.)

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Earth-science symposia under the Scientific Committee on Antarctic Research (SCAR) have now spanned forty years. Earliest ones had a significant role in acceptance of the theory of continental drift by Antarctic geologists from the Northern Hemispherc, a concept now without debate. An attendee of all nine SCAR meetings, the author focuses this report on the first three symposia, held at 7-year intervals: (1) Cape Town, South Africa in 1963; (2) Oslo, Norway in 1970; and (3) Madison, Wisconsin, USA in 1977. The 4- and 5-year intervals of succeeding symposia reflect the increasing pace of research in Antarctica (SCAR-4, Adelaide 1982; SCAR-5, Cambridge 1987; SCAR-6, Tokyo 1991; SCAR-7, Siena 1995; SCAR-8, Wellington 1999; SCAR-9, Potsdam 2003). Registrations rose from 45, of nine nations (SCAR-1), and 138 (SCAR-2), to more than 200, from 15 nations at SCAR-3. Tne rising numbers of papers published in those symposia - 76 to 126 to 151 - reflect the surge of Antarctic geologic research in those years. Two scientific threshholds were crossed across that time: (1) the begrudging general acceptance of continental drift by northern hemisphere geologists; and then (2) the rapid acceptance by all of plate tectonics theory thatt replaced drift in the late 1960s.

Cape Town was the perfect setting for SCAR-1. Geologic mapping of Antarctica had barely begun. Knowledge of Antarctica's geology was largely based on reconnaissance dog-team or over-snow geophysical traverses. South African Alex DuToit's 1937 bible of continental drift, "Our Wandering Continents," that demonstrated Antarctica's key role in Gondwana was unknown to northern geologists invading Antarctica. DuToit presciently foresaw that geologic events of the South African Cape province would someday be found recorded in mountains just then seen by Lincoln Ellsworth at the head of the Weddell Sea (Sentinal Range, Ellsworth Mountains) on his 1935 transcontinental flight. Surprisingly in South Africa, continenal drift was the subject of only one of Cape Town's 76 papers - one by Lester King, who himself had not worked in Antarctica. Those who had worked in areas around the Weddell Sea, including the author, never envisioned in their Cape Town reports how their areas might fit into extra-Antarctic settings. That is not surprising. Northern Hemisphere geologists like the author were trained in concepts of crustal rigidity and fixity. Ideas of movement of continents laterally were ridiculed, though surprisingly, horizontal nappe and thrust movements were in vogue by alpine structural geologists.

Too late for writing SCAR-1 papers, F.C. Truter led an incredible field excursion around all of South Africa for the prupose of showing northern geologists the same rocks and stratigraphy that they had seen in the Ellsworth and Pensacola Mountains and Transantarctic Mountains. It was convincing. Continental drift gained more respectablity at the 1970 Oslo meeting, where one session was dedicated to "Antarctica and Continental Drift," though including only four of the 126 papers. Few papers in other sessions referred to Gondwana relations. "Plate tectonics" had just arrived and is cited only once in the contents of the Oslo volume. Drift and plate tectonics were sufficiently matured by the 1977 Madison meeting that a separate session on the subject was not needed. By then, authors were racing to board the wagon: most papers on topical and regional studies of Antarctica included exta-Antarctic speculations in terms of the new plate tectonics. That 1963 Cape Town field trip was pivotal and changed the way Antarctic geologists from the northern hemisphere looked at southern lands. After that, in the formations of Antarctica's Ellsworth and Pensacola Mountains and elsewhere, we could see the Dwyka, Beaufort and Karroo of South Africa. And now, "Rodinia"? "Antarctica and Rodinia," a separate session of the Potsdam meeting, is for future historians to evaluate.

Volumes of SCAR Earth Science Symposia:
Adie, R.J. (1964): Antarctic Geology.- New York, John Wiley, 758 pp.
Adie, R.J. (1972): Antarctic Geology and Geophysics.- Oslo, Universitetsforlaget, 876 pp.
Craddock, C. (1982): Antarctic Geoscience.- Madison, Univ. Wisconsin Press, 1172 pp.

Oliver, R.L., James, P.R. & Jago, J.B. (1983): Antarctic Earth Sciences.- Cambridge, Cambridge Univ. Press, 697 pp.
Thomson, M.R.A., Crame, J.A. & Thomson, J.W. (1991): Geological Evolution of Antarctica.- Cambridge, Cambridge Univ. Press, 722 pp.
Yoshida, Y., Kaminura, K. & Shiraishi, K. (1992): Recent Progress in Antarctic Earth Science.- Tokyo, Terra Sci. Pub. Co., 706 pp.
Ricci, C.A. (1997): The Antarctic Region: Geological Evolution and Processes.- Siena, Terra Antarctica, 1206 pp.
Gamble, J.A., Skinner, D.N.B. & Henrys, S. (2002): Antarctica at the Close of a Millenium.- Royal Soc. New Zealand, Bull. 35, 652 pp.

Biodiversity and climate change in Antarctic Paleogene floras
(oral p.)

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The Cenozoic was an important period in Earth's climatic history, since it records the change from greenhouse climates during the early Palaeogene to icehouse climates in the Neogene. In particular, the record of this major climate transition in the Southern Hemisphere is important because it involves the initiation and development of the Antarctic ice sheet, which now exerts a major control on our global climate.

Fossil plants from Palaeogene strata on Seymour Island, Antarctica, are being investigated to determine the nature of vegetation response to climate change in southern high latitudes. The fossil assemblages represent vegetation which once grew on the terrestrial volcanic arc that now forms the Antarctic Peninsula, but which was subsequently washed into the adjacent sedimentary basin and preserved within shallow marine sediments of the Cross Valley Formation and La Meseta Formation. The presence of temperate vegetation at palaeolatitudes of approximately 65°S (approximately the same latitude as snow-covered Seymour Island today) indicates that the Antarctic experienced much warmer climates during the early Cenozoic.

Analyses of Palaeocene floras have identified at least 35 angiosperm leaf morphotypes, along with pteridophytes, and podocarp and araucarian conifers. The angiosperm assemblage is dominated by leaves with affinities to extant families typical of cool-warm temperate (e.g. Nothofagaceae, Proteaceae) and sub-tropical (e.g. Lauraceae, Sterculiaceae) vegetation.

Physiognomic analysis of angiosperm leaf assemblages using CLAMP analysis has determined a mean annual temperature of 13.5 ±0.7°C for the late Palaeocene. These warm temperatures in Antarctica during the early Cenozoic indicate that the climate was warm enough to sustain large forests with relatively high diversity, even at such high-latitudes. Eocene floras show decreasing diversity and increased dominance by cool-temperate *Nothofagus* as a response to cooler (~10°C), more seasonal climates that ultimately led to the onset of the Cenozoic ice age.

Comparative studies of rare earth element and heavy metal loads and the corresponding natural organic matter fractions in sediments from three lakes of Amery Oasis, East Antarctica
(poster p.)

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Within the scope of an Australian-German expedition in austral summer 2001/2002 first sediment cores were recovered from three lakes of different environmental settings in Amery Oasis, northern Prince Charles Mountains, East Antarctica. The Beaver Lake is the largest lake in Antarctica. It is located at the southern end of a u-shaped valley that is dammed to the north by the Stagnant Glacier, penetrating into the oasis as part of the Charybdis Glacier. Beaver Lake has a hydraulic connection to the open ocean beneath the glaciers and the Amery Ice Shelf, leading to a stratified water column with marine waters overlain by more light melt waters. The Radok Lake in the western part of the oasis, in contrast, is a fully ventilated fresh-water lake, with a lake level 7 m above modern sea level. With at least 362 m water depth Radok is the deepest fresh-water lake in Antarctica. The lake is met by the Battye Glacier, which drains a small area of the western Prince Charles Mountains, forming a floating ice tongue on the southwestern lake part. Lake Terrasovoje, finally, is a much smaller fresh-water lake of only 31 m depth, being located in the northern part of the oasis. This lake today has no glacier ice in its catchment.

At the obtained sediment cores the partitioning behaviour of NOM (Natural Organic Matter) species has been investigated. Humic and fulvic acids, main compounds of the NOM, are amphiphilic and polyelectrolyte substances with the capability to form permanent and stable complexes with heavy metals and rare earth elements (REEs) (TIPPING 2002). These NOM-species are ubiquitous in nearly all soils and sediments (AIKEN et al. 1985). Depending on the geochemical parameters humic substances remain at the aqueous phase or form coatings on the sediment surfaces (ZIECHMANN 1993). The sorption equilibrium of the humic substances can be described by the Langmuir isotherm. REEs and heavy metals bound via complexation on humic substances follow this distribution pattern. The humic substances were isolated and the amounts of the sediments were determined by the use of the extraction procedure suggested by the IHSS (International Humic Substance Society) (THURMAN & MALCOLM 1981). The characterization of the humic substances have been performed by combustion method, SEC (Size Exclusion Chromatography) and SCA (Sequential Chromatographic Analysis) (RÖßLER et al. 2000). Sediments and humic substances have been digested by microwave-assisted combustion (sediments: HF, HNO_3, H_2O_2 / humic substances: HNO_3, H_2O_2) for determination of heavy metals and REEs. The amounts have been determined by the use of ICP-MS (PQExCell, Thermo Elemental).

The presence of humic substances at the core samples has been demonstrated. Furthermore, the high reactivity and metal complexing capability of humic substances could be shown by means of the amounts of REE and metals (U, Pb, Th, Cu, Zn, Ag, Ni, Co, Cd, Mn and As). The total amounts of REEs and metals have been compared with the organically bound shares. Both, the REE and metal contribution allow a clear differentiation of the investigated sediments. Typical fingerprints can be obtained. On the basis of the REEs and heavy metals distribution investigations of fractionation processes at the sediments of the Amery Oasis become possible. A comparison of the fingerprints of other periglacial sediments allow continuative palaeo-environmental investigations.

Aiken, G. R., McKnight, D.M., Wershaw, R. L. & MacCarthy, P. (1985): Humic Substances in Soil, Sediment, and Water. Wiley-Interscience, New York.
Rößler, D., Franke, K., Süß, R., Becker, E. & Kupsch, H. (2000): Radiochim. Acta 88: 95-100.

Tipping, E. (2002): Cation binding by humic substances. Cambridge University Press.
Thurman, E. M. & Malcolm, R. L. (1981): Environ. Sci. Technol. 15: 463-466.
Ziechmann, W. (1993): Humic Substances. BI Wissenschaftsverlag, Mannheim.

Mesoproterozoic continental growth: The South Africa-East Antarctica connection
(oral p.)

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The apparent contiguity of the Grenvillian tectonic belts from southern Laurentia, around the Kalahari Craton into East Antarctica has formed an important cornerstone in the reconstruction of the inferred Rodinia supercontinent. From recent and new geochronological data it becomes apparent, however, that continental growth around the Kalahari Craton (including the Grunehogna Province) in Grenvillian times did not take place simultaneously but occurred in several stages over a time span of some 200 m.y. The first major Mesoproterozoic crust-forming event recorded in the Namaqua, Natal and Maud Belts is the formation of a 1350-1280 Ma magmatic arc along the northwestern margin of the craton. Only in the northern Namaqua Belt is this arc floored by a 2.0 Ga (Eburnian) basement that was possibly accreted onto the Kalahari Craton during the 1.8 Ga Kheis orogeny. The second stage of continental growth, between 1250 and 1200 Ma, involved the formation of a second magmatic arc in the Namaqua Belt and the first and only arc recorded in the Natal Belt. Continuity from the Namaqua to the Natal Belt is now evidenced by geochronological data that indicate arc-continent collision in both belts between 1190 and 1170 Ma. This continental growth phase along the southwestern and southern margin of the craton caused not only widespread metamorphism and contractional deformation but also a hiatus in sedimentation. A link between the southwestern Grenville Orogen and the Namaqua-Natal Belt, as suggested by DALZIEL et al. (2000), is doubtful. Apart from palaeomagnetic data that indicate separation of Laurentia and Kalahari by as much as 30 ±14° latitude at 1105 Ma (POWELL et al. 2001), no evidence of continental collision exists from the Namaqua-Natal Belt for the time of continental collision in the Llano-West Texas region (1150-1120 Ma). The third stage of continental growth around the Kalahari/Grunehogna Craton affected its eastern margin, with the accretion of an 1160-1130 Ma magmatic arc in the Maud Belt. The kinematic history of that belt is only poorly constrained, because of intense Pan-African tectonic overprint. Deposition of metasedimentary rocks in the Maud Belt was roughly contemporaneous with arc formation and deposition of the volcano-sedimentary successions of the Ritschersflya Supergroup, for which a back-arc setting is favoured. Isolated eclogite boudins in the supracrustal succession of the Maud Belt may have formed during arc accretion. While arc-continent collision took place on the (south-) eastern side of the Kalahari craton, crustal thinning along the western edge of the craton led to intra-continental sediment deposition, as recorded by the ≤1171 Ma Koras and the 1105 Ma Ghanzi-Chobe rifts in southwestern Africa, and later to decompression melting in the lower crust and upper mantle between around 1150 and 1070 Ma. All around the craton, from the Namaqua to the Maud Belt, this period was followed by low-pressure, high-temperature metamorphism and bimodal magmatism in the lower crust that lasted until 1020 Ma. An anti-clockwise P-T path established for some of the granulite facies metamorphism might reflect thickening of the crust due to the emplacement of large volumes of late-tectonic granitoids, with corresponding clockwise P-T paths experienced by the mid-crustal rocks that sank to greater depths due to gravitational redistribution. In spite of the difference in the timing of late Mesoproterozoic accretion and collision, extension-related basin development in the upper crust, and high-temperature, low-pressure metamorphism and partial melting of the lower crust and upper mantle took place more or less simultaneously throughout southern Africa, the southern part of the Grenville belt in Laurentia and Western Dronning Maud Land. If this extension were related to crustal thinning consequential upon lithospheric delamination or orogenic collapse, the delay from the orogenic peak should be similar in all belts. This is not the case. Thus a common cause is sought that is independent of the preceding tectonic history of each area, i.e. independent of crustal processes, such as a thermal event in the mantle as previously proposed to explain the 1105 Ma regional magmatism of the Umkondo Province (HANSON et al. 1998).

Dalziel, I.W.D., Mosher, S. & Gahagan, L.M. (2000): J. Geology 108: 499-513.
Hanson, R.E., Martin, M.W., Bowring, S.A. & Munyanyiwa, H. (1998): Geology 26: 1143-1146.
Powell, C.M., Jones, D.L., Pisarevsky, S. & Wingate, M.T.D. (2001): Precambrian Research 110: 33-46.

Why does large magnetic anomalies appear in Archean crust of the Mt. Riiser Larsen area, Amundsen Bay, Enderby Land, Antarctica? magnetic and chemical properties of metamorphosed banded iron formation
(poster p.)

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Metamorphosed banded iron formation (meta-BIF) at Mt. Riiser-Larsen area, Amundsen Bay, Enderby Land, Antarctica was studied in order to understand why a large magnetic anomaly appears in this region. The area is a part of Napier Complex that has been known as one of the oldest crust dated to 3930 Ma (BLACK et al. 1986). In the field, many meta-BIF layers, consisting of one to nine layers within 30 m thick running in felsic gneiss, were recognized on the anomaly. The thicknesses are usually between 0.5 and 2 m but sometimes varied from zero to six metres. Almost all strong magnetic anomalies reported by DOLINSKY et al. (2002) could be explained by the magnetization of the meta-BIF layers. The largest layer including meta-BIF is estimated to be more than 7400 x 213 m. Magnetite in meta-BIF was examined by X-ray diffraction and X-ray fluorescence analysers, thermomagnetic, magnetic hysteresis and microscopic analyses. The results indicated that almost pure magnetite with pseudosingle-domain and multi-domain structure is the dominant composition of meta-BIF as well as quartz. The single-domain magnetite grains were along the quartz crystal boundaries and formed a network structure. As the saturation magnetization of meta-BIF was 21.39 - 62.27 Am^2/kg, sample include high content of magnetite (23-68 wt.%). Although natural remanent magnetization (NRM) of nine Meta-BIF layers was unstable, the intensity was very strong as 27.26-104.27A/m. The initial susceptibility was in the range of 1.005 and 1.806 (SI), deriving Q ratio between 0.75 and 2.30. While felsic gneiss of dominant formation in this region was less 1/1000 of NRM and susceptibility than these of meta-BIF. This is a reason why a large magnetic anomaly was observed in this region. Chemical composition of meta-BIF resembles that of the Cleaverville area (3300-3200 Ma) in the Pilbara craton and Boolgeeda iron formation (2500 Ma) of the Hamaersley Group, western Australia. We have considered that a precursor of meta-BIF in the Napier Complex is Algoma type BIF, based on the sedimentation age and scale of the iron deposit. The large magnetic anomaly might appear after transformation from hematite in BIF to magnetite in meta-BIF by metamorphisms.

Black, L.P., Williams, I.S. & Compston, W. (1986): Contrib. Mineral. Petrol. 94: 427-437.
Dolinsky, P. et al. (2002): Polar Geosci. 15: 80-88.

Crustal thinning and the development of deep depressions at the Scotia-Antarctic plate boundary, southern margin of Discovery Bank, Antarctica

(poster p.)

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Discovery Bank is a fragment of the continental bridge that connected South America and the Antarctic Peninsula before the Oligocene. The development of the Scotia and Sandwich plates between the South America and Antarctic plates, created the Scotia Sea and forced the dispersion of the continental fragments. The Scotia-Antarctic plate boundary along the South Scotia Ridge consists of a narrow and elongated band of continental fragments bounded by the oceanic crust of the Scotia Sea to the north and of the Weddell Sea to the south. The seismicity indicates that at present, the active structures related to the plate boundary are located within the continental crust, whereas most of the continental-oceanic crust boundaries seem to be inactive.

The structure of the Scotia-Antarctic plate boundary east of the South Orkney Microcontinent is poorly known, probably due to the difficulties to access this region, very often covered by ice. Also the available seismicity data are dispersed and do not delineate clearly the active structures related to the plate boundary. In the southern border of the Discovery Bank and northern Weddell Sea, multichannel seismic profiles (MCS), together with magnetic, gravity and swath bathymetry data obtained during the SCAN97 cruise, show new information on the tectonics of this region. The relief complex, and formed by raised blocks and elongated depressions that may reach more than 6000 m in depth. The main crustal elements include, from north to south: the oceanic crust of the Scotia Plate, the Discovery Bank composed of continental crust, a tectonic domain with intermediate features, both in position and nature, between continental and oceanic crusts that includes the Southern Bank, and the oceanic crust of the northern Weddell Sea, which belongs to the Antarctic Plate. The intermediate domain was probably developed during the Late Cenozoic subduction of the Weddell Sea oceanic crust below the Discovery Bank and prior to the recent transcurrent tectonic.

The fresh fault scarps and the present-day seismicity in the depressions southward of Discovery Bank points that this area corresponds to the active fault zone related to the Scotia-Antarctic plate boundary. Earthquake focal mechanisms indicate a heterogeneous stress field with NW-SE extension and vertical or NE-SW oriented compression. The fault zone associated with the plate boundary is characterized at present by sinistral transcurrent and transtensional slips, which develop NE-SW elongated deep pull-apart basins. Gravity models allow to stablish the nature and variation of crustal thickness across the plate boundary. Extreme crustal thinning and mantle uplift is associated to the deep basins in all the MCS profiles, although we do not observe evidences of oceanic spreading. Satellite free air gravity anomalies indicate that the deep basin ends southwestwards, probably in a fault that transfer the present-day plate motion to the northern margin of the South Orkney Microcontinent. To the NE, a narrow ENE-WSW oriented basin, with scarce seismicity, follows between Discovery and Herdman banks, but probably other NW-SE oriented fault transfers the deformation to the central part of Herdman Bank. The nature of the crust of Herman Bank may not be established with the available geophysical data.

The deep depressions in the southern margin of the Discovery Bank are developed in relation with extensional active structures and constitute an uncommon feature in the oceans, where most of the trenches are formed in subduction contexts. The complex bathymetry and structure of the plate boundary are a consequence of the presence of continental and intermediate crustal blocks, where the deformations are concentrated, between the two stable oceanic domains. The location of the plate boundaries around the Scotia Arc is probably influenced by the occurrence of continental and intermediate crustal fragments surrounded by oceanic crust, due to the differential behavior experienced during deformation.

Bransfield Basin tectonic evolution during the separation of the South Shetland Block from the Antarctic Peninsula

(poster p.)

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Subduction of Phoenix Plate oceanic crust along the Pacific margin of the Antarctic Peninsula came to an end progressively towards the NE, as a result of the ridge-trench collisions. In the central Drake Passage, the Phoenix-Antarctic spreading ridge ends its activity at chron C2A (3.3 ±0.2 Ma). However, subduction continued at the South Shetland Trench, then led to the rifting and separation of the South Shetland Block, a sliver of the Antarctic Peninsula margin carrying the South Shetland Islands. Another consequence is the opening of the NE-SW elongated Late Pliocene-to-recent anomalous backarc Bransfield Basin.

The analysis of multichannel seismic profiles from brazilian, spanish, japanese and chinese cruises allows the shallow structure of the Bransfield Basin and its eastward prolongation through the South Scotia Ridge to be studied. The Bransfield Basin is an asymmetrical backarc basin whose opening is probably related to a low angle normal fault that dips NW, with the South Shetland Block constituting the hanging wall. The margin adjacent to the Antarctic Peninsula exhibits all the features associated with a lower plate passive margin, such as the development of landward tilted half-grabens, the presence of a break-up unconformity, and the deposition of an oceanward dipping 'drift' sequence. However, the margin near the South Shetland Islands is typical of an upper-plate margin: poorly nourished, sharp and with high angle faults. Extension is more developed in the Central Bransfield Basin, where a volcanic axis is recognized as the expression of a young spreading center, and there is possibly incipient oceanic crust. In the Bransfield Basin extremities, present-day deposits represent the synrift sequence, and extension continues. The Bransfield Basin probably develops as a consequence of two interacting processes. The main one is related to the end of oceanic spreading at the Phoenix-Antarctic Ridge in Middle Pliocene times (3.3 Ma) and the subsequent development of a roll-back mechanism that produces the northwestward migration of the South Shetland Block. The second process that takes place in the region is the propagation along the southern boundary of the South Shetland Block, up to the Bransfield Basin, of the deformations associated with the Scotia/Antarctic Plate boundary.

The South Shetland Block is a tectonic element formed by continental crust. Its northwestern boundary consists of two sections separated by the Elephant triple junction at the intersection with the Shackleton Fracture Zone. The southwest section is located at the active subduction zone of the South

Shetland Trench. The northeastern section corresponds to the sinistral, mainly transpressional fault zone located along the contact between the oceanic crust of the Scotia Plate and the continental blocks of the South Scotia Ridge, presently undergoing moderate or low tectonic activity. The Bransfield Basin and its prolongation along the internal depression of the South Scotia Ridge constitute the southern boundary. The variable tectonic features of this southern boundary are determined by the obliquity of the stress field with regard to the active structures: NW-SE extension in the Bransfield Basin, transtensional sinistral faults in the South Scotia Ridge, evolving eastwards to sinistral faults at the block boundary. The southwestern boundary of the South Shetland Block is the most poorly defined one, and may be located in a broad region of crustal deformations related to the transition from active to inactive subduction at the southwestern end of the South Shetland Trench.

Elephant Island recent tectonics in the framework of the Scotia-Antarctic-South Shetland Block triple junction, NE Antarctic Peninsula

(oral p.)

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The development since the Oligocene of the Scotia Arc has produced a tectonic reorganization of the region located between South America and the Antarctic Peninsula. The Scotia and Sandwich plates are located between the major South America and Antarctic plates. The South Shetland Block is a tectonic element of continental nature placed between the Scotia and Antarctic plates. It is bounded to the north by the South Shetland trench and the oceanic crust of the Scotia Plate, and to the south by the Bransfield Strait and the intermediate depressions of the South Scotia Ridge. The Shackleton Fracture Zone (SFZ) is a NW-SE oriented intraoceanic transpressive sinistral fault zone with positive relief, belonging to the Scotia-Antarctic plate boundary, which is subducted below the South Shetland Block. Elephant Island is located at the southeastward intersection of the SFZ with the South Shetland Block that constitutes the present-day active triple junction between South Shetland Block, Scotia and Antarctic plates.

Elephant Island is characterized by the outcropping of HP-LT metamorphic rocks, phyllites, greenshists and blueschists metamorphosed during the Cretaceous, and an abrupt relief, including uplifted and well exposed marine terraces at the western coast. These features may be a consequence of the recent uplift of the island, probably determined in part by the subduction of the SFZ below the northern border of the South Shetland Block. Marine geophysical data indicate that Elephant Island is located in a region of transition between compressive deformations (reverse faults and folds) related to the northern boundary of the South Shetland Block, and sinistral transtensional faults related to the South Scotia Ridge internal depressions. The mentioned deformations affect up to Quaternary marine sediments.

Recently, brittle deformations where measured for the first time along a transect located at the western coast steep cliffs of Elephant Island, in the framework of a Brazilian-Spanish cooperative research. Joints and faults are overprinted on complex ductile deformations with a subvertical main foliation. The measurement of joints and more than 200 faults evidence the heterogeneous character of the deformation. There are several fault sets, with normal and reverse faults in the same outcrops and several striae on fault planes that evidence the reactivation of faults by different stresses. Generally, the northern sectors of the transect are deformed by reverse faults, with top-to the SE or SW kinematics, while the southern extremity is dominated by normal faults. Paleostress ellipsoids have been determined from microfault orientations. Inclined main axes of paleostress ellipsoids suggest that brittle deformations should have been developed partially at depth. Although it is not possible to determine the age of brittle structures, however, the stresses determined agree with the recent tectonic setting of the island. The northern part of the transect (Minstrel Cape), has been affected by NW-SE compressive prolate stress ellipsoids that may be related to the subduction of the SFZ and the Antarctic Plate below the South Shetland Block. Shallow NW-SE compressive earthquake focal mechanisms below the western part of the Elephant Island also support this interpretation. In addition the undulated shape of marine terraces suggests the possible recent folding of the area by these compressive deformations. Southwards in the transect, NE-SW prolate compression stress ellipsoids are identified (Cape Lindsey and Emma Cove) that may be related to the propagation of the sinistral motion related to the Scotia Plate-South Shetland Block boundary. The southern end of the island is dominated by E-W extension, indicating a tectonic regime similar to this observed along the internal depressions of the South Scotia Ridge. Overprinted on these stresses, radial extension has been determined along the transect and may be related to the island uplift.

The study of the recent tectonic evolution of Elephant Island, including geological field data and marine geophysical data allows understanding the processes related to the evolution of a complex triple junction, where an oceanic transpressive fracture zone intersects with a continental block. In addition these data evidence the sharp transition between compressional and extensional deformations between the boundaries of the narrow and elongated South Shetland continental block.

Stromatolites from the Oligocene of King George Island, West Antarctica

(poster p.)

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Stromatolites are among the most common and long-ranging biosedimentary structures in the fossil record and are very useful both for stratigraphical and environmental studies. Here I report on the occurrence of such structures in the Oligocene Polonez Cove Formation of King George Island (South Shetland Islands), West Antarctica.

The Polonez Cove Formation (up to 80 m in thickness) consists of glaciomarine strata formed during the Polonez Glaciation (BIRKENMAJER & GAZDZICKI 1986, BIRKENMAJER et al. 1991). The associated Polonez Cove Fm. biota indicate favorable conditions for life in shallow marine environments during the final stage of the Gondwanaland breakup and onset of the late-Eocene-Oligocene continental glaciation in West Antarctica (GAZDZICKI & PUGACZEWSKA 1984, GAZDZICKI 2001). The stromatolites were mostly collected from the upper part of the Polonez Cove Fm. i.e. Chlamys Ledge Member (sensu TROEDSON & SMELLIE 2002), where they occur sparsely within the sandstone-siltstone sequence

These small, isolated, abiophoric or bacterial stromatolite structures are subspherical or turbinite in shape and characterized by smooth surfaces. The height of individual specimens ranges from 12-46 mm, and their width from 25-87 mm. Lamination are prominent consisting of gently to steeply convex alternating dark (micrite) and light (sparite) laminae. Results of $^{87}Sr/^{86}Sr$ isotope analyses of the stromatolites show that they are older than 35 m.y. (Barrera, personal commun.) Their age and general stratigraphic setting suggest that they were recycled by the mechanisms of iceberg-rafting into the sediments of the Polonez Cove Fm. during the Oligocene glacial event, yet a few appear to in live position, and thus possibly in situ. Although it is difficult to envision a scenario for an in situ interpretation it should not be dismissed out of hand and additional studies will be needed to resolve this problem. It should also be noted that until now such stromatolite structures have not been reported from Antarctica.

Birkenmajer, K & Gazdzicki, A. (1986): Bull. Pol. Acad. Sci. Earth Sci. 34: 219-226.
Birkenmajer, K., Gazdzicki, A., Gradzizski, R., Kreuzer, H., Porebski, S.J. & Tokarski, A.K. (1991): In: Geological Evolution of Antarctica, Cambridge University Press: 663-665.
Gazdzicki, A. (2001): Quad. Geof. 16: 75.
Gazdzicki, A. & Pugaczewska, H. (1984): Stud. Geol. Pol. 79: 59-120.
Troedson, A.L. & Smellie, J.L. (2002): Sedimentol. 49: 277-301.
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Crustal structure, seismic stratigraphy and tectonic evolution of the Enderby Land and MacRobertson Land continental margin, southern Indian Ocean

(poster p.)

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The continental margin of Enderby Land and MacRobertson Land (EL-MRL CM) is examined on the bases of 13 000 km of MCS, gravity and magnetic profiling and 32 sonobuoys collected during three cruises on RV "Akademik Alexander Karpinsky" (Russian Antarctic Expedition) in 2000-2002. These geophysical data give new information on crustal structure, seismic stratigraphy, and geological evolution of the region studied which is represented in the set of structural and geophysical maps compiled in 1: 2 500 000 scale.

The basement surface occurring at shallow (0.5-2,0 km) level in the shelf area descends abruptly beneath continental slope to be as deep as 8,5-9,0 km below the continental rise and abyssal basin. In many cases it shows the structures of extensional tectonics (half-grabens with rotated crustal blocks) which are more distinct within the slope and upper continental rise. Stretched crust on the EL-MRK CM is recognized within the area of 200-300 km wide. Transition from continental crust to oceanic crust is mainly distinguished from sonobuoy data which show the clear change in refraction velocities for the basement surface from 6,0-6,3 km/s to 5,3-5,5 km/s. This transition is poorly expressed in MCS data for the western part of the area studied but is distinguished well for the eastern one where it is marked by a step in the basement morphology (of about 700 m high) and very prominent (300-500 nTl) magnetic anomalies. Northward of the proposed continent-to-ocean boundary the basement demonstrates unusually smooth surface. Magnetic data acquired on the Mac.Robertson Land Margin show the consequence of anomalies from M8 to M11A. Half-spreading rates range from 2.0-2.7 cm/yr between anomalies M11A and M10N to 3.3-3.5 cm/yr between anomalies M8 and M10N. The occurrence of the oldest magnetic anomaly M11A which marks the continent to ocean boundary suggest that the break-up between India and Antarctica occurred at around 134.5 Ma ago.

Four major unconformities (named from CS-2 to CS-5) are identified in the sedimentary basin of the EL-MRL CM. The lower unconformity CS-2 corresponds to the East Gondwana break-up nearly the Jurassic-Cretaceous boundary. Unconformity CS3 is the base of thick (1.5-2.0 km) wage (clinoform) which pinching out oceanward and is interpreted to be Late Cretaceous in age. The Top of this wage is represented by unconformity CS-4 which displays the transition from the lower relatively homogenous part of section (with mostly irregular or continuous reflectors) to the upper heterogeneous one where a variety of drift deposits are developed. This transition appears to reflect the dramatic change in the continental margin depositional environment resulted from first advance of grounded ice sheet at the shelf edge which transported a large amount of sediments to the margin. The total thickness of sediments varies from 0-0,5 km within the shelf of MacRobertson Land to greater than 6,5 km at the continental rise.

The development of the continental margin of the northern Antarctic Peninsula from high resolution multichannel seismic reflection profiles
(poster p.)

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The COHIMAR-SEDANO joint initiative among the Spanish, Italian and Belgian Antarctic programs aims at understanding the impact of the Last Glacial Maximum on seafloor morphology and the glacial history of the Biscoe and Gerlache-Boyd depositional systems (CANALS et al. 2003).

The use of a high resolution, 96-channel seismic reflection system supports a renewed effort to extrapolate at depth the glacial processes interpreted from seafloor and shallow imaging with state-of-the-art techniques. We define high resolution as that obtained from one or two tuned GI guns providing a narrower seismic signature than that traditionally employed on the Antarctic margin. Trace spacing of 12.5 or 6.25 m result in a nominal horizontal resolution of 3125 m. Both sources and streamers are towed at minimum depth, 3 and 4 m respectively, to preserve the highest recordable frequencies. Digital sampling of the signal is with cycles of 1 ms. As a general strategy in order to obtain the best representation of the buried geological structures, profiles are collected along lines planned on multibeam bathymetry processed onboard. Seismic data processing includes horizon velocity analysis (HVA), dip-moveout (DMO) correction for highly dipping events, seafloor multiple attenuation, especially on the continental shelf, and pre-stack depth migration.

Because of erosion by ice streams, seismic profiles located along the axis of the Biscoe glacial trough produce a longer seismic record above the seafloor multiple and penetrate deeper into old, pre-glacial, sedimentary sequences. Below the shelf break and slope a paleo continental slope appears in geometric discordance with the overlying prograding glacial slope sediments whose thickness may exceed 1.5 km. This suggests, according to correlation to results of ODP Leg 178, that prior to the Plio-Pleistocene main phase of margin outbuilding there was a high-energy sedimentary system that dissected the pre-glacial, or incipient glacial, margin. We propose a pre-Late Miocene age for the eroded and buried paleo-slope below the discordance. Large erosional surfaces cutting through the pre-glacial and post-glacial margin suggest slope failure below the inter-lobes areas. Reprocessing of older deep penetration OGS profiles permits the direct correlation of events from shelf to rise across the dissected continental slope. The pre-glacial geological basement below the continental shelf shows intense tectonic deformation with folding and over imposed extensional faults, which may offset young glacial bedforms on the inner continental shelf. Such an extensional tectonics appears to be related to the development of the Mid Shelf High.

Another multichannel seismic route along the Gerlache-Boyd glacial trough reveals a glacial wedge underlain by an angular discordance produced by tilting of inner shelf strata. The discordance angle becomes progressively lower basinward, until it disappears suggesting that the sedimentation on the glacial slope has been continuous over a long time span. Likely pre-glacial terrigenous sedimentation in the South Shetland fore arc appears to have gradually changed into pro-glacial sedimentation under the influence of the advancing Gerlache-Boyd wedge. By locating a seismic profile across the Gerlache-Boyd progradational lobe, three superimposed seismic units reflected in continental slope terraces left by successive glacial advances have been imaged. It is inferred that the latest Gerlache-Boyd ice stream carried a lower sediment volume than in previous phases.

Canals et al., 2003. Eos, 84(11): 97, 102-103.

Neogene-Quaternary Antarctic cryosphere evolution – The view from Southern Ocean sediment archives
(oral p.)

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The evolution of the Antarctic cryosphere represents a major component of global Cenozoic climate evolution. The modern East Antarctic Ice Sheet (EAIS), which started to develop during the middle-late Eocene constitutes c 85 % of the Antarctic continental ice and stores a volume of water equivalent to a c 60 m sea level rise. While the largest portion of the EAIS is grounded above sea level, most of the base of the smaller West Antarctic Ice Sheet (WAIS) is below sea level. Therefore the stability of the WAIS and its potential representing an immediate thread of strong sea-level rise at future warmer climate conditions (at total WAIS release 4-6 m) is strongly debated (e.g. OPPENHEIMER 1998). Despite its relatively small size and volume, the WAIS exerts major influence on climatic relevant processes in the Southern Ocean. The WAIS shelf ice regions are major source areas of cold surface, deep and bottom water as well as of sea ice, which strongly influence ocean circulation, albedo and ocean/atmosphere gas exchange, respectively. WAIS related melt water injections into the Southern Ocean impact significantly Southern Ocean hydrography as well as heat transfer and distribution at global scale (WEAVER et al. 2003). However the WAIS history is yet not well known. Because of the small WAIS volume global ice volume proxies such as sea level reconstruction and benthic oxygen isotope records alone are not indicative for WAIS reconstruction. A more complete view of the WAIS history can be achieved combining the ice volume proxies with microfossil indicators of surface water conditions and Southern Ocean thermal evolution and estimates of surface water salinity and stratification. Examples of such studies will be presented from the middle/late Miocene, the middle Pliocene and the Pleistocene.

Diatom assemblages recovered from a S-N transect in the Atlantic sector of the Southern Ocean indicate that after the middle Miocene thermal optimum the Southern Ocean surface waters were cooling gradually, reaching thermal isolation around 13 Ma (CENSAREK & GERSONDE subm.). The cooling trend culminated around 10.8 Ma when diatoms indicate a maximum expansion of the Antarctic cold water sphere extending as far north as the Agulhas Ridge region located in the present northern Subantarctic Zone. The co-occurring drop in sea level and bottom water temperatures (HAQ et al. 1987, BILLUPS & SCHRAG 2002) indicates further expansion of Antarctic continental ice and the massive production of cold bottom water. This is interpreted to reflect the establishment of a broad WAIS and expanded shelf ice in the Weddell Sea embayment, setting the first full glacial conditions in the Southern high latitudes during Cenozoic climate evolution.

Large-scale draw-down of the Antarctic ice sheet including the total collapse of WAIS during the late Early Pliocene was originally postulated by WEBB et al.(1984) based on the occurrence of recycled diatoms in the Sirius group deposited in the Transantarctic Mountains. Such event would have had a significant effect on sea level and Southern Ocean hydrography, which is however not recorded. To resolve the mismatch, GERSONDE et al (1997) proposed that the introduction of marine microfossil was as ejecta from the latest Miocene Eltanin asteroid impact into the Bellingshausen Sea.

Reconstruction of melt water injections during the Pleistocene glacial/interglacial development show a massive event during the cold marine isotope stage (MIS) 12. It is speculated that this event represents a major WAIS draw down triggered by deformable till conditions, a mechanism proposed by MCAYEAL (1992). This event may have caused the increased sea level reported for MIS 11.

Billups, K. & Schrag, D.P. (2002): Paleoceanography 17(1): 10.1029/3000PA000567.
Gersonde, R. et al. (1997): Nature 390: 357-363.
Haq, B.U., Hardenbol J. & Vail, P.R. (1987): Science 235: 1156-1167.
Oppenheimer, M. (1998): Nature 393: 325-332.
MacAyeal, D.R. (1992): Nature 359: 29-32.
Weaver, A.J., Saenko, O.A., Clark, P.U. & Mitrovica, J.X. (2003): Science 299: 1709-1713.
Webb, P.N., Harwood, D.M., McKelvey, B.C., Mercer, J.H. & Stott, L.D. (1984): Geology 12: 287-291.

Crustal ages in the western Weddell Sea between break-up and Chron 34: their relationship with the opening of the South Atlantic Ocean

(EANT workshop p.)

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The tectonics of the Western Weddell Sea is difficult to resolve because of the paucity in data coverage which adds to its inherent complexity. Although considerable progress has been achieved in the past 15 years with new marine aeromagnetic data and satellite derived gravity anomaly maps, there are still several models which differ in crustal ages and schemes of opening. There is considerable consensus on the fact that the West Antarctic crustal blocks directly related to the Weddell Sea were welded and moving together at 150 Ma. Attempts to consider the Antarctic Peninsula block fixed to Antarctica prior to that (i.e. since break-up) either result in unwanted overlap between the Peninsula and South America or in unconfirmed convergent motion between the Peninsula and East Antarctica. Crucial in this framework are the Mesozoic South Atlantic poles of rotation. They are needed to test closure between the East Antarctica-Africa spreading system poles and those inferred from Antarctica -South America motion in the Western Weddell Sea.

In this presentation we make a review of the available existing models. Our attention is focused on synthetic isochrons and flowlines. We proceed backward in time beginning at Chron 34 (83 Ma), as it is relatively well defined oceanwide, and thus we present maps with isochrons which display the estimated trace of the SAM-ANT-AFR triple junction. Maps derived from ANT-AFR and AFR-SAM poles show that diverse (although widely accepted) South Atlantic opening models notably influence in the resulting ages for the ANT-SAM spreading generated crust, whereas maps derived from directly determined ANT-SAM poles (which are poorly constrained, as the northern flank no longer exists) do not produce a good match of the derived (through SAM-AFR poles) ANT-AFR spreading system with the crustal ages where they are known.

Thus we conclude that the problems in finding a reliable model of the opening of the Weddell sea are not only due to the known problems for surveying the Antarctic seas, but are also due to the poor knowledge of the early opening of the South Atlantic.

One of the sets of South Atlantic poles that we have used proposes a fragmentation of South America along a WNW-ESE transtensional fracture that virtually replicates the opening of the Colorado Basin, but it acts continent wide; the fragmentation is posed as active between 132 and 118 Ma (LAWVER et al., 1999). On the continental shelf and flanking the southern border of the Colorado basin there is a high intensity magnetic anomaly that is abruptly interrupted on a line along which also the margin and oceanic lineations either end or are shifted to the east (GHIDELLA et al. 2002). The line stands out as a first order northwest-trending magnetic discontinuity, and cannot be correlated with any known morphological feature, as it traverses a basement high in the Somuncura Massif . It could perhaps be related with the above mentioned proposed fragmentation, but the timing is difficult to ascertain.

Further indications of possible needed adjustments to the South Atlantic poles of rotation lie in the gravity and bathymetric features south of parallel 43 in the Argentine margin. These features suggest the existence of pull-apart basins that could have been generated by shear tension between the forming oceanic crust and the Faulkland/Malvinas plateau. However, this proposition needs additional study.

Lawver, L.A., Gahagan, L.M. & Dalziel, I.W.D. (1999): <www.ig.utexas.edu/research/projects/plates/movies/akog.ppt>.
Ghidella, M.E., J. Köhn, J. C. Gianibelli, J. Kostadinoff & C. J. Chernicoff (2002): AAGG 2002 CD ROM. See also: www.conae.gov.ar/~iaa/marta/mararg/Interpretacion/

Emplacement ages and interaction evidence from the mafic-felsic complex of Teall Nunatak, northern Victoria Land, Antarctica

(poster p.)

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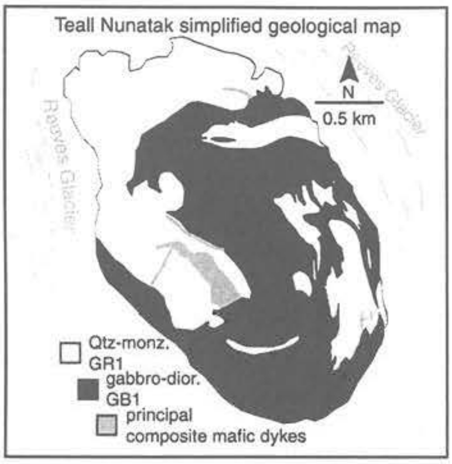
New field and geochemical data indicate that Teall Nunatak (S 74°50'-E 162°33', Antarctica) is part of a large area of the northern Victoria Land dominated by composite acid-basic intrusions of Cambro-Ordovician age: the Terra Nova Intrusive Complex (TENIC; DI VINCENZO et al. 1997, DI VINCENZO & ROCCHI 1999). The plutonic bodies belong to the Granite Harbour Intrusive Complex (GHIC) and are interpreted as evidence of a coeval crustal-mantle magmatic activity related to the early Palaeozoic Ross orogeny (DI VINCENZO & ROCCHI 1999). Mainly monzonitic and gabbro-dioritic rocks crop out over the Teall Nunatak and build up a chaotic melange of sheeted bodies, each of them up to some hundreds of meters wide (see geological map). The prevailing lithotypes are: i) a Bt bearing, coarse-grained Qtz-monzonite rich in Ksp megacrysts (GR1) and ii) a medium-grained gabbro-diorite (GB1), rich in coarse Bt flakes. The contacts between felsic and mafic rocks show complex mingling-mixing relationships and suggest that the emplacement of the two lithotypes was not exactly coeval. The gabbro-diorite is considered to be a younger melt intruding the Qtz-monzonite. Different types of contacts have been observed. Sharp transitions are marked by brittle fracturing of the GR1 and chilled margins of GB1, which changes into a fine-grained gabbro. In these sites, composite dykes of mafic pillows set within a net-veined fine-grained granite (GR2) matrix, intrude the GR1. In other areas GB1 gradually changes to more leucocratic facies towards the GR1 and displays a weak foliation parallel to the contact: here, evidence of magma mixing is found both in the GB1 and in the GR1.



Geochemical data and isotopic composition of mafic rocks reported by previous studies on samples from Teall Nunatak and adjacent areas (Vegetation Island and Abbott area) indicate that the mafic rocks have a high-K calcalcaline to shoshonitic affinity and anomalous high $\delta^{18}O$ and Sr/Sr values (ROCCHI et al. 1998, DI VINCENZO & ROCCHI 1999, DALLAI et al. 2003).

High precision in-situ U/Pb dating of zircon grains extracted from one selected sample of GR1 and two samples of GB1 were carried out using ICPMS laser microprobe. The dating results indicate that the emplacement of the felsic rocks took place around 512 ±2.7 Ma. Relatively younger ages around 490 ±5 Ma have been obtained for the mafic rocks.

The two different emplacement ages, strongly support the field observations, suggesting a scenario in which relatively younger mafic batches of melt intruded an almost cold and solidified Qtz-monzonite. This explains the presence of scattered chilled margins in the gabbro-diorite towards the contacts with the granitoid and the mixing-mingling relationships between late-stage felsic melts (or GR1 re-melting products?) and mafic magmas, producing hybrid rocks of intermediate composition.

Dallai L. et al. (2003): Lithos 67: 135-151.
Di Vincenzo G. & Rocchi S. (1999): Contrib. Mineral. Petrol. 137: 15-25.
Rocchi S. et al. (1998): Tectonophysics 284: 261-281.
Di Vincenzo G. et al. (1997): The Antarctic Region: Geological Evolution and Processes. Terra Antarctica Publ.: 253-260.

Convergent and transform boundaries along the SE Australian sector of the proto-Pacific Gondwana margin in the Ordovician

(oral p.)

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Recent structural and palaeontological research has clarified the nature of the margin between the proto-Pacific plate and the southeastern part of the Tasmanides of eastern Australia. This work has led to the recognition of four separate terranes in the Ordovician of the Lachlan Orogen.

The first terrane is the intraoceanic Macquarie Arc, built on Cambrian and Ordovician MORB-like oceanic crust. This arc indicates the presence of a subduction zone, with general westward dip from the earliest Ordovician until the earliest Silurian (Llandovery). This arc was constructed in three main stages, with hiatuses in volcanic activity in the early Middle Ordovician and the early Late Ordovician. The first stage of arc activity occurred just after latest Cambrian post-collisional volcanism ~1000 km west along the old cratonic boundary and indicates very rapid retreat of, or a jump in the position of, the plate boundary.

The second terrane is the Adaminaby Superterrane which is divided into three smaller terranes. All consist of Early to Middle Ordovician quartz-rich turbidites derived from the new cratons of the Ross and Delamerian orogens to the west and southwest. In two of the terranes making up this superterrane, these turbidites are overlain by a Late Ordovician condensed sequence of black shale.

The third terrane consists of Ordovician MORB-like mafic volcanics and cherts that at least in some cases underlie the turbidites of the Adaminaby Superterrane.

The fourth terrane is a small late Cambrian to Late Ordovician oceanic terrane that originated near a spreading ridge ~2500 km east of the developing Tasmanides. Most of this Narooma Terrane consists of deep marine cherts, but these pass upwards into argillites, siltstones and sandstone as the terrane was carried by seafloor spreading west towards the Australian plate. Concurrent with this approach was the extensional faulting of the terrane with formation of olistostromes.

The Narooma Terrane is now accreted to part of the Adaminaby Superterrane that was tectonically emplaced outboard of the arc in the earliest Silurian by major strike-slip faulting during compressional deformation. Our reconstructions suggest that the boundary between the Australian plate and the proto-Pacific margin of Gondwana in the Ordovician was in part a convergent boundary outboard of the Macquarie Arc and in part a strike-slip transform boundary elsewhere.

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Tectonic and magmatic evolution of conjugate continental margins: a multi-stage rift event between New Zealand and West Antarctica

(oral p.)

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The fragmentation of continents and formation of rifted margins around Antarctica during and after Gondwana break-up developed in various ways, indicating different geodynamic and magmatic processes. While most conjugate rifted continental segments show structural and magmatic similarities, the crustal characteristics of the southeastern plateaus of New Zealand (Campbell Plateau and Chatham Rise) and the West Antarctic blocks of Marie Byrd Land and Thurston Island/Jones Mountains seem to be fundamentally different.

A large portion of the greater New Zealand continent underwent a high degree of extension before break-up in late Cretaceous times with the development of either oceanic or extremely thinned continental crust in the Bounty Trough and Great South Basin (Campbell Plateau). Similar extensional features are not observed in the conjugate Marie Byrd Land and Thurston Island sectors of West Antarctica. Here, the marginal continental and oceanic crust segments are rather characterized by post-rift to recent volcanism.

We develop a scenario in which the conjugate margins of greater New Zealand and West Antarctica experienced multi-stage rifting processes before the final separation and continuous formation of oceanic crust occurred. Although geophysical and geochronological data are still sparse on either side, we will attempt to show aspects of different stages of the break-up between both margins and put these in context using recent high-resolution plate-kinematic reconstructions of the earliest stages of southern Pacific seafloor spreading.

Crustal provinces of the Prince Charles Mountains region and surrounding areas in the light of aeromagnetic data

(poster p.)

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The objective of the aeromagnetic investigations as a part of the earth science program carried out by the Polar Marine Geological Research Expedition (PMGRE) in the Prince Charles Mountains (PCM) and surrounding areas was to contribute data on major aspects of Antarctic geology: the tectonics of the mobile belts and cratonic fragments; the crustal structure of the Lambert-Amery rift system and its development; the determination of the boundaries between different tectonic terranes and the tracing known structures underneath the ice-sheet so that they can be arranged in the regional framework.

The aeromagnetic data of the Lambert Glacier-PCM area provide a rather complex but surprisingly coherent image for studying the geology and tectonic history of this region. Several distinct structural units may be differentiated in the magnetic anomaly data. In the northeastern block intense short-wavelength, high-amplitude positive anomalies extend around the Vestfold Hills and are associated with high-grade metamorphic Early Archean rocks known as the Croocked Lake and Rauer Group orthogneisses. Northern MacRobertson Land is characterized by predominantly low-amplitude anomalies within an area of low gradients. From its pattern and position, this unit may be caused by the Rayner Complex, which displays a similar magnetic response in Enderby Land. The southern boundary of the Larsemann magnetic sub-unit is outlined by the striking Amery Lineament (AL) that runs continuously from MacRobertson Land across the Amery Ice Shelf and further eastward possibly delineating the southern boundary of the Vestfold Hills crustal block. The nature of the AL within the coastal outcrops of southern Prydz Bay is related with the early Neoproterozoic orthogneissic basement rocks (Søstrene Orthogneiss). Metasedimentary cover sequences (Brattstrand Paragneiss) of this area known to largely reflect metamorphism and deformation at ~500 Ma do not show any outstanding magnetic responses and mainly associated with the negative anomalies of a local appearance. The NPCM displays a predominantly northeasterly trending magnetic fabric (Beaver magnetic unit, BMU) that continues to the western shoulder of the Lambert Rift. The negative and positive anomalies reflect Athos and Astronomov supracrustals and Porthos orthogneisses, respectively. Elongate and moderate magnetic banding appears to characterize the Mesoproterozoic rocks of the Fisher Massif. The Beaver magnetic unit might be evident on the eastern side of the Lambert Rift. Here, the magnetic anomalies are less variable with relatively diminished amplitudes. The prominent alternating system of linear NE-SW positive and negative anomalies over the eastern shoulder of the Lambert Rift may reflect the eastern boundary of the BMU. The Grove Mountains (GM) magnetic unit is clearly differentiated from the adjacent the BMU by an uncomplicated anomaly pattern of low-amplitude anomalies. The origin of the GM magnetic unit is not constrained due to insufficient geologic data; it is assumed that this unit may mark a distinct terrane similar to those observed in the Vestfold Hills or in the SPCM. Two different magnetic anomaly patterns are well distinguished over the southern PCM and the southern Mawson Escarpment. The Ruker terrane of the southern PCM and southern Mawson Escarpment are mainly associated with low or moderate amplitude anomalies in a low-gradient area. The central Mawson Escarpment and to a lesser degree its northern part of the Lambert Terrane is largely characterized by negative anomalies produced by Late Proterozoic granite-gneiss-schist sequences. Majorities of positive anomalies over the SPCM are associated with co-called Mawson orthogneiss. The most prominent magnetic lineament of the SPSM is the Ruker Anomaly that is related with a banded iron formation. The Ruker Anomaly extends 130 km westward of Mount Ruker with amplitudes up to 2600 nT.

Analysis of the aeromagnetic data and the produced scheme of interpretation clearly evidenced that the Pan-African mobile belt in Prydz Bay was obviously not linked with Lützow-Holm Bay or may have extended inland towards the Mawson escarpment or Grove Mountains, thereby indicating that the East Gondwana might not be divided into Indo-Antarctic and Australo-Antarctic sectors, as recently was suggested by a number of authors. The allocation of basement outcrops to specific structures based solely on similarities in the age is dangerous in the absence of evidence for tectonic continuity. In this respect the aeromagnetic data are the best tool to make or break tectonic correlations.

ADMAP – a Digital Magnetic Anomaly Map of the Antarctic
(poster p.)

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The ADMAP project was initiated in 1995 after encouragement from IAGA and SCAR to produce the first version of a unified magnetic anomaly map of the whole Antarctic region south of 60°S and to incorporate the available magnetic data into a digital database. This effort integrated near surface anomaly surveys acquired by the international community for site-specific geologic objectives since the International Geophysical Year 1957-58 through the year 2000 with lithospheric anomaly estimates from the Magsat mission has been successful; the composite magnetic anomaly map of the Antarctic is now completed and a 5 km grid covering the entire region was produced. A printed version of the map has recently been produced which is being distributed as the British Antarctic Survey publication (GOLYNSKY et al. 2001). The aeromagnetic and marine data in the compilation were processed from digital profiles and grids, as well as from manually digitized graph maps. The near surface magnetic data were separately compiled for the Weddell Sea, East Antarctic and Ross Sea sectors. In each sector, the magnetic data were edited for high-frequency errors, levelled and adjusted and assessed for data quality by statistical analysis of the crossover errors. The three regional sector grids were merged to create the master grid over the Antarctic with minimal mismatch between adjacent data sets. The final master grid of the Antarctic was filtered to remove residual low frequencies before being added to a long wavelength regional grid developed from the joint inversion of the Magsat anomalies and the low-passed filtered (≥400 km) near surface anomalies.

The map shows a wide variation of magnetic anomaly patterns, trends and types reflecting the diversity of the geologic terranes of varying ages, degree of reworking, lithological and metamorphic variations. Not all changes in the apparent magnetic fabric signify differences in magnetic properties, some may be caused by variations in survey specifications. The new map readily portrays the first-order magnetic differences between oceanic and continental regions. The magnetic anomaly pattern over the continent reflects many phases of geological history whilst that over the abyssal plains of the surrounding oceans is dominated by simpler patterns of linear seafloor spreading anomalies and fracture zones. The Antarctic compilation reveals terranes of varying ages, including Proterozoic-Archaean cratons, various Proterozoic-Palaeozoic mobile belts, Palaeozoic-Cenozoic magmatic arc systems, the boundary between East and West Antarctica, continent-ocean transitions, and other important crustal features. The map delineates basement structural trends, suture zones, the basement terranes, intra-continental rifts and major rifts along the Antarctic continental margin, and the regional extent of plutons and volcanics, such as the Ferrar dolerites and Kirkpatick basalts. The magnetic anomaly map of the Antarctic together with other geological and geophysical information provides new perspectives on the break-up of Gondwana and Rodinia evolution.

The Antarctic anomaly map is limited by the highly variable specifications of the surveys and regional gaps in coverage of the near surface surveys. ADMAP is working to improve the compilation for the 50th anniversary of the IGY with additional high-resolution magnetic data sets and by using CHAMP magnetic observations as they become available.

Golynsky, A., Chiappini, M., Damaske, D., Ferraccioli, F., Ferris, J., Finn, C., Ghidella, M., Ishihara, T., Johnson, A., Kim, H.R., Kovacs, L., LaBrecque, J., Masolov, V., Nogi, Y., Purucker, M., Taylor, P. & Torta, M. (2001): In: Morris, P. & R. von Frese, eds., BAS (Misc.) 10, Cambridge, British Antarctic Survey.

Magnetic anomaly pattern of the Grove Mountains region: Implications for the tectonic correlations

(poster p.)

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The Grove Mountains are located eastward from the Prince Charles Mountains (PCM) and Mawson Escarpment and about 350 km south from the Prydz Bay coast. Up to now these isolated mountains remained one of the last unstudied regions of exposed rocks in East Antarctica despite were visited by several field parties. The geological and tectonic settings of the GM rocks have remained poorly understood. In accordance with several authors they might be correlated with: the southern (PCM) or with northern PCM; the intensity of the Pan-African event shows some affinities with the Prydz Bay coast area and they might be considered as a distinct terrane (MIKHALSKY et al. 2001).

It is believed that aeromagnetic surveys are a powerful tool in mapping basement structures and particularly useful in areas of poor outcrop for unraveling the structural history of a region. They provide a means to extrapolate known geology exposed in widely separated outcrops into broad-covered areas and help to delineate structural features that are not clearly recognizable from outcrop mapping. The aeromagnetic data in the GM area (71.9-73.6°S, 72-76°E) were collected by the PMGRE in 2000 along flight lines 5 km apart provide the only geophysical information of the upper crustal structure of this region. The magnetic anomalies of the GM and surrounding areas are characterized by a simultaneously simple and complex fabric. Four major magnetic anomaly patterns are well distinguished (Northern, Central, Gale and Law Plateau sub-units) which were further subdivided into a number of areas with outstanding magnetic grain. One of the essential features of the GM and surrounding areas is the regulation of magnetic anomalies along its periphery and the absence of intensive magnetic anomalies in the northern part of region. The most intensive anomalies (up to 500-600 nT) are distinguished within the Robertson Lineament in the north-western corner and along the western boundary of the survey area. The oblique character of the magnetic anomalies observed along the south-eastern, western and north-western boundary of the study area in respect to its central part (taking into account additional data from the eastern shoulder of the Lambert rift and located northward from 72°S; GOLYNSKY et al. 2002) clearly evidenced that the basement of the northern part of the GM is seen to comprise much older crust then in the neighboring terranes with Meso- to early Neoproterozoic high-grade metamorphic rocks. The existence of two ancient cratonic blocks in the SPCM and Vestfold Hills allow assuming that this region may contain the Archaean- to Paleoproterozoic juvenile crust. This is supported by preliminary U-Pb dating of GM rocks which allowed to conclude that the protolith of metasediments are either Paleoproterozoic age or derived from source rocks of this age (MIKHALSKY et al. 2001). To clarify our assumption it would be reasonable more extensive geological studies to carry out visiting northern group of outcrops (Cook Peak and Vukovich Peaks) which magnetically appear to be unaffected by younger events. As to the GM crustal block itself, it is clearly discernible in the aeromagnetic data and can be considered as a region underwent either Grenvillian or Pan-African or both tectonism and reworking. Magnetic anomaly patterns of the GM and NCPM are not compatible and therefore the GM rocks not related to the Mesoproterozoic mobile belt of the NPCM, although Proterozoic histories of these regions have at least some features in common. The absence of any visible magnetic trends running towards the Prydz Bay coast area precludes any clear correlation with this region. Similarities of the magnetic patterns of the study area together with northern territory and the SPCM are rather distinctive suggesting that both regions apparently could form one indivisible terrane of Archean to Paleoproterozoic age. A continued southwards trajectory of the Gale magnetic sub-unit leads apparently to the Gamburtsev Subglacial Mountains although insufficient data are available to constrain a lateral extent of this distinct terrane in accordance with our interpretation. Whatever courses of the observed magnetic anomaly patterns they can not be discounted in any models for the reconstruction of both Rodinia and Gondwana.

Golynsky, A.V., Alyavdin, S.V., Masolov, V.N., Tscherinov, A.S. & Volnukhin, V.S. (2002): Tectonophysics 347: 109-120.
Mikhalsky, E.V., Sheraton, J.W. & Beliatsky, B.V. (2001): Terra Antarctica 8: 3-10.

Major crustal provinces of eastern Dronning Maud Land and Enderby Land and their aeromagnetic signature

(EANT workshop p.)

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The coastal outcrops in the Sør-Rondane and Lützow-Holm Bay, all indicate a Grenville-age basement that underwent different degrees of Pan-African thermal overprint and reworking probably associated with pegmatite emplacement and mylonite development (FITZSIMONS 2000, SHIRAISHI et al. 1994), with an Early Palaeozoic, yet undiscovered and mysterious suture hidden under the ice-cover. It was suggested that the Lützow-Holm Complex (LHC) comprises such a suture-zone between the Yamato-Belgica Complex to the southwest and the Rayner Complex to the northeast, because at least the western part of the Rayner Complex was differentially reworked at c. 500 Ma (SHIRAISHI et al. 1997).

Analysis of the aeromagnetic data shows that all major crustal provinces of the study area and their transitional zones are associated with distinct magnetic signatures. In northern Enderby Land, a roughly oval band of mostly positive anomalies clearly divides the Archean Napier Craton from the largely negative magnetic effects of the Mesoproterozoic Rayner Complex to the south. The Napier Craton displays a complex magnetic fabric that tends to reflect the lithology of granulites with metasedimentary rocks and granitoids associated with magnetic lows, and orthogneisses with highs. A broad magnetic low at least 100 km in width is related with the structural grain of the Rayner Complex that extends in an EW direction from the Prince Olav Coast towards MacRobertson Land. The magnetic variations over the Rayner Complex reflect the differences in metamorphic grades and lithologies within the sub-ice crust. The border line between the Rayner Complex and the neighboring

LHC to the west is clearly identified by a 350-nT anomaly over the offshore and the ice-covered interior of the Prince Olav Coast and the difference in the anomaly patterns and trends on either side of this anomaly. The elongated, fragmented magnetic highs and intervening lows of the LHC are associated with rocks metamorphosed under granulite facies conditions. The magnetic anomaly pattern of the Lützow-Holm Bay area shows distinctive affinity to that observed over the northern Prince Charles Mountains area. Both regions were formed largely from Neoproterozoic rocks that appear to define a continuous single geological terrane under the ice-covered interior of East Antarctica. The boundary between the LHC and the westward neighboring Yamato-Belgica terrane is marked by an abrupt change of the magnetic anomaly pattern that can be followed eastward to the Yamato Mountains along 36.5°E. The regional magnetic low with higher frequency, subdued highs over the Yamato-Belgica terrane reflect the effects of metasedimentary gneisses and granitoids of amphibolite facies grade.

The pattern of magnetic anomalies within the study area does not appear to be consistent with the proposed model of Gondwana reconstruction in which the LHC in East Antarctica and Highland Group of Sri Lanka developed in the suture zone during the final phase of the Pan-African orogeny where the Late Proterozoic supercontinent was separated by the Mozambique Ocean at the position of the LHC (SHIRAISHI et al. 1994). The absence of any coherent well-defined anomalies stretched in the direction of the proposed Cambrian orogenic belt seems to us to be contrary to the concept of southward subduction in a single continental block and lends credence to intraplate models rather than to suture-zone models (GOLYNSKY et al. 2002). It is obvious that the Pan-African event was undoubtedly of much greater significance in the geological evolution of East Antarctica than was once believed, but only future work will show which of the models discussed here is correct.

Fitzsimons, I.C.W. (2000): J. African Earth Sci. 31: 3-23.
Golynsky A.V., Alyavdin, S.V., Masolov, V.N., Tscherinov, A.S. & Volnukhin, V.S. (2002): Tectonophysics 347: 109-120.
Shiraishi, K., Ellis, D.J., Fanning, C.M., Hiroi, Y., Kagami, Y. & Motoyoshi, Y. (1997) In: C.A. Ricci (ed). The Antarctic region: geological evolution and processes. Terra Antarctica Publication, Siena, 79-88.
Shiraishi, K., Ellis, D.J., Hiroi, Y., Fanning, C.M., Motoyoshi, Y. & Nakai, Y. (1994) J. Geol. 102: 47-65.

Rift- to active-margin sedimentation in Neoproterozoic and lower Paleozoic siliciclastic rocks of the central Ross Orogen, Antarctica: detrital record of provenance and orogenic denudation rates

(oral p.)

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Siliciclastic rocks in the Transantarctic Mountains record the tectonic transformation from a Neoproterozoic rift-margin setting to an active early Paleozoic orogenic setting along the paleo-Pacific margin of East Antarctica. Detrital mineral ages from sandstones constrain their depositional age and sedimentary provenance, as well as denudation rates during the Ross Orogeny. In the central Transantarctic Mountains, quartz arenites of the late Neoproterozoic Beardmore Group contain Archean and Proterozoic zircons, reflecting distal input from the adjacent cratonic shield, Mesoproterozoic igneous provinces, and Grenville-age parts of East Gondwana. Similarly, Lower Cambrian sandstones of the autochthonous Byrd Group (Shackleton Limestone) record a dominantly cratonic shield source. Detrital zircons from the Koettlitz Group in southern Victoria Land show a similar age signature and constrain its depositional age to be ≤670 Ma. Significant populations (up to 22 %) of ~1.4 Ga zircons in the Neoproterozoic and Lower Cambrian sandstones suggest a unique source of Mesoproterozoic igneous material in the East Antarctic craton; comparison with the ~1.4 Ga trans-Laurentian igneous province suggests paleogeographic linkage between East Antarctica and Laurentia prior to ~1.0 Ga. In strong contrast, detrital zircons from upper Byrd Group sandstones (≤520 Ma; Early Cambrian or younger) are dominated by young components derived from proximal igneous and metamorphic rocks of the Ross Orogen. Sandstones from the Pensacola Mountains are dominated by Grenville and Pan-African zircon ages, suggesting a source in the western Dronning Maud Land equivalent of the East African Orogen.

Integration of stratigraphic relationships and detrital age patterns leads to a tectonic model involving Neoproterozoic rifting and development of a passive-margin platform, followed by rapid transition in the late Early Cambrian (Botomian) to an active continental-margin arc and forearc setting. Large volumes of molassic sediment were shed to forearc marginal basins in Middle Cambrian and Ordovician time, primarily by erosion of volcanic rocks in the early Ross magmatic arc. U-Pb and $^{40}Ar/^{39}Ar$ mineral ages from detrital zircons and muscovites in the molasse deposits allow us to estimate cooling and denudation rates in the source terrain. Based on stratigraphic evidence for a common provenance, the detrital zircon and muscovite ages indicate cooling rates of 10-30°C/m.y. in the source area. Evidence of rapid cooling and unroofing suggest that crustal thickening associated with both magmatic intrusion and structural shortening was balanced by erosional exhumation. The calculated cooling rates, along with a geotherm determined from crystalline basement of the orogen, indicate denudation rates of 0.3-1.4 mm/a, which are comparable to those in recent convergent or collision orogens. Profound syntectonic denudation, followed by Devonian peneplanation, removed the entire volcanic carapace and exposed the plutonic roots of the arc. Rapid erosion and unroofing in the axial Ross Orogen is consistent with a sharp carbonate-to-clastic stratigraphic transition observed in the upper Byrd Group, reflecting a sudden outpouring of alluvial-fan and fluvial-marine clastic detritus, and with denudation rates inferred from mineral cooling ages in the adjacent metamorphic basement. The forearc deposits were themselves intruded by late-orogenic plutons as the locus of magmatism shifted offshore during oceanward trench retreat. Deposition of individual molasse units continued until ~490-485 Ma (earliest Ordovician), based on ages from cross-cutting igneous bodies and neoblastic metamorphic phases. The entire episode of interrelated tectonic, denudational, sedimentary, deformational, and magmatic events is restricted to a period of 7-25 m.y. in the late Early Cambrian to earliest Ordovician, and it reflects a short time lag between tectonism and sedimentary response documented in other continental-margin arc systems.

Depositional environment of the Byrd Group, Byrd Glacier area: A Cambrian record of sedimentation, tectonism, and magmatism on the Paleo-Pacific continental margin of Gondwana

(oral p.)

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The geology of the Byrd Group immediately south of Byrd Glacier records a major sequence of geologic events, beginning with the development of a carbonate platform (Shackleton Limestone) during the early Atdabanian (approximately 525 Ma), followed by a transitional interval of siliciclastic deposition and volcanism (Starshot Formation) during the late Botomian (approximately 512 Ma), and ending with a coarse cover of siliciclastic molasse deposition (Douglas Conglomerate), no younger than plutonism at 492 ±2 Ma. Thus, the Byrd Group was deposited during a span less than 33 m.y., representing passivie shelf-margin sedimentation into active uplift and erosion related to the Ross Orogeny.

The development of the carbonate platform is represented by the newly subdivided Early Cambrian Shackleton Limestone. The lower half of the Shackleton Limestone is a succession of high-energy, shelf margin, limestone tempestites (Cross-bedded member), followed by low- to moderate-energy, semi-restricted to restricted shelf deposits (Cherty member), overlain by low-energy, tidal flat deposits (Butterscotch member). This nearly 1,000 m-thick shoaling upwards succession is newly interpreted to represent a first- to second-order progradation and offlap of carbonate shelf sediments, possibly in response to a eustatic lowering of sea-level during the Early Cambrian. The upper half of the Shackleton Limestone (Upper member) is a sequence, approximately 1500 m thick, of mainly shallow-water shelf deposits, interpreted to record sedimentation in response to the Cambrian Sauk transgression. However, the lower part of the Upper member records a significant emergence of the carbonate shelf, possibly the platform, resulting in an interval of karst development, most likely caused by local tectonism and uplift of the carbonate shelf. The uppermost Upper member of the Shackleton Limestone contains two closely-spaced lithosomes, a volcanic ash bed followed by a horizon of argillite. The argillite represents the first major pulse of clastic sedimentation into the Shackleton carbonate basin. The volcanic ash provides the first isotopic age of this event (512 ±5 Ma), and upper bounding depositional age of the Shackleton Limestone. These new geochronological data constrain the span of deposition of the Shackleton Limestone to approximately 13 m.y..

Basalt flows and pillows of the Starshot Formation accompany the carbonate to siliciclastic transition, coeval with limestone deposition. Sandstones of the Starshot Formation coarsen upwards into the Douglas Conglomerate. Within the Douglas Conglomerate, second-generation clasts indicate that the basin was feeding on itself during continued tectonism, which produced a thick molasse in response to regional uplift of carbonate and siliciclastic sources. The clasts of the Douglas Conglomerate reveal that the primary sources of clastic detritus were derived from the Shackleton Limestone, Starshot basalt, and possibly much of the Starshot sandstone. Additionally, discoveries at previously unvisited nunataks extend the clastic basin further to the east in this area.

Refinement of the sequence of sedimentation, tectonism, and magmatism that deformed the Byrd Group has improved our understanding of the regional geologic history and has raised several questions regarding the evolution of the central Transantarctic Mountains and the Ross Orogen, such as the geometry and location of the Early Cambrian paleo-Pacific continental margin, the direction of siliciclastic sources, the location of the magmatic arc (thought to be the locus of tectonic uplift and molasse progradation), and the relationship with older terrain to the north of Byrd Glacier separated by the Byrd Glacier Discontinuity (Stump et al. this volume).

Multiple post-Miocene deglaciations and marine transgressions at Vestfold Hills, East Antarctica
(oral p.)

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Post-Miocene glacial minima and marine transgressions along the coastline of East Antarctica are poorly constrained. Here we describe amino acid (D/L) ratios from 60 calcareous fossils taken from three sedimentary environments at Vestfold Hills, East Antarctica. The first environment is the in situ Pliocene sediments at Marine Plain, which has fossils with distinctive D/L ratios commensurate with its early-mid Pliocene age. The second environment is glacially transported and deposited sediments, which have fossils with a broad range of D/L ratios that indicate up to seven ice-free episodes from the late Pliocene to the late Pleistocene. The third environment is the in situ marine shorelines, whose ^{14}C-dated fossils have D/L ratios that reflect a Holocene age. Amino acid and ^{14}C data from these calcareous fossils not only reflect multiple marine transgressions since the early Pliocene, they also constrain the ice sheet margin to at least its present position for much of the Plio-Pleistocene.

Crustal characteristics and seismic stratigraphy of the Riiser-Larsen Sea basin
(poster p.)

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About 12 000 km of MCS, gravity and magnetic data as well as 28 sonobuoys have been acquired in the Riiser-Larsen Sea (RLS) sedimentary basin by PMGRE on RV "Akademik Alexander Karpinsky" (Russian Antarctic Expedition) during three austral seasons (1996 to 1998). MCS investigations allow to identify major unconformities in sedimentary cover and to define basement characteristics within different types of Earth crust. The set of maps have been compiled for the RLS which include: depth to the basement, thickness of sediments, magnetic and gravity anomaly maps, distribution of basement seismic pattern (seismic reflection character of acoustic basement) and tectonic map.

The basement of the RLS dips steeply from the upper continental slope northward to the depths of about 8-10 km below the continental rise. Totally, eight types of the acoustic basement with different reflection characteristics have been identified. Continent-to-ocean boundary is distinguished by the changes in basement morphology and in refraction velocities on the basement surface (from 6.0-6.2 km/s, inherent in stretched continental crust to 5.4-5.6 km/c, which are proposed to belong to oceanic crust). In the eastern RLS, the consequence of magnetic anomalies from M16 to M0 (with half spreading rate of 1.4-2.7 cm/yr) were identified. Unlike previous Gondwana reconstructions, which proposed that Madagascar Ridge was attached to Antarctica before chron M0, our new data prove that Madagascar Ridge did not occupy the eastern RLS and the Riiser-Larsen Sea Basin opened simultaneously in the Middle Jurassic time as a result of separation between Africa and Antarctica.

The thickness of sediments in the RLS ranges from 1.0-3.0 km within the Astrid Ridge, Gunnerus Ridge and abyssal plane to 7.0-9.0 km below the continental rise. Five distinct unconformities (marked from RLS-1 to RLS-5) are recognized in the sedimentary cover of the RLS Basin. Two of them bound three major seismic (sedimentary) units: lower, synrift (presumably Middle-Jurassic) unit; middle post-rift pre-glacial (presumably Middle-Jurassic-Late Eocene) unit; and upper, synglacial unit. Transition between pre-glacial and synglacial units is marked by prominent unconformity RLS-4 showing distinct upward change from relatively homogeneous part of section to heterogeneous one with a variety of well-stratified seismic facies. This transition is appear to reflect a dramatic alteration in the depositional environment resulted from the onset of East Antarctic glaciation in Late Eocene-Early Oligocene time. The unit above unconformity RLS 4 contains mostly channel-levee deposits generated by high density channelized flows while other types of drifts are almost absent. The main buried channel system of SW-NE orientation is situated in the eastern part of the area. The thickness of synglacial unit ranges from 1.0 to 1.5 km.

Crustal structure, seismic stratigraphy and tectonic evolution of the southeastern Indian Ocean between 0°E and 60°E

(EANT workshop p.)

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About 25 000 km of MCS, gravity and magnetic data as well as 60 sonobuoys have been acquired in the south-eastern India Ocean (Riiser-Larsen Sea, Cosmonaut Sea, Cooperation Sea) on RV "Akademik Alexander Karpinsky" (Russian Antarctic Expedition) during six austral seasons (1996 to 2002). Additionally, 3500 km of MCS profiles and 10 sonobuoys were collected in the western Cosmonaut Sea and the eastern Riiser-Larsen Sea during 2002 and 2003 seasons under the joint project between PMGRE and NPD. Conducted investigations enable to define crustal characteristics of this region, to recognize the position continent-to-ocean boundary and to develop a seismic stratigraphy of sedimentary cover. The set of maps have been compiled for the region studied which include: depth to the basement, thickness of sediments, magnetic and gravity anomaly maps, distribution of basement seismic pattern and tectonic map.

The basement surface occurring at shallow (0.5-2,0 km) level in the shelf areas, Astrid Ridge and Gunnerus Ridge descends beneath continental slopes to be as deep as 8,5-10,0 km below the continental rise and abyssal plane. In many cases it shows the structures of extensional tectonics (half-grabens with rotated crustal blocks) which are more distinct within the slope and upper continental rise. The set of geophysical data allow identifying the continent-to-ocean boundary everywhere in the region studied. It is mainly distinguished from sonobuoy data, which show the clear change in refraction velocities for the basement surface from 6,0-6,3 km/s to 5,3-5,5 km/s.

Four major regional unconformities (named from RLS-1 to RLS-4 for the Riiser Larsen Sea and from CS-2 to CS5 in the Cosmonaut Sea and Cooperation Sea) are identified in the sedimentary basins. Unconformity RLS-1 is locally developed and represent the top of volcanic unit (Explora Wedge). unconformities RLS-2 and CS-2 correspond to the East Gondwana break-up and are different in age depending on time of plate separation. Unconformities RLS-3 and CS3 are possibly similar in age and are connected with Cretaceous plate reorganization in Indian Ocean. Unconformities RLS-4 and CS-4 display the transition from the lower relatively homogenous part of sedimentary section (with mostly irregular or continuous reflectors) to the upper heterogeneous one where a variety of drift deposits are developed. This transition are most likely synchronous for the all East Antarctic margin and reflect the dramatic change in the continental margin depositional environment resulted from first advance of grounded ice sheet at the shelf edge which transported a large amount of sediments to the margin. The total thickness of depositional package in the basins varies from 0-0,5 km within the shelf areas and basement highs to greater than 7 km at the continental rise.

Seismic crustal structure of West Antarctica between the Elephant Island and Marguerite Bay

(oral p.)

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During four Polish Geodynamic Expeditions in years 1979-1991, a wide geophysical and geological program was performed in the transition zone between the Drake and South Shetland microplates and the Antarctic Plate in West Antarctica. The expeditions carried out seismic refraction studies of the Earth's crust and lower lithosphere together with geological, sedimentological and palaeontological investigations, within the general program of geodynamic studies in West Antarctica. These studies were carried out along the Antarctic Peninsula from the Elephant Island to the Marguerite Bay including: the South Shetland Islands, the Bransfield Strait, subduction zone in the Drake Passage, the Deception Island, the Palmer Archipelago and the Adelaide Island. Special attention was paid to tectonically active zones and the contact zones between blocks of the Earth's crust and the lithospheric plates. Seismic refraction and wide angle reflection measurements were done using explosions in the sea along profiles of total length about 4500 km. All shots were recorded by three and five channel seismic stations located on land. Shots along profiles in the Bransfield Strait were recorded by Ocean Bottom Seismographs. Additionally 1200 km reflection profiles were made in the Bransfield Strait and Drake Passage. In the area between the Palmer Archipelago and the Adelaide Island, the Earth's crust has a typical continental structure, where the crustal thickness decreases from 36-42 km in the coastal area to about 25-28 km toward the Pacific Ocean. In the surrounding of the Bransfield Strait area, the Moho boundary depth ranges from 10 km beneath the South Shetland Trench to 40 km under the Antarctic Peninsula. Beneath the trough of the Bransfield Strait in the 10-32 km depth range, the presence of a high velocity body, with longitudinal seismic wave velocities $V_p > 7.0$ km/s, was detected. This inhomogenity was interpreted as an intrusion, coinciding with the Deception-Bridgeman volcanic line. In the transition zone from the Drake Passage to the South Shetland Islands, a seismic boundary in the lower lithosphere occurs at a depth ranging from 35 to 80 km. The dip of both this boundary and the Moho, is approximately 25° towards the southeast, indicating the direction of subduction of the Drake Plate lithosphere under the Antarctic Plate. In general, the interpretation yielded two-dimensional models of the crust and lower lithosphere down to 80 km depth. Based on the two-dimensional models supplemented with results of the three-dimensional tomographic modelling, a map of the depth of the Moho interface was prepared. Such a map is a compilation of all Polish seismic refraction data.

Palaeoenvironmental change in the Paleocene and Eocene of Seymour Island based on quantitative palynological analysis
(poster p.)

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A regressive sequence of Paleocene and Eocene strata record the late stages of fill within the Larsen Basin. These sediments contain a unique record of life in the high southern latitudes under climatic conditions not seen on the Earth today. Previous studies on these sequences have concentrated on taxonomic composition and biostratigraphic applications of the microfossils. However, quantitative data reveals additional information about the response of the organisms to environmental change. Detailed counts were analysed statistically by Correspondence Analysis. Dramatic changes in marine conditions in the earliest Danian are reflected in palynomorph abundance and composition. In the Eocene terrestrial and marine assemblages show a marked quantitative response to base level changes within the basin. The changes reflect a complex interplay between coastal plain and hinterland environments for the terrestrial elements.

Topography and dynamics of the ice cover for the Graham Land between 65-66°S with ERS SAR interferometry *
(oral p.)

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The region of the Antarctic Peninsula adjacent to Vernadsky Ukrainian Antarctic Station was observed with several ERS SAR images acquired between November 1995 and January 2003. Six pairs of scenes by ascending and descending orbits for the same region of 100 x 100 km with central coordinates Lattitude 65.33°S, Longitude 64.25°W were considered. The Antarctic Peninsula occupies most part of the frame. The main geomorphological provinces visible on images are: the mountain Graham Land, Graham Coast, Bruce Plateau and eastern slope of the Peninsula with three many kilometers outflow glaciers flowing direction to the Foyn Coast of the Weddell Sea.

The analysis of the SAR data brings a lot of new information even without geometric correction due to the high resolution of images and repeatability in various seasons. Result show geomorphological features of geological structures and glaciers movement to the ocean. Visible images, coherence maps and interferograms were computed and analysed with the POLIMI ISAR software (ESA/ESRIN) and the phase unwrapping procedure were carried out by the SNAPHU software (Stanford Univ.).

The topographic contour maps and 3D images were built by DEMs. It is good seen such great scale structures as: Graham Coast valley, surrounding ridges, passages to the bays, Penola Strait and so on. Several profiles through the same structures were computed also for different seasons to obtain quantitative assessments of the topography variation.

*This research is within the framework of the ESA/ESRIN AO3.358 project.

Geodynamic features and density structure of the earth's interior within the Scotia Arc with the geoid and altimetric data

(oral p.)

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Deep structure and geodynamics of the Scotia Arc and adjacent provinces within limits of 48-66°S and 80-10°W are submitted with the EGM96 gravity geoid model. The distribution of density inhomogeneities for whole range of Earth's depths is displayed along the characteristic latitudinal and longitudinal cross-sections, and on lateral levels of region with the spatial resolution of 30 km also. Assessments of the depths are computed with the known harmonic function in the geoid theory 1/r, on which the dependence between number of a harmonic and distance up to the disturbing mass is determined. Density anomalies (relatively of the "density of the zero potential") are computed with the internal potential harmonics by means of the solution of the inverse gravity problem by (MORITZ 1990).

The images of differential anomalies (relatively of homogeneous deep layers) as three-dimensional surfaces show a detailed distribution of masses in the upper layers of the lithosphere, geometry and sizes of density inhomogeneities, their displacement on depth under influence of dynamic processes, and correlation of subsurface bodies with the bottom topography also. Density structure and geodynamic processes on depths more than 100 km are distinguished considerably from upper layers. The amomalous more dense body like a lens is revealed on the 43°W vertical longitudinal cross-section on depth of 780 km. Its kernel is 200 km on thickness (depth of 680-880 km) and 1100 km on extension. This layer is placed on the northeast part of the region. An interchange of different amomalous layers is observed more deeply. On depth of 500 km less dense layers do not block the lens completely, creating the narrowed channel to the upper horizons. Due to, probably, the energy and masses of the lens became as a basis for transition crustal type and lithosphere of the Scotia Sea.

On depths of 120-150 km there are clear contours of the actual Scotia body, which in the basis has an ellipse form with axes 630 x 300 km and placed from northern of the Bransfield zone up to the South Orkney Islands. The lateral walls of the body are extended to surface. On depth of 35 km two branches are formed. The main eastern branch with an inclination is directed to the rear area of the South Sandwich island arc (Sandwich Plate), and another - in an opposite direction to the Bransfield zone. The basic epicentres of more dense masses on all depths are placed not at the centre of the Scotia sea, but on the southern and eastern margins.
Latitudinal vertical cross-sections through the island arc are shown a situation of root parts of the island arc and the trench on depth. The roots of the island ridge are inclined to the Scotia sea side and plunged on extention of 500 km up to depths of 25-30 km. Such significant displacement of root areas on depth show intensive counter geodynamic processes of different plate blocks. A characteristic extension of the root foundation can be seen in both island ridge, and the trench on depth of 20 km. It is the effect of mass fluidity owing to their own weight (USHAKOV & KRASS 1972). The similar phenomena we observed also in the Caribbean sea and at the analysis of the South America continental margin within the coastal zone of Argentine (GREKU & GREKU 2002). Structure of the subsurface layer can be shown also with the altimeter data with higher resolution (some kilometers and even hundreds meters for the ERS data), than by geoid model.

Moritz, H. (1990): The Figure of the Earth;
Greku R. & Greku D. (2002): Space Research in Ukraine: 11-18.
Ushakov S.A. & Krass M.S. (1972): Gravity Field and Mechanics of the Earth's Interior.

Argentine Island archipelago topography, bathymetry and geodetic GPS survey

(oral p.)

(as well as poster presentation under
Topographic and geodetic GPS survey on islands and in aquatoria of the Argentine Archipelago)

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Topographic and geodetic data are required for many Earth Science investigations. Therefore GPS-survey have begun in region of Vernadsky Ukrainian Antarctic station since 1997 and continue now. Following works in this area are carried out under the auspices of the Ukrainian Antarctic Center:

- Season many days GPS-survey at the "SCAR GPS 2002" site on Galindez Island; within the framework of the GIANT project;
- Restoration of coordinates of the British triangulation stations and creation of new network on islands of the archipelago;
- Large-scale topography mapping of islands and coastal contours with the GPS positioning and ground photogrammetry survey;
- Mapping of the Galindez ice-house and ice streams of the Antarctic Peninsula with the ERS radar interferometry;
- Echosounding of the of the Argentine archipelago's sea-bed in the shallow unsurveyed areas (within the framework of the project IBCSO);
- Determination of a detailed local geoid with the altimeter data of the Bellinsgausen sea (within the framework of the project ANTEC).

Following scientific information is received now as results: GPS observations are carried out at the "SCAR GPS 2002" site for 15 days in 2002 and 2003, the error of coordinates of 2002 is 1-2 mm, the data of 2003 are processed. More than 300 GPS points had determined for positioning of different geophysical measurements on islands. 30 of them are fixed in rock and can they can be used for repeated observations and development of a local geodetic network. Sounding survey with GPS positioning is about 400 km. 12 radar ERS1/2 images (including the Tandem mission) for the same area of the Graham Land on area 100 x 100 km are received. These images are used for investigation of variability of the ground and ice cover topography for period 1996-2003, and for geological, oceanological and ecological researches also. The ERS1 altimeter data with the EGM96 geoid gravity model are used for determination of density structure and geodynamics of the lithosphere of the Scotia Arc region. In the report the various maps and images by results of topographic, bathymetric and satellite survey are shown.

The main goal of these works consists in following: creation with the GPS survey of a precision geodetic network and determination of geodynamic characteristics of the region, determination massbalans and dynamics of the ice cover by the satellite radar interferometry, modeling of a deep structure of the lithosphere with the altimeter data, creation of the "Vernadsky-Argentine Islands" GIS.

In a complex with other researches at Vernadsky station (seismology, geomagnetism) topographic-geodetic works will be an important contribution to fundamental area of study of global geodynamic processes.

Bathymetric map and geomorphological features of the Argentine Archipelago's sea-bed with Ukrainian (1998-2003) and British (1964-1965) soundings
(poster p.)

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The archipelago of the Argentine Islands is located on the western shelf of the Antarctic Peninsula. It is separated from the Peninsula by the deep (more than 300 m) and wide (7 km) Penola Strait. The archipelago is a tectonic mesoblock, which is broken at smaller fragments by system of fractures.

Echo-sounding and geological sampling on the equipped boat were carried out in the internal water between islands of the archipelago (The Barchans, Forge, Galindez and Skua) during March-April 1998 and then added in 2002 and 2003. Depths and co-ordinates were recorded with two second period (or 5 m interval approximately). Depth accuracy is not worse than 0.1 %. Depths are corrected for the instantaneous tidal level. RMS error of the GPS positioning was ±23.5 m in 1998 and better than one meter in 2002-2003.

DEM with 20 m resolution and an electronic map of the bottom topography were constructed (GOZIK et al. 2002). On this base, different morphometric and geomorphological maps (slope, aspect, curvature, ridge and channel directions) were created with the LandSerf software (Lester Univ.). Depths within the archipelago are not more than 70 m. The general nature of the bottom is rock with thin mud and sand sediments distributed in morphological traps.

Main of the relief genetic factors are both geological-tectonic and historical glaciological processes of the ice streams effect. A system of the fracture zones in northeastward, northwestward and latitudinal directions is well visible on the maps.

Comparison of the bottom topography images between Ukrainian and British Royal Navy soundings was carried out. The original British chart K4655 with depths along regular tracks, which has been given kindly by BAS was used. This data were digitized an d used for DEM computing. Images of the sea-bed on common areas of the maps are similar. Four areas from different regions of the archipelago were used for comparison by 1430 node pairs. An average difference between latitudes are -4.4 m, for longitudes 8.0 m and for depths 0.2 m, std for depths is 2.8 m. Quantity of depth difference lower than ±5 m is more than 80 %. Maximum differences are more than 20 m at the steep relief.

Bathymetric map can be used as a layer of a new International Bathymetric Chart of the Southern Ocean (IBCSO Project) for different researches and for yacht and boat navigation also in region of the Vernadsky Ukrainian Antarctic station.

Gozik P.F., Greku R.Kh. et al. (2002): Geol. Journ. 1: 128-131.

Using a GIS to analyse marine mollusc distribution in the Southern Ocean
(poster p.)

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SOMBASE (Southem Ocean Mollusc Database) is a comprehensive biogeographic database of Southem Ocean and Antarctic mollusca. Containing information on over 1400 species from 3300 locations, the database is a powerful tool for assessing biodiversity around the South Pole. The database, whilst useful in itself, becomes even more effective when combined with a GIS. Analysing the data within its spatial context shows up patterns which rnay be overlooked using more traditional methods of analysis. The GIS is used to rnanage, analyse and display the data as well as to export the data for use in statistical packages.

Exporting the results of attribute or location based queries from the GIS allows the data to be used in complex statistical analyses. Working with distributional data for rnany species it is possible to perform multivariate statistical analyses. Using species distributions from SOMBASE it is possible to analyse and compare the community compositions of pre-defined geographic areas.

A GIS is also used to display and interpret the results of other investigations. SOMBASE shows that ten species of the genus *Limopsis* occur in the Southem Ocean, of those species *Limopsis marionensis* is the most widely distributed. We generated a molecular phylogeny for seven species of *Limopsis* from the Southem Ocean using DNA sequences from the ribososornal 28S and ITS genes. Displaying the distribution sites on a GIS shows the locations of specimens from the different groups within the *Limopsis marionensis-complex.* This allows us to analyse the geographic reasons for the speciation and distributions.

Archiving and distributing earth-science data with the information system PANGAEA
(poster p.)

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The information system PANGAEA - Network for Geological and Environmental Data (http://www.pangaea.de) is presented. The system is aimed at publishing, distributing and archiving data related to climate variability, to the marine environment, and to the solid earth. Data are stored in a relational database in consistent formats with related meta-information following international standards. Data are geocoded in space and/or time, also allowing the extraction of newly configured subsets. Any kind of information can be served, e.g. profiles, maps, photos, graphics, text and numbers). PANGAEA may be seen as a 'data library' distributing data to the scientific community by use of the Internet. Operation by AWI and MARUM is ensured on a long-term perspective, both institutes providing the technical infrastructure, system management and support for project data management.

Access to data on the Internet is established through different possibilities:

(1) PangaVista is a search engine, prompting the user with a list of links to pre configured data sets in PANGAEA, related to a given keyword,
(2) links on web pages to any defined subset of information,

(3) advanced retrieval tool (ART) to give the user full access to the relational system and to retrieve individually configured subsets of data from the inventory. ART is designed as a 'data mining tool' to support the use and interpretation of comprehensive data collections.

PANGAEA can be used by national or international projects for the archiving of results. Data managers serve the project members with procedures for collection, harmonization, visualization and quality assurance. Antarctic earth science data available from PANGAEA are e.g. results from the Cape Roberts Project, marine geology data from POLARSTERN sediment core material, published paleoceanographic data from the Southern Ocean and geological investigations from the Antarctic continent. Software for the visualization of geodata in maps and sections is provided as downloads from the PANGAEA web server (PanMap, PanPlot, Ocean Data View).

The major advantage of PANGAEA is its easy accessibility on the Internet and the added value of data due to the highly consistent internal format allowing the definition of new sets from different sources. The scientific community is invited to make use of the new concept of PANGAEA for long-term archiving and distribution of data related to earth sciences.

Evidence for orbitally controlled size variations of the East Antarctic Ice Sheet during the Late Miocene

(oral p.)

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Ocean Drilling Program Site 1165 penetrated drift sediments on the East Antarctic continental rise and recovered sediments from a low energy depositional environment. The sediments are characterized by prominent alternations between two main facies: a dark gray, laminated, terrigenous one, interpreted to represent muddy contourites or hemiturbidites, and a greenish, homogeneous, biogenic- and coarse-fraction- bearing one, interpreted as hemipelagic deposits with ice rafted debris (IRD).

Our investigation of a late Miocene section used high-resolution color spectra, multi sensor core logs, and XRF-scans, and reveals that sedimentation changes occur at Milankovitch orbital frequencies of obliquity and precession. Superimposed on these short-term variations, significant uphole changes in average sedimentation rates, total clay content, IRD amount, and mineral composition were interpreted to represent the long-term lower to upper Miocene transition from a temperate climate to a cold-climate glaciation.

Among the record registered by multisensor track, cycles at Milankovitch periodicities are best described by spectral reflectance data and in particular by a parameter calculated as the ratio of the reflectivity in the green color band and the average reflectivity (gray). A numerical evaluation of spectral reflectance data was performed and substantiated by correlation with core photos to provide an objective description of the color variations within Site 1165 (REBESCO in press). The resulting color description provides a reference to categorize the available samples in terms of facies and hence a framework for further analyses. Moreover, a link between visually described features and numerical series suitable for spectral analyses was provided.

We used the investigation of Milankovitch orbital frequencies in a late Miocene section to derive an astronomical calibrated time scale and to calculate iron mass accumulation rates, as a proxy for sediment accumulation rates (GRÜTZNER et al. in press). Terrigenous iron fluxes change by up 100 % during each obliquity cycle. This change and an episodic pattern of enhanced ice rafted debris (IRD) deposition during times of deglaciation, provide evidence for a dynamic and likely wet-based late Miocene East Antarctic Ice Sheet (EAIS) that experienced large size variations at orbital time scales.

The dynamic behavior of the EAIS implies that a significant proportion of the variability seen in oxygen isotope records of the late Miocene reflects Antarctic ice volume changes.

Grützner J., Rebesco M., Cooper A.K., Forsberg C.F., Kryc K.A. & Wefer G. (in press): Evidence for orbitally controlled size variations of the East Antarctic Ice Sheet during the late Miocene.- Geology.
Rebesco M. (in press): Data Report: Numerical Evaluation of Diffuse Spectral Reflectance Data and Correlation with Core Photos, ODP Site 1165, Wild Drift, Cooperation Sea, Antarctica.- In: A.K. Cooper, P.E. O'Brien , C. Richter (Eds.). Proc. ODP, Sci. Results, 188

The Antarctic Rock Magnetic Database: an overview
(poster p.)

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Rock magnetic property data from the few but very important bedrock exposures in Antarctica represent ground truth for geophysical surveys. Well over 10,000 paleomagnetic cores, representing more than 1000 sites have been collected in Antarctica from Precambrian to late Cenozoic rocks. Such a collection represents a unique source of rock physical property data because of the scarcity of bedrock exposures. The magnetic information from these rocks is useful for geophysical surveys in interpreting the sub ice bedrock geology especially when there is significant variability within similar rock units.

Hence, an Antarctic Rock Magnetic database has been established online for use by the Antarctic community. The compiled rock magnetic data in the Antarctic Rock Magnetic Database (ARMD) can help address the following issues:

1) Demarcation of crustal boundaries in both East and West Antarctica; are there terrane boundaries in West Antarctica, crustal suture zones in East Antarctica, etc.?
2) Determine the provenance of pebbles in the West Antarctic ice sheet: measurement of magnetic properties of pebbles beneath the ice is a non-destructive way to understand clast provenance and glacial flow dynamics. While magnetism alone will not uniquely identify provenance, magnetism in conjunction with petrography and geochemistry can identify the likely source terrane.
3) Geometry and extent of Jurassic Ferrar Group magmatic rocks: large variations in Ferrar Group susceptibilities within the TAM makes it useful to know the range and variability of Ferrar magnetic properties for inferring the subice location of Ferrar Group rocks.
4) Provenance analyses for paleoclimate research: the magnetic mineral assemblages have been studied to identify the magnetic carriers of the 200-300 yr cyclic susceptibility signal often found in Holocene sediments (Brachfeld, pers. comm.). The rock magnetic database could help resolve issues concerning dilution vs. dissolution of magnetic material by providing magnetic information on the probable source rocks for the sediments.

All researchers with rock magnetic data can enter their information into the database as well as being able to access information in the database. The database information is set up on the paleomagnetic site level. The Antarctic rock magnetic database has been modeled on the United States Antarctic

Geologic Database (AGD): The AGD has been established at the Byrd Polar Research Center for cataloging Antarctic rocks collected by US researchers. The computer system for the AGD will act as the server for the Antarctic Rock Magnetic database. The ARMD has the same format as the AGD in that many of the AGD primary fields remain the same for the rock magnetic database (Site-coordinates, lithology, age, location, formation/unit name, structural information, etc.). The subfields have been changed to include relevant rock magnetic data such as NRM directions, NRM intensity, susceptibility, anisotropy analyses, magnetic mineralogy, Curie temperature and other information about the samples and locations. Field maps and photos of outcrops have also been included. The ARMD also includes a 'Notes' section where relevant information can be updated, e.g. new isotopic or faunal ages. The magnetics database has a search option for those wishing to obtain the rock magnetic data from a particular region, unit or researcher.

Deep crustal seismic models along Antarctic Peninsula, West Antarctica

(poster p.)

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During four Polish Geodynamic Expeditions in years 1979-1991, a wide geophysical and geological program was performed. The expeditions carried out seismic refraction studies of the Earth's crust and lower lithosphere together with geological, sedimentological and palaeontological investigations, within the general program of geodynamic studies in West Antarctica. These studies were carried out along the Antarctic Peninsula from the Elephant Island to the Marguerite Bay including: the South Shetland Islands, the Bransfield Strait, subduction zone in the Drake Passage, the Deception Island, the Palmer Archipelago and the Adelaide Island. Special attention was paid to tectonically active zones and the contact zones between blocks of the Earth's crust and the lithospheric plates. Seismic refraction and wide angle reflection measurements were done using explosions in the sea along profiles of total length about 4500 km. All shots were recorded by three and five channel seismic stations located on land. Shots along profiles in the Bransfield Strait were recorded by Ocean Bottom Seismographs. In the area between the Palmer Archipelago and the Adelaide Island, the Earth's crust has a typical continental structure, where the crustal thickness decreases from 36-42 km in the coastal area to about 25-28 km toward the Pacific Ocean. In the surrounding of the Bransfield Strait area, the Moho boundary depth ranges from 10 km beneath the South Shetland Trench to 40 km under the Antarctic Peninsula. Beneath the trough of the Bransfield Strait in the 10-32 km depth range, the presence of a high velocity body, with longitudinal seismic wave velocities Vp >7.0 km/s, was detected. This inhomogenity was interpreted as an intrusion, coinciding with the Deception-Bridgeman Volcanic line. In the transition zone from the Drake Passage to the South Shetland Islands, a seismic boundary in the lower lithosphere occurs at a depth ranging from 35 to 80 km. The dip of both this boundary and the Moho, is approximately 25° towards the southeast, indicating the direction of subduction of the Drake Plate lithosphere under the Antarctic Plate. Two- and three-dimensional seismic models along all profiles in the area of investigation are presented.

Formation and characterization of ice-cemented soils in Victoria Valley, Antarctica
(poster p.)

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An apparent paradox of the Dry Valleys of Antarctica is that these valleys contain ubiquitous ground ice (massive subsurface ice and ice-cemented soils) despite findings from both process-based models and actual measurement of net sublimation rates that indicate that this pore ice should only form seasonally and that any near-surface ice should disappear rather rapidly. The presence of ground ice is fundamental to diverse geomorphic processes in the Dry Valleys, including patterned ground formation, micro-relief generation, sublimation till development, and pedogenesis.

This study addresses the formation of ice-cemented soils and its characteristics in Victoria Valley, Antarctica. Here, ice-cemented soils occur below 10-20 cm depth. Samples were collected over a depth of 1.20 m during the austral summer of 2001-2002. Water was extracted immediately after thawing soils in closed polyethylene bags by centrifugation. The samples were analyzed for stable isotopes and major cations and anions. Models of ice formation based on the isotopic compositions are presented, and solute evolution is modeled using PHREEQC, PHRQPITZ, and FREZCHEM.

The ice content of soils is between 6 and 13 wt.% water equivalent and increases with depth. Total salinity of melted ice samples is between 2.9 and 4.7 ‰ (0.1-0.2mol/L) and decreases with depth. The solute composition is dominated by Na^+ and SO_4^{-2} in the upper profile, whereas Ca^{+2} and Cl^- are dominant at depth. Furthermore, absolute concentrations (mg/kg$_{soil}$) of Mg^{+2}, SiO_2 and Sr^{+2} increase with depth while absolute concentrations of K^+ and $B(OH)_3$ decrease. The variation in total salt concentration and composition is best explained by loss of ice either through sublimation or evaporation accompanied by formation of insoluble and soluble salts like carbonate, gypsum, mirabilite, and others, as has been observed in many areas of the Dry Valleys.

Stable isotopes in ice plot linearly for δD_{SMOW} versus $\delta^{18}O_{SMOW}$ with a slope of 4.8, with deuterium excess decreasing from -77 in upper profile to -13 at depth. Furthermore the isotopic values at depth in the soil are close to values of water of upper Lake Victoria outflow. The intercept of the regression line of ground ice with the global meteoric water line (GMWL) is -37.7 and -291 for $\delta^{18}O$ and δD, respectively, and is close to modern precipitation measured in snow samples collected in 2001 at the same location. Assuming that the intercept represents the isotopic composition of the source of the ice, the observed trend in isotopes cannot be explained by isotope fractionation due to condensation solely, according to the model of SOUCHEZ & JOUZEL (1984). Alternatively, two other models are considered: 1) Evaporation (or sublimation) of ice with the initial isotopic composition determined by the intercept. 2) Melting of snow cover and downward migration of water, accompanied by evaporation, which combines with ice at depth. However, both models assume the presence of ground ice with a primary isotopic composition close to modern precipitation. While the model of pure evaporation (sublimation) would suggest a net loss of ground ice, the model of downward translocation of water would stabilize or lead to a net gain of ground ice. Both models will be discussed and combined with models for the chemical composition of the ground ice.

Souchez, R.A. & Jouzel, J. (1984) : J. Glaciol. 30: 369-372.

Neogene glacial deposits in the James Ross Island Volcanic Group
(oral p.)

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Research on the Neogene glacial record of Antarctica has been largely focused in the Transantarctic Mountains, the Prince Charles Mountains, King George Island and on the continental shelf. Two schools of thought have emerged concerning the stability of the East Antarctic Ice Sheet: that it was subject to major fluctuations either up until mid-Miocene or Pliocene time. Resolution of this issue is important if we are to link future response of the ice sheet to the projected warming of the next few centuries. This can only be resolved if new sites with glacigenic sediments can be documented and effectively interpreted in terms of glacier dynamics.

Extensive glacigenic sediments (named the Hobbs Glacier Formation) occur extensively within and at the base of the James Ross Island Volcanic Group. They provide an opportunity to investigate Miocene glacier dynamics at a relatively low latitude (64°S), i.e. in a region where glaciers are likely to be sensitive to climatic change. Basal outcrops of the Hobbs Glacier Formation lie unconformably on soft Cretaceous strata, and form a discontinuous sediment horizon that is rarely more than 10 m thick. Detailed logging of several sections indicates that the principal facies are diamictite and mudstone, overlain by a variety of volcanic rocks (tuff, lava, breccia). The diamictite is interpreted as a remobilised proximal glaciomarine sediment and, in one place at least, as a basal till. Clast assemblages indicate transport from the Antarctic Peninsula to the west, as reported previously. Mudstones with dispersed clasts are distal glaciomarine sediments. Many of the basal glacial outcrops contain fragmented a fossil fauna dominated by pectinids. Samples are currently being dated by the $^{87}Sr/^{86}Sr$ method but a wide range of ages is anticipated based on an assumed coeval relationship with overlying volcanic strata (see Smellie et al., this volume).

Within the volcanic sequence itself, there is further evidence of repeated glacial activity in the form of striated pavements and thin diamictite units, which separate all of the volcanic units mapped so far. Clasts were derived solely from James Ross Island. The association with the overlying volcanic strata is variable. At one locality the upper surface of diamictite has been contact-metamorphosed by basaltic lava. Elsewhere, the diamictite was intruded as soft sediment into hyaloclastite breccia, with some blocks of the former being detached as rafts, suggesting very rapid loading of the glacigenic horizon. Our observations suggest that volcanism was approximately contemporaneous with glacial deposition.

Overall, the range of facies and textural characteristics of the glacigenic sediments suggest deposition by wet-based, probably polythermal glaciers carrying little supraglacial debris. It appears that two sources of ice are indicated: (i)from the Antarctic Peninsula, which would have swamped the intervening marine basin; and (ii) from a local ice cap on James Ross Island. It is likely that both sources could have contributed ice simultaneously, with lower peripheral locations being affected by Antarctic Peninsula-derived ice, and higher locations affected by James Ross Island ice.

New geochemical aspects to the petrogenesis of the Jurassic Ferrar igneous rocks from northern Victoria Land, Antarctica

(oral p.)

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Compared to the Karoo and Paraná provinces, the Ferrar Large Igneous Province (FLIP) represents the most significant continental flood basalt province associated with the break-up of Gondwana. The distribution as well as the geochemistry of the igneous rocks of the FLIP are unique. Extrusives and intrusives extend in a linear belt for 3000 km along the western margin of the East Antarctic Craton from the Theron Mountains to Tasmania.

They are geochemically distinct with respect to their degree of differentiation, elevated initial Sr isotope ratios, low eNd values and crust-like trace element signatures. According to previous studies, the origin of these remarkable characteristics is attributed to a magma source within the subcontinental lithosperic mantle, which experienced the overprint by a crustal component with a sediment-like isotopic signature during paleozoic subduction processes at the western margin of the East Antarctic craton.

On the basis of samples gathered in northern Victoria Land during GANOVEX VIII in 1999/2000 our investigations are directed towards the objectives petrogenesis of differences between low-Ti and high-Ti magma series, and identification of a mantle plume component as possible thermal source for the voluminous magmas.

Modelling the differences between the two magma series includes the options of one and two primary melts respectively as well as the effects of variable pressures, H_2O activities and oxygen fugacities on the composition of fractionating pyroxenes, plagioclase and Fe-Ti oxides.

He-isotope analyses on pyroxene separates are under progress in order to identify the involvement of a mantle plume component. To characterize the melting source, samples were analyzed for platinum-group elements. Initial results indicate sulfur undersaturated conditions during fractionation comparable to the North Atlantic Tertiary Igneous Province.

Natural radioactive tracers between Africa and Antarctica: preliminary results from POLARSTERN expedition ANT XX/2

(oral p.)

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Samples have been taken along 0° and 23°E during POLARSTERN expedition ANT XX/2 for the determination of the naturally occurring radionuclides ^{226}Ra, ^{228}Ra, ^{227}Ac and ^{234}Th (half-lives 1600, 5.8, 21.8 years and 24 days, respectively).

Both ^{226}Ra and ^{228}Ra are released to the water column from the sediment through decay of thorium isotopes, but in consequence of a difference in parent distribution and half-life, the release of ^{226}Ra is strongest from deep-sea sediments while ^{228}Ra accumulates to high activities in shallow water regions. ^{227}Ac is almost exclusively released from deep-sea sediments into bottom waters. Any excess activity over its parent nuclide ^{231}Pa in the upper water column indicates rapid upwelling of deeper water masses (GEIBERT et al. 2002). The combination of ^{228}Ra and ^{227}Ac allows for a better distinction between lateral advection versus deep upwelling of water masses in the open ocean. ^{234}Th has been measured in order to estimate the export production from the upper water column into deeper water layers.

Three key regions were sampled for radionuclides during ANT XX/2:

• Agulhas Retroflection Area
Intense mixing of subtropical and subantarctic water masses takes place in the region south of South Africa (BOEBEL et al. 2003). The mixing waters carry very distinct ^{228}Ra signals, a feature that should help especially in a better distinction of the origin of cyclonic eddies. While waters moving north from the Antarctic zone are typically low in ^{228}Ra, cyclones developing along the South African coast in the course of a Natal Pulse can be expected to carry a strong coastal signal.
• Polar Frontal Region
In the context of iron as a limiting factor for the productivity of the Southern Ocean, the oceanic fronts within the Antarctic Circumpolar Current. Especially the Polar Front has been suggested as an effective transport mechanism for iron released from continental shelf sediments (DE BAAr et al. 1995). If the shelf areas represent indeed important source areas of iron for the open South Atlantic, this should be mirrored by increased ^{228}Ra activities. Results from previous cruises indicate an ambiguous picture, pointing to inputs that are highly variable in both space and time. Hence, high resolution sampling of the Polar Frontal Region along 0° and 23°E was done in order to get a better picture of possible shallow water inputs at the Polar Front.
• Eastern Weddell Gyre
Inflow of North Atlantic Deep Water into the Weddell Gyre takes mainly place in its south-eastern part (ORSI et al. 1993), a region where currently only very few natural radionuclide data are available for (GEIBERT et al. 2002, HANFLAND 2002). The determination of ^{228}Ra will help to demarcate the extension of coastal waters into the Weddell Gyre. ^{227}Ac will be used to determine upwelling rates for this poorly known region that is of particular importance for the vertical exchange of water on a global scale. For a better understanding of the productivity in this region, the depletion of ^{234}Th the upper water column was measured in order to determine the export production taking place in this region.

Boebel, O., Lutjeharms, J., Schmid, C., Zenk, W., Rossby, T. & Barron, C. (2003): Deep-Sea Research II, 50: 57-86.
de Baar, H.J.W., de Jong, J.T.M., Bakker, D.C.E., Löscher, B.M., Veth, C., Bathmann, U. & Smetacek, V. (1995): Nature 373: 412-415.
Geibert, W., Rutgers van der Loeff, M.M., Hanfland, C. & Dauelsberg, H.-J. (2002) Earth Planet. Sci. Lett. 198: 147-165.
Hanfland, C. (2002): Rep. Polar and Marine Res. 431: 135pp.
Orsi, A.H., Nowlin Jr., W.D. & Whitworth III, T. (1993): Deep-Sea Research I, 40:169-203.

Bryozoan growth-forms – as palaeoenvironment indicators of the La Meseta Formation (Eocene), Seymour Island, West Antarctica
(oral p.)

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Bryozoans - the modular, colonial, marine organisms are necessarily limited in their possible responses to environment, so consequently their growth-forms are very useful as a palaeoenvironmental indicators (SMITH 1995, HAGEMAN et al. 1997). Abundant and well-preserved, bryozoan biota which occur among the richly fossiliferous, clastic sediments of the Eocene La Meseta Formation on Seymour Island (GAZDZICKI & HARA 1994, HARA 2001), are well suited to studies which capitalize on correlations between a bryozoan's colonial growth-form and the environmental factors such as water depth, sedimentation rate, water energy etc. (STACH 1936, HAGEMAN et al. 1997). The indication of the dominant bryozoan growth-form, its distribution and other parameters such as orientation of the colony to substrate, methods of attachment are considered for palaeoenvironmental reconstruction of the analysed sedimentary setting (cf. STACH 1936, HAGEMAN et al. 1997, 1998). Two distinctive bryozoan-bearing assemblages were recognized within the stratigraphical section of La Meseta Formation in lowermost part (Telm1 unit) and in the upper part (Telm6-7) of the formation (HARA 2001). They differ significantly in the distribution and diversity of the bryozoan growh-forms as well as in taxonomic composition what points to a different palaeoenvironments (facies) for the both localities (ZINSMEISTER & CAMACHO 1982, GAZDZICKI 1996, HARA 2001, DUTTON et al. 2002).

The characteristic and the most common colonies which occur within a 2 m thick interval of the basal transgressive facies of Telm1 unit acquire a multilayered growth which is typical for mound-like, nodular-sheet as well as massive colonies which form a great variety of shapes being roughly hemispherical, mushroom-shaped or even spheroidal (HARA 2001). The multilayered growth is characteristic for limited substrata and represented by over 90 % colonies of Telm1 unit among which the dominant zoarial colony forms are celleporiform and cerioporids. The stenohaline, cyclostome cerioporids, which form a sturdy zoaria are attached to the substrate by the basal laminae, typify shallow and agitated waters. The free-lying morphotypes which are represented by the celleporiform zoarial forms are good indicators of sandy bottoms and commony occur in a range of depth 0-60 m, with a max. of 20-30 m (POUYET 1973). Very often the multilamellar colonies are formed at the base of the transgressive facies, in a high-energy environment, with strong currents, low sedimentation rate, on sandy bottoms in shallow and warm waters (see WALTER 1991).

The bryozoan assemblage within the upper part of the formation (Telm6-7 unit) is characterized by a great abundance of the encrusting, foliaceous, bilamellar, strongly calcified, loosely attached to the substratum, eschariform colonies of *Smittina* sp., which form a biostrome layer up to 5 cm thick (HARA 2001). From the paleoecological point of view, dominant bryozoan-growth form in the upper part of the formation suggests a sublittoral environment with a wave affected zones (MYRCHA et al. 2002), and is well-adapted to sandy bottom with a water depth of at least 20 meters (STACH 1936). A reduced in biodiversity bryozoans may be a direct response to cooling event at the time of deposition of the upper part of the formation what is proved by the isotopic and paleofloristic data (ASKIN 1992, GAZDZICKI et al. 1992, DOKTOR et al. 1996, DUTTON et al. 2002). La Meseta bryozoan dominant colonial growth-forms are a tool of considerable value in palaeoenvironmental interpretation, particulary corroborated with other lines of evidence such as associated biota and sedimentary structures (Zinsmeister & Camacho 1982, GAZDZICKI 1996, POREBSKI 1995, 2000).

Askin, R.A. (1992): Amer. Geoph. Union, Ant. Res. Ser. 56: 61-73.
Doktor, M., Gazdzicki, A., Marenssi,S., Porebski, S.J. & Zastawniak, E. (1996): Palaeont. Pol. 55: 127-146.
Dutton, A.L., Lohmann, K.C. & Zinsmeister, W.J. (2002): Paleoceanography 17: 1-14.
Gazdzicki, A.& Hara, U. (1994): Geol. Result. Pol. Ant. Exp. 104:105-116.
Gazdzicki, A., Gruszczynski M., Hoffman, K, Malkowski, K., Marenssi, S. Halas, S. & Tatur, A. (1992): Antarct. Sci. 4: 461-468.
Gazdzicki, A. (ed.) (1996): Paleont. Polonica, 55: 1-192.
Hageman, S.J., Bone, Y., McGowran, B. & James, N.P. (1997): Palaios, 12: 405-418.
Hageman, S.J., Bock, P.E., Bone, Y. & McGowran (1998): J. Paleont. 72: 418-436.
Myrcha A., Jadwiszczak P., Tamussi C., Noriega J.I., Gazdzicki A., Tatur, A. & del Valle R. (2000): Pol. Pol. Res. 23: 5-46.
Porebski, S. (1995): Stud. Geol. Polonica, 107: 7-97.
Porebski, S. (2000): Geology 28: 147-150.
Pouyet, S. (1973): Doc. Lab. Geol. Fac. Sci. Lyon, 55: 1-266.
Smith, A.M. (1995): Geol. Soc. Spec. Pub. 83: 231-243.
Stach, L. W. (1936): J. Geol. 24: 60-67.
Walter, B. (1989): Rev. Paleobiologie 8: 373-403.
Zinsmeister, W.J. & Camacho, H.H. (1982): Antarctic Geosciences: 299-304.

The age of UHT metamorphism in the Napier Complex, East Antarctica

(oral p.)

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The age of the UHT (1050-1120°C; 7-11 kbar) metamorphic event in the Napier Complex is controversial as a result of the polymetamorphic complexity in the terrane and the difficulties in interpreting zircon U-Pb isotope data in the UHT gneisses. HARLEY & BLACK (1997) have suggested an age of ~2840 Ma for the UHT event and attributed abundant 2480-2450 Ma zircon ages to a later upper-amphibolite to lower granulite facies overprint. In contrast, other workers interpret the 2480-2450 Ma zircon ages to approximate the age of the UHT event and infer older zircons to be inherited grains in orthogneisses or detrital grains in paragneiss precursors. To resolve this issue, new SHRIMP zircon U-Pb isotopic data have been obtained from two high-grade but locally discordant garnet-bearing leucosomes in paragneisses.

Leucosome 49606 contains 100-400 μm multifaceted and weakly structured zircons with moderate U (800 ppm; Th/U = 0.25-0.4). SHRIMP ages from these zircons are spread along concordia from 2590 Ma to 2460 Ma, with most in the range 2550-2590 Ma. Leucosome 49639 contains large (1-4 mm) multifaceted zircons often enclosed in garnet. The two-stage zircons preserve distinctive high-U (4000 ppm; Th/U <0.09) cores overgrown by thin (30-60 μm) lower-U (800 ppm; Th/U = 0.33) euhedral rims. Both zircon types yield SHRIMP ages of 2550 ±6 Ma. Hence, these leucosomes constrain the UHT metamorphic event in the Napier Complex to be older than 2550 Ma, and probably near 2590-2600 Ma. Though much younger than the age proposed by HARLEY & BLACK (1997), this age is also significantly older than the 2480-2450 Ma estimates preferred by other workers, and raises the question of what the latter ages mean.

In order to evaluate the significance of younger, post-2550 Ma zircon ages, zircon-garnet REE systematics have been determined for the garnet-bearing leucosomes and compared with those in Napier paragneisses. Zircons and garnet in leucosome 49606 have negative Eu anomalies and flat HREE patterns (Yb(n)/Gd(n) = 0.5-0.8) at 150-300 times chondrite. The REE partitioning between zircon and garnet, D_{REE}, is systematic from near unity at Eu and Gd (D_{Gd} = 0.9) to 0.65 at Yb (D_{Yb} = 0.65). Similar D_{REE} are calculated from 2550 Ma zircon core / garnet pairs in leucosome 49639 (D_{Gd} = 0.92, D_{Yb} = 0.61). The zircon-garnet HREE data in both cases are consistent with equilibrium between the minerals in the leucosomes during or following UHT. In contrast, the 2550 Ma zircon rims in 49639 have variable and elevated HREE (Yb(n)/Gd(n) = 2-12) that lead to low D_{Gd} (0.6) and high D_{Yb} (1.5-6.6), indicating their continued formation subsequent to the growth of and equilibration with garnet.

Metamorphic zircon formation in Napier Complex garnet-bearing paragneisses has been evaluated using this approach. Two distinct types of zircon textural microdomains are observed in these rocks. Zircons show 2900-2500 Ma structured cores, often transected by sealed fractures, inside relatively homogeneous overgrowths, which give U-Pb "ages" of 2660-2450 Ma. The oscillatory zoned cores show steep HREE patterns (Yb(n)/Gd(n) = 20-45) that reflect formation in igneous sources to the paragneiss precursors. In contrast, the low Th/U (<0.1) and homogeneous rim areas preserve flat HREE patterns (Yb(n)/Gd(n) = 2-4). Garnets also have flat HREE patterns at 200-1000 times chrondrite (Yb(n)/Gd(n) = 2-6), strong negative Eu anomalies, and may contain up to 90 ppm Zr. Zircon rim /garnet D_{REE} are consistently low (D_{Gd} = 0.35, D_{Yb} = 0.55) and depleted with respect to equilibrium zircon-garnet D_{REE} values as defined from the leucosomes 49606 and 49639. The chemistry of these zircon rims does not, therefore, reflect zircon-garnet equilibrium but rather the disequilibrium uptake of trace elements into zircon as REE (and Zr) are preferentially but slowly liberated from reacting garnet. Hence, these "metamorphic" zircon rims are interpreted to have formed through the partial breakdown of garnet subsequent to UHT metamorphism, and the 2480-2450 Ma zircon U-Pb ages do not correspond to the age of the UHT event in the Napier Complex. Instead, these "young" ages reflect post-peak zircon formation (e.g. ROBERTS & FINGER 1997), diffusional Pb loss (e.g. ASHWAL et al. 1999) or a combination of both processes.

Ashwal, L.D., Tucker, R.D. & Zinner E.K. (1999): Geochim. Cosmochim. Acta 63: 2839-2851.
Harley S.L.& Black L.P. (1997): Antarctic Science 9: 74-91.
Roberts M.P. & Finger F. (1997): Geology 25: 319-322.

The impact of 530-510 Ma Prydz Belt tectonism on the Archaean of the Rauer Islands: constraints from zircon-garnet-pyroxene REE relationships
(poster p.)

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The Rauer Islands form a distinct terrane containing both Archaean and Proterozoic crustal components. Its complex evolution involves magmatism and high-grade tectonism prior to 2800 Ma, 1030-1000 Ma granulite facies deformation (Rauer tectonic event) of late Mesoproterozoic intrusives and sediments (KINNY et al. 1993, HARLEY et al. 1998), and overprinting of both Archaean and Proterozoic gneisses at 530-510 Ma by amphibolite-granulite facies high strain zones (SIMS et al. 1994) linked with the Prydz Belt tectonism now recognised in East Antarctica. A key question that emerges from this complex history is whether the Prydz Belt tectonism was responsible for the interleaving of distinct Archaean and Mesoproterozoic terranes, or merely reworked a mixed Archaean-Proterozoic terrane assembled previously in the 1030-1000 Ma Rauer tectonic event. To discriminate between these alternatives it is critical to determine whether the Archaean gneisses were reworked in both the Rauer and Prydz tectonic events and establish the grade and effects of the Prydz tectonic event in these rocks.

Zircon U-Pb and REE, and garnet + orthopyroxene REE data, have been obtained from an Archaean layered igneous complex in the Rauer Islands (the Scherbinina Layered Complex: HARLEY et al. 1998) in order to evaluate the impact of the 530-500 Ma Prydz metamorphic overprint and establish its relation to granulite facies assemblages in the Archaean component of the Rauer Islands. Original 2844 ±6 Ma magmatic zircons in a metamorphosed ferrodiorite now containing the granulite facies assemblage garnet-orthopyroxene-plagioclase show partial and localised U-Pb resetting at ca. 510 Ma, texturally correlated with lobate and cuspate chemically-distinct microdomains (HARLEY et al. 1998). The chemically modified zircon microdomains show highly enriched and steep HREE patterns (Yb(n)/Gd(n) = 40-90) that are more fractionated than the unmodified igneous domains (Yb(n)/Gd(n) = 20), and are characterised by low Th/U (0.05) compared with Th/U of 0.50 for the magmatic zircon domains. Zircon oxygen isotopes show a shift of ca. 2 ‰ to lighter values of between 4 and 5 ‰ in the disturbed zircon microdomains, supporting fluid infiltration as a mechanism of chemical modification and U-Pb resetting.

The abundant garnet in this rock preserves flat to slightly depleted HREE patterns (Yb(n)/Gd(n) = 0.8-2.5) in cores, but zones to steeper HREE (Yb(n)/Gd(n) = 10-45) within 50 microns of resorbed rims adjacent to coronal plagioclase and orthopyroxene (Yb(n)/Gd(n) = 6). Hence, garnet was modified in its REE content only during or after the retrograde reactions that produced the coronas. Zircon/garnet REE partitioning (D_{REE}) calculated using garnet cores coupled with the modified zircon microdomains is inconsistent with equilibrium, as D_{REE} range from 0.15 at Gd to 4 at Yb. Resorbed, high-HREE garnet rims coupled with the modified zircon microdomains also yield D_{REE} that are low (0.1 at Gd to 0.45 at Yb), but the ratios of the D_{REE} are consistent with a closer approach to REE-equilibrium. The zircon-garnet REE data and textural relationships suggest that the magmatic zircon and metamorphic garnet modified their REE chemistries in response to a later fluid infiltration episode that does not correspond to the main HT metamorphism responsible for garnet formation. In this instance the old magmatic zircon was "blind" to the peak granulite event in which garnet formed because Zr was sequestered in unreactive minerals.

The zircon-garnet REE relationships indicate that garnet formation and peak metamorphism in the Archaean of the Rauer Islands pre-dates the chemical modification of zircon. However, whether the granulite assemblage formed in the Rauer tectonic event at 1000 Ma or early in the Prydz tectonic event (e.g. at >530 Ma) is as yet unresolved. Pb-loss and changes in REE abundances occurred in older zircon as a consequence of amphibolite facies fluid infiltration during the Prydz tectonic event at 510 Ma. This overprint correlates with ca. 530-510 Ma higher-grade deformation and metamorphism evident in Proterozoic paragneisses exposed in areas to the south-west of the Rauer Islands, and potentially records the amalgamation of the Rauer Islands with those areas late in the Prydz tectonic event.

Harley S.L., Snape I. & Black L.P. (1998): Precambrian Res. 89: 175-205.
Kinny P.D., Black L.P. & Sheraton J.W. (1993): Antarctic Science 5: 193-206.
Sims J.R., Dirks P.H.G.M., Carson C. & Wilson C.J.L. (1994): Antarctic Science 6: 379-394.

Glacial stratigraphy and sea-ice diatom history suggest Late Neogene paleoenvironmental shift from polythermal to cold polar Antarctic Ice Sheet
(oral p.)

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The age, sequence and history associated with the switch from a "dynamic" mode (polythermal) to a modern, cold, "stable" mode (cold-polar) of Antarctic glaciation continues to be a point of discussion regarding Neogene history of the East Antarctic Ice Sheet (EAIS). Interpretations derived from landscape evolution, ash deposits and polar desert pavements in the Dry Valley region lead to the interpretation of persistent cold-polar climate and the onset of the modern climate system by middle Miocene time. In contrast, interpretations based on glacigene strata and fossils of the Sirius Group in the Transantarctic Mts. and Pagodroma Group of the Prince Charles Mountains support the persistence of a dynamic, polythermal ice sheet in East Antarctica until the late Pliocene. Marine sediments on the Antarctic continental shelf preserve a record of sea-ice history, as indicated by the presence and absence of a distinctive sea-ice diatom flora. The history of this flora bears on the timing of the switch from a polythermal to cold-polar glacial regime, because the development of persistent sea-ice in the late Pliocene appears to have led to lowered regional marine and atmospheric temperatures, and provided a feedback mechanism for cooling of the Antarctic ice sheet. Elements of the modern sea-ice diatom flora are scarce to absent in available Late Neogene to late Pliocene sediment records, yet this community appears to have evolved by the late Miocene. Reduced influence of sea-ice during the Late Neogene impacted the terrestrial glacial regime by lowered albedo of the ocean surface, higher ocean to atmospheric heat and moisture transfer, both of which would result in prolonged regional warming. Development and expansion of the sea-ice belt around Antarctica during the late Pliocene and Pleistocene appears to have been one of the most important events, if not the key climatic threshold, that led into the modern cold, polar environment. This paper will review the history of Neogene sea-ice and present stratigraphic evidence on the characteristics of glacigene deposition in terrestrial and glacimarine environments during the Miocene and Pliocene, as recorded in the Sirius and Pagodroma groups. Exposures of these glacigene deposits suggest deposition by an ice sheet of quite different character than the present ice sheet, and a glacial regime that included significant erosion, transportation and deposition. In situ marine macrofossils and microfossils within formations of the Pagodroma Group indicate that this warmer than present climate regime, and polythermal character of the East Antarctic ice sheet continued through the late Miocene and into the Pliocene. The floating ice margin retreated up the Lambert Valley by as much as 300 km south of its present grounded limit, where distal glacimarine facies deposited diatomaceous muds of the Battye Glacier (late Miocene) and Bardin Bluffs (Pliocene) formations. The grounding zone of the paleo-Lambert Glacier/Amery Ice Shelf system fluctuated across a distance greater than 600 km during the Neogene, from a position on the continental shelf edge in Prydz Bay to the inner reaches of the Lambert/Amery Embayment. Glacigene deposits of the Sirius and Pagodroma groups provide direct evidence of the polythermal character of Late Neogene Antarctic ice sheets. The appearance of the modern sea-ice diatom community as dominant elements in marine sediments on the Antarctic shelf may provide the best proxy evidence to date the transition to the present cold-polar glacial conditions. Future stratigraphic studies and climate modeling should focus attention on the history and influence of the sea-ice record; it provides a critical link between the oceanic, atmospheric, and cryospheric realms. Future stratigraphic drilling targets on the Antarctic shelf obtained through the ANDRILL and SHALDRIL initiatives will address the Antarctic region's past and future response to, and influence on, global Late Neogene climate events.

The structure of the continental slope in the area of Larsen Shelf, Eastern Antarctic Peninsula Margin

(poster p.)

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The Antarctic Peninsula is the northern part of Antarctica and shows the most variable climate variations. Its western margin is bordered by the Pacific Ocean, while its eastern one focus the Weddell Sea and thus a colder climate. The long term climate conditions produced different shelf geometries and types of sediments along both margins. In addition the different tectonic histories (Pacific: convergent margin; Weddell Sea: rifted margin) of both regions had a pronounced influence on the style of the margin. While the Pacific margin of the Antarctic Peninsula is one of the geophysical best surveyed areas in Antarctica, the opposite is true for the eastern margin. Thick multiyear ice prevented any geophysical investigations in the last decades. A comparison of the sedimentary structure of both margins was so far not possible.

During the austral summer 2002 seismic investigations could be performed along this margin south of 67°S. Gravity, Parasound and more than 2000 km multichannel seismic data were acquired with the research vessel "Polarstern". Due to reasonable ice conditions we collected data with a 24 l-airgun-array over the entire continental slope of the Larsen Shelf and the adjacent deep sea. Only in the very north of the seismic network we were able to reach the edge of the ice shelf.

Up to 50 km west of the shelf break the acquired seismic data clearly show the presence of glaciomarin prograding sedimentation pattern. Dips of the continental slope range from 1-3°, slightly increasing to the north. Sedimentation patterns of the shelf at 68°S show undisturbed prograding sequences while the northern profiles show little slumps, chaotic reflections and channel/levee structures at the foot of the slope. Here a large slump was found (between 66-67°S) in the lower part of the continental slope at a water depth of 2000 m. From the detailed bathymetric survey we estimate the slump extention with 70 km times 20 km. A huge mass of sediment slided due to an unstable lower slope (4° dip) into the deeper part of the Weddell Sea abyssal plain. We see disturbed/chaotic reflection patterns in more than 60 km distance from the erosional surface (original slide location) which we interpret as parts of the slided body. As a consequence of the slump drift bodies were formed. To our knowledge the slump area of the Larsen Shelf is the largest known submarine landslide along the continental margin of Antarctica. The trigger and age of this event is currently unknown.

SHRIMP-dating of high-grade metamorphic and igneous rocks from Oates Land at the Pacific margin of the Transantarctic Mountains, Antarctica

(oral p.)

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Oates Land, located on the inboard side of the Ross Orogenic Wilson Terrane (WT) close to the Antarctic craton, is mostly built up by high-grade, in part granulite-facies metamorphic to migmatitic rocks of mostly metasedimentary (turbiditic) origin (e.g. HENJES-KUNST & SCHÜSSLER submitted). These rocks were locally intruded by magmatites of the late-Ross orogenic Granite Habour suite. Previous attempts to date high-grade metamorphism and related mobilisation of granitic melts at the inboard side of the WT yielded ages in the range of about 800-490 Ma and led to various models on the timing of the relevant geological processes (SHERATON et al. 1987, BLACK & SHERATON 1990, SCHÜSSLER & HENJES-KUNST 1994, SCHÜSSLER et al. 1999, ADAMS & ROLAND 2002). We present the results of a SHRIMP-dating study on zircons and monazites from gneisses, migmatites, and unfoliated anatectic granites of the Wilson Hills located at the Pacific margin of Oates Land.

Monazites of two migmatites yielded well-defined and nearly identical ^{206}Pb-^{238}U ages of 500 ±5 Ma and 496 ±4 Ma. Zircons from these samples, however, gave discrepant and, compared to the monazite ages, in part significantly younger ages of 495 ±5 Ma and 474 ±4 Ma, respectively. For the zircon populations of a granitic gneiss and a granitic dyke, well-defined ages of 487 ±5 Ma and 482 ±4 Ma, respectively, were obtained. There is only minor evidence of age inheritance in zircons of these four samples. Zircons of two other samples (diatexite, granitic dyke) gave scattering ^{206}Pb-^{238}U ages. While there is a significant component similar in age to those of the other samples, the presence of inherited components is indicated by ages up to c 3 Ga. In the diatexite, a major detrital contribution from c 550-680 Ma old source rocks can be identified.

The new age data further support the model of SCHÜSSLER et al. (1999) that high-grade metamorphic and igneous processes in the Oates Coast basement are confined to a relatively short period of time of late Cambrian to early Ordovican age. The monazite ages of on average 498 Ma are interpreted to represent the best age estimate for granulite to high-amphibolite-facies peak-metamorphic conditions. The in part significantly younger zircon ages probably reflect variable fluid-supported resetting of their U-Pb system in the course of a retrograde metamorphic evolution. It may be linked to the late-stage amphibolite-facies formation of ms+bi assemblages in the basement rocks (SCHÜSSLER et al. in prep.) which lasted until about 465 Ma.

The presence of inherited zircon components of latest Neoproterozoic age indicates that the high-grade metamorphic and anatectic basement rocks in the Wilson Hills in part originated from clastic series of Cambrian age and, therefore, may well represent deeper-crustal equivalents of the lower-grade metasedimentary series of the WT (c.f. HENJES-KUNST this volume, HENJES-KUNST & SCHÜSSLER, submitted).

Adams, C. & Roland, N. (2002): Royal Soc. N. Z. Bull. 35: 93-98.
Black, L.P. & Sheraton, J.W. (1990): Prec. Research 46: 275-293.
Henjes-Kunst, F. (2003) this volume.
Henjes-Kunst, F. & Schüssler, U. (submitted): Terra Antartica.
Schüssler, U. & Henjes-Kunst, F. (1994): Chemie Erde 54: 297-318.
Schüssler, U., Bröcker, M., Henjes-Kunst, F. & Will, T. (1999): Prec. Research 93: 235-258.
Sheraton, J.B., Babcock, R.S., Black, L.P., Wyborn, D. & Plummer, C.C. (1987): Prec. Research 37: 267-286.

Single-crystal Ar-Ar laser dating of detrital micas from metasedimentary rocks of the Ross orogenic belt at the Pacific margin of the Transantarctic Mountains, Antarctica

(poster p.)

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Detrital muscovites from very-low to low-grade metasedimentary series of the Ross orogenic Wilson (WT), Bowers (BT) and Robertson Bay (RBT) terranes at the Pacific margin of the Transantarctic Mountains were investigated for their age patterns by single-crystal Ar-Ar laser techniques. This study was undertaken in order to determine the late thermal evolution of their protoliths and to identify possible source components. In addition, this investigation was aimed to determine maximum deposition ages of the still unconstrained series in the WT.

From the western WT, one sample of the flysch-type Berg Group (33 grains analysed) and one of the more variegated shallow-water-type Rennick Schists (n = 34) were investigated. Both series crop out at the western "inboard" side of the WT close to its suspected margin to the Antarctic Craton. Detrital muscovites of these samples show broadly similar age spectra, with several dominant peaks between about 530-600 Ma and a series of distinct small peaks in the range of 750-1170 Ma. No ages older than 1170 Ma were found within the two WT metasediments. The youngest grains are 511 Ma followed by a group of three at 519 Ma in the Berg Group sample and 505 Ma and 513 Ma in the Rennick Group sample. From the central BT, two samples of the flysch-type Molar Formation were studied. The Molar Formation is intercalated with the primitive IA-type Glasgow Volcanics (WEAVER et al. 1984) and has a maximum Middle Cambrian deposition age (WOLFART 1994, COOPER et al. 1996). The BT samples (n = 59) show a dominant population with several peaks in the range of 500-720 Ma. In addition, single grains were dated at 830 Ma, 1130 Ma, 1390 Ma, 1480 Ma, and 2247 Ma. The youngest grains (n = 2) are 500 Ma old. From the eastern RBT, five samples of the flysch-type Robertson Bay Group were investigated. Four samples yielded nearly identical age spectra with a dominant population in the range of about 490–650 Ma (n = 140). Only five grains gave older ages between 830-1125 Ma. The youngest grains (n = 4) are in the range of 489-493 Ma. One sample from the easternmost RBT (n = 64) is clearly distinguished from all other samples by having a mica population with ages within the very restricted range of 486-524 Ma. Only one older grain with an age of about 690 Ma was observed.

This study reveals maximum sedimentation ages of about 510 Ma for the WT Rennick Schists and Berg Group, of about 500 Ma for the BT Molar Formation and of about 485-490 Ma for the RBT Robertson Bay Group. While the age constraints for the BT and RBT metasediments compare well to palaeontological marker and more recent SHRIMP dating of zircons (IRELAND et al. 1999, BASSETT et al. 2002; FIORETTI et al. 2003), the maximum Early to Middle Cambrian deposition age for the two WT metasedimentary series is new and has important implications for the interpretation of the Ross-orogenic evolution of the WT. The dominant age population in the range of about 500-650 Ma found in all but one samples compares well to the "Ross peak" typical of detrital zircons from Lower Palaeozoic sediments along the Gondwana margin (IRELAND et al. 1999). Comparison with geochronological data obtained on high-grade metamorphic and magmatic basement rocks of the Ross-Delamarian Orogen, however, shows that these rocks cannot be regarded as the major source for detrital muscovites in the metasediments. In its unusual muscovite age pattern, the sample from the easternmost RBT closely compares to metasediments of the Lachlan Fold Belt (TURNER et al. 1996).

Bassett, K.N., Weaver, S., Bradshaw, J.D. & Ireland, T. (2002): Gondwana 11, Christchurch. (abstr.).
Cooper, R.A., Jago, J.B. & Begg, J.G. (1996): N.Z. Jour. Geol. Geophys. 39: 363-387.
Fioretti, A.M., Black, L.P., Henjes-Kunst, F. & Visona', D. (2003): this volume.
Ireland, T.R., Weaver, S.D., Bradshaw, J.D., Adams, C. & Gibson, G.M. (1999): Proc. 8th ISAES, Wellington, 150.
Turner, S.P., Kelly, S.P., VandenBerg, A.H.M., Foden, J.D., Sandiform, M. & Flöttmann, T. (1996): Geol. 24: 941-944.
Weaver, S.D., Bradshaw, J.D. & Laird, M.G. (1984): Earth Planet. Sci. Lett. 68: 128-140.
Wolfart, R. (1994): Geol. Jb. B84: 1-161.

On the late-Quaternary history of ice sheet and climate in Dronning Maud Land, Antarctica: A compilation of records on land

(poster p.)

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Intensive glaciological survey during the last decade has shown the East Antarctic ice-sheet (EAIS) to be a complicated system of drainage areas, composed of slowly moving ice (mainly near to the interior domes and divides) and fast flowing ice streams and outlet glaciers, feeding floating ice shelves at the ice sheet margin.

Recently, ice sheet modelling as well as available terrestrial and marine sedimentary records have indicated locally different changes of volume and extent of the Antarctic ice sheet during the last glacial cycle.

Compiling geomorphological findings in ice-free locations of the Schirmacher Oasis, Wohlthat Massif and Orvinfjella (71-72°S, 8-13°E), ^{14}C ages and proxy data series from proglacial freshwater lake sediments as well as from ornithogenic deposits, the paper provides a status review of the glacial and environmental history of key sites in central Dronning Maud Land since 40 kyr BP.

Geochronological problems and regional differences are discussed. Timing and duration of detected glacial and climatic events are compared with late-quaternary records developed from ice cores.

Evidence of Miocene bottom water flow reversal from a fossil patch drift plastered on seamounts on the continental rise west of the Antarctic Peninsula
(poster p.)

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A fossil mounded sedimentary body (MB) has been identified in the sedimentary record on the central continental rise off Adelaide Island (Antarctic Peninsula, Pacific margin) (Fig. 1A). The MB geometry has been constrained with a detailed regional stratigraphic analysis using multichannel seismic reflection (MCS) profiles provided by several projects and research groups. The MB has an elongated NE trend adjacent to a group of seamounts, and it is bounded by two marginal erosional channels. Seven seismic units have been recognized in the sedimentary record (Fig. 1B): Unit 1 (the pre-MB stage); Unit 2 (the MB growth stage); Units 3 and 4 (the MB maintenance stage); Unit 5 (the transitional stage) and Units 6 and 7 (the fossilization stage). The MB is interpreted as a patch drift plastered, against the NE (lee) side of an obstacle, as a long contourite sedimentary tail, within a deep current flowing towards the NE (Fig. 1C). However, at present, this rise domain is affected by a branch of SW-flowing Weddell Sea Deep Water (WSDW). The depositional patterns of the MB, that is attributed to a Miocene age on the basis of the regional correlation of the MCS profiles with the ODP Leg 178 drill sites and DSDP-Site 325, provide evidence that bottom currents may have flowed toward the NE, probably as part of the Lower Circumpolar Deep Water (LCDW) of the Antarctic Circumpolar Current (ACC). Therefore, we suggest that significant paleocirculation and paleoceanographic changes occurred in this area at the end of the Late Miocene. Although these results do not modify the regional stratigraphy of the major sediment drifts of the continental rise of the Antarctic Peninsula Pacific margin, they do indicate that the bottom processes controlling the development of contourite deposits may have evolved thought time and also that several water masses were probably responsible for their distribution.

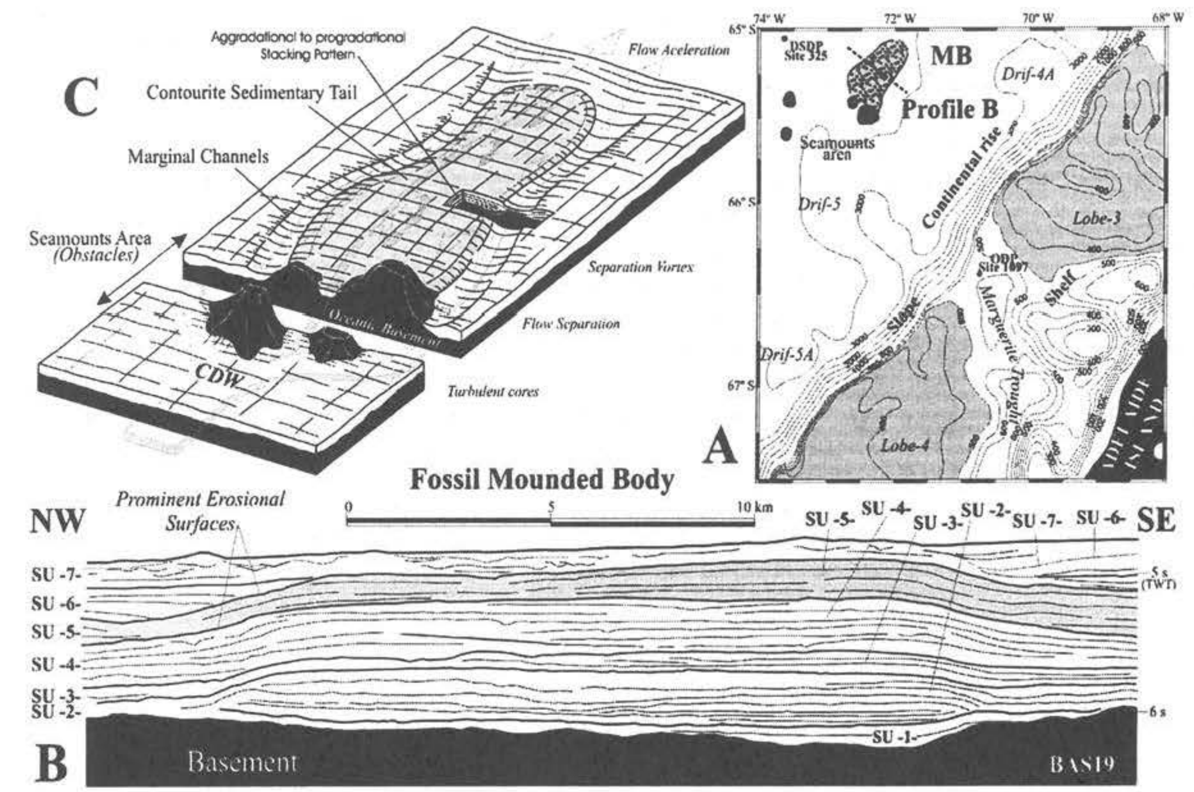

Fig. 1: A) Sketch with the MB position. B) Interpretive sketch of a MCS profile BAS878-19 across the proximal area of the MB. C) Genetic mode

Pliocene and Quaternary stratigraphic evolution of the Pacific margin of the Antarctic Peninsula offshore from Adelaide Island
(poster p.)

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A regional stratigraphic study offshore from Adelaide Island has carried out, using seismic reflection profiles and multibeam echo sounder data collected by different projects and research groups. The network of seismic lines consists mainly of multichannel seismic (MCS) profiles, and it has been possible to integrate the seismic stratigraphy from the MCS profiles with the results of Ocean Drilling Program Leg 178 and DSDP Site 325 (Fig. 1). The resulting stratigraphic framework has been correlated with stratigraphic schemes developed by previous authors (LARTER et al. 1997, REBESCO et al., 1997, BARKER & CAMERLENGHI 2002).

Eight seismic units have been recognized. Only the last four belong to the Pliocene and Quaternary sedimentary record which the last three main evolutionary stages of the margin (Fig. 1). Transitional stage (Seismic Unit 4, base of the Lower Pliocene). This is the first progradational unit over the continental shelf and slope, above the Base of the Glacial Margin Sequences (BGMS). On the rise the unit has drift facies and represents an important change in the depositional style. The lower boundary is a prominent regional erosional surface, whereas slide deposits are present above the top boundary in the base of the slope. Progradational glacially-influence margin stage (Seismic Unit 3 and 2, Lower to Upper Pliocene) Unit 3 over the shelf and slope is composed of three progradational wedges (a, b and c), although the youngest one (a) is the thickest and represents the most important progradational stage of the margin. On the rise there is a change in the depositional style between the earliest and the other two subunits with progressive landward migration of depocentres. Unit 2 over the shelf and slope includes both progradational and aggradational deposits and it recorded a significant change in the margin growth pattern. It is composed of two subunits (a and b) but the youngest one (a) extends farther landward over the shelf. The deposits have an aggradational stacking pattern over the rise, with a new change in the depositional style. Lateral migration of the Marguerite Trough took place during the deposition of Units 3 and 2, reaching the present position at the end of the Unit 2. Aggradational glacially-influence margin stage (Seismic Unit 1, Quaternary). On the shelf and slope this unit is a relatively thick upward and outward aggrading/prograding sediment wedge composed by three minor subunits (a, b and c) that are very well preserved on the sedimentary shelf lobes 3 and 4. This unit on the rise, however, is thin or absent due to the dominance of the erosive processes.

Barker, P.F. & Camerlenghi, A. (2002): Proc. ODP, Sci. Results, 178, 1-40.
Larter, R.D., Rebesco,M., Vanneste, L.E., Gamboa; L.A.P. & Barker, P.F. (1997): Antarctic Res. Ser. 71: 1-27.
Rebesco, M., Larter, R.D., Barker, P.F., Camerlenghi, A. & Vanneste, L.E. (1997): Antarctic Res. Ser. 71, 29-49.

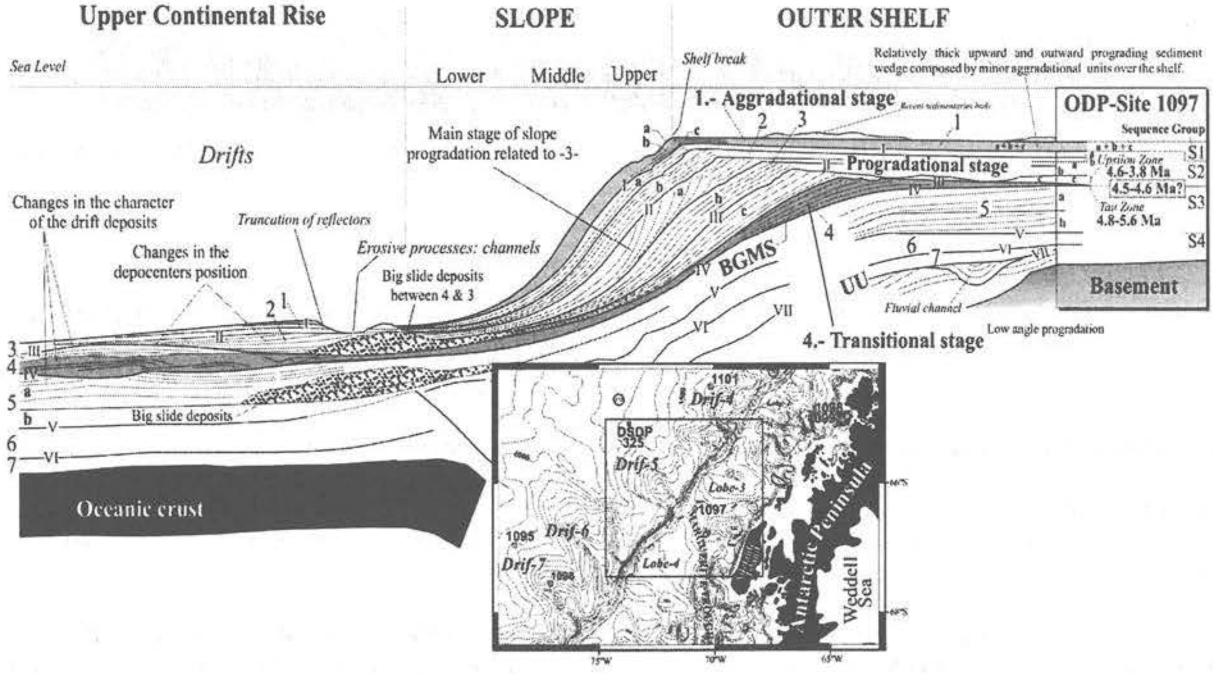

Fig. 1: Stratigraphic sketch of the continental margin

The Pacific slope offshore from Adelaide Island, Antarctic Peninsula: glacial processes and growth pattern

(poster p.)

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Pliocene and Quaternary sedimentary deposits show a progradational to aggradational stacking pattern in the continental slope offshore from Adelaide Island, Pacific margin of the Antarctic Peninsula. Seven depositional sequences (DS) are recognized bounded by discontinuities that are characterized by prominent erosional surfaces on the upper slope and outer shelf. Each discontinuity from the last four DS presents the same morphosedimentary domains and seismic facies equivalent to the deposits of the present sea floor. Evidence of large-scale failures associated with the discontinuities has been recognized particularly between the oldest and second oldest major DS boundaries.

The present morphology shows a sharp shelf edge at an average depth of 488 m, with a steep slope (10.1° on average) in comparison with the average global slope (3°). The slope can be divided into three domains: a) An upper slope with an erosive surface dipping 7.6° on average, in which numerous gullies are incised in deposits with frequent internal erosive surfaces and non-organized seismic facies; b) A middle slope with a convex-up shape and the steepest inclinations (16.8° on average), it has occasional gullies over deposits with a high acoustic response and a poor internal organization, and c) A lower slope dipping 5.3° on average, with a smooth and concave-up external shape over deposits with well organized seismic facies. Locally, high amplitude reflectors have been recognized at base of the slope related to the occurrence of small channels. These general characteristics change laterally and seaward of 50-km-wide shelf trough (Marguerite Trough) the middle and lower slope shows the lowest gradients in the area. Down-slope facies transition represent the evolution of the sedimentary processes resulting from a broad source of poorly sorted sedimentary material along the shelf margin. Rapid supply of till deposits to the grounding line during the periods of rapid ice-sheet flow to the shelf margin favoured frequent mass wasting events at the shelf edge and the upper slope. These events produced chaotically stratified, graded and massive sediments on the upper slope, that evolve downslope into well organized debris flow deposits.

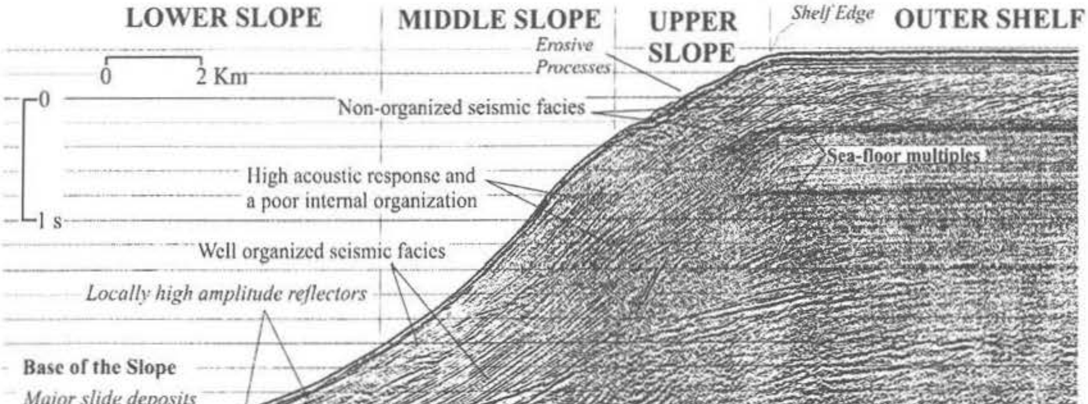

Fig. 1: Multichannel seismic (MCS) profiles of the continental slope offshore from Adelaide Island with the main domains and seismic facies.

SHRIMP U-Pb detrital zircon ages from the Liberty Hills Formation, Ellsworth Mountains, Patriot Hills area, Antarctica
(poster p.)

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Detrital zircons from a low grade metasandstone from the Middle to Late Cambrian Liberty Hills Formation (LHF), of the Heritage Group, which crops out in the southern Heritage Range, were dated to investigate about the source area of the sediments. The Liberty Hills Formation is a coarse grained siliciclastic succession of conglomerates, quartzites and argillites (CURTISS 2001).

Most of the 53 analysed grains plot on the Concordia line in a $^{207}Pb/^{235}U$ vs. $^{206}/Pb^{238}U$ diagram with the exception of the six which give ages under 950 Ma. The preferred ages of the rest of the analysed zircon grains vary between 951 and 1267 Ma. In an age vs. probability plot, c 90 % of the data form a large peak at c 1080 Ma, which can be resolved into two peaks at 1041 ±12 Ma (2σ) Ma and 1090 ±9.5 (2 σ) Ma. Only one zircon is significatively older at 1483 Ma.

The pattern of detrital zircon ages has the following implications:

a) The source area was entirely composed of Grenvillian age rocks or their sedimentary derivatives.
b) The only rocks of Grenvillian age that crop out in the area are those of the Haag nunatacks, 300 km to the north. This unit is thus the probable source area for the sandstones of the LHF. Its areal extension must have been significantly larger than the present restricted outcrop during the deposition of the LHF.
c) There is no evidence in the detrital zircon assemblage of zircons produced during the Ross orogeny.

These observations support the hypothesis that the intracontinental rift where the LHF was deposited (CURTISS 2001), was probably not in the vicinitiy of a magmatic arc. This rift, which formed in relation to the break-up of Pannotia, when Laurentia and Gondwana separated, was related to a segment of the newly established continental margin where no magmatic arc developed, maybe as a result of a strike slip tectonic regime.

Curtiss, M.L. (2001): Bull. Geol. Soc. Amer. 113: 939-958.

Late Quaternary relative sea-level change and reconstructed Antarctic ice history
(poster p.)

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The lower limit of past relative sea-level variations (Holocene and 30-46 ka) were obtained from sampling elevation and radiocarbon dating age of in situ fossil shells (*Laternula elliptica*) around the Lützow-Holm Bay region (MIURA et al. 1998). Relative sea-level variation is combination of two contributions: (1) the global eustatic sea-level change caused by the growth or melting of ice-sheets, and (2) the isostatic adjustment of the land surface in response to regional changes in ice and water distribution. Then spatial and temporal sea-level variations provide constraints of the melting history of ice sheet. We selected relatively accurate sea-level observations at following eight sites around Antarctica: South Geogia, King George, McMurdo, Terra Nova, Windmill, Bunger Hills ,Vestfold Hills and Lützow-Holm Bay. Predictions on the previous representative LGM Antarctic ice sheet models (ANT3, ANT4, HB and ICE3G) cannot explain the observations at eight sites simultaneously. The thicknesses of Antarctic ice removed around most of sites much thinner than those of previous representative models. Refined new two Antarctic ice sheet models (ANT5 and ANT6) can explain the observations at eight sites simultaneously (NAKADA et al. 2000). Features of these new ice models are as follows: (1) thickness removed from the LGM around Ross Embayment is significantly thinner than that of previous ice models, (2) the melting of ice from the peripheral region of the East Antarctica is significant, and (3) significant melting is predicted around the Weddell Sea region.

Miura, H. et al. (1998): Special Map Series of NIPR, No. 6.
Nakada, M. et al. (2000): Marine Geology 167: 85-103.

Sediment drift formation on the Pacific margin of the Antarctic Peninsula: implications from project ANTDRIFT
(oral p.)

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The continental rise west of the Antarctic Peninsula is characterized by eight asymmetric sediment mounds, which elevate up to 1000 m above the surrounding sea floor and are interpreted as drifts (REBESCO et al. 1997). The drifts are separated by erosional channels starting at the base of the continental slope and running seaward down to the abyssal plains. Investigation of high-resolution multichannel reflection seismic profiles enabled the identification of six seismostratigraphic units representing a "pre-drift", "drift growth", and "drift maintenance" stage (REBESCO et al. 1997, 2003). Shallow gravity coring (e.g. LUCCHI et al. 2002) and drill cores recovered during Ocean Drilling Program (ODP) Leg 178 (BARKER et al. 2002) showed the upper Miocene to Quaternary drift sediments predominantly to consist of two lithological facies types. Thin-bedded bioturbated to massive, diatom-bearing muds were deposited during interglacial periods and thick-bedded, purely terrigenous, often laminated clayey silts were deposited during glacials. The terrigenous components are assumed to have been primarily supplied to the drifts by a SW-ward flowing, near-bottom contour current, which was fed by muddy particles of distal turbidites. The turbidity currents had travelled down the channels during glacial times triggered by the advance of grounded ice streams across the shelf. In detail, however, the individual role of along-slope versus down-slope transport in building-up and shaping the drifts is not enlightened, yet (REBESCO et al. 1997, MCGINNIS et al. 1997, BARKER et al. 2002).

The project ANTDRIFT aims to construct a 3D numerical forward model in order to simulate the evolution of Drift 7 and to evaluate the contribution of different processes of sediment supply, transport, and (re-)deposition. In a first step, boundaries between the defined seismostratigraphic units were tracked along previously interpreted and not-interpreted seismic lines crossing Drift 7 within an interpretation system database (LANDMARK™). Post-cruise work on sedimentary sequences recovered at ODP Leg 178 Site 1095, which is located at the distal flank of Drift 7, and Site 1096, which lies near its crest, allowed the conversion of the acoustic depths of the boundaries between the seismostratigraphic units into vertical subbottom depths as well as the assignment of these boundaries to chronostratigraphic ages (BARKER et al. 2002). Further age control was derived from magnetic anomalies of the oceanic crust underlying a particular seismostratigraphic unit (LARTER & BARKER 1991, REBESCO et al. 2003). Besides this assesment of spatial and temporal boundary conditions for the numerical modelling, we defined physical and sedimentological input parameters by attributing discrete mean grain-sizes, physical properties, and lithological characteristics to the different seismostratigraphic units.

In our contribution we will display the link between the sediment properties of the sequences drilled at Sites 1095 and 1096 and the seismic facies observed on the corresponding reflection profiles. Furthermore, we will present paleo-bathymetric profiles and maps illustrating the seafloor topography in the area of today´s Drift 7 at the onset of deposition of a particular seismostratigraphic unit.

Barker, P.F., Camerlenghi, A., Acton, G.D. & Ramsay, A.T.S. (eds.) (2002): Proc. ODP, Sci. Res. 178.
Larter, R.D. & Barker, P.F. (1991): J. Geophys. Res. 96 (B12): 19583-19607.
Lucchi, R.G., Rebesco, M., Camerlenghi, A. et al. (2002): Mar. Geol. 189: 343-370.
McGinnis, J.P., Hayes, D.E. & Driscoll, N.W. (1997): Mar. Geol. 141: 91-109.
Rebesco, M., Larter, R.D., Barker, P.F. et al. (1997): Ant. Res. Ser. 71: 29-49.
Rebesco, M., Pudsey, C.J., Canals, M. et al. (2003): Geol. Soc. London Mem. 22: 353-371.

Investigations of crustal structures beneath Dronning Maud Land, Antarctica
(poster p.)

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The western part of Dronning Maud Land (DML), Antarctica, principally consist of the Archean Grunehogna Craton and the Grenville-age (1.1 Ga) Maud Province (JACOBS 1991). Most of the area is covered by ice. Outcrops are the mountain ranges Heimefrontfjella, Kirvanveggen and Sverdrupfjella. These are the western parts of the East Antarctic Orogen, the southern continuation of the East African Orogen, formed during the collision of East and West Gondwana (Pan-African orogenesis, c 550 Ma).

The Heimefrontfjella metamorphic complex is splitted by the Heimefront shear zone. This steeply dipping and NE trending dextral shear zone separates two regions with a different tectonic history: the Vardeklettane and Kottas terrane with Grenvillian crust at the NW side and the Sivorgfjella Terrane with strong Pan-African tectono-thermal overprinted crust at the SE side of the shear zone. (GOLYNSKY & JACOBS 2001)

The structure of the crust and mantle in western DML is mostly unknown. Especially the deeper crustal fabric along the geological boundaries is of great interest. Thus, during the Antarctic summer 2002/2003, a temporary seismometer network consisting of five seismometers was installed along a 250 km line crossing the Heimefrontfjella shear zone. In addition a permanent broadband seismometer station at Kohnen Station (c 75°S, 0°E) was established. In combination with registrations from the Neumayer seismometer network and the seismometer at the South African SANAE IV Station, a spatial mapping of crust thickness (Moho depth) by means of calculating the receiver functions will be obtained. Further analysis of the data will yield to the recent/past strain/stress distribution (seismic anisotropy) and the detection of local seismicity.

Preliminary results (ECKSTALLER et al. 1991) from an analysis of a refraction seismic profile, perpendicular to the shear zone, are showing different regions of crustal thickness: in the northwest 42 km and in the southeast 50 km. This confirms that the Heimefrontfjella shear zone is also a boundary in terms of crustal evoloution and fabric. The interpretation of this seismic profile together with newly obtained aerogravity, aeromagnetic and ice thickness data in combination with the seismological data will provide a 3D model of the crustal structures beneath western DML.

3-D Crustal Model in the western Dronning Maud Land region, Antarctica, from the interpretation of different geophysical data sets

(EANT workshop p.)

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While the receiver function analysis of seismograms obtained from a temporary installation of five seismometers along a profile in central Dronning Maud Land (CDML) only produces two-dimensional information about the structure beneath the seismometer station, the combination with other geophysical data sets allows to design a crustal model in three dimensions. This is done with use of additional seismological studies at Neumayer Station, Kohnen-Station and from SANAE by means of investigating the seismic anisotropy and receiver function analysis. Existing airborne measured gravity and magnetic data, together with ice-thickens radar measurements will improve the crustal model in areas between the seismological stations.

Integrated interpretation of onshore and offshore models from adjacent regions e.g. Weddell Sea magnetic and gravity data, will extend the information about the tectonic history in this region.

Archaean ~Early Proterozoic history of the Napier Complex: constraints from U-Th-Pb zircon and monazite chronology

(oral p.)

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Geochronological framework of the Archaean~Proterozoic history including the age of ultrahigh-temperature (UHT) metamorphism in the Napier Complex has been argued since GREW & MANTON (1979) and BLACK & JAMES (1983) proposed the contrasting interpretation of the timing of UHT event either at c 2900 Ma, or c 2500 Ma. A number of 2500-2400 Ma ages with lesser abundance of 3000-2800 Ma ages have been reported, and CARSON et al. (2002) indicated that the UHT event was not older than 2630 Ma and possibly at 2480-2450 Ma.. HARLEY et al. (2001) suggested based on the SHRIMP analyses combined with REE partitioning between zircon and garnet that the 2590-2550 Ma zircons which are interpreted to be equilibrated with garnet were formed at the UHT event. Pre-UHT crust forming events are further less understood. Although the oldest zircon core ages of ~3800 Ma from tonalitic gneiss (HARLEY & BLACK 1997) has been brought to attention, it has been recognized much younger protolith ages from the recent studies; ~2700 Ma (ASAMI et al. 2002) and ~2630 Ma (CARSON et al. 2002).

We carried out U-Th-Pb zircon and monazite chronology using SHRIMP and electron microprobe for the ultrahigh-temperature (UHT) metamorphosed gneisses from Mt. Riiser-Larsen, from where ~1100°C peak metamorphic conditions have been estimated. We have obtained the following data:

• SHRIMP zircon analyses of tonalitic orthogneiss yield 3300 Ma ages interpreted as igneous protolith ages with 2850-2790 Ma and 2520-2460 Ma ages interpreted as metamorphic events. Structureless metamorphic zircons from the garnet-orthopyroxene-bearing paragneiss also represent 2520-2460 Ma ages, and in situ analyses of zircons in the UHT leucosome give 2481 ±3 Ma suggesting the timing of the UHT event.
• Electron microprobe zircon analyses of sapphirine-quartz and osumilite-bearing UHT paragneisses show c 2600-2400 Ma age cluster with minor 3000-2700 Ma ages from zoned core. This could imply that multiple igneous sources at ~2700 Ma supplied the sedimentary precursors, and that they were metamorphosed at c 2500 Ma.
• 2500~2450 Ma ages are also obtained by electron microprobe analyses of monazites in various paragneisses. These monazite grains occur commonly enclosed within anhydrous metamorphic minerals such as quartz, sillimanite, garnet and osumilite, Some of monazite grains associated with retrograde reaction zones suggest 2400 Ma ~700 Ma apparent ages.

Based on these geochronological data, tonalitic magmatism started at least 3300 Ma in the Mt.. Riiser-Larsen area, which is considerably younger than ~3800 Ma tonalitic gneisses at Mt.. Sones and Gage Ridge (HARLEY & BLACK 1997). Two metamorphic events, c 2800 Ma and c 2500 Ma, are recorded. The former event possibly associated with magmatism to form protolith of some Napier gneisses, and the latter presumably corresponds to the UHT event. Sedimentary precursors of some paragneisses were deposited after 3000-2700 Ma igneous activity, and were also metamorphosed at c 2500 Ma UHT event.

Our data presented here are consistent with the 2480-2450 Ma UHT event (e.g. GREW, 1998, CARSON et al., 2002), nevertheless they do not exclude the possibility of another high-grade (~UHT) event at ~2550 Ma (e.g. HARLEY et al. 2001). U-Th-Pb compositions of monazites were modified only in those associated with retrograde reaction textures which may be formed at 2400 Ma.

Asami, M., Suzuki, K. & Grew, E.S. (2002): Precambrian Res. 114: 249-275.

Black, L.P. & James, P.R. (1983): In: Antarctic Earth Sci.: 11-15.
Carson, C.J., Ague, J.J. & Coath, C.D. (2002): Precambrian Res. 116: 237-263.
Grew, E.S. (1998): Mem National Inst. Polar Res. Spec. Issue. 53: 74-92.
Grew, E.S. & Manton, W.I. (1979): Science 206: 443-445.
Harley, S.L. & Black, L.P. (1997): Antarctic Sci. 9: 74-91.
Harley, S.L., Kinny, P.D., Snape, I. & Black, L.P. (2001): Abst. 4th Int. Archaean Symposium: 511-513.

Peak and post-peak development of UHT metamorphism at Mather Peninsula, Rauer Islands: Monazite U-Th-Pb and REE chemistry constraints
(poster p.)

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Ultrahigh-temperature (UHT) metamorphism at 1030°C and 11-12 kbar followed by near-isothermal decompression (ITD) at >950°C is recorded in the Mather Paragneisses of the Rauer Islands (HARLEY 1998). The Mather Paragneisses occur interleaved with Archaean TTG gneisses that suffered U-Pb resetting at 520 Ma (HARLEY et al. 1998) and hence are likely to have also recorded that event. However, it is not yet clear whether the UHT-ITD metamorphism progressed at 520 Ma or earlier, and whether or not c 1000 Ma event reported by KINNY et al. (1993) is widespread in the area.

The Mg-Al-rich gneisses in Mather Peninsula preserve UHT mineral assemblages including garnet, high-Al orthopyroxene and/or sillimanite that are locally replaced by fine-grained symplectites composed of sapphirine, cordierite, orthopyroxene, spinel or plagioclase, suggesting an initial post-peak ITD evolution. These gneisses have also undergone extensive hydration to form biotite-bearing reaction coronas and biotite-rich reaction zones, some of which are then overprinted by low-Al orthopyroxene + cordierite symplectites. Biotites in these textural settings preserve low fluorine (<0.9 wt.%) and chlorine (<0.3 wt.%) contents consistent with their formation on cooling below 800-900°C.

Apatite, monazite and zircon occur both as early phases enclosed in orthopyroxene and/or garnet, and as new grains localized in reaction coronas and in biotite-rich zones. Despite their varied textural settings (i.e. included in UHT orthopyroxene, grains in symplectites, grains grown with late biotite) almost all monazite grains yield 580-450 Ma U-Th-Pb electron microprobe chemical ages, with only minor ~700 Ma inheritance. The monazites occasionally show distinct internal structures, typified by 580-560 Ma dark-BEI cores, 550-520 Ma mid-BEI mantles and 510-500 Ma bright-BEI rims. The monazite cores are relatively enriched in HREE whereas the mantles or structureless grains have lower HREE and the outermost ~510 Ma rims the lowest REE concentrations. These chemical variations may reflect changes in the monazite forming reactions or fluid compositions. Electron microprobe U-Th-Pb ages obtained on zircons are scattered and of low precision due to low PbO concentrations and incomplete resetting of U-Th-Pb systematics. However, the preliminary analyses suggest preservation of late-Archaean protolith zircons, a major zircon population with an "age" in the range ~1000 Ma, but few zircons in the 580-450 Ma age range determined for the monazites in the same rocks and textural microdomains.

These data can be interpreted in terms of two alternative tectonic histories. The first, single tectonic event, scenario proposes that UHT, ITD and subsequent biotite formation all occurred during the age interval 580-510 Ma and hence reflect the Prydz Belt tectonism seen further SW in Prydz Bay. This model involves major assumptions regarding age retention in monazite under UHT conditions and zircon inheritance. The second, two tectonic event, scenario proposes that an older, >700 Ma and possibly 1000 Ma UHT metamorphism was overprinted by the later high-T hydration event at 580-510 Ma. This model assumes that it is valid to use the preliminary but low-precision zircon chemical age data, that these refer to metamorphic zircons rather than inherited protolith grains, and that partial to extensive Pb isotopic resetting in monazites at T >800°C. In order to distinguish between these two possibilities it is necessary to obtain SHRIMP U-Pb data on the zircons so far only assessed by electron microprobe.

Notwithstanding which of the two alternative scenarios presented here are correct, it is apparent that the Rauer Islands suffered an intense Pan-African event which, at least at Mather Peninsula, caused the formation of biotite-bearing high-T assemblages and fabrics and reset monazite U-Th-Pb systems. The intensity of this overprint renders the unambiguous interpretation of older ages extremely difficult.

Harley, S.L. (1998): J. metamorphic Geol. 16: 541-562.
Harley, S.L., Snape, I. & Black, L.P. (1998): Precambiran Res. 89: 175-205.
Kinny, P.D., Black, L.P. & Sheraton, J.W. (2003): Antarctic Sci. 5: 193-206.

A new regional stratigraphy for Eastern Ellsworth Land
(poster p.)

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New results from eastern Ellsworth Land substantially refine the regional stratigraphy and indicate that the Latady Formation is obsolete as a stratigraphic classification term. The traditional Latady Fm. is a thick, undivided terrestrial and marine succession with a long depositional and tectonic history from 180 to 145 Ma. Where it crops out it is closely associated with a series of intracaldera silicic ignimbrites known locally as the Mount Poster Formation. Recent field work shows that it is possible to divide the Latady Fm. into five identifiable lithostratigraphic units based on lithofacies and fossil assemblages. A revised stratigraphy is proposed with a new group consisting of five formations which would replace the original Latady Fm.. Extracaldera basalts and interbedded sedimentary units around the margins of the intracaldera Mount Poster Fm. have in the past been separately assigned to the Latady Fm. (sedimentary units) and the Mount Poster Fm. (volcanic units). However, the sedimentary units are unlike any currently identified from the Latady Fm. and basaltic volcanic rocks are only found in the extracaldera sequences and not with the silicic ignimbrites. An additional new formation is proposed to encompass this extracaldera sediment and basalt association, which would not be part of the new Latady Fm.-based group, but may form part of a larger supergroup including the Mount Poster Fm., and perhaps even the underlying basement rocks which crop out to the west.

Geochemical and isotopic constraints on the generation of the Hesperides Point Intrusion from Hurd Peninsula, Livingston Island, Antarctica
(poster p.)

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Hesperides Point Intrusion (HPI) is an igneous complex comprising stocks and dikes, emplaced at the northern Hurd Peninsula, Livingston Island. The characteristics of major elements for the HPI belong to I-type granite and sub-alkaline series for stocks and alkaline series for two samples of dikes. Total REE of stocks are higher than of dikes, but total HREE are almost equal at stocks and dikes. HPI is plotted at the region of volcanic arc related granite and island arc environment. HPI shows LIL elements enrichment with respect to primitive mantle and mid-ocean ridge basalt. The negative anomaly of the immobile element is clear at stocks, on the other side that is weak at dikes. The geochemical characteristics of the HPI indicates relatively low degrees of partial melting of enriched mantle, followed by high level crystal fractionation.

K-Ar age of HPI is 88 to 64 Ma for stocks (gabbro, 88Ma and 85Ma; diorite, 73Ma and 67Ma; quartz diorite, 67Ma and 64Ma) and 51 to 49 Ma for dikes. Rb-Sr whole-rock age of stocks of the HPI is 97.7 ±16.9 Ma (1σ error range and 3.00 of MSDW). The Sr initial ratios (stocks, 0.70559 to 0.70587; dikes, 0.70546 to 0.70712), Nd initial ratio (stocks, 0.51243 to 0.51259; dikes, 0.51257 to 0.51284) and εNd values (stocks, -1.6 to 1.5; dikes, 0.0 to 5.2) implying a possible contamination process.

Evidence for instability events in the central Bransfield Basin since the last glaciation

(poster p.)

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The Trinity Peninsula margin in the Bransfield Basin, Antarctica, is characterized by a series of medium-scale slope instabilities that have affected a large segment of the margin since the last glaciation and left a striking pattern of slide scarps on the middle and lower slope, on water depths ranging from 1600 to 1950 m.

The largest of these submarine landslides, the Gebra Slide, has created a 30 km long, 6 km wide and 175 m deep depression in the Trinity Peninsula lower slope, clearly visible on the present-day bathymetry. Seismic data give evidence of an associated debris flow deposit embedded in the interglacial-period basin-fill strata of the King George Basin floor. The total volume of sediment involved in this mass movement is about 20 km^3. Indirect dating of the mass-wasting event, using seismic-stratigraphic criteria, suggests that it took place at the transition between the last glacial period that affected the area and the present-day interglacial (between 13500 and 6500 yrs. B.P.).

Immediately west of the Gebra Slide scar, two additional slide scars are present in the Trinity Peninsula lower slope. They can be followed over a distance of 15-20 km and show a maximum relief of 90-120 m. Their associated debris-flow deposits also fill the King George Basin. Seismic stratigraphy suggest that they are younger than the Gebra Slide debris-flow deposit.

The uppermost sequence of the sedimentary infill of King George Basin is composed of an alternation of acoustically transparant debris-flow lenses and acoustically stratified interglacial deposits (mixed turbidites/hemipelagites). The recurrence pattern of the debris flow lenses suggests a certain cyclicicty in the instability events that have affected the Trinity Peninsula lower slope. The thickness of the debris-flow lenses ranges from 25-35 ms TWT on the lower slope to 4-20 ms TWT in the King George Basin, with the exception of the Gebra Slide debris-flow deposit, which by itself accounts for a quite uniform infill of 100 ms TWT. In this way, the deglacial to Holocene sedimentary record in the King George Basin consists of at least 35 % of mass-wasting deposits.

It is difficult to identify the trigger mechanism responsible for the initiation of the Gebra Slide and the slope instabilities west of it. High sedimentation rates during the last glacial period combined with the unloading effect of a retreating ice sheet during deglaciation may have induced higher-than-normal pore pressures in the Trinity margin deposits and rendered them prone to failure. However, additional triggers, such as tectonics and/or earthquakes, were probably required to destabilize these deposits and initiate the slides.

The gradual reduction in thickness of the debris-flow lenses in the King George Basin through time is possibly the expression of a gradual diminishing amplitude of the trigger mechanism itself. An interglacial open-marine sedimentary environment has been installed since the end of the last glaciation with a gradual decline in the impacts of the various ice-sheet-related processes. On the other hand, the multi-phase character of the debris flows could also be the expression of the earthquake recurrence pattern in this young, active basin, which may have been modulated by glacio-isostatic effects.

Mass balance and present-day Antarctic rebound and gravity change

(oral p.)

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Two satellite missions, one designed to detect gravity change (Gravity Recovery and Climate Experiment, or "GRACE") and the other (ICESat) for determining changes in ice sheet elevation may soon provide a powerful new data set capable of determining mass changes within the Antarctic ice sheet. WU et al. (2002) and VELICOGNA & WAHR (2002) have recently advocated that additional data from GPS crustal motions may be employed as a third independent data set, when combined with GRACE gravity and ICESat altimetry simultaneously, to constrain postglacial rebound (PGR). Here we examine the estimated signal and possible sources of error for the purpose of separating the ongoing ice mass change signature from that associated with past deglaciation. Bounds on the uplift signature now appear to be emerging from a number of recent GPS data sets obtained on solid bedrock across the Antarctic continent. During the past decade other information (on ice GPS, differential radar interferrometry, radar altimetry, etc.) have determined bounds on the total volume change of ice that contribute to equivalent sea level rise (ESL) during 1990-2000. The rate of positive ESL change due to the net mass imbalance of West Antarctica occurs at a rate of about 0.11 +- 0.026 mm/yr (RIGNOT & THOMAS 2002). East Antarctica is less well-determined but appears to be near net balance. If valid, such comprehensive studies place bounds on the time rate of change in geoid that should be observable with GRACE. The ice mass loss from glaciers that feed into the Amundsen Sea produce secular geiod changes that are at the -1 to -1.5 mm/yr level over 800-1000 km wavelengths. Such a signal could be detected with GRACE gravity data over the projected 5-year mission lifetime. A PGR geoid change signal may be predicted from the variety of ice sheet reconstructions available, albeit, the undetermined regional mantle viscosity is a far more tricky issue at the present time. A preliminary estimate is made based upon our current modification of a model published by DENTON et al. (1990) and "Fennoscandian" mantle viscosity profile and lithospheric thickness. The geoid changes are comparable in magnitude, but opposite in sign, to those of present-day mass wastage (MW) signal. The PGR signal has a substantially longer wavelength signal than does that produced by MW. The peak PGR uplift signature tends to be of order 4-8 mm/yr while the peak MW induced isostatic (elastic) uplift signal is 2-5 times smaller and of shorter wavelength.

Denton, G.H., Prentice, M.L. & Burckle, L.H. (1991): In: R.J. Tingey (ed.). Geology of Antarctica, Oxford Univ. Press, 365-433.
Rignot, E. & Thomas, R.H. (2002): Science 297: 1502-1506.
Velicogna, I. & Wahr, J. (2002): J. Geophys. Res. (DOI 10..1029/2001JB001735).
Wu, X., Watkins, M.M., Ivins, E.R., Kwok, R., Wang, P. & Wahr, J.M. (2002): J. Geophys. Res. (DOI 10.1029/2001JB000543).

The transition from the active margin of the SW end of the South Shetland Trench to the passive pacific margin of the Antarctic Peninsula

(poster p.)

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The SW lateral ending of the South Shetland Trench (Antarctic Peninsula) is analysed on the basis of swath bathymetry and multichannel seismic profiles. The main aim of the study is to establish the tectonic and stratigraphic features of the transition from a northeastward active to a southwestward passive margin style. The trench is associated with a lithospheric-scale thrust that accommodates the internal deformation in the Antarctic Plate. Around the tip-line of this thrust lies an area with distributed compressional deformation, both in the oceanic crust of the subducting plate and the accretionary prism of the overriding plate. Also the shelf in this transition zone is deforming by shortening.

The evolutionary model deduced from the structures and the stratigraphic record includes a first stage during the Tortonian with a compressional deformation that predated the end of the subduction in the southwestern part of the study area. This first stage produced reverse faults in the oceanic crust. During the Messinian, the second stage occurred with distributed compressional deformation around the tip-line of the basal detachment, originating a high at the base of the slope, and the collapse of the now inactive accretionary prism of the passive margin. The initial subduction of the high at the base of the slope induced the deformation of the accretionary prism and the formation of another high in the shelf —the Shelf Transition High. The third stage, from the early Pliocene to the present-day, included the active compressional deformation of the shelf and the base-of-slope around the tip-line of the basal detachment, while extensional deformations were active in the outer swell of the trench.

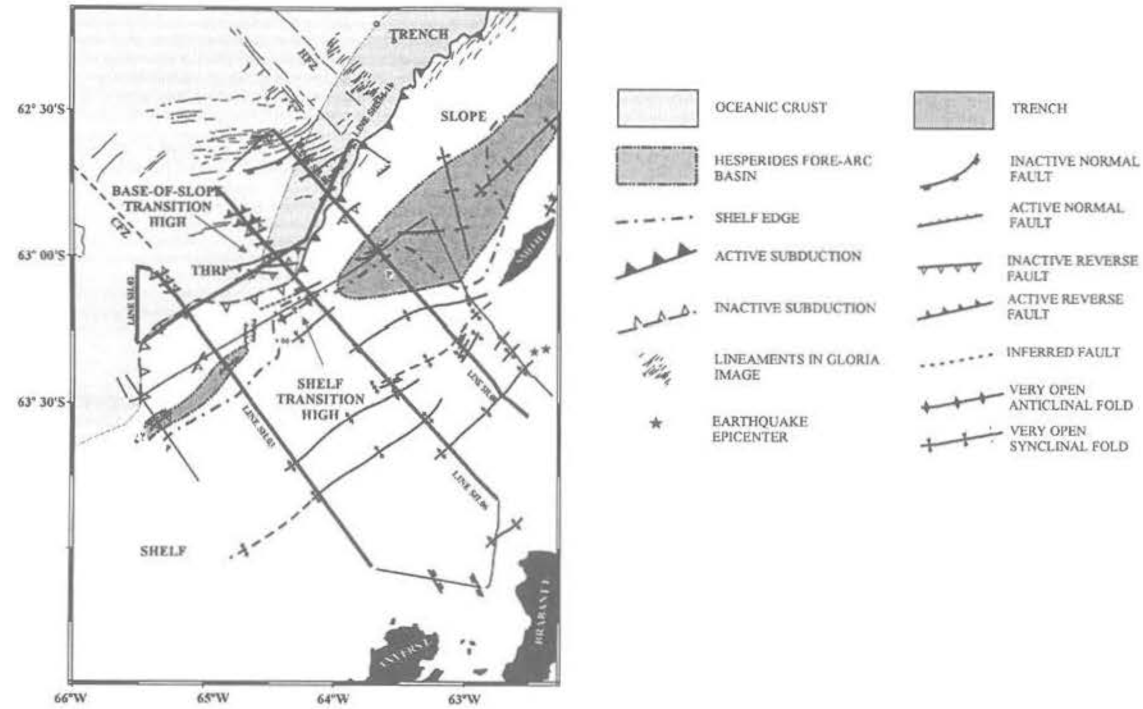

Fig. 1: Tectonic sketch of the SW end of the South Shetland Trench

New age constraints for Grenville-age metamorphism in western central Dronning Maud Land, East Antarctica, and implications for the palaeogeography of Kalahari in Rodinia

(oral p.)

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New SHRIMP zircon data from Gjelsvikfjella and Mühlig-Hoffmann-Gebirge (East Antarctica) indicate that the metamorphic basement is composed of Grenville-age rocks that are most likely part of the NE continuation of the Namaqua-Natal-Maud Belt. Crystallisation ages of meta-igneous rocks range between c 1150-1100 Ma, with little inheritance >1200 Ma recorded. Protolith probably formed along island arcs. Metamorphic zircon overgrowth during high-grade metamorphism is dated between c 1090-1050 Ma in several samples. Both, the crystallisation ages and the metamorphic overprint are similar to U-Pb data from a number of areas along a c 2000 km stretch from Natal in South Africa to central Dronning Maud Land. The basement then underwent in part strong high-grade reworking during the collision of E- and W-Gondwana, or parts thereof, between c. 620 and 530 Ma.

Proto-Kalahari is interpreted as an indenter, whith intense dextral transpressional shearing on the Namaquan side and sinistral transpressional shearing seen in Natal (JACOBS et al. 1993). The precise timing of Grenville-age metamorphism has important implications for the position of Kalahari in Rodinia. One reconstructions interprets Proto-Kalahari as an indenter into Laurentia (DALZIEL et al. 2000). The Ottawan cycle of the Grenville Orogen has identical metamorphic ages than the Namaqua-

Natal-Maud Belt (e.g. MEZGER et al. 1993). Alternatively, Kalahari could have been attached to western Australia (POWELL et al. 2001, PISAREVSKY et al. 2003), which however, in our view is less like, chiefly because the Kalahari indenter would have no counterpart in this reconstruction. Our new data also questions whether Coats Land, to the south of the Maud Belt, is part of the Maud Belt, since the undeformed volcanic rocks of Coats Land are older than the main metamorphism within the Maud Belt, and therefore must rest on older basement. This interpretation would reason why the paleomagnetic pole of Coates Land at c 1110 Ma differs from the Kalahari poles by 30° (GOSE et al. 1997), i.e. Coates Land had not yet amalgamated to Kalahari. On the other hand, the paleopoles from Coates Land and Laurentia at 1110 Ma are identical within error. Thus, Coats Land could have been part of Laurentia or an older inboard part of the Grenville Orogen. The suture between Kalahari and Laurentia could be represented by the Beattie magnetic anomaly in southern Africa.

Dalziel et al. (2000): J. Geol. 108: 499-513.
Gose et al. (1997): J. Geophy. Res. 102: 7887-7902.
Jacobs et al. (1993): Geology 21: 203-206.
Metzer et al. (1993): Contrib. Min. Pet. 114: 13-26.
Pisarevsky et al. (2003): in press.

Major structural elements of the East African/Antarctic Orogen between the Grunehogna and Napier cratons and significance for the amalgamation of Gondwana
(oral p.)

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A comparison of geological, geochronological and aerogeophyscial data in Dronning Maud Land (DML) highlight a number of important structural discontinuities, that were probably significant elements during the amalgamation of Gondwana. In DML an Archean cratonic fragment, the Grunehogna craton, is exposed, that is rimmed by the c 1.1 Ga Maud Belt. The Maud Belt is characterized by high-amplitude, elongate magnetic anomalies, that are parallel to the craton margin (GOLYNSKY & ALESHKOVA 2000). These anomalies can be correlated with similar anomalies in the Mesoproterozoic Natal Metamorphic Province of southern Africa (CORNER & GROENEWALD 1991), to which this part of East Antarctica was attached during the Mesoproterozoic. In DML, these elongate anomalies terminate sharply at the Heimefront Shear Zone in western DML (GOLYNSKY & JACOBS 2001). This structural discontinuity coincides with Grenville-age Ar-Ar and K-Ar cooling ages to the West and Pan-African cooling ages to the East. East of the shear zone the basement has been pervasively reworked, and the degree of reworking and the grade of metamorphism increases east-wards. Since on either side of the Heimefront Shear Zone Grenville-age rocks are exposed, we interpret this structure as the orogenic front of the southern continuation of the East African Orogen into East Antarctica. It is unlikely, that this structure represents a suture, since on either side of the shear zone Mesoproterozoic rocks are exposed.

The internal structure of the combined East African/Antarctic Orogen is thus far only known from near coastal outcrops in central and eastern DML. However, new aeromagnetic data (VISA) allow some speculations about the continuity of the major inland structures in the ice covered continental interior. For example, the new VISA data show an elongate, more than 300 km long, high amplitude and NE trending anomaly that seems to continue beyond the survey area, both to the NE and to the SW. To the NE it projects into central DML, into the area of Orvinfjella, where it could correlate with the South Orvin Shear Zone. The South Orvin Shear Zone separates two structurally distinctly different domains and therefore might correlate with a major crustal boundary. Unfortunately, the late

Neoproterozoic to early Paleozoic structural history of the outcropping area is highly complicated due to large volumes of post-tectonic Cambrian igneous rocks that occupy more than 50 % of the outcropping area. To the SW the major anomaly is located N of the Kohnen Station.

The eastern margin of the East African/Antarctic Orogen is in the Lützow-Holm Bay area. Here structures of coastal outcrops and aeromagnetic anomalies trend northwest, i.e. at right angles to the dominant structures in central DML. This might indicate that the Lützow-Holm Bay area represents a perpendicular and independent branch of the East African/Antarctic Orogen, possibly being connected with the southern Prince Charles Mts.

Corner, B. & Groenewald, P.B. (1991): Gondwana reunited.- S. Afr. J. Ant. Res. 21: 172.
Golynsky, A.V. & Aleshkova, N.D. (2000): Polarforschung 67: 101-118.
Golynsky, A.V. & Jacobs, J. (2001): J. Geol. 109: 136-142.

Magnetic susceptibilities of the different tectono-stratigraphic terranes of Heimefrontfjella, western Dronning Maud Land, East Antarctica
(poster p.)

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In Heimefrontfjella, western Dronning Maud Land, Grenville-age gneisses are exposed, that are part of the extensive Namaqua-Natal-Maud Belt, fringing the Zimbabwe-Kaapvaal-Grunehogna craton. The eastern portion of Heimefrontfjella was intensely reworked during Late Neoproterozoic/Early Palaeozoic times. The up to 20 km wide Heimefront Shear Zone marks the western front of the Late Neoproterozoic/Early Palaeozoic East African/Antarctic Orogen. It also separates distinct tectono-stratigraphic terranes and thus is an important structure in East Antarctica. The Heimefront Shear Zone is associated with a particular aeromagnetic anomaly pattern.

We collected a large number of susceptibility data from different rock types across this shear zone and from all major lithologies, in order to give a better understanding of available aeromagnetic data of this mostly ice-covered region. The surprisingly highest susceptibilities of up to 70 x 10^{-3} SI units were measured in felsic gneisses, which are part of a metamorphosed bimodal volcanic sequence. The highly oxidized stage of these felsic rocks is typical for magmatic protoliths, originating from a lower crustal source without supracrustal involvement. The susceptibilities of the felsic metavolcanic rocks exceed the susceptibility of associated amphibolites on the order of about one magnitude. In the metavolcanic rocks, magnetite is the main magnetic mineral, formed by metamorphic reactions in excess of annite within highly oxidised rocks that lack supracrustal involvement. Thus far, these highly magnetised rocks are not clearly recognised in available aeromagnetic surveys (GOLYNSKY & ALESHKOVA 2000), because the flight-line spacing of 5 km is probably too large to resolve these units. A smaller flight line spacing would probably decipher the Late Neoproterozoic/Early Palaeozoic structures along the orogenic front of the East African/Antarctica Orogen and would significantly help in the understanding of this structurally complex region along the southwestern extension of the East African/Antarctic Orogen.

Golynsky, A.V. & Aleshkova, N.D. (2000): Polarforschung 67: 101-118.

Eocene penguins of Seymour Island: systematics, evolution and paleoecology
(poster p.)

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The fossil remains of penguins are known from localities within the geographic ranges of Recent Spheniscidae (SIMPSON 1976, FORDYCE & JONES 1990). The Eocene penguin fauna from the La Meseta Formation of Seymour Island, Antarctic Peninsula, represents the only fossil record of Spheniscidae south of the Antarctic Convergence. As it is the oldest locally productive record of extinct penguins, it is critical for understanding the early evolution of these birds.

Fossil remains are mainly isolated, often poorly preserved, bones (FORDYCE & JONES 1990, JADWISZCZAK 2000, MYRCHA et al. 2002). The vast majority of penguin bones from the La Meseta Formation were found in the late Middle to Late Eocene sediments (JADWISZCZAK 2000, MYRCHA et al. 2002). This corresponds to cool, wet, non-seasonal conditions, relatively dry and cold at the end of the period (DINGLE et al. 1998).

Rich Argentine and Polish collections of penguin bones from the La Meseta Formation were recently taxonomically revised on tarsometatarsal morphology (MYRCHA et al. 2002). The analysis of 126 specimens enabled the revision of diagnoses of already described species: *Anthropornis nordenskjoeldi, A. grandis, Palaeeudyptes klekowskii, P. gunnari, Archaeospheniscus wimani* and *Delphinornis larseni.* Furthermore, two genera (*Mesetaornis* and *Marambiornis*) and four species (*Mesetaornis polaris, Marambiornis exilis, Delphinornis arctowskii* and *D. gracilis*) were erected.

The estimations of body sizes based on hind limb bones from the Polish collection of penguin fossils from Seymour Island indicate that mean interspecific body size of Eocene Antarctic Spheniscidae exceeded that of Recent species (JADWISZCZAK 2001). Predicted body masses range between 6.4 and 108.0 kg, and estimated total body lengths range from 83.7 to 205.7 cm (based on tarsometatarsi, Model I regression method). Values estimated by means of Model II regression method were smaller, but they did not affect the pattern described above (JADWISZCZAK 2001).

Exceptionally abundant penguin remains cropping out from the upper part of the La Meseta Formation may indicate that during climate deterioration (e.g., GAZDZICKI et al. 1992, DINGLE et al. 1998) and accompanying ecosystem changes penguins found favourable conditions for breeding and increasing numbers of their populations (MYRCHA et al. 2002). On the other hand, the adaptive radiation under periodically unfavourable trophic conditions was proposed as an explanation for the abundance of fossil penguin taxa (JADWISZCZAK 2000).

Dingle, R.V., Marenssi, S.A. & Lavelle, M. (1998): J. South Amer. Earth Sci. 11(6): 571-579.
Fordyce, R.E. & Jones, C.M. (1990): In: L.S. Davis & J.T. Darby (eds). Penguin Biology, Academic Press, San Diego, 419-446.
Gazdzicki, A., Gruszczynski, M., Hoffman, A., Malkowski, K., Marenssi, S.A., Halas, S. & Tatur, A. (1992): Antarctic Sci. 4: 461-468.
Jadwiszczak, P. (2000): Polish Polar Stud., 27th Internat. Polar Sympos. Torun: 39-45.
Jadwiszczak, P. (2001): Polish Polar Res. 22(2): 147-158.
Myrcha, A., Jadwiszczak, P., Tambussi, C.P., Noriega, J.I, Gazdzicki, A., Tatur, A. & del Valle, R.A. (2002): Polish Polar Res. 23(1): 5-46.
Simpson, G.G. (1976): Yale University Press, New Haven and London.

Seismic modelling of the Hero Fracture Zone, West Antarctica
(poster p.)

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During four Polish Antarctic Geodynamical Expeditions in the period 1979-1991, deep seismic sounding measurements were performed in the transition zone between the Drake and South Shetland microplates and the Antarctic plate in West Antarctica. The network of 20 deep seismic sounding (DSS) profiles ranging in length from 150 to 320 km covered the western side of the Antarctic Peninsula from Adelaide Island on the south to Elephant Island on the north. Summarised seismic results obtained during four expeditions, which were published in a number of papers (GUTERCH et al. 1985, GRAD et al. 2002, 1997, 1992, JANIK 1997a,b, SRODA 2002).

Evolution history of the western marginal part of the peninsula was reconstructed mainly from surface distribution of synchronic magnetic anomalies of the neighbouring sea floor by many authors, e.g., HERRON & TUCHOLKE 1976, BARKER 1982. The ocean crust at the Aluk Ridge must have also disappeared under the peninsula, until the ridge itself had been consumed as long as subduction was stopped. Subduction and spreading halted at definite segments of plates, the rift topography disappeared and the zone became a passive boundary. These processes repeated in successive segments of the subducting plate, cut by numerous transformation rifts. According to LARTER & BARKER (1991), this process had occurred until about 6.5-4 million years ago when the last segment of the ridge reached a rift to the south of the Hero Fracture Zone (HFZ). Between the latter and the Shackleton Fracture Zone (SFZ), there is the last preserved although disrupted fragment of the spreading Aluk-Antarctic axis. HFZ separates the volcanic arc of the South Shetland Islands and the Bransfield Basin from a continental, passive zone further to the south (HERRON & TUCHOLKE 1976).

Results of two-dimensional modelling of the network of linear DSS profiles provide images of the very complicated deep structure of the Earth's crust in the Bransfield Strait and margin of the Antarctic Peninsula. Of importance is the fracture corresponding to the location of the HFZ which separates very sharply the area of typical three-layer crystalline continental crust from the two-layer crust with high velocity body intrusions. They correspond, respectively, to the passive continental margin of the Antarctic Peninsula shelf and the active marginal zone of the Bransfield Strait.

The HFZ was intersected by our two seismic transects, the jointly modelled lines of the profiles DSS-10 and DSS-7 and DSS-6 and DSS-5. Images of the HFZ on both lines are different. On the DSS-10 and DSS-7 line, located more on the north, the HFZ is about 70 km wide and very clearly expressed. High velocity (>7.3 km/s) is observed at a depth of about 7 km. The Moho boundary is much shallower (~21 km) than in the neighbouring tectonic units. The patern of the HFZ on the DSS-6 and DSS-5 line is different, 90-120 km wide, with some similarities in the crustal structure to the Bransfield Strait; HVB (Vp = 7.3-7.6 km/s) was detected at depths a 12-22 km, but the Moho boundary is at 43 km.

Barker P.F. (1982): J. Geol. Soc. London 139: 787-802.
Grad M., Guterch A.; Janik T. & Sroda P. (2002): In: J.A. Gamble, D.N.B. Skinner & S. Henrys, Royal Soc. N. Zealand Bull. 35: 493-498.
Grad M., Shiobara H., Janik T., Guterch A. & Shimamura H. (1997) Geophys. J. Internat. 130: 506-518.
Grad M., Guterch A. & Sroda P. (1992): Antarctic Sci. 4: 469-476.
Guterch A., Grad M., Janik T., Perchuc E. & Pajchel J. (1985): Tectonophysics 114: 411-429.
Herron E.M. & Tucholke B.E. (1976): In: C.D. Hollister et al. (eds). Init. Rep. DSDP 35: 263-278.
Janik T. (1997a): In: C.A. Ricci (ed.). The Antarctic Region: Geological Evolution and Processes: 679-684.
Janik T. (1997b): Polish Polar Res. 18: 171-225.
Larter R.D. & Barker P.F. (1991): Spec. Publ. Int. Ass. Sediment 12.
Sroda P. (2002): In: J.A. Gamble, D.N.B. Skinner & S. Henrys (eds.,. Royal Soc. N. Zealand Bull. 35: 555-561

Estimates of heat flow from gas hydrate BSRs on the South Shetland margin, Antarctic Peninsula

(poster p.)

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A bottom simulating reflector (BSR), representing the base of gas hydrate stability field, is widespread on the South Shetland margin (SSM), Antarctic Peninsula (LODOLO et al. 1993, LODOLO et al. 2002, JIN et al. 2003). With phase diagram for gas hydrate stability field, heat flow can be derived from BSR depth beneath the seafloor determined on multichannel seismic profiles.

The heat flow values in the study area range from 50 mW/m^2 to 85 mW/m^2 with an average value of 65 mW/m^2. A small deviation of heat flow values from the average one suggests that heat flow regime in the study is relatively stable. The landward heat flow decrease from the South Shetland Trench would be attributed to the landward thickening of the accretionary prism and the upward advection of heat associated with fluid expulsion.

The continental slope 1500 m to 3000 m deep, where BSRs are most distinct in the SSM, shows high variation of heat flow possibly due to complex tectonic activities in the study area. The heat flow high is observed near the NW-SE trending large-scale fault. The fault would be related to a fracture zone in the Phoenix plate or a transfer fault across the Bransfield Basin.

Lodolo, E., Camerlenghi, A. & Brancolini, G. (1993): Antarctic Sci. 5: 207-210.
Lodolo, E., Camerlenghi, A., Madrussani, G., Tinivella, U. & Rossi, G. (2002): Geophys. J. Intermat. 148: 103-119.
Jin, Y.K., Lee, M.W., Kim Y., Nam, S.H. & Kim, K.J. (2003): Antarctic Sci. in press.

First results on carbonate-bearing picrites and olivine-phyric carbonatite from East Antarctica

(poster p.)

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The occurrence of carbon-enriched magmas in different tectonic settings is a worldwide phenomenon that is usually ascribed to a primary magmatic enrichment of certain mantle derived melts (e.g., kimberlites) in CO_2. However, controversy still remains as to whether CO_2 enrichment is an inherent feature of the mantle source peridotite, or CO_2 saturation in magmas occurs en route to the surface due to the melt-peridotite reactions or/and silicate-carbonate melt immiscibility. Magmatic carbonate-bearing rocks or carbonatites are virtually unknown from Antarctica (except for the Lambert Glacier rift system in northern Prince Charles Mountains, nPCM, ANDRONIKOV 1990, EGOROV et al. 1993), and this report aims to present first results on the unusual high-CO_2, low-SiO_2 magnesian rocks collected by G.T. Nichols from nPCM.

The nPCM is the Mesoproterozoic terrain dominated by granulite facies orthogneisses, but also contains metapelitic, calc-silicate, mafic gneisses, as well as charnokites (NICHOLS 1995). Picritic rocks (# 77081, 77082) and carbonatite (# 77083) were collected within 5 m of each other from a lateral-glacial moraine adjacent to Mt. Meredith. All three rocks were distinctive from other rocks in the moraine, which in this region is typically composed of reddish-brown gneisses.

Sample 77081 is a porphyritic, carbonate-bearing (CO_2 5.3 wt.%) picrite (MgO 27.3 %) with a strong layering defined by phenocrysts of olivine and minor clinopyroxene, and narrow (1 mm) carbonate and serpentine veins. Elongated and aligned olivine grains (up to 5 mm) are fractured and serpentinised. Olivine has a narrow range of composition in terms of Fo (88-89.5) and CaO (0.12-0.16 %), but variable NiO (0.2-0.5 %). Clinopyroxene is magnesian (Mg# 86-94 mol%), and extremely high in CaO (26 %). Euhedral brown spinel is enclosed in olivine, and also present as individual microphenocrysts (0.4 mm). Its composition is characterized by moderate enrichment in Al_2O_3 (26-3 %, Cr# 31.5-36.5) and TiO_2 (1.3-1.5 %). Both olivine and spinel contain microcrystalline inclusions of presumably silicate-carbonate melt. Fine-grained groundmass is composed of calcite, phlogopite, Ti-magnetite and perovskite.

Sample 77082 is a fine-grained, carbonate-bearing (CO_2 6.2 %) picrite (MgO 19.1 %) with euhedral microphenocrysts (<0.5 mm) of phlogopite, olivine and clinopyroxene, and larger (1-1.5 mm) crystals and fragments of olivine. Olivine is represented by five compositional groups (Fo: 1. ~93; 2. 87-89; 3. 82-85; 4. 79-80; 5. 76-77). Olivines in groups 3-5 can be related by fractional crystallization, as CaO and NiO gradually decrease from 0.2 to 0.02 and 0.4 to ~0 %, respectively. Group 1 olivine with very low CaO (<0.05 %) and high NiO (0.3-0.45 %) can be interpreted as fragments of disintegrated mantle xenoliths. Group 2 olivines are distinct in having high CaO (0.4-0.65 %) and low NiO (<0.2 %). Most olivines contain trails of small melt and fluid inclusions, and also euhedral inclusions of dull green spinel (exceptionally high Al_2O_3 up to 57 %, elevated TiO_2 (0.6-0.8 % and very low Cr_2O_3 1-3 %). The groundmass consists of calcite, phlogopite, perovskite and secondary minerals.

Sample 77083 is a carbonatite (CO_2 22.4 %, CaO 28.8 %) with large (up to 1.5 mm,) euhedral, partly altered crystals of olivine (Fo 88-89.5 %, CaO and NiO <0.03), amphibole and deformed phlogopite set in coarse, granular calcite. All phenocrysts have intergrowths with each other, which show that olivine is the earliest phase and amphibole is the latest. Inclusions of euhedral calcite are found trapped in olivine together with emerald green Al-spinel, high-Ca clinopyroxene, and phlogopite.

We present several models explaining the origin of these different but genetically related rocks in a perspective of development of Lambert Glacier rift system.

Andronikov, A.V. (1990): Antarctic Sci. 2: 321-330.
Egorov et al. (1993): Doklady RAN 328: 230-233;
Nichols, G.T. (1995): J. Metamorph. Geol. 13: 223-238.

New map of metamorphic facies of Antarctica 1: 5 000 000
(poster p.)

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A progress in the study of metamorphism of the Antarctic geological formations for the last two decades of XX^{th} century allowed considerably to renew the map of metamorphic facies of Antarctica published in 1978 by the Research Institute of the Geology of the Arctic, Ministry of Geology, USSR.

A legend to the new map was compiled in compliance with the general recommendations of the Commission for Geologic Map of the World. Accordingly, we recognize in Antarctica four facies groups (from low to high temperature): laumontite-prehnite-pumpellyite facies group, greenschist facies group, amphibolite facies group and granulite facies group. First of the groups was not subdivided into facies series by pressure estimations. Facies series of high pressure was identified in greenschist facies group through appearance of such minerals as glaucophane, crossite, jadeite, lawsonite and aragonite (glaucophane-schist facies). Facies series of low pressure was identified in amphibolite facies group through appearance of andalusite and cummingtonite in mineral assemblages (cummingtonite-amphibolite facies). What is more the epidote-amphibolite facies is recognized in that facies group in places where the migmatites are absent. Granulite facies group was divided into low temperature subgroup with widespread brown hornblende and biotite in mineral assemblages and high temperature subgroup without these minerals. Last subgroup was subdivided onto three facies series: 1) higher pressure because of assemblage of hypersthene with sillimanite; 2) intermediate pressure because of assemblage of sapphirine and spinel with quartz; 3) lower pressure because of assemblage of garnet with hypersthene, osumilite and cordierite. All named facies series, groups and facies are represented on the map by own sets of related colors. Polymetamorphism is shown by alternating color stripes. Relic metamorphic facies stripes are narrower the stripes of superimposed metamorphic facies.

Symbols for special rocks like eclogite, anorthosites, ultrabasic rocks, alkaline rocks, kimberlite and lamproite dykes and pipes, volcanoes, special colors and lithology patterns for prometamorphic and unmetamorphic sedimentary and igneous formations are also shown in the legend.

Large-scale massifs of metamorphosed mafic rocks and granitoids are shown color patterns correspondingly to metamorphic facies. Migmatites are distinguished by black pattern on the color of metamorphic facies. Other conventional signs include strikes of folds, main faults and boundaries of metamorphic complexes and intrusions. Ages of metamorphism are shown by usual Roman letters. ? designate unknown age. Designation of the type: AR/PR indicates that first metamorphism have happened in Archean and second one in Proterozoic.

The real minerogenic provinces of Antarctica

(oral p.)

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Large-scale real minerogenic provinces of Antarctica are confirmed by the existence of mineral, ore and coal occurrences, which were discovered in last XX century in the process of geological research.

A wide range of mineragenic provinces are representative of the East Antarctic craton. There are Early Precambrian iron-ore provinces in the Enderby Land and the Prince Charles Mountains, Late Precambrian provinces of magnesian skarns in the Enderby Land (phlogopite-ore) and in the Shackleton Range (apatite-ore), Late Precambrian porphyry-copper reometamorphic province in the Prince Olav Coast. Much more likely Early Paleozoic mineragenic provinces of the craton include phlogopite-ore province of magnesian skarns in the Dronning Maud Land, pegmatite province in the Southern Prince Charles Mountains and Mawson Escarpment and great pegmatite belt extended through the Southern Enderby Land and the whole Dronning Maud Land to Kirwanveggen. Pegmatite veins in the certain fields are enriched by muscovite or beryl, spodumene, rock crystal or minerals rich in REE. Late Paleozoic mineragenic provinces of the craton are represented by only Permo-Triassic Amery coal basin in the Beaver lake area.

Two types of real minerogenic provinces are obviously distinguished in the Phanerozoic mobile belt of the Transantarctic Mountains and West Antarctica. These are belts of Permo-Triassic coal basins in the rear side of the Transantarctic Mountains and great Antarctic-Andian porphyry-copper belt including the whole Antarctic Peninsula and surrounding islands. Probably the same type of porphyry-copper belt exist in the Transantarctic Mountains, but data about ore occurrences there are very poor. The named minerogenic provinces are characterized in brief outline.

A presence in Antarctica the specific hypogenic intrusive complexes of tectonomagmatic activizations of stable blocks is an indication of the certain potential mineralization. Such complexes are: the Jurassic layered Dufek intrusion, Mesoproterozoic differentiated intrusions of the Ritscher Upland in the western Dronning Maud Land, the Neoproterozoic layered anorthositic Eliseev massif in the central Dronning Maud Land, the series of Mesoproterozoic differentiated and layered intrusions in the northern Prince Charles Mountains (so called "Fisher Complex"), the Jurassic alkaline Gburek intrusion of the central type in the western Dronning Maud Land, Ordovician-Silurian lamproite of the Enderby Land and the Prince Charles Mountains, Jurassic-Cretaceous alkaline-ultramafic dykes, stocks and sills, Paleogene olivine-leucite basalts on the north-western side of the Lambert-Amery rift system, Holocene leucite basalts of the Gaussberg volcano.

Local seismic activity around Syowa Station, East Antarctica

(poster p.)

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The observation of seismic monitoring at Syowa Station (69°S, 39°E; SYO), located on the continental margin of the western Enderby Land, East Antarctica, was started in 1959. Phase readings of the earthquakes have been reported since 1967 and have been published from the National Institute of Polar Research once a year since1968, as one of the Data Report Series (e.g., KANAO 1999).

An observation of a tripartite seismic network had been carried out at SYO during three years of 1987-1990 (AKAMATSU et al. 1989). Epicenters of local earthquakes were determined the first time by the array network during the three years. A many different type of earthquakes, such as a main-shock-after-shock type, twin earthquake, earthquake swarms, etc., were detected at that time. Since that period, local events around SYO can be detected empirically from their waveforms on the monitoring seismograms. The seismic activity during 1987-1990 was higher than that of the following a decade. Earthquake location at that period was concentrated along the coast area and the central part of the Lützow-Holm Bay (LHB).

In the period of 1990-1996, nine local earthquakes were recorded with many different types of events. The seismicity during the period was very low and the magnitudes ranged from 0.1 to 1.4. Some of the events were determined their locations by a single station method at SYO, by using particle motions of the initial phase and S-P times (KAMINUMA et al. 1998).

Two local events were detected in 1998 and one event in 2001. The last event was recorded on February 21, 2001. The P-S time of the event was determined 10.8 s on the three-component seismogram of the short period seismograph (HES). The low seismic activity is still continued around 2000.

In this presentation, we discuss about the characteristics of time series for the local seismicity around the LHB region relating to the deglacial lithospheric uplift and the sea-level changes.

Akamatsu, J., Ichikawa, N. & Kaminuma, K. (1989): Polar Geosci. 3: 1-12.
Kaminuma, K., Kanao, M. & Kubo, A. (1998): Polar Geosci. 11: 23-31.
Kanao, M. (1999): JARE Data Rep. 236 (Seismology 33), 1-65.

Multidisciplinary surveys by structure and evolution of the East Antarctic lithosphere: SEAL-2000; 2002

(poster p.)

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Lithospheric evolution and deep structure viewed from East Antarctic Shield have significance in relating to the continental growth process in Earth's evolution. Here, we focus on the lithospheric structure of the early-Paleozoic crust of the Lützow-Holm Complex (LHC), Enderby Land, East Antarctica. LHC is considered to be one of the collision zones between the East- and the West- Gondwana during the formation of a paleo-supercontinent when the Pan-African orogeny. The "Structure and Evolution of the East Antarctic Lithosphere (SEAL)" project has been carried out since 1996-1997 austral summer season in the framework of the Japanese Antarctic Research Expedition (JARE). Several geophysical studies and deep seismic refraction / wide-angle reflection surveys have been conducted in the LHC. The main target of the SEAL seismic traverse is to obtain a lithospheric imaging in several geological terrains from the eastern Archean (Napier Complex) to the early-Paleozoic ages (LHC and Yamato Mountains) between western Enderby Land and eastern Dronning Maud Land.

In the austral summer season in 2000, and 2002, deep seismic surveys were conducted on ice sheet in the northern Mizuho Plateau of the LHC by JARE-41, and -43, respectively. In both surveys, more than 170 plant-type 2 Hz geophones were installed on the Mizuho plateau totally 190 km in length. A total of 8300 kg dynamite charges at the fourteen seismic shot points on the ice sheet gave an enough information concerning the deep structure of a continental margin of the LHC. These surveys revealed that the Moho depth was more than 40 km with the velocity of the surface layer, middle crust, lower crust and mantle, about 6.2, 6.4, 6.7 and 7.9 km/s, respectively. Moreover, the clear reflections from the lower crustal depth and around the Moho discontinuity were observed on the record sections; which implies the existence of heterogeneity on the crust-mantle boundary beneath the Paleozoic orogenic zone of the LHC. Laminated layers around the Moho discontinuity could also be identified by the precise spectral analyses for the Moho reflection phases (PmP waves).

Broadband seismic array deployment around the Lützow-Holm Bay area, East Antarctica

(poster p.)

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Seismic Array observations by several broadband seismometers have been carried out from the end of 1996 on the coastal outcrops along the Soya Coast to Prince Orav Coast area, around the Lützow-Holm Bay, East Antarctica. The observation system consists of a portable broadband seismometer, a digital recording unit and a lead and solar-panel battery power supply unit. The CMG-40T seismometers have been used with a three-component velocity-response (flat frequency response for velocity from 0.1 s to 20 s). The signal is digitized at the sampling frequency rate of 20 Hz with a dynamic range of about 90 dB (16 bits) and then stored on a hard-disk (2GB). This process was carried out using a digital data-recorder (LS8000-WD). The total powers of the solar panels are 200 W at 12 V DC and the total capacity of the lead batteries was 100 x 5 Ah. Except for power supply failure in winter seasons for three months, observations have been conducted well and many teleseismic earthquakes have been recorded. At present in 2002 wintering season, four field stations (TOT, LNG, SKV and SKL) have been continued to recording. In the near future, we are planning to transmit the stored data in digital data-recorder of the field stations to the WS server of the nearest permanent station Syowa (SYO; 69°S, 39°E) via Intersat telecommunication system joining with Iridium satellite transmission.

Obtained data were of good enough quality for the uses of various waveform analyses to clarify the heterogeneous structure of the lithosphere. Conventional passive studies such as receiver functions and shear wave splitting have been carried out for some outcrop stations along the Coast; indicate the gradual complex structure from the north to the south, toward the Shirase Glacier. The obtained data have advantages not only to these lihospheric studies but also to the deeper Earth's interior such as the D" zones, CMB and the Inner Core by applying as a large span array stations located in these polar region. Our BroadbandArray deployments in the Lützow-Holm Bay area would be an effective contribution to the Global Alliance of Regional Networks (GARNET) project by NIED, Antarctic Array projects (Regional Leapfrogging Arrays, Program Oiented Experiments) as recommended by SEAP-2003 workshop and also to the SCAR / Antarctic Neotectonics (ANTEC) program.

In the poster presentation, together with the field Array deployment, we will show the present status of seismological observations and data accessibility for public use of the permanent Syowa Station (SYO).

Lithospheric shear velocity models beneath continental margins in Antarctica inferred from genetic algorithm inversion for teleseismic receiver functions

(oral p.)

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Seismic shear velocity models of the crust and the lithospheric mantle were investigated by teleseismic receiver functions inversion beneath the continental margins in Antarctica. In order to eliminate the starting model dependency, non-linear Genetic Algorithm (GA) (SHIBUTANI et al. 1996) was introduced in the time domain inversion of the radial receiver functions. The approach provides a good sampling of the model space, and enables the estimation of the shear-wave speed distribution in the crust, along with an indication of the ratio between Vp and Vs. Many models with an acceptable fit to data are generated during the inversion, and a stable crustal model is produced by employing a weighted average of the best 1,000 models encountered in the development of the GA. The weighting is based on the inverse of the misfit for each model, so that the best fitting models have the greatest influence.

In this presentation, shear velocity models beneath the permanent stations at Antarctica belonging to the Federation of Digital Seismographic Networks (FDSN) are presented in relation to geotecnotics and crustal evolution of each terrain. The shear velocity model around MAW has a sharp crust / uppermost mantle boundary at 42 km depth that might have involved re-working of adjacent Archaean craton of Napier. High velocities in the upper crust around SYO may have a relationship with surface geology of granulite facies metamorphic rocks with Pan-African ages. Middle grade variations of the velocities for DRV may have been caused by the Middle Proterozoic metamorphism. Broadening low velocity zones about 30 km depth at VNDA, might be caused by the rift system besides the Trans Antarctic Mountains. As for the Antarctic Peninsular, the Moho discontinuity was found at 34 km depth from PMSA data. Besides the Antarctica, shear velocity models of the crust and uppermost mantle were already determined in eastern Australia (HILST et al. 1998), then we will make a comparison with those structure in terms of Gondwana members.

We also introduce briefly the ongoing Broadband-Array observations by CMG-40T seismometers installed on the coastal outcrops around SYO. Obtained data were of good enough quality for the various waveform analyses of lithospheric studies. Conventional receiver functions indicate the gradual complex structure from the north to the south, toward the Shirase Glacier. This complexity is assumed to have a relation with the metamorphism in 500 Ma, which have the maximum thermal axis around the southern part of the coast. Besides, the Moho gradually increases in 2 km depth from the north to the south; which corresponds well with the Bouguer gravity anomalies from field surveys.

Shibutani, T., Sambridge, M. & Kennett, B.L. (1996): Geophys. Res. Lett. 23: 1829-1832.
Van der Hilst, R.D., Kennett, B.L. & Shibutani, T. (1998): Geodynamics 26: 39-57.

Lithospheric evolution of Gondwana east from interdisciplinary deep surveys (LEGENDS)

(EANT workshop p.)

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Systematic exploration of the continental lithosphere by deep seismic reflection profiling over the past 20 years has revolutionized our view of the deep crust and upper mantle. Thus, while major networks of deep seismic profiles now span North America, Europe, Japan and Australia/New Zealand, much of the world's continents remain unsampled. Although recent multinational efforts have produced important deep geophysical transects of such key targets as the Himalayas/Tibet (INDEPTH), the Urals (URSEIS) and the Andes (ANCORP), most of Asia, Africa, South America and Antarctica remain terra incognita in terms of modern, high resolution deep seismic imaging. From a geological perspective, perhaps the largest expanse of unexplored continental lithosphere lies in those fragments that were once part of the supercontinent of Gondwana. Geological and geo-chemical studies of the rocks in East Africa, Madagascar, India, Sri Lanka, Australia and East Antarctica now provide a firm basis for framing geotectonic questions that can be addressed by such surveys. Furthermore, the present-day dispersal of the fragments of Gondwana make many of these geological problems accessible to marine deep seismic profiling, which is considerably less expensive than similar surveys on land.

As for East Antarctica, particularly in Western Enderby Land, a project "Structure and Evolution of the East Antarctic Lithosphere (SEAL)" has already been underway since the 1996-1997 austral summer season by Japanese Antarctic Research Expedition (JARE). The SEAL constitutes an important lead element for deep seismic exploration of Gondwana. Synthesis of these results with the proposed program of systematic seismic exploration of neighboring elements of Gondwana should offer major new insights into how continental lithosphere both amalgamates and breaks up. Deep seismic profiling by the LEGENDS (Lithospheric Evolution of Gondwana East iNterdisciplinary Deep Surveys) project (BROWN et al. 2001) would be expected to reveal the architecture and lithospheric evolution of these regions. The SEAL transect has also been carrying out as a chief contribution for the LEGENDS, to delineate a crustal imaging in several geological terrains from Western Enderby Land to Eastern Queen Maud Land, East Antarctica. In this presentation we will describe the LEGENDS initiative and recent SEAL prominent results, an attempt to build upon both the experience of previous deep seismic programs and the geologic perspectives promoted by the IGCP to probe one of the last major frontiers in deep seismic exploration.

Brown, L.D., Kroner, A., Powell, C., Windley, B. & Kanao, M. (2001): Gondwana Research 4: 846-850.

High-Pressure and high-temperature phase relations of a sillimanite-cordierite-sapphirine granulite from Rundvóagshetta, Lützow-Holm Complex, East Antarctica

(oral p.)

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High-pressure experiments were carried out to determine the phase relations of a ultra-high-temperature granulite from Rundvóagshetta (KAWASAKI et al. 1993, MOTOYOSHI & ISHIKAWA 1997), Lützow-Holm Complex, East Antarctica at pressures 7 to 15 kbar and temperatures 850 to 1200°C using a piston-cylinder apparatus. The pulverized granulite (c 10-50 μm in grain size) was sintered under the dry condition in an inner molybdenum-foil capsule within an outer Pt tube, edges of which were welded by carbon arc to prevent from escaping and adding volatile components. We found evidences of the addition of the volatile components from surroundings in the preliminary experiments using the crimping technique on a metal capsule.

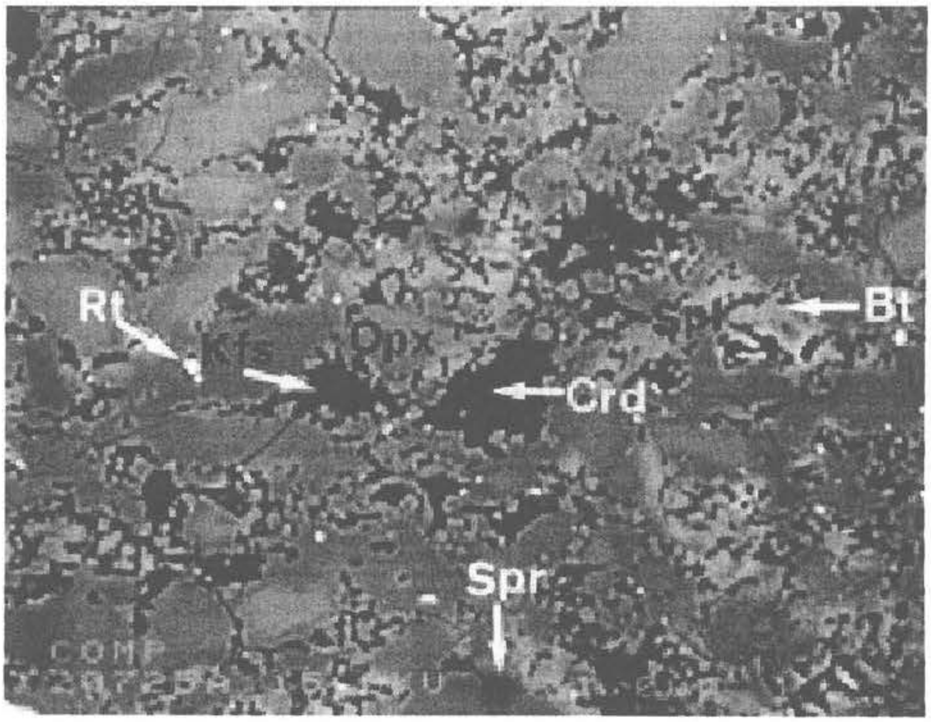

Fig. 1: Back scattered electron image (BSEI) of the run products sintered in the molybdenum capsule at 9 kbar and 1050°C for 453 hours. Photo area is about 120 x 90 μm. Bt, biotite. Crd, cordierite. Kfs, K-feldspar. Opx, orthopyroxene. Spl, spinel. Spr, sapphirine. Rt, rutile.

Cordierite is stable at 7 kbar and 850°C in equilibrium with a subsolidus assemblage of orthopyroxene, biotite, rutile and plagioclase. At 9 kbar cordierite is unstable above 950°C. Figure 1 shows cordierite was emplaced to Kfs by the reaction: Crd + Bt ! Kfs + Spl + Opx + Rt + vapor. At 11 kbar and 1050°C garnet is stable coexisting with orthopyroxene, sapphirine, spinel, biotite, K-feldspar and rutile. The new orthopyroxene-garnet geothermometer (KAWASAKI & MOTOYOSHI 2000) shows the peak metamorphic temperature of this granulite as 925-1039°C and 10-12.5 kbar with the stable assemblage of garnet + orthopyroxene + sillimanite. The orthopyroxene-sapphirine thermometer (KAWASAKI & SATO 2002) indicates that this granulite experienced the subsequent retrograde metamorphism at 824-1000°C and 6.5-9.5 kbar breaking down of garnet to the assemblage of orthopyroxene + sapphirine + cordierite + spinel.

Kawasaki, T., Ishikawa, M. & Motoyoshi, T. (1993): Proc. NIPR Symp. Antarct. Geosci. 6: 47-56.
Kawasaki, T. & Motoyoshi, Y. (2000): Polar Geosci. 13: 114-133.
Kawasaki, T. & Sato, K. (2002): Gondwana Res. 5: 741-747.
Motoyoshi, Y. & Ishikawa, M. (1997): In: C.A. Ricci (ed.). The Antarctic Region: 65-72.

Submarine volcanic geology of Bransfield Strait, Antarctica
(poster p.)

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Bransfield Strait is a Quaternary, ensialic backarc basin between the South Shetland Islands and the northern tip of the Antarctic Peninsula. Fresh volcanic rocks occur on numerous submarine features within the basin, including a discontinuous, axial neovolcanic ridge similar to the nascent spreading centers seen in some other backarc basins. Based upon morphological comparisons of the volcanic features to those in other backarc basins, as well as geochemical arguments, extension in Bransfield Strait may be transitioning from rifting to seafloor spreading (GRACIA et al. 1996, KELLER et al. 2002). Trace element and radiogenic isotopic compositions of the volcanic rocks range from similar to arc rocks from the nearby South Shetland Islands to virtually indistinguishable from mid-ocean ridge basalts. Volcanic and geochemical variations are not systematic along-axis, and do not reflect the NE to SW propagation of rifting suggested by geophysical data (BARKER & AUSTIN 1998).

In the interest of understanding the volcanic and tectonic evolution of the Bransfield rift, we are mapping the rock types found along the submarine part of the rift using published geochemical data (KELLER et al. 1992, KELLER et al. 2002), plus new data from samples dredged in 1999 "Nathaniel B. Palmer" and 2001 by "Sonne". Almost all sizable bathymetric features along 240 km of the rift (from 55°45'W to 60°W) consist of young volcanic rocks. The most common forms of recovered samples are rubbly chunks of pillows and thin sheet flows. Most samples contain abundant vesicles and have at least one glassy surface that is fresh to only slightly palagonitized. Several of the dredges contained cryptocrystalline to glassy black rhyolite in addition to or instead of the mafic samples. Over 165 glass analyses range from 48 wt.% to 79 wt.% SiO_2, with an almost completely bimodal distribution. With the exception of a single high-silica andesite, all of the samples fall within the ranges of either 48-58 wt.% SiO_2 or 69-79 wt.% SiO_2. About 15% are basalts, 70% are basaltic andesites, a few are andesites, dacites are absent, and 12% are rhyolites. Published whole rock analyses show this same bimodal distribution of SiO_2 contents, although olivine accumulation in the whole rocks moves some of the basaltic andesites down into the basalt field. Rhyolites were found on four different axial volcanic features near 57°W and 59°W. These are the same two areas where seafloor and water column studies found evidence for hydrothermal activity (KLINKHAMMER et al. 2001).

Barker, D.H.N. & Austin, J.A. (1998): J. Geophys. Res. 103: 24017–24043.
Gracia, E., Canals, M., Farran, M., Prieto, M.J., Sorribas, J. & GEBRA Team (1996): Mar. Geophys. Res. 18: 429-448.
Keller, R.A., Fisk, M.R., White, W.M. & Birkenmajer, K. (1992): Earth Planet. Sci. Lett. 111: 287–303.
Keller, R.A., Fisk, M.R., Smellie, J.L., Strelin, J.A., Lawver, L.A. & White, W.M. (2002): J. Geophys. Res. 107(B8): 4-1-4-17.
Klinkhammer, G.P., Chin, C.S., Keller, R.A., Dahlmann, A., Sahling, H., Sarthou, G., Petersen, S., Smith, F. & Wilson, C. (2001): Earth Planet. Sci. Lett. 193: 395–407.

Metamorphic events in the Napier Complex revisited: a re-interpretation of U-Pb SHRIMP data

(oral p.)

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At least three major episodes of deformation and metamorphism are recognised to have affected the Napier Complex between c 2980 Ma and 2450 Ma. Although UHT metamorphism is now well acknowledged to have occurred at sometime between 2600 and 2450 Ma, its precise timing is still debated. Moreover, the meaning of ~2850 Ma ages, originally interpreted to reflect the timing of the UHT event, has become unclear. The uncertainty over these relative ages rests largely on the ambiguity surrounding the timing of zircon growth with respect to peak and retrograde metamorphism during the UHT event, and the difficulty of fabric correlation. In this study, U-Pb SHRIMP data from three samples (originally dated by HARLEY & BLACK 1997) were re-interpreted in light of detailed CL/BSE images and REE analysis of zircon grains, with the aim of addressing 1) the age of apparently syn-tectonic magmatism; 2) what is the nature of ~2850 Ma ages; and 3) the timing of UHT metamorphism.

Garnet-absent charnockite from Proclamation Island contains ~2990 Ma magmatic zircon grains that reflect the crystallisation age of the charnockite. Homogeneous or planar banded, low CL mantles and rims on these grains are slightly depleted in MREE relative to magmatic zircon and have ages of ~2850 Ma. The internal zoning of these mantles and rims is interpreted to reflect growth during a high-grade metamorphic event. High CL rims and grains with planar banding and sector zoning (yet to be dated) are more MREE-depleted and also slightly HREE-depleted compared with low CL zircon rims, and are interpreted to have formed during a later metamorphic event. Garnet-orthopyroxene-bearing orthogneiss from Dallwitz Nunatak has ~2950 Ma magmatic zircons. Based on the textural relationship with zircon overgrowths, these grains are inferred to date the crystallisation of the precursor to the orthogneiss, and are not inherited as previously suggested. Low CL, homogeneous and weak planar banded rims on these grains are MREE-depleted and HREE-enriched relative to magmatic zircon, and reflect a distinct phase of growth at ~2840 Ma. High- to moderate CL rims with planar growth banding and sector zoning have ages that cluster at ~2490 Ma. These rims are M-HREE-depleted and have "flat" REE patterns that are similar to those from garnet and orthopyroxene in the same sample. This is interpreted to reflect growth in the presence of garnet and therefore a minimum age for the garnet-orthopyroxene-bearing fabric in this rock. The REE patterns for ~2840 Ma zircon are inferred to reflect a phase of zircon growth at high metamorphic grade, but possibly at pressures lower than those required to produce garnet. Paragneiss from Zircon Point contains a garnet-bearing fabric and coarse-grained mesoperthite, interpreted to reflect equilibration at UHT conditions. Low-moderate CL cores, low CL outer rims and mod-high CL rims, all with planar banding and sector zoning, occur on detrital magmatic zircon grains. This zircon is M-HREE-depleted with slightly negatively sloping patterns, reflecting growth in the presence of garnet. Each of these zircon types vary in REE concentration, with the oldest (~2575 Ma) low-moderate CL grains highest in REE and high CL rims (~2490 Ma) lowest, suggesting growth at different stages in this UHT metamorphic event.

The combined zircon data from the samples discussed above indicate that magmatism occurred at Dallwitz Nunatak at ~2950-2990 Ma, and not at ~2850 Ma as previously suggested. This age correlates with ~2990 Ma magmatism at Proclamation Island. In addition, ~2850-2840 Ma zircon growth indicates that a high-grade metamorphic event, at below UHT conditions, affected the Napier Complex. The minimum age of the S_1 garnet-orthopyroxene fabric in the Dallwitz Nunatak orthogneiss is ~2490 Ma, contradicting the original interpretation as a "syn-D_1" orthogneiss. This result also suggests that the "S_1" fabric in this location has overprinted earlier fabrics and is part of the UHT event series. The zircon data presented here underlines the difficulty in correlating fabrics between outcrop areas based solely on fabric similarity alone. We suggest that to understand the P-T-d-t history of the Napier Complex and other such polymetamorphosed terranes that detailed structural interpretation of sampled outcrops and CL-BSE image and REE analysis of dated minerals is required.

Harley, S.L. & Black, L.P. (1997): Antarctic Sci. 9: 74-91.

Volcanology and sedimentology of the Paleocene-Eocene Sejong Formation, Barton Peninsula, King George Island, Antarctica

(poster p.)

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The volcanic sequence in the Barton Peninsula, King George Island, Antarctica, ca. 300-500 m thick, consists of a lower volcaniclastic succession (Sejong Fm., 100-200 m thick) and an upper succession of basaltic-andesite lava flows interlayered with rare welded tuffs (TOKARSKI 1988, BIRKENMAJER 1998, LEE et al. 2002). Recovered plant fossils indicate deposition of the formation during the Late Paleocene to Eocene (CHUN et al. 1994). Previous studies have centered on the structures and petrology of the formation, but paid little attention to the eruptive and depositional processes and environments (YOO et al. 2001). This study focuses on paleoenvironmental reconstruction of the formation based on sedimentary facies analysis.

The Sejong Fm. can be grouped into three distinct facies associations (FA): (1) near-vent association (FA I), (2) volcanic-apron association (FA II), and (3) distal-apron association (FA III). FA I, occurring at base of the formation, consists of basaltic agglomerates and tuff breccias that are laterally gradational into massive/jointed ponded basalt lavas through a zone of brecciated basalt. FA II, unconformably overlying FA I, is represented by very thick, tabular beds of andesitic to basaltic, either welded or non-welded, lapilli tuff of pyroclastic-flow origin, rare intervening lava flows, and fluvial red sandstones/siltstones. FA III is characterized by channelized mass-flow conglomerates alternating with fluvial red sandstones/siltstones. Intimate relation of FA I with vent-filling ponded lavas suggests activity of Hawaiian or fire-fountaining eruptive centers early during deposition of the Sejong Fm.. The overlying FA II suggests onset of explosive and effusive eruptions of more evolved (intermediate) magmas, resulting in repetitive emplacement of ignimbrite sheets and attendant lava flows on a volcanic arc and fringing volcaniclastic aprons. Reworked conglomerate units of FA III suggest active hydrologic remobilizations during and in the immediate aftermath of the eruptions.

Birkenmajer, K. (1998): Bull. Pol. Acad. Sci., Earth Sci. 46: 191-209.
Chun, H.Y., Chang, S.G. & Lee, J.I. (1994): J. Paleontol. Soc. Kor. 10: 69-84.
Lee, J.I. et al. (2002): Geological map of the Barton and Weaver peninsulas. KORDI.
Tokarski, A.K.. (1988): Stud. Geol. Pol. 105: 53-63.
Yoo, C.M., Choe, M.Y., Jo, H.R., Kim, Y. & Kim, K.H. (2001): Ocean Polar Res. 23: 97-108.

Elastic wave velocities and anisotropy of high-grade metamorphic rocks from Lützow-Holm Complex, East Antarctica

(poster p.)

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Seismological studies reveal physical and geometrical characteristics of extensive areas of the continental crust. Those data do not directly indicate the rock constitutions of deeper parts of the continental crust. The laboratory measurement of rock velocity under high-P, high-T condition is essential to estimate the petrological characteristics of mid to lower crust. We performed P wave velocities (Vp) and their anisotropy measurement for basic high-grade metamorphic rocks from the early Paleozoic Lützow-Holm Complex, East Antarctica in order to understand the processes of formation and evolution of the continental crust. The measurements were conducted at pressures from 0.1 GPa to 1.0 GPa and at temperatures from 25°C to 400°C with a piston-cylinder apparatus. We selected eight mafic rock samples for Vp measurement; two amphibolites, a biotite (Bt) amphibolite, a Bt-hornblende (Hbl) granulite, a pyroxene (Px)-Hbl granulite, a Bt-2Px granulite, a 2Px granulite and a Hbl-2Px granulite. The results of our measurements at 1.0GPa were as follow, 7.08 and 6.95 km/s for amphibolites, 6.89 km/s for Bt amphibolite, 6.84 km/s for Bt-Hbl granulite, 7.34 for 2Px granulite and 7.08 for Hbl - 2Px granulite, respectively. All samples show comparable Vp anisotropy (5.17, 6.68, 6.04, 5.99, 9.80, 5.87, 2.46 and 3.57 %). The reflection coefficients obtained by simple calculation using these values indicate the possible lithologic interfaces in middle to lower crust. Our data may explain the lower crustal reflectively of Mizuho plateau, East Antarctica estimetsd by explosion experiment (YAMASHITA et al. 2002).

Yamashita, M, Kanao, M & Tsutsui, T. (2002): Polar Geosci. 15: 89-103

The Matusevich Fracture Zone, Oates Land

(poster p.)

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The Matusevich Glacier in Oates Land is running parallel to the Rennick Glacier in northern Victoria Land 120 km to the west of it. The structural development of the Rennick Glacier area is well known and documented: Mainly it is a graben (e.g. ROLAND & TESSENSOHN 1987), accompanied, maybe followed, by dextral strike-slip kinematics combined with transpression (e.g. LÄUFER & ROSSETTI 2000). The age of these brittle structures is estimated as being post-Jurassic to Cenozoic (ROLAND & TESSENSOHN 1987, LÄUFER & ROSSETTI 2000), but they are tracing an older, ductile thrust system, the eastward directed Ross-aged „Wilson Thrust" (FLÖTTMANN & KLEINSCHMIDT 1991, KLEINSCHMIDT 1992). Even if the Matusevich Glacier is smaller (width 10 km) than the Rennick (up to 25 km), a certain analogy of the geological history seems to be evident, first of all because of the parallelism.

However, the Matusevich Glacier area doesn't show any indication of a graben formation. It trends 170° totally straight for more than 100 km. For this reason, just a major fault (GAIR et al. 1969) has been assumed along the glacier. FLÖTTMANN & KLEINSCHMIDT (1991) verified a westward directed, 170° trending ductile thrust system at the upper Matusevich Glacier ("Exiles Thrust"), formed under amphibolite facies conditions and coeval with the Wilson Thrust, both making up a conjugated thrust system. They thought, that the Exiles Thrust caused the course of the Matusevich Glacier instead of GAIR's et al. (1969) postulated fault.

During GANOVEX VIII (2000), all small-scale structures at the margins of the Matusevich Glacier have been mapped. Strangely enough, only a few turned up, which are related to the Ross-aged, ductile Exiles Thrust. Most of the small-scale structures formed at cold and brittle conditions, i.e. they are relatively young. The most conspicuous and meaningful of these structures occur at the western side of the glacier (Lazarev Mts.): NW- to N-trending thrusts with slickensides, decorated with quartz fibres and uniformly SW-thrusting (-220°). These structures could be interpreted as indicators of transpressional tectonics forming a flower structure in the area of the Matusevich Glacier und they are consistent with strike-slip tectonics along the glacier. Unfortunately, fitting dextral strike-slip faults, which should strike about 170°, have not been observed directly. Even any other dextral strike-slip faults were found in the area only twice. But 30 km to the west, 160 to 165° trending strike-slip tectonics is exposed at the eastern edge of Outrider Nunatak. The attitude of lineations on steep fault planes is indicating dextral displacement. This strike-slip tectonics produced an excellent flower strukture visible in one of the main granite-walls of Outrider Nunatak. Thus the neo-tectonics of westernmost Oates Land (around 157°E, Matusevich Glacier and Outrider Nunatak) is characterized by brittle dextral strike-slip faulting, following the trend of a much older ductile thrust tectonics - like at the Rennick Glacier.

Two brittle dextral strike-slip fault zones of Oates and Victoria Lands (Matusevich/Outrider and Rennick fault zones) cross at high angle the coastline of Antarctica and coincide directionally roughly with offshore fracture zones, the active parts of which are the transform faults between Antarctica and Australia. These fracture zones mark dextral offsets of the Australian-Antarctic spreading ridges, but show sinistral kinematics in their active sections, of course. Do the dextral faults onshore represent the continuations of the fracture zones offshore? At a first glance, this seems to be absurd in principle. But 1) The shelf shows offsets where fracture zones reach Antarctica; But 2) Magnetic anomalies along Matusevich and Rennick Glaciers seem to continue offshore (DAMASKE et al. in press); But 3) There are examples of continuation of transform faults (fracture zones) into continental crust elsewhere (KUKOWSKI et al. 2000). Thus the following model seems to be plausible: Dextral strike-slip faults developed before separation of Australia and Antarctica in the realm of rifting of the continents. These faults are responsible for the dextral offsets of the later spreading centres. After beginning of spreading, the dextral strike-slip faults are used as transform faults, sinistrally in their active sections, of course.

Damaske, D., Ferraccioli, F. & Bozzo, E. (in press): Terra Antartica.
Flöttmann, T. & Kleinschmidt, G. (1991a): Geology 19: 45-47.
Gair, H.S., Sturm, A., Carryer, S.J. & Grindley, G.W. (1969): Antarctic Map Folio Ser. Fol.12: Pl. XII.
Kleinschmidt, G. (1992): Polarforschung 60: 117-120.
Kukowski, N., Schillhorn, T., Flueh, E.R. & Huhn, K. (2000): Geology 28: 355-358.
Läufer, A.L. & Rossetti, F. (2000): Terra Antartica Rep. 5: 77-80.
Roland, N.W. & Tessensohn, F. (1987): Geol. Jb. B66: 203-229.

A new bathymetric model for the Southern Ocean
(oral p.)

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Over the last years bathymetric information gained increasing importance for many kinds of marine sciences, e.g. as a basic knowledge to support marine geological sample location and sampling, to route oceanographic models, to understand topographically induced processes in the transition zone of the geo- and hydrosphere and as the spatial fundament for spot data regionalization and calculation of areal particle fluxes and budgets.

However, our effective knowledge about Southern Ocean bathymetry is still sparse and fragmentary. The existing global topographic or bathymetric data compilations, e.g. ETOPO5 and GEBCO are based on few source data sets in these remote and partly ice-covered regions. Moreover the data quality is often hard to estimate due to the lack of detailed metadata information. The spatial resolution of those global compilations may meet the demands of macro-scale scientific topics, though if it comes to questions of regional to local scales these coarse data sets can hardly be of value.

Nevertheless, during the last decades many countries fulfilled research and logistic missions around Antarctica collecting multifarious data describing the sea floor topography. Many regional bathymetries were produced on the basis of these surveys, e.g. the AWI Bathymetric Charts of the Weddell Sea (SCHENKE et al. 1998). Based on this existing but widespreaded bathymetric information a new circum-Antarctic Digital Terrain Model (DTM) should be derived. Sources include acoustic measurements (multibeam, single beam, etc.) and contours in existing bathymetric charts as well as marine gravity data and free air gravity models from satellite altimetry wherever no in-situ depths measurements are available.

The DTM resolution will vary in the range of one to several kilometers according to the kind, regional distribution and quality of the source data (e.g. multibeam bathymetry vs. sparse spot soundings). It will cover the Antarctic waters south of 60°S latitude. The DTM and respective metadata will be brought to the interested community via a user friendly web interface linked with the underlying geographic information and data base systems used for data collection, homogenization and analysis. Care will be taken to ensure comfortable data and metadata query and retrieval, thus satisfying the needs of the multidisciplinary user community.

The project work should be organized under the auspices of and in close cooperation with the Intergovernmental Oceanographic Commission (IOC), International Hydrographic Organization (IHO) and the Scientific Committee on Antarctic Research (SCAR). One targeted project outcome is a new "International Bathymetric Chart of the Southern Ocean" (IBCSO) comparable to the widely-used International Bathymetric Chart of the Arctic Ocean (IBCAO, JAKOBSSON et al. 2001) being part of the International Bathymetric Chart (IBC) program of the IOC.

Jakobsson, M. & IBCAO Editorial Board Members (2001): EOS Transactions 84.
Schenke, H.W., Dijkstra, S., Niederjasper, F., Schöne, T., Hinze, H. & Hoppmann, B. (1998): Antarctic Res. Ser. 75: 371-380.

Rayleigh wave group velocity distribution in the Antarctic Region
(poster p.)

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Analyzing surface waves is a very suitable way to investigate the seismic structure beneath the Antarctic region. In this study, we determined 2D group velocity distribution of Rayleigh waves at periods of 20-150 s in the Antarctic region using a tomographic inversion technique. The data are recorded by both permanent networks and temporary arrays.

Group velocities of Rayleigh waves are measured by using the multiple filter technique (DZIEWONSKI et al. 1969) with correction for systematic errors from the distribution of the input spectrum amplitude (SHAPIRO & SINGH 1999). Then the group velocity distribution is estimated by using a tomographic inversion technique of BARMIN et al. (2001). The blocks are defined according to latitude and longitude. The block size is five degrees. Since the interval between the longitudinal lines becomes much shorter in the polar region, the target region is shifted to the equator area. Thus the aspect ratios of the blocks in Antarctica are well improved.

In East Antarctica, the velocities are high at periods of 90-150 s, suggesting that the root of East Antarctica is very deep. On the other hand, the velocities in West Antarctica are low at all periods, which may be related to the volcanic activities and the West Antarctic Rift System. Low velocity zones appear at periods of 40-140 s around the Southeastern Indian Ridge and the western part of the Pacific Antarctic Ridge, but the velocities are not so low around the Atlantic Indian Ridge, Southwestern Indian Ridge, and eastern part of the Pacific Antarctic Ridge, where the spreading rates are small. A low velocity anomaly is not visible around the Australian-Antarctic Discordance, where the upper mantle is considered to be cold. Around two hotspots, the Mount Erebus and Balleny Islands, a peak of low velocity appears at periods of 50-150 s.

Barmin, M.P., Ritzwoller, M.H. & Levshin, A.L. (2001): Pure Appl. Geophys. 158: 1351-1375.
Dziewonski, A., Bloch, S. & Landisman, M. (1969): Bull. Seism. Soc. Amer. 59: 427-444.
Shapiro, N.M. & Singh, S.K. (1999): Bull. Seism. Soc. Amer. 89: 1138-1142.

When and how did the early Weddell Sea develop ?
(oral p.)

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Models about the early break-up of Gondwana and the development of the Weddell Sea have been subject of detailed research since many years. Due to the lag of unequivocal, detailed high resolution data these models were not very well constrained and resulted in controverse scenarios in terms of timing and geometry.

The results of EMAGE (East Antarctic Margin Aeromagnetic and Gravity Experiment), an aeromagnetic database comprising of more than 90000 km of closely spaced (ca. 10 km) flight lines, acquired during the years 1996-2002, led to a new detailed model for the early break-up of Gondwana in the Weddell , Lazarev and Riiser-Larsen seas.
The resulting high resolution magnetic anomoaly grid for the Weddell and Lazarev Sea shows a continuous sequence of coast parallel seafloor spreading anomalies off western Dronning Maud Land

(DML) covering the period from chron C34N to M16N. The magnetic anomaly grid for the Riiser-Larsen Sea shows a sequence which can be identified from M0 to M24N. Thus, the first generation of oceanic crust off DML occurred in late Jurassic times some 155 Ma ago in the Riiser-Larsen Sea. The initial opening in the western Weddell Sea is still not known, but most likely happened also in the late Jurassic. The different spreading velocities and directions of South America and Africa resulted in the creation of the first oceanic crust in the South Atlantic at chron M9N.

Helicopter and ship borne magnetics from the central and western Weddell Sea off the Antarctic Peninsula acquired in the austral summer 2002, could be used to extend and densify existing data sets from the USAC (US-Argentina-Chile) experiment (1985-1989) and marine trackline data from the National Geophysical Data Center, Boulder, Colorado (NGDC) in this region.

The results from a combined processing and interpretation of these data could be linked with the magnetic anomaly grid for the eastern Weddell Sea and identifications used for the break-up model off DML could be transferred to the western Weddell Sea. This allows the connection and reinterpretaion of previous studies with the newly dated anomalies. The pronouced anomalies for chrons C34 and M0 can be traced along a track from 45°W to 10°W. Earlier identifications, clearly visible off DML, are more difficult to pick further in the west and terminate somewhere between 20°W and 35°W.

The new magnetic compilation for the Weddell Sea and its interpretaion will be presented and compared with recently published models for the early break-up of Gondwana.

Geodynamic model for the Weddell Sea using aeromagnetic and palaeomagnetic data
(EANT workshop p.)

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The results of a new aeromagnetic compilation for the Weddell , Lazarev and Riiser-Larsen Sea, joining the EMAGE (East-Antarctic Margin Aeromagnetic and Gravity Experiment, JOKAT et al. 2003), USAC (US-Argentina-Chile, LABRECQUE et al. 1989) and shipborne magnetic data from the NGDC (National Geophysical Data Center, Boulder, Colorado), give refined constraints on the early development of the Weddell Sea and adjacent areas during the initial stages of Gondwana break-up.

Clear coast parallel sea floor spreading anomalies off the west coast of Dronning Maud Land and another pattern of clearly discernible spreading anomalies in the Riiser-Larsen Sea could be used for magnetic modelling. This led to a well constrained age model from the beginning of seafloor spreading in the Riiser-Larsen Sea at ca. 155 Ma and the eastern Weddell Sea at about 144 Ma to the final separation of South America from Africa about 130 Ma ago. The linear trend of the magnetic anomalies together with their detailed age determination allowed the calculation of new rotation poles for the times when Antarctica and Africa began to drift away from their Early Jurassic position within Gondwana and South America and Antarctica separated through the opening of the Weddell Sea.

For the Early Jurassic no constraints on the position of East- and West-Gondwana (Antarctica, Madagascar, India, Australia and South America, Africa) and the West Antarctic microplates (Antarctic Peninsula - AP, Ellsworth-Withmore Mountains block,Thurston Island block, Mary Byrd Land) can be derived from magnetic seafloor spreading anomalies since no ocean floor exists from this period. For these times palaeomagnetic pole positions give the best information about palaeogeography.

Palaeomagnetic poles from GRUNOW (1993, 1999) show relative movements of the Antarctic Peninsula and the other West-Antarctic microplates just prior and during the early opening of the Weddell Sea. In these models the AP forms the southern continuation of the Permo-Triassic subduction zone of South America. With partly large movements of the different blocks between 200 Ma and 130 Ma. The model presented by JOKAT et al. (2003) based on mainly aermagnetic data suggests a far southerly position of South America for this period with the AP beeing fixed to the East Antarctic craton.

An advanced model will be presented combining the results based on dating of magnetic seafloor spreading anomalies and palaeomagnetics and trying to adjust the different views of the early history of Gondwana break-up and the development of the Weddell Sea.

Grunow, A.M. (1993): Creation and destruction of Weddell Sea floor in the Jurassic.- Geology 21: 647-650.
Grunow, A.M. (1999): Gondwana events and palaeogeography: a palaeomagnetic review.- J. African Earth Sci. 28: 53-69.
Jokat, W., Boebel, T., König, M. & Meyer U. (2003): Timing and Geometry of Early Gondwana Break-Up.- J. Geophys. Res. (in press).
LaBrecque, J.L., Bronzena J., Parra, J.C., Keller, M.A., Haxby, W., Raymond, C.A., Kovaks, L., Bell, R., Yanez, G., Peters, M., Cande, S. & Valladares, J. (1989): USAC Aerosurvey Results for the Weddell Basin: Part I. 28th International Geological Congress, Washington, DC.

Subduction related dyke systems of the South Shetland Islands, West-Antarctica: tracing geodynamic history combining structural, geochemical and isotopic data

(oral p.)

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Even though often disregarded, magmatic dykes are essential components of volcanic arcs, penetrating the host rocks following joints and fracture zones. Thus, they reflect the tectonic as well as the magmatic parameters at the time of their intrusion.

Subduction related volcanic activity on the South Shetland Islands began about 130 Ma ago (HATHWAY & LOMAS 1998) and did not cease before Middle Miocene. Rocks related to the volcanic arc are exposed on this island group over a length of 300 km parallel to the Antarctic Peninsula. Several changes of subduction direction between Upper Cretaceous and Lower Tertiary times may have caused changes of the tectonic regime in the overlying Antarctic Peninsula (MCCARRON & LARTER 1998). Between Mid and Late Eocene (49-34 Ma) the northern Antarctic Peninsula and southern South America underwent extensional tectonics, which led to sea-floor spreading in the Drake Passage c. 28 Ma ago. Spreading occurred at this ridge until c. 7 Ma ago. Subsequent slab-roll-back caused arc-extension and the opening of the Bransfield Rift as a backarc-basin between 4 and 1.3 Ma. Therefore, the South Shetland Islands as an autonomous block exist only since that time. Very slow subduction (1 mm/a) at the South Shetland trench and extension of c 11 mm/a in the Bransfield Rift continue until the present day. However, extensive joint measurements carried out within this project indicate at least on Hurd Peninsula (Livingston Island) a rather monotonous tectonic situation during the time of dyke intrusion. All these dykes are probably of Tertiary age, as indicated by uppermost Cretaceous nannofossils found in the turbiditic host rock (STOYKOVA et al. 2002). The different strike directions of the dyke sets are possibly due to minor changes of the tectonic stress field, which produced dextral and sinistral 1st- and 2nd-order shear joints of the main and secondary folding phase and rarely h0l-joints.

On King George Island (KGI) and Livingston Island (LI) several dyke systems were mapped in areas of up to 100000m^2, with the outcrop situation being good enough to observe many relative age relationships directly, permitting the construction of a genealogical diagram of the dykes. On Hurd

Peninsula (LI), evidence was found for 7 tectonic phases using four different directions, and six intrusive events. With one exception, the tectonic phases parallel perfectly the intrusive events.

ICP-MS geochemical analysis on 132 dykes of the South Shetland Islands show, as expected, that the majority of them correspond to a typical subduction-related calcalcalic suite, ranging from basalts to rhyolites. Nevertheless, some dykes have a shoshonitic composition and are possibly related to an early stage extensional crustal regime. This is supported by the relative ages observed in the field, indicating, that these dykes are the oldest ones outcropping in the investigated area. Another exceptional dyke shows adakitic characteristics, being a hint on the involvement of partially molten subducted oceanic crust.

In several areas (e.g. Potter Peninsula, KGI, and Hurd Peninsula, LI) a strong correlation between composition and strike of the dykes - and therefore tectonic regime and age - is observed. Ce/Pb, Ce/Y, Zr/Hf and also some Ba/HFSE ratios have been used as a powerful means to distinguish the different intrusive events.

The results prove the good suitability of magmatic dyke systems to trace the change of geodynamic parameters over time and space. Present work includes extensive isotope geochemical analysis (Sr, Nd, Pb) to get hints on the mantle source and its possible changes, as well as the sediment input into the subduction zone. Preliminary Nd-isotope data indicate that the magma source did not change during the time of dyke intrusion.

Hathway, B. & Lomas, S.A. (1998): Cret. Res. 19: 43-67.
McCarron, J.J. & Larter, R.D. (1998): J. Geol. Soc. London 155: 255-268.
Stoykova, K., Pimpirev, Ch. & Dimov, D. (2002): J. Nannoplankton Res. 24 (2): 166-167.

Post-Jurassic Antarctic fish diversity patterns
(oral p.)

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The modern fish fauna of the Southern Ocean is striking in its low diversity and highly endemic teleostean fauna. Only about 1.3 % of the world's fish fauna occurs in Antarctic waters although the Southern Ocean forms about 10 % of the world's ocean surfaces. About 55 % of all benthic and demersal fishes belong to the notothenioids (Perciformes). These fishes are peculiar in that they have no fossil record (apart from a questionable identification) and that their evolutionary history and relationships are far from being understood. Based on molecular analyses it is assumed that the average age of radiation is approximately 3.4 my indicating that speciation occurred during periods of partial deglaciation. Gadiformes ("cods") are present with only five families. The evolution of the distinct modern Antarctic fish fauna might be related to low temperatures, isolation, habitat loss, and climatic cycles of Antarctica due to the break-up of Gondwana.

The post-Jurassic local and beta diversity of Antarctic fish is analysed based on literature data and material from Alexander Island (Early Cretaceous), James Ross and Seymour Island (Late Cretaceous, Palaeogene), and from drilling-cores (Cenozoic). The diversity of Cretaceous fishes is highest in the Campanian being related to the Campanian thermal optimum and the opening of trans-equatorial seaways.

Eocene strata of Seymour Island have yielded the most divers fish fauna of Antarctica so far. The diversity of these assemblages is analysed for every stratigraphic level (Telms 1-7) based on new data and in relation to depositional environments and climatic conditions. Striking is the predominance of a single lamniform shark taxon in all levels and associations. The overall fish diversity is very low in Telm 1 when low-energy and/or protected environments (lagoon/estuarine) persisted in seasonal climatic conditions until the middle Eocene. The highest diversity is found in Telms 4 and 5 when the climate changed to strongly seasonal and cool-temperate and coincides with a "polytaxic period" indicated by a remarkable increase in species diversity of many other oceanic groups. The selachian beta diversity is rather low compared to other localities of the same age and the taxonomic composition is remarkably mixed. Striking is the first appearance and last appearance of some cosmopolitan selachian taxa in the La Meseta fauna. Selachians are rare in Telm 5 and no remains have been found in Telms 6 and 7 although actinopterygian remains as well as bones of whales and penguins are abundant in the upper parts of the La Meseta Formation.

The diversity of teleosts is highest in the Palaeogene. In the Pliocene, the diversity of teleost shows strong local perturbations. The diversity of Gadiformes has not changed since the late Pliocene.

Geophysical Investigation on the Princess Elizabeth Margin-new data from 2003 season

(poster p.)

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About 4200 km of multi channel seismic (MCS), gravity and magnetic data as well as 10 sonobuoys have been acquired on the Princess Elizabeth margin and southern Kerguelen Plateau (between 76- 89°E) with RV "Akademik Alexander Karpinsky" in 2003. In this season, unlike previous year, new seismic equipment which included a 3000 m long, 240-channel digital streamer and a msx-6000 recording system (I/O Inc.) was used. New data supplemented the huge geophysical data set (more than 15 km of profiles) obtained by Russian Antarctic Expeditions in Cooperation Sea and Elizabeth Trough during 1986-1996. MCS data with greater depth penetration of acoustic waves and resolution of seismic section (in comparison with previous research) give a chance to understand better the tectonic and depositional history of this region. Based of new and all available data several maps have been compiled, which include: depth to the basement, thickness of sediments, magnetic and gravity anomaly maps, tectonic map.

Patterns of biogenic and terrigenous sedimentation: a record of Late Quaternary climate and environmental changes in the Antarctic Zone of the South Atlantic

(poster p.)

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High-resolution sediment sequences were recovered during Leg 177 of the Ocean Drilling Program on a transect across the frontal system of the Antarctic Circumpolar Current (ACC). Sediment cores from the Antarctic Zone of the ACC were taken at Sites 1093 and 1094. Site 1093 is located south of the present Polar Front at 3626 m water depth. More to the south, Site 1094 is situated north of the Weddell Gyre/ACC-Boundary in a small basin north of Bouvet Island at 2807 m water depth. Today both sites lie outside mean winter sea ice coverage. Both sediment records document a depositional setting within the circum-Antarctic opal belt and permit high-resolution inferences of climate-induced environmental changes during the last 700 kyr on both Milankovitch and sub-Milankovitch time scales. Some of these changes may be correlated with climate signals documented in the Vostok ice core.

Diatom oozes dominate both sediment records that were deposited at high sedimentation rates of ~25 cm per kyr at Site 1093 and ~14 cm per kyr at Site 1094. They document a high biosiliceous export production and good preservation of biogenic opal. Temporal variations in the amount and the accumulation rates of biogenic opal show maxima during interglacial periods and minima during glacial periods. Variations in total organic carbon (TOC) exhibit maxima during glacial periods. The glacial pattern possibly reflects expanded sea ice coverage that reduced algal growth, while increased preservation of organic carbon may indicate poorly ventilated bottom waters.

The contents of biogenic carbonate also show glacial/interglacial variations, pointing to cyclic changes in both biological production of calcareous organisms and, more likely, the depth of the lysocline that is controlled by the distribution of corrosive bottom water masses. Carbonate contents reached values up to 80% during warm climate optima at the northern Site 1093 (MIS 11), while only maximum values of up to 12% were reached at the southern Site 1094. This north-south gradient in carbonate preservation reflects the temporal variability of North Atlantic Deep Water (NADW) inflow. At both sites, carbonate-free sediment intervals give evidence of the dominance of corrosive southern hemisphere water masses during cold climate periods. In turn, enhanced carbonate preservation during warm stages reflects the presence of NADW, particularly at the northern Site 1093.

High accumulation rates of terrigenous matter, mainly related to the supply of fine-grained material, are associated with glacial periods, indicating increased glacigenic sediment supply from Antarctica and increased current speeds and particle fluxes in the ACC.

Pleistocene millennial-scale climate variability from the Atlantic sector of the Southern Ocean based on diatoms

(poster p.)

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Diatom assemblages from ODP Leg 177 sites 1093 and 1094 were analysed in order to reconstruct the climate development during the past 640,000 years, as reflected by summer sea surface temperature (SSST) and sea ice distribution. Site 1094 (53°10.8'S, 5°7.8'E, 2807 m water depth) is situated south of the Polar Front in the southern part of the ice-free Antarctic Zone whereas site 1093 (49°58.58'S, 05°51.92'E, 3624 m water depth) is located north of Shona Ridge near the present-day position of the Polar Front. Summer sea surface temperatures were estimated using the transfer function technique of Imbrie and Kipp, while the presence of seasonal winter sea ice was reconstructed based on the occurrence of diatom sea ice indicators (*Fragilariopsis curta* and *F. cylindrus*).

The high temporal resolution climate records show between Marine Isotope Stage (MIS) 16 and 12 cold SSST values and low temperature fluctuations. At the MIS 12/11 boundary, ca. 420,000 years ago, a distinct shift to marked glacial and interglacial temperature changes (MIS 11 to 1) is observed. This significant climate change, the so-called Mid-Brunhes Event was a global phenomenon, which was forced by the orbital eccentricity.

Particularly during the temperature optima of MIS 11, MIS 9, MIS 7, MIS 5 and MIS 1 the reconstructed SSST values exceeded the modern summer sea surface temperatures by 1-4°C. The climate optimum of both, MIS 11 and 9, have been encountered to represent the warmest periods during the Middle and Late Pleistocene.

The Terminations V to I are characterized by a stepwise temperature rise up to 4-6°C punctuated by one or two cold reversals. The structure of these temperature rebounds is comparable to cooling events such as the Antarctic Cold Reversal in the southern and the Younger Dryas in the northern hemisphere at Termination I. Significant climate changes occur at the Terminations within 2,000-3,000 years. The SSST maxima during the Terminations are associated with very high sedimentation rates pointing to increased export production of biogenic opal.

High relative abundance of sea-ice diatoms during the glacials indicate that the present-day ice free Antarctic Zone was seasonally covered by sea ice. Clearly marked fluctuations of these sea-ice indicators during the glacials indicate the presence of millennial-scale climate instabilities in the Southern Ocean. Comparable millennial-scale oscillations, the so-called Dansgaard-Oeschger cycles have been found in continental ice and marine records from the northern as well as from the southern hemisphere.

Seismic expression of deep-marine deposits attributed to glacial sediment flux in the Riiser Larsen Sea, East Antarctica

(oral p.)

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A prominent reflector (reflector RLS-4) that can be mapped over the entire lower continental slope and abyssal plain in the Riiser Larsen Sea is interpreted to represent the base of glaciomarine deposits (Fig. 1). This reflector marks the transition from parallel/subparallel reflectors below to a much more varied seismic reflection pattern above, representing several different types of facies. The sedimentation appears to have involved a combination of down-slope and alongslope currents, including large channel-levee complexes and sediment ridges. Eastward migration of channels resulted in asymmetrical and strongly oblique channel-levee complexes.

The Gunnerus Ridge, considered a remnant of continental crust that stretches 400 km northward of the adjacent continental margin, forces contour currents to flow along its slope, and hence the majority of contourite deposits occur along this structure. Giant sediment ridges occur also on the abyssal plain of the Riiser Larsen Sea.

The glaciomarine deposits are attributed to the advances of the East Antarctic Ice Sheet, which has delivered huge amounts of sediment to the shelf edge and upper slope at times of glacial maxima. Instability generated slumping and debris flows, and the slump scars probably evolved into large turbiditic channels leading to channel-levee systems. The sedimentation probably occurred during both glacials and interglacials, but the turbidity currents predominated during glacial maxima.

The seismic signatures of deposits in this area have been compared with data from other East Antarctic margins such as the Weddell Sea and Prydz Bay, as well as published data from the Wilkes Land margin.

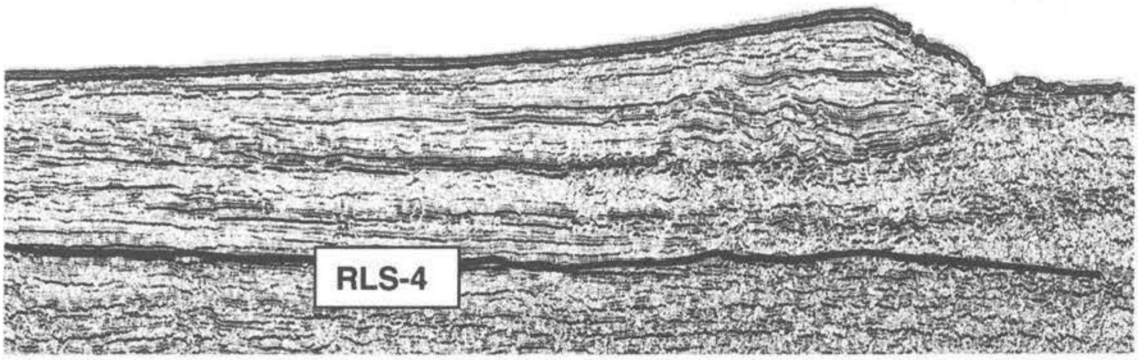

Fig. 1: Example of a large contourite deposit on the Riiser Larsen Sea abyssal plain

Regional interpretation of glaciomarine sediments along the East Antarctic continental margin
(EANT workshop p.)

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As yet, there has been no section drilled on the continental slope or rise in Antarctica that clearly spans the transition from preglacial to glacial conditions. This study focus on the presumed glaciomarine sediments along the East Antarctic margin, based on available DSDP and ODP results and seismic interpretations from the Weddell Sea, off Prydz Bay, the Riiser Larsen Sea, the Cosmonaut Sea and published data from the Wilkes Land margin.

Characteristic of the presumed glaciomarine sediments in the Weddell Sea and Prydz Bay are development of large scale deep-sea fans, each consisting of major channel-levee complexes, although the Prydz Bay sequences also record a number of large drift deposits (KUVAAS & KRISTOFFERSEN 1991, KUVAAS & LEITCHENKOV 1992). In the Weddell Sea, the base of the large fan systems was termed W4 by a tentative correlation to Site 693 of ODP Leg 113 on the eastern Dronning Maud Land margin (KUVAAS & KRISTOFFERSEN 1991). Here W4 represents a major Albian-early Oligocene unconformity, and the occurrence of dropstones in sediments of early Oligocene age led to an interpretation of a transition from preglacial to glacial conditions associated with this unconformity. Off Prydz Bay, the base of the thick sediment prism containing channel/levee systems and contourites was termed P1 and interpreted as the base of glaciomarine sediments (KUVAAS & LEITCHENKOV 1992). Site 1165 of ODP Leg 188 drilled through the upper 999 m of the Wild Drift, encountered glaciomarine sediments of early Miocene to Pleistocene age, but the unconformity was not penetrated.

Seismic stratigraphic interpretations from the Wilkes Land margin also points to increased turbidite deposition after the development of an unconformity which in this area has been termed T (EITTREIM & SMITH 1987, HAMPTON et al. 1987), U3 (WANNESSON 1991) and WL2 (TANAHASHI et al. 1994). WL2 is an erosional surface on the shelf and is interpreted to mark the onset of glacial conditions in this area (EITTREIM et al. 1995). The inferred time for the formation of unconformity WL2 is Eocene, on the basis of indirect correlation with DSDP 269 (EITTREIM et al. 1995, WANNESSON 1991).

When comparing new seismic profiles from the Riiser Larsen Sea and the Cosmonaut Sea with the Weddell Sea, Prydz Bay and Wilkes Land margins, we observe several similarities including a correlative base of turbiditic and contouritic sediments. We propose that this boundary, termed RLS-4 (Riiser Larsen Sea) and CS-4 (Cosmonaut Sea) correlates to W4 (Weddell Sea), P1 (Prydz Bay) and T/U3/WL2 (Wilkes Land).

In this study, we demonstrate that all examined margins have a typical change in reflection pattern from a lower sequence showing parallel-subparallel reflectors to an upper sequence consisting of turbidites and contourites. The observed change in reflection pattern, and its apparent correlation to a change from preglacial to glaciomarine environment although still not precisely defined by drilling, suggest a change in depositional environment resulting from an increased input of sediments to the continental slope due to glacially influenced processes.

Eittreim, S.L. & Smith, G.L. (1987): CPCEMR Earth Sci. Ser. 5A: 15-43.
Eittreim, S.L., Cooper, A.K. & Wannesson, J. (1995): Sedimentary Geology 96: 131-156.
Hampton, M.A., Eittreim, S.L. & Richmond, B.M. (1987): CPCEMR Earth Sci. Ser. 5A: 75-87.
Kuvaas, B. & Kristoffersen, Y. (1991): Marine Geology 97: 345-362.
Kuvaas, B: & Leitchenkov, G. (1992): Marine Geology 108: 365-381.
Tanahashi, M, Eittreim, S.L. & Wanneson, J. (1994): Terra Antarctica 1: 391-393.
Wannesson, J. (1991): AAPG, Studies in Geology 31: 77-87:

Monitoring volcanic activity at Mount Erebus, Antarctica
(poster p.)

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Mount Erebus, Ross Island is the most active volcano in Antarctica. Monitoring of the on-going volcanic activity has been undertaken since 1995 by the Mount Erebus Volcano Observatory (MEVO) with support from the Office of Polar Programs, National Science Foundation. The primary tools used to monitor the activity include seismic, infrasonic, deformation, video and measurement of gas emissions. In this presentation we will review the various data collected over the last four years and discuss the nature and consequences of the on-going activity.

The activity of Erebus makes it an ideal laboratory to study the dynamics of small strombolian eruptions which occur from the actively convecting phonolite lava lake and adjacent vents within the centrally-located summit crater. In recent years the number of eruptions has declined from the typical 2-6 observed per day to only a few per week. The cause of the change is unknown. The lava lake has remained unchanged in position and size for the last four years. A new small lava pool developed on the south side of the Inner Crater and in January 2001 was observed to issue a small lava flow. Several new ash vents developed at sites once occupied by small explosion craters in the 1970's. Volcanic tremor which has rarely been observed at Erebus has shown a dramatic increase in frequency over the last two years. The tremor is of some concern as at other volcanoes it can be a precursor to eruptive activity. The tremor and several other lines of evidence suggest that the magma system at Erebus is possibly being recharged by more basic magma.

We installed five integrated geophysical observatories during the 2002-2003 field season at elevations ranging from 2100 to 3700 m. Each observatory is powered by AGM lead-acid storage batteries, charged by solar panels and wind generators. We hope to have sufficient power to run the observatories all year-round. Current instrumentation includes five Guralp 40T broadband seismometers with digitizers, five continuous Trimble dual frequency GPS receivers, a video camera, three infrasonic sensors, two infrared radiometers, three tiltmeters, assorted temperature sensors, voltage and amperage sensors and various meterological instruments. The data, including digital BINEX output from the GPS, are multiplexed and telemetered to McMurdo Station in time-stamped packets using the Guralp digitizer and 900 MHz Freewave spread-spectrum data links. At McMurdo, the telemetered data are acquired using Guralp Scream and USGS Earthworm protocols and then buffered and simultaneously exported to NM Tech over the internet. The BINEX data from the GPS are exported daily to both UNAVCO and NMT. From NMT, earthworm data streams are reexported to the IRIS Data Management Center for backup archiving. Additional monitoring instrumentation includes six short period (1 sec) vertical component seismometers and three continuous single frequency (L1) GPS receivers which are also telemetered to McMurdo. Records for all the instrumentation can be viewed in near real time at the MEVO web site http://www.ees.nmt.edu/Geop/Erebus/erebus.html.

Subalcaline polyphase pluton of mount Collins, Prince Charles Mountains: the latest studies results

(poster p.)

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The Mount Collins is located in the central part of the Prince Charles Mountains and composed granitic and syenitic intrusive rocks. Coordinates of central mount are 71°30'S and 66°42'E. There are have been preliminary studies in the 1989 year by Soviet geologists and in the 1991 year by the Australian geologists. The preliminary U-Pb isotopic ages for syenites are 854-1400 Ma (MIKHALSKY et al. 1992). The isotopic ages by SHRIMP for a syenite and granite rock is showed for both same boundaries, about 980 Ma (KINNY et al. 1997).

By the our results of the geological studies in 2000 year the pluton of Mt. Collins ("Collins pluton") is defined as subalcaline polyphase pluton, formed in Middle Proterozoic time in orogenic(?) conditions. By the aeromagnetic data, the size of pluton is 5 x 14 km, the exposed part (Collins mount) reach 2 x 11 km size. We are determined five intrusive phases and the variables late dyke complex. The intrusive phases include 1) diorite and syenodiorite; 2) monzodiorite; 3) syenites and quartz syenite; 4) granites; 5) subalcaline gabbro (syenogabbro). The dyke complex is divided into six groups: trachydolerite-I; monzodiorite-I; trachydolerite-II; trachydolerite-III; monzodiorite-II; trachydolerite-IV. Is determined compositional (genetic) affinity as within them intrusive phases as between intrusive phases and vein groups. There are distinguished three related series of rocks: 1) diorite - monzodiorite - syenite - quarz syenite; 2) subalcaline gabbro - trachydolerite-I - trachydolerite-III - monzodiorite-II; 3) trachydolerite-II - trachydolerite-IV.

The schist-gneissic rocks in the Mt. Collins are divided too. It is outcropped in intrusive pluton as xenolithic blocks and obviously the part of country frame of Collins pluton. It is consist of three litological types of rocks: (pyroxen)-biotite-amphibole schist, biotite-amfibole mafic gneisses (majority) and biotite-amfibole gneisses. The investigations are shown that igneous and others rocks of Mt. Collins were undergone by three stages of the metamorphism under conditions of amfibolite and greenschist facies. The five stages of the tectonic deformations, include two stages of folding, were reconstructed.

By the U-Pb zircon (isochronal) dating the certain age of first intrusive phase is 1247 ±8 Ma, age of fifth intrusive phase is 1219 ±3 Ma, and age of dykes monzodiorites-II is 1119 ±3 Ma. Taking as basis obtained isotopic ages and account previous investigations, have been proposed following age model of formation and transformation polyphases Collins pluton. 1) It is forming metavolcanic (?) schist-gneissic sequence, earlier deformations and amphibolite facies metamorphism, pre 1250 Ma; 2) Intruding igneous (magmatic) phases, 1250-1220 Ma; 3) Intruding vein groups, about 1120 Ma; 4) Last deformation and last amphibolite facies metamorphism (including metasomatic alterations), 980-880 Ma.

Mikhalsky, E.V., Andronikov, A.V. & Belyatsky, B.V. (1992): In: Recent progress in Antarctic Earth Sciences: 173-178.
Kinny P.D., Black L.P. & Sheraton J.W (1997) AGSO Journ. 16: 637-654.

Main geological features of the Prince Charles Mountains region by results of Soviet (Russian) geological investigations in the 1970-2000 years

(oral p.)

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In our understanding the Prince Charles Mts. region unites all the mountain exposures on both sides of the Lambert Glacier and Amery Ice Shelf. Mesozoic-Cenozoic rift system, intersects the Precambrian oldest sublatitudinal geologic structures of the crystalline basement now. The Vestfold Block on the northeast is a representative of northern Archean high grade metamorphosed protocraton. Archaean-Paleoproterozoic Ruker granite-greenstone terrain in the south represents low-grade metamorphosed protocraton. Proterozoic Wegener-Mawson polymetamorphic Mobile belt divides the protocratons. It consists of distinct structural zones or terrains: Rayner, Beaver, Fisher, Lambert, Rauer and Grove. The evidences of the Fisher zone forming in the convergent (island arch) conditions in Grenville times are determined by Laiba and Mikhalsky. Rauer and Lambert terrains of Mobile belt are adjacent to protocratons. Interior terrains of mobile belt are formed in the Mesoproterozoic partly from the substance of nearest protocratons (paragneisses of Prydz and Beaver areas) and from newformed materials from mantle and low crust. In the so-called Grenville time about 1000 Ma ago they had significant transformation, including high-grade metamorphism, migmatisation, active and repeated folding, intrusion of various granitoides. Late tectono-thermal event was related to the so-called Pan-African orogeny which taken place 550-500 Ma ago. It is displayed as local metamorphism from greenschist to granulite facies, brittle deformations and "younger" granitoides. It has been very strongly affected Prydz, Rauer and Grove terrains. Ancient Ruker protocraton is partly affected by both intensive Proterozoic and Early Palaeozoic regional events.

Brittle structural architecture of the Lambert Glacier area, southern Prince Charles Mountains, Antarctica: a preliminary report

(poster p.)

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The Lambert Rift (LR) is one of the major crustal structures in East Antarctica. It is interpreted as a failed rift that runs approximately 700 km from Prydz Bay into the Antarctic continent. The formation of the LR is generally attributed to the break-up of Gondwana and the separation of India and Antarctica starting around 130 Ma ago. The continental crust in the centre of the LR is thinned out from an original thickness of 35-40 km to approximately 25 km. The depocentre is filled with 5-10 km thick sediments. The LR represents a typical half graben with rather complicated internal structure. The Phanerozoic rifting processes in the LR are generally interpreted to be the main reason for uplift and erosion of the southern Prince Charles Mountains (PCM). One of the major aims of the Prince Charles Mountains Expedition of Germany and Australia (PCMEGA) in the austral summer 2002/03 was focused on brittle deformation events linked to the development of the Lambert Rift (LR). We present preliminary results on the brittle structural architecture of the Lambert Glacier region in the southern PCMs. The structural data were collected in different subareas covering a wide variety of litho-tectonic units. These subareas were in particular: (i) Mt.. Stinear / Mt.. Rymill, (ii) Rofe Glacier (northern Mawson Escarpment), (iii) Cumpston Massif, (iv) Tingey Glacier (southern Mawson Escarpment), (v) Mt.. Ruker / Mt. Rubin. At present stage, the data on brittle deformation point to an at least two-fold tectonic history in the area of the LR. The data point to the presence of two subsequent conjugate strike-slip systems with the maximum horizontal palaeostress directions oriented roughly perpendicular to each other. The older of these systems is likely responsible for large-scale right-lateral offsets along the Mawson Escarpment. These offsets in the order of at least 50-60, possibly reaching approximately 100 km, displace the older inherited Precambrian to Early Palaeozoic structural and metamorphic features in the southern PCMs. Approximately E-W directed extension along roughly N-S trending faults may be linked to this system. At this stage, this event is tentatively related to the Cretaceous break-up history of Gondwana in the Indian-Antarctic sector. The younger system parallels the orientation of some tributary glaciers of the Lambert Glacier system and thus plays a geomorphologic role in the southern PCMs. For instance, WNW-ESE trending glaciers (e.g. between Mt. Ruker and Mt. Rubin) follow normal faults indicating roughly NE-SW directed extension located in the extensional sector of the observed younger strike-slip system. Similarly, WSW-ENE trending glaciers (e.g. Rofe Glacier in the northern Mawson Escarpment) follow right-lateral faults of the system.

Late-orogenic structures in the Wilson Terrane and the western front of the Ross Orogen in northern Victoria Land, Antarctica

(oral p.)

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The geology of northern Victoria Land (NVL) is characterized by three lithotectonic units (W to E: Wilson, Bowers, Robertson Bay terranes). They formed during W-directed subduction associated with magmatic growth and accretion at the palaeo-Pacific active margin of Gondwana during the Early Palaeozoic Ross Orogeny. The Wilson Terrane consists of polyphase metamorphic rocks and late- to post-kinematic Cambro-Ordovician Granite Harbour Intrusives. Remarkably, post-Precambrian (IRELAND et al. 1999) low-grade metasedimentary rocks with occasionally well preserved sedimentary structures neighbour high-grade metamorphic to migmatitic units with locally granulite-facies relics. The low-grade rocks could constitute the former sedimentary cover of a pre-Ross passive margin cratonic basement (FANNING et al. 1999) or the high- and low-grade units represent different crustal sections of the Ross active margin separated by major crustal shear zones (FLÖTTMANN & KLEINSCHMIDT 1991). A general problem of the Early Palaeozoic geology of NVL and adjacent regions is the exact location and the character of the western boundary of the Ross Orogen towards the Proterozoic East Antarctic Craton (EAC). It could involve (i) W-directed thrusts with or without a molasse basin (e.g. the 500 km wide Wilkes Basin as one possibility), (ii) a former back-arc basin somewhere in Oates and/or George-V-Land, or (iii) a continuous transition with gradually decreasing Ross-age deformation. Aeromagnetic and structural data from Oates Land show that a prominent anomaly paralleling the Matusevich Glacier coincides with late-Ross W-directed thrusts which displace rocks of different crustal origin (Exiles Thrust: FLÖTTMANN & KLEINSCHMIDT 1991). The craton-orogen boundary may thus be located within or W of Matusevich Glacier. In a southern projection of Matusevich Glacier, the Central Victoria Land Boundary represents another prominent anomaly W of Priestley Glacier and is suggested to coincide with the Ross Orogen-EAC boundary (FERRACCIOLI & BOZZO 1999). To gain new hints on nature and location of this boundary, we performed structural analyses of ductilely deformed metamorphic and magmatic rocks of the Wilson Terrane in the Rennick Glacier area in NVL. The polymetamorphic and magmatic basement of the easterly located Lanterman Range shows top-to-E/-NE directed sense of shear compatible with W-directed subduction of the palaeo-Pacific Ocean. No indication of late-stage high-grade overprint of the Granite Harbour Intrusives was found. In contrast, locally solid-state foliated Granite Harbour Intrusives and metamorphic rocks of the northern Morozumi Range and in the westerly located southern Daniels Range-Emlen Peaks-Outback Nunataks area reveal opposite-directed ductile shear zones. High-grade metamorphic and migmatititc rocks are thrust W- and E-ward over low-grade metasedimentary rocks and shallow-level granitic intrusions. Synkinematic sillimannite growth in the strongly localized shear zones indicates high-grade deformation temperatures. Co-genetic E-vergent and W-vergent folds overprint the metasedimentary country rocks and Granite Harbour pegmatites. Younger dykes and the post-Ross cover rocks remained unaffected by folding or ductile shear. This attests a late-Ross age for the structures. The different fault segments are offset in a step-like pattern suggesting the presence of ENE trending right-lateral faults. We interpret the opposite directed reverse shear zones as being closely related to the late-Ross bilateral Exiles and Wilson thrust systems in Oates Land and comparable structures in the Campbell Glacier area in central Victoria Land (FLÖTTMANN & KLEINSCHMIDT 1991, KLEINSCHMIDT 1992) which can now be traced across Victoria Land from the Pacific coast to the Ross Sea. The Ross Orogen-EAC boundary is presumably located not much further W of the W-vergent reverse shear and fold systems. It may best be interpreted as a W-vergent fold-and-thrust belt - comparable with the Delamerian Orogen in Australia - where the intra-Wilson Terrane magmatic arc was detached and thrust W-ward onto the cratonic foreland. It possibly coincides with the western termination of the aeromagnetic Central Victoria Land Boundary Zone W of Priestley Glacier (FERRACCIOLI & BOZZO 1999).

Ireland, T.R., Weaver, S.D., Bradshaw, J.D. et al. (1999): VIII ISAES, Wellington (Abstr.): 150
Fanning, C.M., Daly, S.J., Bennet, V.C. et al. (1995): VII ISAES, Siena (Abstr.): 103
Ferraccioli, F. & Bozzo, E. (1999): J. Geophys. Res. 104: 25297-25319
Flöttmann, T. & Kleinschmidt, G. (1991): Geology 19: 45-47
Kleinschmidt, G. (1992): Polarforschung 60: 124-127

Structural geology of Filchnerfjella and adjacent areas in central Dronning Maud Land, East Antarctica: preliminary results
(poster p.)

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Structural analyses were carried out in Filchnerfjella and surrounding areas in central Dronning Maud Land (DML) during a joint Japanese-German-Norwegian expedition in 2001-02 in order to reconstruct the Proterozoic to Early Palaeozoic kinematic and crustal evolution between E- and W-Gondwana. Furthermore, the aim was to investigate the Meso-Cenozoic structural architecture of central DML in the light of break-up and fragmentation of Gondwana. The metamorphic rocks of Filchnerfjella and the other studied areas (Hoggestabben, Jaren-Jøkulkyrkja, and Fenriskjevten) suffered polyphase deformation and metamorphism. They consist of banded and migmatitic gneisses and supracrustal rocks (paragneisses, sillimannite-gneisses, calcsilicates, etc.) and are intruded by post-tectonic pan-African plutons. The high-grade overprint affected both migmatitic and supracrustal rocks and the rocks are strongly foliated and locally show a strong mineral lineation. No pre- or syn-migmatic structures are preserved in the banded and migmatitic gneisses indicating that the observed deformation occurred after the migmatization event. At least three folding events are associated with formation of the gneisses. Furthermore, the foliation planes in Filchnerfjella are folded into spectacular large-scale folds visible along the northern flank of the mountain. These open folds are N to NNW vergent. Axes are shallowly dipping and trend roughly E-W. We observed at least two anticlines likely displaced by a large, shallowly S-dipping thrust fault in the intermittent syncline position. The lower one of the anticlines is offset by shallowly dipping faults. The fault gouges along the fault traces are recrystallized. From structural relations along these faults, we argue for a first increment of north-directed thrusting co-genetic to folding reactivated by later-stage S-directed extensional movements. Both the folds and the recrystallized faults are crosscut by undeformed aplitic dykes belonging to the widespread pan-African magmatism in the area. At the present preliminary stage, we tentatively interpret at least these large-scale folds and thrust and the subsequent normal faults as pan-African in age and linked to E- and W-Gondwana collision. Whether also some of the older fabrics are pan-African in age or whether they all formed during the Grenville orogenic event is not clear at the present stage of our studies. Structural analyses associated with brittle deformation consistently indicate the presence of a conjugate strike-slip system in all investigated areas between Hoggestabben and Fenriskjevten. Corresponding faults are NNW-SSE trending left-lateral and WSW-ENE trending right-lateral to oblique-slip faults resulting from approximately WNW-ENE oriented maximum horizontal palaeostress. Locally, we observed right-lateral striations overprinting an older not-well preserved extensional event. At Hoggestabben, a likely Jurassic WSW-ENE trending basaltic dyke is overprinted by dextral movements. At several localities, large-scale thrust faults developed perpendicular to the main palaeostress direction inferred from the conjugate strike-slip system. Positive flower structure geometries in association with this system are locally present. The brittle structures can clearly be attributed to the break-up and fragmentation of Gondwana. The older, scarcely preserved N-S oriented extension is linked to Jurassic basaltic volcanism and likely related to initial break-up. The overprinting conjugate system and co-genetic reverse faults are difficult to date but at present we tentatively regard them to be at least Late Cretaceous or Cenozoic in age.

What caused Late Cretaceous rifting between New Zealand and Antarctica?
(oral p.)

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The Late Cretaceous rifting that occurred between New Zealand and Antarctica has potential to yield valuable insights into causes of continental fragmentation. Recent suggestions for the causes of this rifting include subducted slab capture (LUYENDYK 1995) and a mantle plume that migrated beneath the Pacific margin of Gondwana (STOREY et al. 1999). However, a common feature of many papers considering this topic is that the tectonic reconstructions they are based on are highly schematic and take little account of constraints from the ocean floor.

Recent results from marine geophysical studies, both north of New Zealand and in the Bellingshausen and Amundsen seas, provide new constraints on rifting models. Firstly, the Osbourn Trough, which lies mid-way between the Hikurangi Plateau and the Manihiki Plateau, has been recognized as a relict spreading centre (BILLEN & STOCK 2000). This suggests that the Hikurangi Plateau originated as a fragment of the Manihiki Plateau, and therefore probably formed at some distance from the Pacific margin of Gondwana in mid-Cretaceous time. Secondly, new Late Cretaceous reconstructions, based on constraints from marine magnetic data and regional free-air gravity fields, show the sequence of events as Chatham Rise and Campbell Plateau rifted from Marie Byrd Land (LARTER et al. 2002). I will discuss the implications of these recent results for models of the causes of rifting between New Zealand and Antarctica.

Billen, M.I. & Stock, J. (2000): J. Geophys. Res. 105: 13,481-13,489.
Larter, R.D., Cunningham, A.P., Barker, P.F., Gohl, K. & Nitsche, F.O. (2002): J. Geophys. Res. 107(B12): 2345, doi:10.1029/2000JB000052.
Luyendyk, B.P. (1995): Geology 23: 373-376.
Storey, B.C., Leat, P.T., Weaver, S.D., Pankhurst, R.J., Bradshaw, J.D. & Kelley, S. (1999): J. Geol. Soc. London 156: 659-671.

SHRIMP U-Pb age characteristics of detrital and magmatic zircons, eastern Ellsworth Land
(poster p.)

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SHRIMP U-Pb zircon ages for seven magmatic rocks, and SHRIMP detrital zircon age spectra for eight sedimentary rocks from eastern Ellsworth Land (EEL) have been determined.

Volcanic rocks of the Antarctic Peninsula Volcanic Group (APVG) are widespread thoughout the Antarctic Peninsula (AP). In EEL south of 74°30'S they are called the Mount Poster Formation (MPF). Zircons from four samples of MPF yielded Jurassic ages. From east to west these are: Sweeney Mts. NW of Mt. Ballard, 189 ±3 Ma (Toarcian); Sky Hi Nunataks, 187.5 ±2.3 Ma (Toarcian); Mount Rex, interpreted magmatic age of 167 ±3 Ma (Bathonian), with an inherited component of c 185 Ma, and older inheritances ca. 600 Ma, and 1050-1070 Ma; and Mt. Peterson, 188.3 ±3 Ma (Toarcian).

Two APVG samples from north of 74°15'S, and west of 76°W yielded Cretaceous zircons: Schwartz Peak, 110 Ma (Albian); and FitzGerald Bluffs, 97.5 ±5 Ma (Cenomanian).

Zircons from granodiorite of the Lassiter Coast Intrusive Suite at Quilty Nunataks are 107.5 ±91 Ma (Albian). FitzGerald quartzite beds, known from a single outcrop at FitzGerald Bluffs, are medium-grained quartzite, contact metamorphosed by Cretaceous granite of the LCIS. Correlation with the Devonian Crashsite Quartzite of the Ellsworth Mountains has been suggested. The detrital zircon age spectrum of a single sample is dominated by grains interpreted to be 550-600 Ma (Pan African) in age. A smaller, older group ranges around 950-1150 Ma. A few older grains of Archean age, and younger grains of Ordovician age are present. FQB have been interpreted to represent pre-Mesozoic basement of the AP.

Erehwon beds are definitely known from only a single tiny outcrop with abundant Glossopteris erehwonensis of Upper? Permian age. Dominant age group of detrital zircons from a single sample is 250-300 Ma (Permo-Carboniferous). An older, subordinate group ranges around 300-350 Ma (Carboniferous). These, together with magmatic arc provenance suggest pre-Mesozoic magmatism in the area. A large grouping of grains with ages from 500-1,000 Ma, and three still older grains indicate significant basement contributions.

Outcrops of the Latady Formation are the most widespread and abundant in EEL. Locally abundant marine fossils indicate that most of the Latady is of Upper Jurassic age. Middle Jurassic fossils have been found at four locations in the southern Behrendt Mountains. Detrital zircon age spectra of six samples exhibit surprising variations. Four, in the central part of the study area, are dominated by early Mesozoic and late Paleozoic ages believed to represent contributions from the APVG and earlier magmatism. Significant older age groupings represent pre-upper Paleozoic basement.

At Lyon Nunataks, in the NW, LF sandstone with abundant Jurassic fossils is essentially devoid of Mesozoic zircons. Most range in age from 550-1150 Ma, with five between 1500 and 2000 Ma, and one of 3180 Ma. Similarity with FitzGerald beds in terms of detrital zircon ages, chemistry, and petrology raises the possibilty that FQB may be correlative with the LF at Lyon Nunatak, and that the NW part of EEL may be allocthonous, having been formed elsewhere, beyond the influence of Mesozoic magmatism.

In the southeast near McCaw Ridge, in an area with abundant Upper Jurassic fossils, detrital zircons from a single LF sample are overwhelmingly of Lower Cretaceous (20 grains from 141-133 Ma) to Upper Jurassic (14 grains from 152-142 Ma) age, indicating maximum age of Early Cretaceous for this sample. This is younger than the youngest age (Tithonian) attributed to LF from paleontologic evidence, and supports recently proposed mid-Cretaceous age for the Palmer Land Deformational Event.

Geologically eastern Ellsworth Land (EEL) is the southwesternmost part of the Antarctic Peninsula (AP), which is dominated by volcanic, plutonic and sedimentary rocks of Jurassic to Tertiary age. Jurassic-to-Tertiary volcanic rocks are called the Antarctic Peninsula Volcanic Group (APVG). Mesozoic plutonic rocks are called the Andean Intrusive Suite (AIS). Volcanic rocks of the APVG are widespread in EEL. South of 74°30'S they are called the Mount Poster Formation (MPF) and are mostly of Jurassic age. Approximately twenty small plutons of the AIS are exposed in EEL where they are called the Lassiter Coast Intrusive Suite (LCIS) of Early Cretaceous age.

Sedimentary rocks in EEL are assigned to three units: mid-Paleozoic? FitzGerald quartzite beds (FQB); Upper? Permian Erehwon beds (EB); and Jurassic Latady Formation (LF). FQB and EB are known from only a few small nunataks, and have been foound only in EEL. LF outcrops are abundant in EEL and southern Palmer Land.

Field occurrence, geochemical indicators, and sandstone modes indicate continental interior provenance, and deposition in a passive margin tectonic setting predating the inception of active margin tectonics on the Pacific margin of Gondwanaland. They are of magmatic arc provenance, and indicate that subduction related volcanism of the Pacific margin of Gondwanaland began in EEL by Permian.

Antarctic Marginal Gravity Highs - AMGH - and the tectonic evolution of the East Antarctic margin

(oral p.)

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The opening of seaways around Antarctica must be corrected for glacially derived sediments that were deposited after the break-up of Gondwana. Satellite gravity maps derived from sea-surface altimetry data can be used as a proxy to the ocean-continent boundary (LAWVER et al. 1998). Remarkably tight fits are found between conjugate margins of East Antarctica with northeast Mozambique, Sri Lanka, much of India and the central, southern margin of Australia. In the Arctic, marginal gravity highs have been discussed by VOGT et al. (1998). It is likely that deposition of glacially derived sediments on older seafloor that is not isostatically adjusted for the load produces an AMGH. Around East Antarctica, the most prominent AMGH lies along the western half of the outer shelf of Prydz Bay, undoubtedly produced by sediment loading that has been derived from upstream of the Lambert Graben. An areally larger AMGH is found at the ocean-continent boundary at the mouth of the Wilkes Land Basin. When Australia is reconstructed to East Antarctica, there is a large overlap between what must be cratonic Australia, including in particular the Pre-Cambrian and Cambrian Kangaroo Island, presently located at 36°S, 137°W, and the AMGH produced by glacial deposition off the Wilkes Land Basin. To the west, between 124°W and 134°W along the present day Australian margin and the conjugate East Antarctic margin, there is a remarkably tight fit between the two proxies to the ocean-continent boundary.

By assuming that the AMGH off the Wilkes Land Basin represents a post-breakup constructional feature on oceanic crust, the satellite-derived proxies to the prominent fracture zones that can be traced from Australia to East Antarctica are more uniform and room for the South Tasman Rise and the Tasmania block can be accomodated without overlap. If the Wilkes Land AMGH formed only after initiation of latest Eocene glaciation then there is room for a deep water gateway between the South Tasman Rise and the Oates Land part of East Antarctica as early as 38 Ma. There is also the possibility of an up-to 3000 m deep passageway between Tasmania and the South Tasman Rise through the present-day South Tasman Saddle that may have cleared East Antarctica as early as Early Eocene.

With this earlier opening of a seaway between Australia and East Antarctica, the timing of the opening of Drake Passage between South America and the Antarctic Penisula is the critical factor in allowing the development of the Antarctic Circumpolar Current. Unfortunately, the unconstrained plate motions of small blocks in the Scotia Sea region make it difficult to determine an exact time for initiation of an Antarctic Circumpolar Current. Drake Passage was open as a deep water passageway by 30 Ma and was perhaps open earlier than that time. Development of these features will be shown as a powerpoint animation.

Lawver, L.A., Gahagan, L.M. & Dalziel, I.W.D (1998): Mem. Nat. Inst. Polar Res. 53: 214-229.
Vogt, P.R., Jung, W.-Y. & Brozena, J.M. (1998): Marine Geophys. Res. 20: 459-477.

Evolution of Cenozoic Antarctic plankton biotas
(poster p.)

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The austral ocean underwent major cooling during the Cenozoic, due to changing regional tectonics and global climate shifts, which gave rise to a distinct Southern Ocean circulation by the late Eocene / early Oligocene. Planktonic biotas responded to these changing environmental conditions, and this record can be studied from the numerous well dated deep sea sediment sections recovered by DSDP and ODP.

The record shows that in the Paleocene to mid Eocene, austral plankton was not strongly differentiated from mid southern latitude plankton biotas, and local diversity changes primarily reflect global trends in plankton evolution. The oldest endemic Southern Ocean plankton biotas are recorded from late Eocene sediments close to the Antarctic continent. By the early Oligocene, a distinct, widespread Southern Ocean plankton biota existed, although some components were still very cosmopolitan. Opal secreting taxa increased in diversity and abundance at the expense of carbonate secreting forms. Further reduction in plankton diversity, increased rates of evolutionary turnover and increased dominace of opaline forms parallels continued cooling, increased isolation of circulation and the spread of sea ice in the Neogene.

The actual evolutionary mechanisms that created this pattern are not yet clear. Direct local adaptation to decreasing temperature, changes in water column structure and increasing biologic productivity presumably played a dominant role. However, the presence of bipolar taxa, and the Neogene development of low-latitude coastal upwelling zones ("stepping stones"), suggest that bipolar biotic exchange my have also played a significant role in regulating Cenozoic Antarctic plankton diversity.

Identification of continent-to-ocean boundary on the Antarctic passive margin
(oral p.)

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The boundary between continental and oceanic crust at passive (rifted) margins is the locus of continental break-up and so identification of this boundary as well as its accurate mapping are fundamental geoscince problems. The Antarctic continental margin (ACM) having a long history of rifting and plate separation in the course of Gondwana break-up shows different structural styles and tectonic settings nearby the COB known elsewhere in the World. Different diagnostic features based on seismic and potential field data can be applied to recognize the COB on the ACM.

1) Seismic data.
Seismic studies (MCS profiling and refraction seismic experiments, RSE) are the major means for COB identification in Antarctica allowing to reveal distinctions in an internal structure and velocity characteristics peculiar to two types of crust. On the MCS sections a rifted continental crust displays a complex structure with prevalent extensional features while an oceanic crust is more homogeneous in a reflection pattern. At present, only few MCS lines with improved MCS technique enable to observe such differences and to identify the COB with confidence. As a rule, a limited depth penetration of the acoustic signal (due to relatively short streamers usually applied for Antarctic research) precludes the

necessary study of crustal structure and so a major diagnostic feature in terms of COB identification is mostly a basement morphology. In some cases the COB shows a step in basement surface resulted likely from volcanic activity during early phase of see-floor spreading. (eastern Cosmonaut Sea, western Cooperation Sea, Wilkes Land Margin, Powell Basin) however, this feature is not universal and is absent in many cases. In places, basement surface going over the COB gets more rugged with many diffractions (Riiser-Larsen Sea) or flat and high reflective (western Cooperation Sea). An oceanic crystalline basement unlike a stretched continental one shows locally internal dipping reflectors. Differences in refraction velocities on a basement surface is one of the main criteria in recognition of crustal types. Continental crust is usually characterized by velocities of between 5.9-6.3 km/s, whereas oceanic crust ranges from 5.4 to 5.8 km/s.

2) Magnetic data. Magnetic data are generally reliable source of information to identify an oceanic (spreading) crust generating linear anomalies, however in Antarctica magnetic measurements are mostly sparse enough to map the pertinent pattern. In some cases a contrast between weekly magnetic continental crust and strongly magnetic oceanic crust creates a prominent anomaly ("edge effect") enabling to define the COB (Cooperation Sea; Wilkes Land Margin). One more opportunity of magnetic study is a mapping of volcanic units on the rifted ACM related to an initial phase of continental break-up and usually located close to the COB. In Antarctica such units are recognized in the Weddell Sea and Lasarev Sea where magnetic data provide a good control of the COB.

3) Gravity data.
Gravity information is restricted in resolving of the COB problem. Nevertheless a Free-Air anomaly field based on satellite altimetry data, presently existing for the Southern Ocean, clearly shows in many places a position of transform faults which are traced within the oceanic crust and disappear close to the COB.

Using aforesaid approaches the COB has been mapped (with different reliability) around the all Antarctic margin. Over the most of passive Antarctic margin the COB is located at a distance of 200-250 km from the shelf edge in the Riiser-Larsen Sea, 300-350 km in the Cooperation Sea, about 200 km on the Wilkes Land Margin but very close to the shelf edge in the Ross Sea.

New identifications of seafloor spreading magnetic anomalies in the southwestern Indian Ocean. Early history of East Gondwana break-up

(EANT workshop p.)

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Magnetic data collected on the East Antarctic margin between 25-70°E during several cruises of RV "Akademik Alexander Karpinsky" show the magnetic anomaly consequence from M16 to M0 (with half spreading rate between 1.4 and 2.7 cm/yr) for the eastern Riiser-Larsen Sea and from M11A to M8 (with half spreading rate between 2.0 and 3.5 cm/yr) for the Cosmonaut Sea and Cooperation Sea. Unlike previous Gondwana reconstructions, which proposed that Madagascar Ridge was attached to Antarctica before chron M0, our new data proves that the Riiser-Larsen Sea Basin started to open simultaneously in the Middle Jurassic time. In the Cooperation Sea, a pronounced, well-correlated high-amplitude magnetic anomaly (identified as M11A) is proposed to mark the continent-to-ocean boundary, position of which was suggested from sonobuoy and MCS data. According to new identifications of magnetic anomalies in the Cosmonaut Sea and Coperation Sea, onset of seafloor spreading between India and Antarctica is dated by 134.5 Ma. The crustal separation between two continents followed a complicated extensional (rift) phase with the change in tensional stress trends from NW-SE to N-S, which produced a vast region (more than 350 km) underlain by the highly stretched continental crust.

Anomalies in the erosion of Marie Byrd Land volcanoes over the past 35 m.y: implications for the history of the West Antarctic Ice Sheet

(oral p.)

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Alkaline volcanism in Marie Byrd Land (MBL) has been accompanied by the uplift of a broad dome throughout the past 25-29 m.y. The dome now stands ~3 km above sea level and is ~800 km across. Erosion has not kept pace with dome uplift during this time, even though the estimated rate of uplift of ~100m/m.y. is exceedingly slow. Topography still clearly reflects the magnitude and sense of structural displacements. For example, the late Cretaceous West Antarctic erosion surface is preserved at Mt. Petras, on the crest of the dome, 2700 m above sea level, where it is overlain by weakly indurated 25-29 Ma hydrovolcanic tuff breccias. Mt. Petras is, however, deeply dissected by cirques, in contrast to nearby Miocene (10-12 Ma) shield volcanoes that are virtually unmarked by erosion. Among the Miocene and younger volcanoes, only 8.3 Ma Mt. Murphy, located on the coast, is deeply eroded by cirques.

A coarse-grained alkaline gabbro is exposed on the eastern flank of the dome, ~470km east of the center of Neogene uplift. It is the only known Cenozoic intrusive body in MBL, and is therefore likely to represent the inception of magmatism and uplift in this region. The results of recent $^{40}Ar/^{39}Ar$ dating of the gabbro and associated dike rocks indicate an emplacement time of 34-37 Ma. We estimate that a minimum of 5 km of uplift, followed by removal of 4-5 km of overburden, was required to expose the gabbro at its present elevation of 600-800 m. Erosion must have kept pace with uplift during exhumation of the gabbro, and this contrasts significantly with the history of the past 25 m.y. We infer, therefore, that exhumation of the gabbro took place mainly in the Oligocene (~35-25 Ma), and was followed by reduced erosion rates in the early Miocene (~25-15 Ma) that were still effective enough to cut the cirques at Mt. Petras. Effective erosion seems to have ceased before 10-12 Ma in inland areas, but persisted in coastal localities until ~6-7 Ma. These variations were likely linked to a deterioration of climate that led to the establishment of the West Antarctic ice sheet. We suspect that the 25-29 Ma hyaloclastites at Mt. Petras represent the beginnings of a proto-West Antarctic ice sheet, prior to uplift, at a near sea level elevation, and that the mid- to late Miocene decrease in erosional effectiveness reflects a gradual transition from warm to cold-based glacial conditions. The latter inference is consistent with recent findings along the western coast of the Ross Sea.

What supports the Marie Byrd Land Dome?
(poster p.)

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The Marie Byrd Land (MBL) tectonomagmatic dome is a reactivated portion of the West Antarctic rift system that has undergone uplift and contemporaneous volcanism since early Oligocene time. It occupies an area of about 800 x 500 km on the MBL coast. Uplift and basalt magmatism began about 37-34 Ma in eastern MBL, but the center of uplift shifted ~470 km westward to the present crest of the dome (Mt. Petras) around 29-25 Ma. Since then, there has been ~3 km of dome uplift accompanied by sometimes voluminous basalt volcanism and the development of horst and graben structure. Felsic volcanism began ~19 Ma with the growth of Mt. Flint volcano, near the crest of the dome, and has accompanied basalt volcanism and dome uplift ever since. There are 17 other felsic volcanoes in the province, and they become systematically younger toward the distal flanks of the dome, where all the presently active volcanoes are found.

The volume of volcanic products and magnitude of fault offset have been difficult to estimate. IGY-related oversnow traverses provided the first and only seismic data for this entire region. A seismic line across the east end of Toney Mt. shows a contact between Cenozoic basalt and basement rock at a depth of 3 km below sea level, or ~5 km below the exposed top of the basalt section. This single line provides the only data on the magnitude of fault offset in this region (~4 km), and the most direct evidence that the MBL province may be a large igneous province (LIP). Less direct evidence for the latter comes from attempts to model the amount of basalt required to produce the large volumes of felsic rock found in the 18 felsic volcanoes. However, no realistic estimate of the volume of volcanic products can be made without additional seismic data.

Estimates of crustal thickness in coastal MBL have been based on models of gravity data and on surface wave dispersion studies, neither of which resolves questions about the origin of dome uplift. Mantle plume activity has been proposed to explain the coincidence of uplift and basalt volcanism, and this seems to be compatible with available gravity data. However, seismic determinations of crustal thickness and upper mantle velocity are needed to test this proposal, and to answer other petrologic and tectonic questions. Is, for example, the dome supported by thick crust or low-density mantle (Airy vs. Pratt compensation, or a combination of both)? If plume activity can be confirmed, and if plume activity has supplied the suspected large volume of new igneous material over the past 37-34 m.y., has the crust been correspondingly thickened, or has extension compensated for the addition of new material? Seismic imaging of the faults is also relevant to the question of extension, by determining if they flatten with depth or are high angle and planar.

Quaternary deep-water exchange between the South Atlantic, Southern and Indian oceans
(poster p.)

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Until now little information exists about past changes in the exchange of deep and bottom water masses between the South Atlantic / Southern Ocean and the Indian Ocean during the Pliocene to late Quaternary. We present a multi-proxy study with sedimentological, geochemical, sediment physical and micropaleontological investigations along a NW-SE core transect between the South African continental margin and the Conrad Rise ("Polarstern cruise" ANT XI/4). Main target is to evaluate the significance and timing of the oceanic transmission of Antarctic and Northern hemisphere climate signals into the Indian Ocean at Milankovitch and millennial time scales.

The selection of cores for the proposed study was based on the position, water depth, sediment physical parameters and core descriptions. The cores are from water depths between 3035 m and 5202 m, presently bathed by different deep and bottom water masses (NADW, LCDW, CDW). Temporal and spatial changes in the past configuration of these water masses are recorded at the different sites. Records of magnetic susceptibility, density, and porosity show marked fluctuations in association with glacial-interglacial climate changes allowing a preliminary stratigraphic assessment of the sedimentary records. The "oldest" core (PS2562-6) extends into the Pliocene, the other cores cover several glacial-interglacial cycles, except of core PS2557-1 that seems to contain sediments for the last glacial-interglacial cycle only. According to their origin and age, the different deep and bottom water masses exhibit characteristic suspended sediment load, nutrient and oxygen concentrations, salinity, and carbonate saturation. Changes in the hydrographic configuration are mirrored by the distribution of clay minerals, carbonate, geochemical element concentrations, and the abundance of benthic foraminifera.

Studies on sediment cores from the Arabian Sea suggest that the deep sea environments did not only record the low-latitude atmospheric signal (monsoon variability) but also northern and southern hemisphere climate signals transmitted with the advection of Atlantic and/or Antarctic deep water masses. Until now, this connection is not well constrained and requires further study and evaluation. Within this context the investigation of cores positioned directly at the transition between the South Atlantic / Southern Ocean and Indian Ocean is promising to trace the northward export of Antarctic climate signals into the low-latitude Indian Ocean.

The Vestfold Hills between Lambert rifting and Gondwana break-up: evidence from apatite fission track dating

(oral p.)

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The Vestfold Hills constitute a 30 x 30 km large Antarctic oasis of subdued morphology at the eastern margin of the Prydz Bay. They are located between two key features that developed since the Palaeozoic, and now dominate MacRobertson Land: the Lambert Graben and the East Antarctic passive continental margin. The basement of the Vestfold Hills is comprised by Late Archean to Palaeoproterozoic gneisses, granitoids, metagabbros and pyroxenites, intruded by a dense network of several generations of Proterozoic mafic dykes.

Apatite fission track analysis has been carried on five basement samples along a 6 km-long N-S transect of the Vestfold Hills to determine the low-temperature cooling and exhumation history (GIBSON 1998, 1998a). The ages range between 264 and 188 Ma. All samples show relatively long track lengths between 13.7 and 14.9 μm, and corresponding standard deviations between 1.7 and 1.2 μm. Modelling of the fission track parameters by Geotrack suggests a very consistent thermal history with two palaeo-thermal events affecting all five samples. The initial phase of rapid cooling below temperatures of 125-65°C occurred in the Permo-Triassic. A final, less well constrained cooling stage may have commenced, depending on the paleo-surface temperature assumptions, at some time in the Cretaceous or Tertiary.

The first cooling episode clearly postdates the latest, Pan African magmatic activities in the Vestfold Hills. It refers to at least 2 km of crustal denudation during the Permo-Triassic. This timing is coeval with the denudation of the northern Prince Charles Mountains and the Mawson escarpment, and the major period of Permo-Triassic sedimentation within the Lambert Graben. Like these processes, it is probably related to the initial rifting of the Lambert Graben, perhaps due to hinterland uplift during the formation of this major crustal structure.

The second phase of denudation probably commenced during the Cretaceous, with an estimated amount of 1.5 km. We interpret it as the immediate response to the Gondwana breakup and the formation of the passive continental margin between Antarctica and India. In this context, the Vestfold Hills may have served as source area for the immature Aptian sediments of the Prydz Bay described by TURNER & PADLEY (1991). However, the low-standing margin morphology of the Vestfold Hills implies that this final denudation phase did not involve considerable amounts of uplift.

Gibson, H.J. (1998): Geotrack Report #685, 59 pp.
Gibson, H.J. (1998a): Geotrack Report #685a, 19 pp.
Turner & Padley (1991): Proc. ODP, Sci. Results 119: 57-60

A Cretaceous cooling episode in the Beaver Lake area, northern Prince Charles Mountains

(poster p.)

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Recent thermochronological investigation in the northern Prince Charles Mountains mainly focussed on the denudation history of the Porthos Range, the Amery Peaks and Medvecky Peak. Apatite fission track studies from ARNE (1994) and LISKER et al. (in press) proposed two cooling/denudation stages during the Paleozoic and the Early Cretaceous, each in the magnitude of up to 5 km of exhumation. Moreover, the good correlation of paleo-temperature estimates from various vertical profiles allowed to calculate the respective pre-Cretaceous geothermal gradients that increase from ~20°C/km in the western Porthos Range towards ~30°C/km at Medvecky Peak (northwestern tip of Loewe Massif).

In contrast to the very well defined cluster reported in these studies, a new apatite fission track data set from the vicinity of the Amery Fault close to the Beaver Lake displays an extraordinary heterogeneous pattern. The ages of thirteen granitoid, gneiss and sandstone samples from the Manning Massif and the southern Loewe Massif scatter between ~270 and ~140 Ma. The mean track lengths of eleven of these samples range from 11.8 to 13.7 μm, with corresponding standard deviations between 2.5 and 1.5 μm. In spite of the relatively small size of the study area and the apparent absence of large-scale post-Cretaceous faulting, no correlation could be observed between the fission track data and the topographic altitude, nor is there any trend with respect to any regional feature (e.g., the Amery Fault). However, six of the samples fail the χ^2 test indicating that their single grain age distributions are not consistent with a single age population. Especially these samples are difficult to interpret whereas all samples with a high χ^2 probability clearly show Permo-Triassic or Early Cretaceous ages.

A similarly inconsistent fission track pattern has been described for the sedimentary deposits around the Radok Lake (ARNE 1994). Such irregular cooling behaviour is not likely related to significant differences of denudation. Instead, it rather reflects the disturbed thermal regime across a large regional fault that potentially resembles the Paleozoic rift shoulder of the Lambert Graben. The occurrence of such thermal perturbation is also supported by the increase of the paleo-geothermal gradient towards the Lambert Graben and the presence of numerous mafic dykes mainly Cretaceous in age. These magmatic and hydrothermal activities, as well as coeval denudation throughout the whole Prince Charles Mountains probably refer to the Early Cretaceous rifting stage of the Lambert Graben.

Arne, D.C. (1994): Antarctic Sci. 6: 69-84.
Lisker, F., Brown, R. & Fabel, D. (in press): Tectonics.

Cold-based glacier advance in the Allan Hills, Antarctica: evidence and preservation potential

(oral p.)

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New evidence is presented from the Allan Hills, South Victoria Land, Antarctica that confirms cold-based glaciers are capable of erosion, substrate deformation and deposition. Four types of erosion, three types of deposition and three scales of glaciotectonism resulting from cold-based glacial advance are described, and a model derived from these observations and those of advancing cold-based glaciers elsewhere. The model entails: (i) ice block apron overriding and entrainment and (ii) ice bed separation leading to the formation of a cavity on the down-glacier side of escarpments. The model is most effective for a horizontally stratified, lithified sedimentary bedrock substrate.

The preservation potential for cold-based glacial features is high in polar climates (e.g. Antarctica) but is very low beyond on account of the more rapid weathering in sub-polar or temperate climates. This explains the perceived absence of cold-based glacial features in the Pleistocene record of today's temperate regions that most likely experienced cold-based glaciation during past glacial maxima.

Tectonics and geomorphology of Elephant Island, South Shetland Islands

(poster p.)

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During the 2002-2003 austral summer, co-operative studies between Brazilian and Spanish groups allowed to obtain new data of the geological evolution of Elephant Island. This island forms part of the southern branch of the Scotia Arc, being located near the triple junction of the Scotia, Antarctic and former Phoenix plates at the intersection of the Shackleton Fracture Zone and the South Shetland Block. Previous geological work on the island is mainly related to ductile tectonics and metamorphic petrology. The metamorphism increases from sub-greenschist facies in the north-east to blueschist facies and finally to amphibolite facies in the south-west. In spite of this work, the level of the geological knowledge is relatively low in comparison to other areas in the region, mainly because of the difficult access. An accurate topographic map of the island does not exist at present and geomorphological and neotectonical studies have not being carried out despite the interest of these topics.

During this study the superposition and the main features of the principal deformation phases, as outlined in previous works, was studied in more detail, especially along a N-S profile in the western sector of the island. The rocks of the northern part of this profile are affected by a D1 deformation phase, that produced a well developed planar-linear fabric. A second deformation phase, D2, that produced crenulation cleavages with related folds, appeared to be more complex than previously thought, and was subdivided into D2a and D2b, according to superposition criteria. D2a produced tight to isoclinal folds with axes parallel to the L1 stretching lineation and steep E-W striking axial planes. D2b refolded these structures including the lineations, with steep NE-SW striking axial planes and subvertical axes. Kink bands predominantly with steep axes, indicating E-W shortening, constitute the D3 deformation phase.

The brittle and brittle-ductile deformation, overprinted on these ductile structures, was analysed systematically for the first time. More than 200 faults with their corresponding kinematic indicators were measured. The major faults observed in the northern part of the studied profile are predominantly reverse with a southward vergence and medium to low dips. Normal faults do also occur in this sector, indicating the overprinting of at least two deformation stages, locally revealed by two sets of striations on the same fault plane. In the southern sector of the island normal faults predominate indicating an extensional setting. Paleostresses have been identified by means of fault population analyses confirming the overprinting of different deformation stages. The stress ellipsoids in the northern part of the profile were determined, with NW-SE and NE-SW subhorizontal main compressional axes, and prolate shape. In addition to these ellipsoids, an extensional stress field was detected in most of the studied area, indicating a radial to E-W oriented extension.

The main part of the coast of the island is constituted by very steep cliffs. Raised marine erosive platforms up to 150 m a.s.l. were recognised and mapped at different places, being especially well developed along the western coast. In some cases terraces show landward tilting. Raised beach deposits are relatively scarce. The continental platform is better developed off the western coast of the island. The analysis of lineaments determined from aerial photographs and satellite images suggests the presence of several sets of subvertical fractures and/or lithological contrasts that have been accentuated by the glacial erosion. A new 1:50,000 topographic map of the island, with contour lines at 20 m interval, has been prepared by the Centro Geográfico del Ejército (Spain) using photogrammetric plotting of aerial photographs, satellite images and differential GPS field work. This map allowed the preparation of more accurate geological and geomorphological maps that integrate the main results of the above presented field work. These maps, also including previous data, show the present status of the geological knowledge of Elephant Island.

Exploring the unknown: history of the First German South Polar Expedition 1901-1903
(poster p.)

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Since 1865 Georg von Neumayer (1826-1909, director of the German Naval Observatory) promoted the dispatch of a German expedition to Antarctica. Not before the XI[th] Geographical Conference at Bremen (17.-19.4.1895), a German Commission for South Polar Exploration was set up to prepare a German South Polar Expedition. It was a lucky circumstance that three months later the VI[th] International Geographical Congress (26.7.-3.8.1895) took place in London under the presidency of Clements Robert Markham (1830-1916, president of the Royal Geographical Society), who also was very much promoting a British Antarctic expedition. At that time the south pole region was still "terra incognita" and object of speculation. Antarctica – was it a gigantic atoll or a big continent covered by ice? A resolution to promote geographical exploration of the Antarctic Regions was passed by the general assembly of the congress. This paved the way for the concrete planning of a German and a British expedition.

Besides political rivalry at the turn of the century, a scientific collaboration was adopted during the VIIth International Geographical Congress under the presidency of Ferdinand Freiherr von Richthofen (1833-1905, president of the Berlin Geographical Society) at Berlin (28.9.-4.10.1899). Markham defined the fields of work and divided Antarctica into four quadrants starting at 0° Greenwich meridian assigning the Ross and Victoria quadrant to England and the Weddell and Enderby quadrant to Germany. Erich von Drygalski (1865-1949, leader of the Greenland expeditions of the Berlin Geographical Society in 1891 and 1892-93) was nominated leader of the "Deutsche Südpolar-expedition". Also the first German polar research vessel "Gauss" was built at Kiel. The instructions for the expedition were rather general referring only to a few fundamental questions and leaving the terms of freedom of action that Drygalski desired. He followed Alexander von Humboldt's ideas of comprehensive investigation of an unknown area concerning the three elements earth, water, air, and the living world within. Due to this scientists representing geology, geography, earth-magnetism, oceanography, meteorology, and biology played the mayor role.

Finally expeditions from Germany, England, Sweden, and Scotland took part in the international co-operation of scientific work. Meteorological observations were defined from October 1901 until 31 March 1903, including all merchant and navy ships sailing on a route south of 30° S. Magnetic term days with hourly observations were defined on the 1st and 15th of each month from February 1902 until February 1903. The co-operation was expanded until 31 March 1904, when the British expedition wintered a second time and a French expedition (1903-05) joint.

On 11 August 1901 the "Gauss" set sail at Kiel for an unknown destination somewhere in the South Indian Ocean at 90°E. They installed an additional meteorological and magnetic base station at Observation Bay on Kerguelen. Unfortunately on 22 February 1902, the ship was beset by ice close to the Antarctic Circle at 66° 2' S and 89° 38' E, 85 km off the Antarctic coast. But luckily the ice was not drifting, so a winter station could be established on sea ice 385 m above the sea-ground. The expedition had discovered the ice-covered coast of Kaiser Wilhelm II. Land and the ice-free extinct volcano named "Gaussberg" of 366 m height. After 50 weeks of captivity the ship came free. A second attempt to go south failed, so they had to sail home arriving at Kiel on 25 November 1903. Emperor Wilhelm II had been disappointed about the results, because Robert Falcon Scott (1868-1912) had reached 82°S at the same time, while the "Gauss" had been trapped at the polar circle. To avoid costs for maintenance, "Gauss" was sold for 75.000 Canadian dollars to Canada, where Joseph E. Bernier (1852-1934) used it under its new name "Arctic" for the Canadian Coast Guard. At the turn to the 20th century, geographical achievements seemed to be much more valuable than thoroughly measured scientific data, which were to be analysed and published over decades (DRYGALSKI 1905-1931).

Research platforms in polar regions - a portal approach

(poster p.)

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A prototype for a portal system targeted at expeditions carried out by the German research icebreaker "Polarstern" has been recently developed by Alfred Wegener Institute for Polar and Marine Research. In this portal, not only detailed ship schedule of past and future expeditions is displayed, but also related AWI publications and meteorological datasets, trackline maps, scientific summary of the expeditions' goals, on-board newsletters and related press releases. Because such a portal system is of great value to the scientific community in terms of providing a connection between resources and scientific results, we propose to expand its scope so as to include all European research platforms dedicated to polar research. Our goal is to foster cross-institutional cooperation in polar studies within Europe and to improve the scientific planning of future expeditions and long-term observatory programs. The latter will certainly lead to a reduction in data redundancy and gaps. LDAP directory technology, known in the e-business world and since 1998 implemented at AWI, will be used as an innovative catalogue engine for metadata archival. The following research platform categories will be considered in an European-wide portal: research vessels, polar stations (with respective observatories), submarines, autonomous underwater vehicles, and airplanes. Peer-reviewed published publications, respective primary data ("Prinzipien guter wissenschaftlicher Praxis") and technology transfer findings associated with construction / usage of moving platforms and/or stations in polar regions will be considered. In addition to the scientific functionality described above, a central repository for academic information of general interest to the scientific community is also planned. This includes white pages (directory) for polar scientists and respective publications, calendar of events, committees, awards, and technology transfer of findings relevant to polar scientists.

Geochemical of Meso-Cenozoic calc-alkaline magmatism in the South Shetland arc, Antarctic

(poster p.)

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Geochemical data are presented from Livingston, Greenwich, Robert, King George and Ardley islands of the South Shetland Archipelago, Antarctic. The samples include basalts, basaltic andesites and andesites. The volcanic rocks have variable SiO_2 ranging from ~46 to 61 wt.%, Al_2O_3 from ~15 to 26 wt.%, and total alkali ($K_2O + Na_2O$) from ~2 to 6 wt.%. Al_2O_3, FeO^T and CaO oxides exhibit positive correlations with MgO (~2-9 wt.%), implying fractional crystallization of olivine, clinopyroxene, calcic plagioclase, Ti-magnetite and minor ortopyroxene, which occur as phenocrysts in some few rocks.

All bulk rocks have chondrite-normalised patterns enriched in LREE relative to HREE. The geochemical data show that the rocks belong to calc-alkaline association formed in a volcanic arc environment. N-MORB-normalized trace element patterns show that the South Shetland samples are enriched in LILE relative to HFSE, and LREE relative to HREE, and show negative anomalies of Nb, Hf and Zr.

Isotopically the $^{87}Sr/^{86}Sr$ ratios vary from 0.7033 to 0.7046 and the $^{143}Nd/^{144}Nd$ ratios are between 0.5127 and 0.5129. εNd values vary from +2.71 to +7.30 which indicate asthenospheric mantle source for the analysed samples. The $^{208}Pb/^{204}Pb$ varies from 38.12 to 38.70, $^{207}Pb/^{204}Pb$ are between 15.49 and 15.68, and $^{206}Pb/^{204}Pb$ from 18.28 to 18.81.

The South Shetland rocks are thought to be derived from a depleted magma source modified by two components mixtures such as slab-derived fluids and small fractions of oceanic sediments. The isotopic compositions of subduction component are expressed by bulk mixing of 4 wt.% of oceanic sediments and 96 wt.% of altered MORB. The geochemical data and Sr, Nd and Pb isotope compositions show a mixing relationship among MORB-type depleted mantle wedge, slab-fluids and sediments.

Tectonic evolution of Deception Island, Bransfield ridge, western Antarctica

(poster p.)

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Deception Island shows the most recent subaerial active volcanism in West Antarctica, being located at the western end of the submarine volcanic ridge of the Bransfield trough between the South Shetland Islands and the Antarctic Peninsula. The recent tectonic evolution of the Deception Island volcano and the entire Bransfield Basin continue being controversial. The majority of the authors who studied Deception Island assume the caldera to be the result of the collapse of just one volcanic cone, and the existence of concentric faults (rings faults) has been proposed. However, recent geophysical studies have shown that the gravimetric and magnetic anomalies are not related to the common circular structure of a classic volcanic caldera, but reveal lineal trends in NE-SW and NW-SE directions. In the same way, most of the seamounts in the Bransfield Basin consist of volcanic ridges or spurs arranged parallel to the NE-SW basin axis. In the other hand, the South Shetland archipelago and the volcanic ridge of the Bransfield trough are affected by faults oriented NW-SE that compartmentalize and moves it.

Palaeostress ellipsoids determined from brittle mesostructures analysis in Deception Island show a recent stress field characterized by an extensional regime, with local compressional stress states. Orientation of the maximum horizontal stress (σy) shows a NE-SW trend and an extension ($\sigma 3$) in SE-NW to SSE-NNW directions related with the opening Bransfield basin. Otherwise, alignments of meso-fractures show a maximum of NNE-SSW orientation and several relative maxima striking N030-050E, N060-080E, N110-120E and N160-170E. In the other hand, subaerial and submarine macro-faults in Deception Island and Port Foster show four main systems controlling the morphology of the island: NNW-SSE to N-S, NE-SW, ENE-WSW and ESE-WNW to NW-SE. In addition, geochemical patterns related to submarine hydrothermally-influenced faulted and fissures pathways and recent linear magmatic intrusions show the same trends. The orientation of the faults system is compared to Riedel shear fractures.

According to this model, two evolutionary stages can be distinguished on basis of the geometrical relationship between the location and orientation of joints and faults. These stages involve a counter-clockwise rotation of Deception Island that may be explained by an extensional regimen related to a regional left-handed strike-slip zone of simple shear in response to the oblique convergence between the Antarctic and Pacific plates. This stress direction is consistent with the present-day movements between the Antarctic, Scotia and Pacific plates. Nevertheless, the type of the present volcanism and the origin of deep earthquakes focal mechanism also suggest the rollback of the former Phoenix subducted slab (presently amalgamated within the Pacific plate). We postulate that both mechanisms could be simultaneously, and therefore, would explain the present-day hydrothermal activity, recent volcanic events and linear magmatic intrusions in Deception Island.

Intensified northern Weddell Gyre flow and splitting of flow pathways since the Middle Miocene, Antarctica

(oral p.)

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The oceanic crust of the Weddell Sea is bounded to the north by the oceanic Powell and Jane Basins, and the continental crustal blocks of the South Scotia Ridge. Jane Bank, which belongs to an island arc, separates Jane Basin from the Weddell Sea. The arc and backarc system was developed during Early Miocene time, approximately after the end of subduction of the northern branch of the Weddell Sea spreading center below Jane Bank. The Weddell Sea Bottom Water (WSBW) flows clockwise in the Weddell Sea, following the Weddell Gyre southward of the Antarctic Circumpolar Current. The WSBW escapes northward at about 3000 m water depth to the Scotia Sea through deep gaps of the South Scotia Ridge. The WSBW also flows northward along the South Sandwich Trench towards the South Atlantic.

Data sets were analyzed from multichannel seismic profiles (MCS), swath bathymetry and magnetometric data from the BIO HESPERIDES SCAN 97 cruise, which were complemented with additional MCS Italian and Russian data. The seismic stratigraphy shows a variety of depositional bodies that can be interpreted to outline bottom current patterns from the region during the Neogene and Quaternary. Four main seismic units, separated by regional unconformities are recognized above the oceanic basement. The basal deposits of these units have ages that range between chron C6n (19.5 Ma) identified as the youngest oceanic basement of the Northern Weddell Sea, and chron C5Dn (17.6 Ma) to chron C5ADn (14.4 Ma) for Jane Basin. The reflector configurations within these units show a distinct change in the depositional style, which indicates a major reorganization of the bottom current processes and probably of the oceanographic regime through time. All the units exhibit characteristics of bottom current deposition, however, the upper two units show a change to significantly stronger currents. The two upper units began depositing in the late Middle Miocene and extend to the present, based on the correlation with ODP sites in the region and the age of the oceanic basement.

Different types of sediment drift are deposited in the two upper units and their development is apparently controlled by the seafloor topography. In locations where there is little topographic disruption to the eastward flows of the WSBW, sheeted drift forms. In locations with high-relief ridges that are oblique to the flow, mounded sediment drift deposits are observed on the downstream eastern side of the ridges. Contourite channels form parallel to the eastern side of the ridges. The channels exhibit erosion on the left margin and extensive eastward deposition of mounded drift on the right margin. In locations with low-relief ridges, apparent contourite channels develop parallel to the western margin of the ridge, and usually channels exhibit erosion of the right channel margin. The sediment drift and contourite channel deposits suggest that current splays split off from the main eastward WSWB contourite flow and travel northward parallel to the high relief ridges. In channels that develop on the east side of high-relief ridges, the Coriolis force intensifies the northward channelized flow on the left channel margin causing erosion. On the right channel margins, where channelized flow is weak, the eastward contourite flow appears to deposit the extensive mounded drift deposits. Where low-relief ridges disrupt the eastward contourite flow, erosion and non-deposition usually take place on the western margin of these low ridges apparently because of the dominant contour currents. Some northward flow also appears to be diverted, however, to contourite channels that parallel these low ridges. The grid of regional profiles indicates that the main contourite flow is funnelled northward into the central Scotia Sea through Jane Basin and gaps of the South Scotia Ridge. Some flows, however, are diverted northeastward along an area of ridges, blocks and depressions of the eastern South Scotia Ridge in this sector of the northern Weddell Sea.

Evolution of the SCAR GIANT program

(oral p.)

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The SCAR GIANT (Geodetic Infrastructure of Antarctica) program was established in 1992 to provide a common geodetic framework over Antarctica as the basis for recording of positional related science.

For the past ten years this has been an active program and their are nine elements in the current 2002-2004 program:

- Permanent Geoscientific Observatories;
- Epoch Crustal Movement Campains;
- Physical Geodesy;
- Geodetic Control Database;
- Tide Gauge Data;
- Atmospheric Impact on GPS Observations in Antarctica;
- Remote Observatoriey Technologies;
- Ground Truthing for Satellite Missions;
- Geodetic Advice on positioning limits of special areas in Antarctica.

The development and status of each sub element within the overarching GIANT program is discussed and access to data highlighted.

Geodetic Results from PCMEGA
(poster p.)

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During the Antarctic summer 2002/2003 a major Geophysical project in the southern Prince Charles Mountains was undertaken jointly between Germany and Australia. It was termed PCMEGA (Prince Charles Mountains Expedition of Germany and Australia).

Extensive airborne gravity, magnetics and ice radar survey flights were undertaken over the ice cap to the immediate south of the mountains. As part of the ground based geophysical investigation of the area a network of GPS sites was established. A number of these points were placed on previously unsurveyed rock outcrops, while others were placed adjacent to existing survey control. Additionally, a GPS point in the nearby Grove Mountains was reoccupied for the third consecutive summer providing information to the ANTEC program about this part of East Antarctica.

Other positioning activities include the survey of a number of new mapping control points, an ice field calibration survey for ICESAT at a satellite crossover point near Mt. Cresswell, and a DORIS beacon deployment on the glacial stream of the Lambert Glacier.

The data gathered at these GPS network sites were subsequently processed and the precisions achieved for this first epoch occupation are assessed. The findings from the Grove Mountains observation and permanent sites at Mawson and Davis are also discussed in light of Nuvel 1A vectors.

The status of continuous GPS stations in Antarctica and their contribution to Global networks
(poster p.)

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Since 1992 the installation of permanent GPS base stations has progressed under the SCAR GIANT program to the extent that eight sites are now contributing data to IGS on a daily basis. A number of other sites are gathering data but this is only available after manual downloading each summer.

The status and history of each of these sites of these sites is examined as a contribution to the global networks and to global reference frameworks.

The ongoing difficulties in establishing a precise reference frame over Antarctica to monitor small vertical motions are discussed.

Vertical Motion from Antarctic GPS base stations
(oral p.)

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The installation of permanent GPS base stations located close to tide gauges potentially can provide a measure of both land and sea level rise or fall. However for the determination of small vertical motions, GPS does not produce a strong result, due to the inherent limitations of the system. To offset the observation noise and the limitations in modelling external variables during processing a long period of continuous observation is necessary. Processing technique of data is critical and the computation of similar orbits and attention to reference frame employed is essential. The TIGA project of the International GPS Service (IGS) examines the data contributions from global GPS located in the vicinity of tide gauges in order to study sea level rise. Antarctic presents a particular problem in this aspect as land motion rise is very small and the results are very dependent on the processing approaches applied to the global or regional GPS models which are employed. The results for all Antarctic sites are presented for both Geoscience Australia processing and other researchers within the TIGA project. Conclusions are drawn on the limitations of the GPS as a single technique for this purpose

Eustatic sea-level changes in northern Antarctic Peninsula during the Eocene
(poster p.)

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A 6-7 km thick sedimentary succession deposited in continental to marine settings off the coast of the northeastern Antarctic Peninsula (James Ross Basin) during Lower-?Upper Jurassic to Eocene times is related to the evolution from continental rift to back arc settings of the Larsen Basin (HATHWAY 2000). Marginal and intrabasinal tectonism in the basin was on the decline after Coniacian times and sedimentation was more directly controlled by base-level changes with a magnitude of 50-100 meters (PIRRIE et al. 1991). Basin uplift or decreased basin subsidence outpaced by the sedimentation rate led to the development of a broad shallow shelf sporadically emergent during the Paleogene (SADLER 1988, PIRRIE et al. 1991, MARENSSI et al. 1998a).

The Eocene La Meseta Formation (ELLIOT & TRAUTMAN 1982), is a composite incised valley system developed onto an emergent marine shelf (MARENSSI et al. 1998a,b). The sedimentary succession subdivided into six erosionally based members (Marenssi et al., 1998b) can be grouped to represent three main sedimentary cycles (ELLIOT & TRAUTMAN 1982, POREBSKI 1995, MARENSSI et al. 2002). The age of the lowermost valley-fill sediments (COCCOZZA & CLARKE 1992, ASKIN 1997, DUTTON et al. in press) suggest that its base may correspond with one or several of the lowstands in sea level that occurred in the 55-54 Ma interval (55 Ma sequence boundary of HAQ et al. 1987). In the same way, the main internal erosional surfaces can be also correlated with lowstands of the sea level. The erosional surface at the base of the Cucullaea I Allomember or Telm 4 is the most significant erosional feature and may corresponds to the 49.5 Ma lowstand. The erosional surface at the base of the Submeseta Allomember may be related to the sequence limit at the 39.4 Ma (HAQ et al. 1987) or 37 Ma (BERGGREN et al. 1995). The thickness of the valley-confined facies of the Campamento, Cucullaea I, Cucullaea II and Submeseta allomembers are in the range of 30 to 70 m (POREBSKI 1995; MARENSSI et al. 1998b) showing similar magnitudes to the Eocene sea level fluctuations (HAQ et al. 1987). Furthermore, the evolution of the depositional systems of the La Meseta Formation (MARENSSI et al. 1998a) fix with the behavior of the Eocene long term sea level curve (HAQ et al. 1987).

Stratigraphic, sedimentological, paleontological and geochemical data strongly support that Eocene sedimentation in the James Ross Basin was mainly controlled by eustatic sea-level changes. The northwestern margin of the Antarctic Peninsula acted as the extending margin of the Weddell Sea and therefore, the James Ross Basin evolved from a continental rift to a back-arc during Jurassic to Late Cretaceous and finally into a continental shelf in the Eocene (latest Cretaceous-Paleogene?).

Askin, R. (1997): In: C.A. Ricci (ed.). The Antarctic Region: Geological Evolution and Processes: 993-996.
Berggren, W.A., Kent, D.V., Swisher III, C.C. & Aubry, M.P. (1995): SEPM Spec. Publ. 54: 129-212.
Coccozza, C. & Clarke, C. (1992): Antarctic Science 4: 355-362.
Dutton, A.L., K, Lohmann & Zinsmeister W.J. (2002): Paleooceanography 17 (in press).
Elliot , D.H. & Trautman, T.A. (1982): In: Antarctic Geoscience, Univ, Wisconsin Press, Madison: 287-297.
Haq, B.U., J. Hardenbol & Vail, P.R. (1987): Science 235: 1156-1166.
Hathway, B. (2000): J. Geol. Soc. London 157: 417-432.
Marenssi, S.A., Santillana, S.N. & Rinaldi, C.A. (1998a): Contribución 64: 1-51, Inst. Antártico Argentino.
Marenssi, S.A., Santillana, S.N. & Rinaldi, C.A. (1998b): Ameghiniana, Publicación Especial 5: 137-146.
Marenssi, S.A., Net, L.I. & Santillana, S.N. (2002): Sediment. Geol. 150: 301-321.
Pirrie, D., Whitham, A.G. & Ineson, J.R. (1991): IAS Spec. Publ. 12: 293-305.
Porebski, S. (1995): Stud. Geol. Polonica 107: 7-97.
Sadler, P.M. (1988): Geol. Soc. Amer. Mem. 169: 303-320.

$^{87}Sr/^{86}Sr$ derived ages from the lower Sobral Formation, Paleocene, Seymour Island, Antarctic Peninsula

(poster p.)

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A biostratigraphic approach has been traditionally used to correlate different units within the 6-7 km thick sedimentary succession of the Lower-?Upper Jurassic to Eocene James Ross Basin, Antarctica. However, many species are endemic or show strong heterochroneity thus jeopardizing correlation with other faunas and floras outside Antarctica. More recently strontium stratigraphy has been used to provide firmer stratigraphic ties between Antarctica and other basin elsewhere in the world (CRAME et al. 1999).

The Sobral Formation is a 250 m thick unconformity bounded unit cropping out on Seymour (Marambio) Island off the coast of northern Antarctic Peninsula. This unit rests on marine Danian strata of the López de Bertodano Formation and is covered by the volcanic-rich Late Paleocene Cross Valley Formation (SADLER 1988). Its base is an erosive surface that locally cuts up to 43 m into the underlying beds (SANTILLANA & MARENSSI 1999) interpreted as a mixed erosive-transgressive (coplanar) surface (MARENSSI et al. 1999). The early sedimentary fill (Unit 1 of MACELLARI (1988) or Tps1 of SADLER (1988)) is composed of poorly fossiliferous finely laminated and wavy to flaser bedded silty mudstones and very fine sandstones that locally onlap the unconformity (SANTILLANA & MARENSSI 1999). The Sobral Formation was first assigned to the Danian by PALAMARCZUK (1982) based on dinocyst evidence. ASKIN (1988) and HUBER (1988) demonstrated that the lower 20 m of Unit 1 is Danian in age but they do not ruled out the possibility that upper levels may be as young as early Thanetian.

High-resolution $^{87}Sr/^{86}Sr$ determinations were carried out at the Radiogenic Isotope Laboratory, The Ohio State University, USA, on oyster shells recovered from two different stratigraphic levels within the Sobral Formation. Shells collected from the lowest part of Unit 1 yielded a mean $^{87}Sr/^{86}Sr$ ratio of 0.707812 that converted to an absolute age of 62.14 Ma (HOWARTH & MCARTHUR 1997) corresponding to the late Early (Danian) Paleocene (BERGGREN et al. 1995). Meanwhile, oysters recovered on the unconformity but 35 m higher, at the very top of Unit 1, yielded a mean $^{87}Sr/^{86}Sr$

ratio of 0.707796 that converted to an absolute age of 59.59 Ma (HOWARTH & MCARTHUR 1997) and corresponds to the Selandian (BERGGREN et al. 1995).

The new strontium isotopic data allow to establish an additional marker horizon within the James Ross Basin. The derived ages restrict the unconformity and the basal deposits (Unit 1) of the Sobral Formation to the Danian and indicate that sedimentation of younger units proceeded during Late Paleocene times.

Askin, R. (1998): Geological Soc. Amer. Mem. 169: 131-153.
Berggren, W.A., Kent, D.V., Swisher III, C.C. & Aubry, M.P. (1995): SEPM Spec. Publ. 54: 129-212.
Crame, A., McArthur, J.M. Pirrie, D. & Riding, J.B. (1999): J. Geol. Soc. 156: 957-964.
Howarth, R.J. & McArthur, J.M. (1997): J. Geol. 105: 441-456.
Huber, B.T. (1988): Geol. Soc. Amer. Mem. 169: 163-252.
Macellari, C.E. (1988): Geol. Soc. Amer. Mem. 169: 25-53.
Marenssi, S.A.; Santillana, S.N. & Rinaldi, C.A. (1999): Cuartas Jornadas de Investigaciones Antárticas II: 251-256.
Palamarczuk, S. (1982): Ameghiniana 19: 353-360.
Sadler, P.M. (1988): Geol. Soc. Amer. Mem. 169: 303-320.
Santillana, S & Marenssi, S. (1999): Cuartas Jornadas de Investigaciones Antárticas II: 262-268.

Grain size, mineralogy and geochemistry in Late Quaternary sediments from the western Ross Sea outer slope: proxies for climate changes

(oral p.)

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Sedimentary sequences from the Ross Sea continental slope provide detailed indications on past environmental conditions and climate changes which have occurred during the Late Quaternary. More specifically, grain size, mineralogical and geochemical data obtained from sediment cores recovered from the outer slope can give useful information on long-term climate cycles (~last 300 ka). Such sedimentary sequences, typically, exhibit low sedimentation rates, and do not include hiatuses due to glacial exaration which, conversely, is much intense upon the continental shelf during glacial periods. Therefore slope cores frequently show cyclical fluctuations in several proxies, which are in good phase with glacial/interglacial changes (marine isotope stages 1-8). Such fluctuations are supposed to be driven by bottom current changes induced by variations in the ice coverage extension over the continental margin and by changes in transport mechanisms, reworking and provenance of the material, connected to glacial/interglacial cycles.

Here we present integrated textural, mineralogical and geochemical data carried out in the framework of the Programma Nazionale di Ricerche in Antartide (PNRA) and some AMS-^{14}C datings from three sediment cores (ANTA91-8, ANTA91-2, ANTA99-c24) collected in the western Ross Sea continental slope and their possible link to climatic and environmental changes occurred during the Late Quaternary.

The sediments are composed of silty clay to clayey silt alternating downcore, with low amounts of sand and gravel, mainly of ice-rafted origin. More silty intervals are ascribed to interglacial periods, characterised by higher bottom current strength, whereas more clayey intervals are ascribed to glacial periods, when current strength is weaker. Sand peaks can testify the intensification of bottom current strength and/or ice-rafting processes (typical of interglacials and deglacials, respectively), as well as the occurring of resedimentation events (typical of glacial maxima) triggered by the bulldozing effect of the ice sheet on continental shelf deposits.

Bulk sediment mineralogy is mainly composed by amorphous biogenic silica, quartz, plagioclase, alkali feldspars, mica, low chlorite and traces of pyroxene. Clay fraction is mainly composed by mica/illite, smectite, chlorite and subordinate caolinite. Bulk sediment mineral distribution is mostly controlled by the grain size of the sediments and by biogenic silica content that dilute them. TEM investigations indicate smectite is mostly detrital and formed through chemical weathering processes on parent rocks containing abundant volcanic materials. Conversely, chlorite and illite can be derived from the physical weathering (glacial scouring) on crystalline and/or metamorphic rocks of the East Antarctic craton. Clay mineral variations might reflect the intensity changes in the influence of the source areas.

Geochemical analyses include concentrations of major and minor oxides, and of trace elements (Cr, Ni, Co, V, Cu, Pb, Zn, Cd) and loss on ignition. Distribution patterns of major and trace elements support the cyclicity defined by the grain size distribution and by clay mineral variations. These fluctuations are controlled by different contents of detrital elements (as Al, Ti, Fe, Mg and K), redox-sensitive elements (Mn) and biogenic proxies of productivity (Si, Cu and Cd). Peaks in organic C downcore testify episodes of high biological productivity probably related to climatic optima and thus to a significantly reduced ice cover (Holocene, Eemian).

In addition, statistical analyses on geochemical, mineralogical and textural data can help subdivide sedimentary intervals downcore based on provenance and palaeoenvironmental/palaeooceanographic conditions and, ultimately, can correlate sediment clusters with climate changes.

Biostratigraphy of the Mosasauridae (Reptilia) from Antarctica*
(oral p.)

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A number of expeditions to Seymour, James Ross and Vega islands, Antarctic Peninsular region, have resulted in significant specimens of mosasaurs (marine lizards). Enough taxonomic diversity is now known (e.g. MARTIN et al. 2002) to allow preliminary biostratigraphic assessment. These specimens were collected from the Early to Late Campanian Santa Marta Formation, the Late Campanian to Early Maastrichtian Cape Lamb Member of the Lopez de Bertodano Formation, and the Late Maastrichtian Sandwich Bluff Member of the Lopez de Bertodano Formation. All specimens are from nearshore marine deposits, and an overall shallowing appears in younger successions. Most mosasaur individuals are represented by single specimens, but occasional jaws and cranial material are encountered. Based upon these specimens, tylosaurines appear in the Santa Marta Fm. and extend into the lower Lopez de Bertodano Fm., Plioplatecarpines and *Leiodon* extend from the Cape Lamb into the Sandwich Bluff mbrs., and *Mosasaurus* and cf. *Moanasaurus* occur in the lower Lopez de Bertodano Fm. Therefore, the extent of mosasaur range in Antarctica is similar to that elsewhere in the world where the bulk of mosasaur differentiation occurred in the Campanian and Maastrichtian. Some differences in taxa occur between Antarctica and elsewhere, but these are at generic levels, not subfamilial. The tylosaurine genera may be endemic, and if the *Moanasaurus* reference is substantiated, this genus is known elsewhere only from New Zealand. Therefore, the ranges and occurrences of taxa suggest a mix of endemic and cosmopolitan genera. Additional field work is required to refine biostratigraphic ranges, and the ranges of many taxa such as that of *Mosasaurus* will be extended.

Martin, J.E., Bell, G.L., Jr., Case, J.A., Chaney, D.S., Fernandez, M.A., Gasparini, Z., Reguero, M. & Woodburne, M.O. (2002): Bull. Royal Soc. New Zealand 35: 293-299.
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British Antarctic Survey vertebrate fossils from the Late Cretaceous Lopez De Bertodano Formation, Antarctic Peninsula area*

(poster p.)

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Members of the British Antarctic Survey collected numerous marine vertebrate fossils from the Lopez de Bertodano Formation (Campanian through Maastrichtian) from Seymour Island, Antarctica. Included within the assemblage at Cambridge are sharks, teleosts, plesiosaurs, and mosasaurs. Sharks are represented principally by teeth, but some ossified vertebrae occur; taxa include: Chimaeridae, Hexanchidae (*Notidanodon*), Odontaspidae (*Odontaspis*) and Cretoxyrhinidae (*Cretolamna*) . Few teleost fish occur and include Enchodontidae (*Enchodus*) and cf. Sphenocephalidae. Plesiosaurs are represented by the Elasmosauridae. Marine lizards (Mosasauridae) are represented principally by teeth and include: cf. Tylosaurinae, cf. *Plioplatecarpus*, and cf. *Leiodon*.

Fossil specimens in the Cambridge collection are normally relatively large and fragmentary due to postmortem disaggregation in the relatively high-energy, near-shore marine environment of deposition, as well as fragmentation from subaerial exposure in the harsh Antarctic environment. Elements represented are usually isolated, resistant elements as exemplified by shark and fish teeth. Interestingly, teleosts are relatively underrepresented compared to fish numbers in other Late Cretaceous marine deposits. Mosasaurs and plesiosaurs are well represented, but in contrast to the Late Cretaceous deposits of central North America, plesiosaurs are more abundant than mosasaurs in Antarctica. Interestingly, a relatively great number of juvenile marine reptile elements were observed. Surprisingly, marine turtles, which occur in nearly every other Late Cretaceous marine assemblage, were not found, and although their absence may be due to collection bias, they may not have occurred at such high latitudes.

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Main results of the Russian ground-based geophysical research of the subglacial Lake Vostok, central East Antarctica
(oral p.)

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Lake Vostok located in East Antarctica, is the largest subglacial water body on our planet. First geophysical studies in this area were carried out in the late 1950th - early 1970th. However, only after the publication of satellite altimetry data (1993), these geophysical materials were revised confirming the existence of a vast subglacial lake, whose comprehensive research due to uniqueness of this phenomenon began immediately by scientists in different fields.

During the austral summer field seasons of the 41st - 48th RAE (1995-2003), the Polar Marine Geological Research Expedition (PMGRE) carried out ground-based geophysical research in the framework of the Russian Antarctic Expedition (RAE) aimed to investigate the geological structure of the subglacial Lake Vostok area. Ground-based geophysical studies (radio-echo and reflection seismic soundings) under the conditions of central Antarctica required creating special equipment and developing operational methods of studies in order to obtain maximum reliable information on the ice sheets of large thickness (greater than 4000 m). More then 200 seismic shots and more then 2400 km of the radio echo sounding profiles were made during this period. The seismic studies were predominantly undertaken in the vicinity of borehole 5G-1 (Vostok Station) and along the reference profiles across and along the lake.

As a result of radio-echo profiling, lake contouring was made for the first time (more than 100 intersection points). An analysis of data obtained allowed us to determine the dimensions and configuration of the coastline of the subglacial water body that differed from the contours in the satellite altimetry data. According to our estimates, the lake surface area comprises around 17000 km. There is a strong meandering of the west shore, which is gentler unlike the steeper east shore.

Radio-echo and seismic studies indicate that the ice sheet thickness above the lake ranges from 3650 to 4350 m (the maximum measured ice thickness above the lake). The lake water table has a complicated geometrical shape and is located below the sea level in depths of -700 m in the north to -200 m in the south. Using radio-echo sounding data, small subglacial water bodies located beyond the boundaries and above the main lake level were detected.

Two areas are defined in the lake basin - deepwater with typical depths of more than 200 m and shallow water up to 200 m. The first is situated in the southern and central parts while the second one occupies the northern and southwestern parts. The maximum measured thickness of the water layer comprises around 1200 m.

The obtained seismic materials do not testify to the presence of loose sedimentary deposits of large thickness (100 m and more), although they do not exclude a possible presence of a non-consolidated layer up to 100 m thick. A comprehensive analysis of gravimetric and seismic data suggests the presence of a consolidated sedimentary mantle 3-5 km thick.

For a by-stage continuation of drilling operations in borehole 5G-1 using the method of vertical seismic profiling, the distance from its bottom to the subglacial lake surface was determined, which comprises 130 m.

Paleomagnetic and rock-magnetic study of deep-sea sediments in central Wilkes Land margin, East Antarctica

(poster p.)

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Paleomagnetic study was made on a deep-sea sediment core obtained from Central Wilkes Land Margin. Long-term secular variation of the geomagnetic field during the last 1 Ma recorded in the core. The sediment material was siliceous silt and showed olive grayish. Abundant foraminiferal skeletons in good preservation were observed throughout the core. They clearly indicate oxidized condition, which gives additional stability of magnetic mineral against alteration throughout burial diagenesis. Paleoclimatically induced lithological variations were not observed. It implies an environmentally stable condition.

The natural remanent magnetization (NRM) direction after thorough stepwise AF demagnetization revealed that the core contains at least 3 polarity intervals. Rockmagnetic parameters, such as saturation magnetization (Js), saturation remanence (Jr), magnetic susceptibility (χ), anhysteretic remanent magnetization (ARM), coercivity (Hc), and remanent coercivity force (Hcr) were measured. They revealed the characteristic magnetic properties of the sediments. Many samples have high coercivities and exhibited a linear change in AF demagnetization experiments. Above the B/M boundary zone, the median destructive field (MDF) lies in the 35–77 mT and the average of MDF is remarkable high value of 56.6 mT. We also performed thermomagnetic analysis (applied fields: 1.0 T) in vacuum. Most of the samples from upper and lower of the core showed characteristic irreversible changes in the heating-cooling cycle. The conspicuous depressions between 200 and 220 degree centigrade, and humps between 220 and 350 degree centigrade were detected in Jr-T, Hc-T and Hrc-T curves. The values of Js and Jr after cooling are three times higher than before heating. In the second heating-cooling cycles in vacuum, the thermomagnetic curves became reversible. For further study, X-ray analysis and observations of magnetic minerals with TEM was carried out. It strongly demonstrated that the sediment core is rock-magnetically uniform and its homogeneity of magnetic mineralogy and magnetic grain size is definitely suitable for paleointensity estimation. The relative paleointensity was obtained from NRM intensities remaining after demagnetization at 30 mT (NRM_{30mT}) normalized by ARM intensity at 30 mT demagnetization (ARM_{30mT}). The appropriateness of the normalization was checked by absence of correlation between the normalized intensity (NRM_{30mT} / ARM_{30mT}) and the normalizer (ARM_{30mT}). The normalized intensity variation showed good correlations with other paleointensity records previously published and thus was used for age control of this core. Hence our core was obtained with a gravity corer, it reliably provided not only inclination variation but also declination variation. The declination variation well correlates with other declination records obtained from the western equatorial Pacific Ocean. It implies our paleomagnetic records possibly reflect a global change of geomagnetic field variation.

Evaluation of an appropriate estimation strategy for the highly precise regional deformation network Antarctic Peninsula
(oral p.)

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Within the framework of the SCAR and two bundle projects funded by the Federal Ministry of Science and Research of Germany (BMBF) the Geodetic Institute of the University of Karlsruhe (GIK) layed the foundations to evaluating and eliminating the effects of various error sources affecting and limiting GPS positioning in Antarctic regions.

The current work of the GIK working group focusses on the hard effort to determine a highly precise height component. Strategies concering the functional model are recent research topics. The most present-day results are presented, related especially to tropospheric and antenna modelling and their effects on the GPS results (e.g. internal precision, height estimates). It is demonstrated in which way incorrect modelling can affect the geodetic results, which are the basis of field or research work of other geosciences. Furthermore unsolved problems and future goals are discussed.

Activities to achieve an appropriate estimation strategy for the highly precise regional deformation network Antarctic Peninsula
(poster p.)

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The current work of the GIK working group focusses on the hard effort to determine a highly precise height component. Strategies concering the functional model as well as the stochastic part are recent research topics. An overview of the most present-day results is presented, related especially to tropospheric and antenna modelling as well as to neglected correlations in state-of-the-art scientific GPS software. Furthermore unsolved problems and future goals are briefly addressed.

An aeromagnetic survey south of the Prince Charles Mountains, East Antarctica
(poster p.)

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This study presents the methodology, data and preliminary interpretations of the airborne magnetic data acquired as part of the Prince Charles Mountains Expedition of Germany and Australia 2002/2003 (PCMEGA). The area of study covered part of the Southern Prince Charles Mountains, East Antarctica, from ca. 72°45' to 77°30' latitude and 62° to 72° longitude. Within a month of field work a total of 20515 km of survey lines at 5 km line spacing and 25 km tie-line spacing was acquired over an area of approximately 81000 km^2. The main grid extended over 350 km, from Wilson's Bluff to about 78°S. To the north of Wilson Bluff, a section over the upper Lambert Glacier towards the Mawson Escarpment was added to bridge a gap to previous Russian aeromagnetic data. The survey was carried out using a Twin Otter as a platform for the aerogeophysical operation which included also gravity and ice radar measurements. An auxiliary tank permitted a total of 6 hours data collection before refuelling. Magnetic base stations were located at the base camp at Mt. Creswell approximately 160 km northwest of the survey area and at Wilson Bluff located just at the northern perimeter of the main grid.

Interpretations of existing Russian magnetic data (north of this survey area) suggest a possible extension of the Lambert Rift system, however the direction and nature of this rift remains uncertain. Preliminary interpretations of the newly collected data have allowed distinction of major geological blocks and magnetic trends, which can be correlated with the known geology of the Southern Prince Charles Mountains. The objective was to contribute to the understanding of the Lambert/Amery rift system and it's possible extension underneath the polar ice cap. This will provide a better understanding of the formation and breakup of Gondwana.

Holocene sea-level and climate fluctuations in Bunger Hills, East Antarctica, reflected by the sedimentary diatom succession in Rybiy Khvost Bay

(poster p.)

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The Bunger Hills (101°E, 66°10'S) constitutes the largest deglaciated coastal area (oasis) of East Antarctica. It is bordered by the Shackleton Ice Shelf to the north, the Antarctic Ice Sheet to the southeast, and outlet glaciers to the northeast, south and west. The oasis comprises a large contiguous land area of about 280 km^2 in the south (Southern Hills) that is separated from numerous islands in the north by marine bays and inlets (epishelf lakes). These waterbodies have a hydraulic connection to the open ocean beneath the Shackleton Ice Shelf and partly floating glaciers.

A 13 m long sediment core (PG1173) was recovered from 91 m water depth in Rybiy Khvost Bay (Fishtail Bay), a fjord-like bay that penetrates deeply into the northern Southern Hills. The core consists of a massive, overconsolidated diamicton at its base, which is interpreted as a till deposited from grounded ice masses. Deglaciation of the area is reflected by partly laminated clastic silts and clays. The upper c 12 m of the record are composed of widely homogeneous sapropels which, according to 20 ^{14}C dates, have been formed with as widely constant rate since 9500 cal. yr BP.

We present results from diatom analyses carried out on 250 samples throughout the entire glacial and postglacial sediment succession of core PG1173. A clear dominance of marine over fresh- water taxa in the clastic sediments overlaying the till evidence that deglaciation of the area was associated with a marine transgression. The marine inundation probably caused floating and thus destabilisation of the ice masses. The subsequent sapropel deposition indicates a stagnant waterbody with anoxic bottom water at the coring site not only today, as known from hydrological measurements, but all the time since 9500 cal. yr BP. This in turn hints on the occurrence of a sill that restricts deep water circulation between Rybiy Khvost Bay and Kakapon Bay to the north, and of limited melt-water supply being also evident from the almost exclusive occurrence of marine diatoms. A negligible supply of ice-rafted debris into Rybiy Khvost Bay is shown by the absence of coarse-grained sediment components. Hence, fluctuations in the marine diatom assemblages in the sapropel have to reflect predominantly changes in the regional temperature and sea level, with the former influencing sea-ice density and duration and the latter influen-cing water exchange with the Kakapon Bay.

Between 9500 and 5250 cal. yr BP relatively high amounts of planktonic open-ocean species indicate more free access of oceanic waters into Rybiy Khvost Bay than that of today, probably in consequence of a higher relative sea level. Information on the holocene temperature development comes from the concentration of planktonic ice-associated diatoms, and of benthic diatoms, which likely are supplied by sea ice since they cannot grow in the deep and anoxic waters at the coring site. Based on these assumptions, simultaneous minima in planktonic ice-associated and benthic diatoms indicate that significantly warmer temperatures than those of today occurred in the periods 9500-9000, 8700-7700 and 3800-1700 cal. yr BP, and probably during two short intervals about 4700 and 300 cal. yr BP. Thereof, the period 3800-1700 cal. yr BP probably was the warmest, because it is the only one with high concentrations of *Chae-toceros resting spores* (*Chaetoceros sp.*) being associated with high concentrations in more significant ice-associated diatom such as *Thalassiosira latimarginata* and *Thalassiosira nordenskoldii.*

Some recent characteristics of geomagnetic secular variation in Antarctica
(oral p.)

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Geomagnetic Observatories are designed to undertake a continuous monitoring of the Earth's magnetic field time variations and specifically oriented at the recording of the absolute level of magnetic field time variations on a very long time scale, in order to reveal secular variation features.

For what concerns Geophysical Observatories, and Geomagnetic Observatories in particular, Antarctica, for its well known hostile weather conditions, is one the most poorly covered areas in the world. At the same time, however, there is a great interest in knowing secular variation behaviour in this area for many reasons. Some of the most interesting features of the Earth's magnetic field are displayed in polar areas, where the geomagnetic field dipole poles are located, and the location of the dip poles can be followed only if secular variation models are defined; all magnetic anomaly maps are realized after a removal of the main part of the geomagnetic field is undertaken and time reduction of magnetic surveys relies on secular variation models.

In this work a study of all available long term observations that can be used to infer secular variation behaviour and its unusual characteristics, is reported. Also the peculiar phenomenon of geomagnetic jerks, as observed in Antarctica, is investigated by means of both single and multi-station analyses applied to the longest series of geomagnetic absolute data. The results will be discussed also in terms of possible explanations about the mechanisms that produce and maintain the geomagnetic secular variation.

Tectonic evolution of the Fueginan Andes and the Magellan fold-and-thrust belt, Tierra del Fuego Island, since Mesozoic

(oral p.)

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The Fueginan Andes are considerated the orogenic belt South of the Strait of Magellan and developed along the western and southern margin of the Tierra del Fuego Island . The Andean Cordillera with a N-S-trending for 3800 km, bends progressively towards E-W trend in correspondence of the Tierra del Fuego Island linking to the eastern northern Scotia Ridge. This progressive rotation is marked by left lateral wrench faults of the Magallanes-Fagnano system.

The belt was originated along a collisional margin by horizontal shortening and crustal thickening, with huge and widespread magmatic emplacements in the late Cretaceous and Cenozoic time. The Mesozoic-Cenozoic Andean orogenic cycle evolved from crustal stretching and widespread silicic volcanism in Middle to late Jurassic, associated with the break-up of Gondwanaland. The continental regions of Southern South America and Antartica Peninsula were not yet physically separated within Gondwana. In the Early Cretaceous mafic volcanism increased with the development of the Rocas Verdes back-arc basin. It was floored with the oceanic crust of the ophiolitic complex, which outcrops now from more than 800 km from Cape Horn to the North of Sarmiento Cordillera. The change of the tectonic regime started in the Albian, probably related with the changes of plate drift with the closure and the inversion of the Rocas Verdes basin. The uplift of the Cordillera, the emplacement of plutonic rocks and the intracontinental polyphase deformation occurred in the late Cretaceous. In the Fueginan Orogen, a high grade metamorphic rock of the Upper Paleozoic to Lower Teriary of the Cordillera Darwin, and the Ophiolitic Complexes of the Rocas Verdes basin, form the major stack of the internal thrusts. The emplacement towards the continent of the different thrusts sheets, in- or out-of-sequence, produced rapid exhumation of the basement rocks and the shortening of the 7000m-thick siliciclastic sedimentary cover of the Magellan foredeep basin, with the formation of a NE verging fold-and-thrust belt. From Mid-Cretaceous to present E-W sinistral wrench tectonics affected the region as a component of the relative motion between South America and the Antarctic Peninsula intimately related to the complex tectonic events, responsible from the late-Oligocene of the development of the oceanic floor in the western Scotia Sea.

The principal tectonic features in the Tierra del Fuego Island evidence the transtensional wrench lineaments. The main structures are asymmetric and restricted pull-apart basins constituted by several segments in an en-echelon arrangement with a ESE-WNW trend, connected with releasing side-steps structures. The shear zones, forming part of the E-W left-lateral strike-slip Magallanes-Fagnano fault system, was identified in the field along part of the shore of the Lago Fagnano, in the Atlantic coast shore line. The outcropping rocks are strongly deformed and metamorphosed in the N-verging fold-and-thrust belts, and splay structures related to N-S-trending faults. The extensional fault system, with a ESE-WNW trend, includes sub-vertical structures with cumulative offset of hundreds of meters. Deformation is of both brittle and ductile types while the kinematic analysis indicates aprevalent left lateral transtensional motion. These transtensional structures are superposed onto the older lineaments and suggest that they may have reactivated pre-existing weak zones formed by Cretaceous- Tertiary shortening.

Geological evolution of the Schirmacher Hills from U-Pb zircon dating and a comparison with the Wohlthat Massif, central Dronning Maud Land

(poster p.)

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Schirmacher Hills (SH) are underlain by high-grade metamorphic lithologies of both sedimentary and igneous origin, intruded by variously deformed mafic dykes and felsic veins. Presumably metasedimentary rocks are: 1) Bt-Grt gneiss, partly migmatitic, 2) intercalated calc-silicate, mafic granulite, charnockitic gneiss, 3) semi-pelitic and pelitic Sil or Bt, Grt-bearing gneiss. Presumably meta-igneous rocks are: 1) variegated felsic (charnockitic and enderbitic) gneisses, their retrogressed Hbl-bearing counterparts and migmatite, in places containing highly deformed K-Fsp megacrysts, 2) mafic schist (two-pyroxene or amphibole-bearing), 3) felsic orthogneiss of at least three generations. The rocks underwent a complex geological history comprising polymetamorphism and multiple episodes of ductile deformations and folding (DASGUPTA et al. 2001 and references therein).

Zircon populations from three lithologies were dated by conventional U-Pb techniques. Four size fractions of mixed igneous (prismatic, but mostly recrystallized) and metamorphic (rounded) zircons from a Hbl-Grt-Bt gneiss of the variegated group define a discordia (MSWD = 0.8) with an upper intercept at 1155 ±2.4 Ma and lower intercept at 0 Ma. Four size fractions of optically similar zircons of predominantly rounded shape recovered from a Bt gneiss representing presumably the oldest felsic orthogneiss define a discordia (MSWD = 2.7) with an upper intercept at 1137 ±30 Ma and lower intercept at 681 ±43 Ma. Nine size/morphology type fractions of igneous and metamorphic zircons from an Opx-bearing orthogneiss of presumably the second felsic intrusion form a discordia with an upper intercept at 712 ±20 Ma, and lower intercept at 554 ±2 Ma (MSWD = 0.54). Rounded zircons of deformed and metamorphosed mafic dykes yielded nearly concordant U-Pb ages; their $^{207}Pb/^{206}Pb$ ages of 625–620 Ma are interpreted to closely date the late-stage high-grade metamorphism and final stage of deformation (HENJES-KUNST in press). Conventional U-Pb dating of monazite of a post-tectonic pegmatite gave concordant age of 610 Ma while SHRIMP dating of igneous zircons from a post-tectonic lamprophyre yielded an age of 590 Ma (HENJES-KUNST in press and in prep.). That proves that Pan-African age of ca 554 Ma reflects hydrothermal/fluid activities rather than magmatic or deformation event. On the contrary, the ca 712 Ma age most likely dates the orthogneiss intrusion which probably also accounts for Pb loss in zircons of the Bt gneiss. The upper intercept ages of ca 1135 and 1155 Ma defined by both metamorphic and igneous zircons are interpreted to date the emplacement of the protolith of the orthogneisses closely followed in time by an early stage of high-grade metamorphism of the SH rocks.

The geological history of the SH (Tab. below) differs significantly from that of the Wohlthat Massif (JACOBS et al. 1998 and references therein). In spite of roughly coeval c 1150 Ma metamorphic rock precursors in both areas, the known syn-tectonic granite ages strikingly diverge, and peak tectonic activities in the former area seem to have terminated by 625 Ma while in the latter it lasted until the Cambrian. Thus the Pan-African tectonics in the central DML were multiple, with the younger structures occurring in the south, and the two areas may represent different crustal blocks.

Schirmacher Hills		Wohlthat Massif	
		Post-tectonic charnockite	512 Ma
Hydrothermal/fluid overprint	550 Ma	High-grade metamorphism	530–515
Post-tectonic lamprophyre dykes	≤ 590 Ma	Syn-tectonic granite	530 Ma
Post-tectonic pegmatite	610 Ma	High-grade metamorphism	570–550
Syn-tectonic mafic dykes	625 Ma	Anorthosite	600 Ma
Orthogneiss (syn-tectonic granite?)	710 Ma	Syn-tectonic granite	1080 Ma
Felsic orthogneisses	1150 Ma	Banded gneiss (volcanism)	1140–1130

Dasgupta, S., Sengupta, S., Bose, S. et al. (2001): Gondw. Res. 4: 337–357.
Jacobs, J., Fanning, C.M., Henjes-Kunst, F. et al. (1998): J. Geology 106: 385–406.
Henjes-Kunst, F. (in press): Geol. Jb.

East Antarctica crust growth from the isotopic data
(oral p.)

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Extensive isotope geochemistry data suggest that most varieties of the exposed Antarctic igneous and metamorphic assemblages, except the oldest (>3.5 Ga) Napier Complex in Enderby Land, were mainly formed at the expense of crustal material whose emplacement age considerably exceeds the time of formation of the analyzed specimens, sometimes by more than 1.5 Ga. Extensive areas of East Antarctica are mostly underlain by rocks with crustal residence time (Sm-Nd T_{DM}) within 3.3-2.4 Ga (most of Enderby Land, south Prince Charles Mountains, Prydz Bay area and eastern regions up to northern Victoria Land) or 2.4-1.7 (±0.1) Ga (most Dronning Maud Land, northern Prince Charles Mountains, parts of Shackleton Range). Transantarctic Mountains and minor parts of the Dronning Maud Land and central Prince Charles Mountains are underlain by rocks with T_{DM} between 1.7 (±0.1) and 1.1 Ga.

The mode and the geodynamic environment of emergence of the Archean and Paleoproterozoic crustal protoliths are largely unknown although their sporadic presence throughout the greatest part of the continent is now well established. Regionally traceable Precambrian events broadly correspond to the Mesoproterozoic cycle (1.7-1.1 Ga) and its terminating Grenvillean orogeny. The nature of this orogeny remains contradictory, since the assemblages of this age exhibit features suggestive of variable geodynamic environments. No appreciable crustal growth can be attributed to the Grenvillean event which was, perhaps, essentially healing of weakened zones in the older continental lithosphere of Rodinia, with local manifestations of subduction-related magmatic activity and limited evidence of formation of new continental crust (western Dronning Maud Land, Sor-Rondane Mountains, central Prince Charles Mountains).

The late Neoproterozoic to early Paleozoic (Pan-African) tectonic processes in East Antarctica were entirely (or at least mostly) of within-plate origin and did not involve formation of mantle-derived rocks, though were obviously responsible for generation of large amounts of anatectic melts resulting in emplacement of predominantly mid-crustal anorogenic intrusions accompanied by transtenional and thrust tectonics in the upper crust. Mid-Neoproterozoic (800-600 Ma) events are only poorly manifested in East Antarctica. Ca 850 Ma mafic dykes (Beliatsky and Laiba unpubl.) are known from central Prince Charles Mountains, and may represent the only known Neoproterozoic mantle-derived rocks. Thus, the Antarctic geological data provide only faint evidence for Rodinia break-up and dispersal.

The c 500 Ma Pan-African event may have been related, if less directly, to assembly of Gondwana, though no evidence for a true suture zone, nor juvenile volcanics of this age, yet have been found in Antarctica. A possible exception may be poorly dated ophiolite assemblage in the Shackleton Range (TALARICO et al. 1999). Nevertheless we believe most tectonic and magmatic events of this age in East Antarctic Shield reflect compressive, or rather transpressional mid-crustal within-plate processes in response to collision of continental blocks during Gondwanaland amalgamation. In the Transantarctic Mountains the synchronous Ross events apparently included extensive subduction-related magmatic processes, although the existence of a Late Precambrian Palaeo-Pacific ocean in place of West Antarctica is not conclusively confirmed.

On the basis of the above observations we believe that throughout its geological history Antarctica (or at least the eastern part of the continent) experienced considerable crustal growth with 3-4 Archaean to Palaeoproterozoic nuclei amalgamated into a continent in Palaeoproterozoic time. Since that time Antarctica behaved as a continental unity whose integral parts never experienced complete separation by major, long-lived oceanic openings.

Talarico, F. et al. (1999): Terra Antartica 6.

Detailed Argentina Islands small ice cap geomorphology

(poster p.)

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The geomorphology survey of the ice caps of the small islands in Antarctic Peninsula region within the framework of the GIS development project for the Argentina Island archipelago is discussed. The main objectives of the GIS-project are: (1) the high precision network creation of the geodesic stations in the vicinity of Ukrainian Antarctic Vernadsky station on the base GPS-positioning data; (2) The large-scale digital maps (1:25000) development of the Argentina Islands region (including Petermann Island, Berthelot Island, adjacent Antarctic Peninsula area). There are three stages of GIS development corresponded to the objectives. The software installation and development, data layers composing: geomorphology, ecology, glaciations, birds and plants, geology. Within 2001/2003 seasons high precision coordinates of geodetic survey marks were measured and local geodetic network was installed on Galindez Island. On the base the photogrammetric survey the large-scale digital map (1:1000) of the Marina Point of Galindez Island was created. The continuous geomorphology survey of the ice caps on Argentina Island archipelago on the base of GPS and photogrammetric survey was started.

The changes of the size, the shape and the edge position of ice caps on Argentina Island archipelago shows the possibility to use the geodetic survey data of the caps to study the regional climate variability. The research is based on historical data of Galindez island ice cap observation (THOMAS 1963). The data of fifty years meteorological observations and tide data at Faraday/Vernadsky station, long-term variability in sea-ice extent/thickness, monitoring of ozone layer and UV energy flow, hydrology measurements provided at Vernadsky, the upper atmosphere change measurements over Antarctica, are the additional sources for climate pattern of Antarctic Peninsula. The geodesy survey technology for the small island ice caps investigation in the Vernadsky station region is presented. It is underlined the expediency of the reflection of glacier close parts in the vertical section. The detailed Galindes Island map (1:1000) is presented.

Thomas, R.H. (1963): Brit. Antarct. Surv. Bull. 2: 27-43.

Provenance of the Trinity Peninsula Group, northern Antarctic Peninsula
(oral p.)

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The Trinity Peninsula Group of the northern Antarctic Peninsula is an accretionary complex consisting of turbiditic rocks, with minor conglomerates and volcanic units, that formed during oblique sinistral subduction along the palaeo-Pacific margin of Gondwana. The relationship of the Trinity Peninsula Group to terranes defined in the southern part of the Antarctic Peninsula is not clear. The current study aims to improve our understanding of this part of the continental margin by examining the provenance of detrital zircons in typical Trinity Peninsula group sediments, and by studying the age distribution of detrital zircons and clasts in the distinctive conglomerates at View Point.

Detrital zircon age distributions from typical Trinity Peninsula Group sandstones from Hope Bay and the Gaston Islands are dominated by complex Permian zircon populations, with mean ages of 274 ±5 Ma and 275 ±4 Ma respectively. Permian zircons make up more than 60 % of analysed grains in the Hope Bay sample; the remaining grains scatter between 350 and 600 Ma, and between 1000 and 1600 Ma. In the Gaston Islands sample, Permian zircons make up 30 % of the total. Significant populations also occur at c 480, 530 and 560 Ma, while the oldest grains give Grenvillian (1000-1100 Ma) ages.

A typical granite clast from the View Point conglomerate has previously given an age of 463 ±5 Ma, while a clast with unusually high $^{87}Sr/^{86}Sr$ has been dated at 3161 ±13 Ma (MILLAR et al. 2002). Three further igneous clasts have now been analysed using SHRIMP. A porphyritic volcanic clast gives an age of 486 ±5 Ma, while two granite clasts give ages of 468 ±5 Ma and 369 ±5 Ma.

Detrital zircons in a quartzite clast from the View Point conglomerate are dominated by a complex grouping between 500 and 700 Ma, with a significant late Mesoproterozoic to early Neoproterozoic population; a few grains give Palaeoproterozoic and Archaean ages. A few grains give young ages, between 310 and 420 Ma, which are thought to reflect real provenance ages rather than Pb-loss. Detrital zircons in sandstone matrix from the same conglomerate show a similar age distribution to the quartzite clast. Most grains give ages between 490 and 650 Ma, while a few give older Proterozoic and Archaean ages. A few grains give younger apparent ages, including a single grain that is concordant at 320 ±5 Ma. Again, this is thought to represent a true provenance age.

The detrital zircon patterns shown by the quartzite clast and sandstone matrix from the View Point conglomerate are similar to those of Cambrian to Ordovician sedimentary rocks on the Gondwana margin, and it is possible that they were derived largely by erosion of such a source. The few younger grains may have been derived from the zircon-poor granites that are present as clasts within the conglomerates. Trinity Peninsula sandstones from Hope Bay and Gaston Islands do not contain Palaeoproterozoic and Archaean zircons, as would be expected if they were derived from Gondwana-margin sediments.

Permian detrital zircons are ubiquitous in Permo-Triassic sedimentary rocks along the Pacific margin of Gondwana, including the typical Trinity Peninsula Group lithologies described here. The absence of Permian or younger zircons in the View Point submarine fan conglomerate is important, in terms of constraining the age and environmental significance of the deposits, particularly if they can be shown to represent glaciomarine deposits or reworked Palaeozoic glacial tillite.

Millar, I.L., Pankhurst, R.J. & Fanning, C.M. (2002): J. Geol. Soc. London 159: 145-157.

Patagonia – Antarctica connections before Gondwana break-up

(oral p.)

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The way as Antarctica and South America were connected before, during and after the existence of Gondwana has been thoroughly discussed during the past decades (MILLER 1983). However, in the meantime all regional specialists agree in that a close spatial relationship of the Antarctic Peninsula and Patagonia/Tierra del Fuego) existed during Gondwana times. Recent palaeomagnetic results in the Weddell Sea (GHIDELLA & LABRECQUE 1997, GHIDELLA et al. 2002) and palaeontological evidence from turbidites of the South Shetland islands (Hurd Peninsula, Livingston Island) confirm this hypothesis.

Within this context recently new stratigraphic evidence has arisen for the continuous time-related deposition of turbidites at the Gondwana Pacific margin from Carboniferous to Late Cretaceous. In Patagonia, at the eastern slope of the Andes, Carboniferous phyllites are widespread, while at the westernmost outcrops, turbidites previously considered as being Devonian have been dated as Upper Triassic and partly possibly younger (HERVÉ & FANNING 2000).

In the South Shetland Islands, which before the opening of the Bransfield Strait were a coherent part of the Antarctic Peninsula, an Upper Tithonian ammonite (*Blanfordiceras*) has been described within equivalents of the Miers Bluff Formation from a probably autochthonous block (PIMPIREV et al. 2001). Also, Late Cretaceous nannofossils were found in outcrops of the Myers Bluff Formation (STOYKOVA et al. 2002). More inwards into the Gondwana continent, at the north-west coast of the Antarctic Peninsula, Upper Triassic fossils evidence the contemporaneous deposition with the fossil-bearing turbidites in western Patagonia (Chonos Archipelago). The Cretaceous metamorphic rocks of Tierra del Fuego and the Cretaceous flysch-like turbidites of the eastern slope of the Andes of Ultima Esperanza are not directly related to these successions.

On the other hand, Upper Jurassic and Cretaceous turbidites are not known in westernmost Patagonia.. However, large outcrops of Jurassic and Cretaceous successions occur in the Antarctic Peninsula. Thus, a continuous Pacific-ward migration of the Gondwana margin basin filling developed from the Carboniferous to the Cretaceous, if the Antarctic Peninsula is admitted to have been adjacent to the Pacific margin of Patagonia up to the Late Cretaceous. Only at the beginning of the Cenozoic, strong left lateral transpression produced the break-up of the Gondwana margin and the gliding of the Antarctic Peninsula relatively to the south. This process continued with the opening of the Drake Passage from the Eocene onwards.

Ghidella, M.E. & LaBrecque, J.L. (1997): In: C.A. Ricci (ed.). The Antarctic Region: Geological Evolution and Processes: 441-451. Terra Antarctica Publication, Siena.

Ghidella, M.E., Yáñez, G. & LaBrecque, J.L. (2002): Tectonophysics 347: 65-86.

Hervé, F. & Fanning, C.M. (2000): Rev. Geol. Chile 28: 91-104.

Miller, H. (1983): In: R.L. Oliver, P.R. James & J.B. Jago (eds.). Antarctic Earth Science: 579-581, Austr. Acad. Sci., Canberra.

Pimpirev, Ch., Ivanov, M., Dimov, D. & Nikolov, T. (2002): N. Jb. Geol. Paläont., Mh. (6): 377-384.

Stoykova, K., Pimpirev, Ch. & Dimov, D., 2002, J. Nannoplancton Res. 24: 166-167.

Initiation of the Antarctic geological research programme of the Czech Republic
(poster p.)

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The Czech Republic has initiated a process to acquire the full membership in the Antarctic Treaty. As a part of this process, the Antarctic Law has been passed and the construction of the Czech base was financed. Under the support of the Ministry of the Environment, a geological research programme has been arranged.

In this early stage of our involvement, the main issues we would like to pursue are attached to the base-location and broad surroundings. The chosen place for base-construction is the Brandy Bay on the NW coast of James Ross Island, the northeast part of the Antarctic Peninsula (63°50'S, 57°58'W). The location of the base was discussed and widely accepted at the XXV Warsaw ATCM in 2002. The environmental impact assessment at the Comprehensive Environmental Evaluation is beeing carried out during 2003 hence the building of the base is not estimated until 2004. The base is for up to 15 people (maximum summer population).

The field of the future Czech research consists of two main distinctive geological areas - James Ross Island and Trinity Peninsula. The greater part of James Ross Island is occupied by the Mt. Hadington shield volcano represented by the Neogene alkalic basalts forming hypabyssal lava flows and associated pyroclastic rocks. The northern coast of James Ross Island is formed by unmetamorphosed Cretaceous rocks, which were accumulated in the back-arc James Ross marine sedimentary basin. The present glaciation consists of central icefields with outlet glaciers, and small cirque glaciers (LUNDQUIST et al. 1995). The Trinity Peninsula (the NE tip of Antarctic Peninsula) is formed by the prevailing Trinity Peninsula Group - complex of strongly deformed and low-grade metamorphosed Permo-Triassic flysch sediments, interpreted as the upper level of an accretionary prism (SMELLIE et al. 1996), together with polyphase intrusions of calcic to calc-alkalic, metaluminous granitic rocks of the Peninsula batholith (LEAT et al. 1995), accompanied by acid and mafic alkaline volcanics and mafic dykes.

The Czech Geological Survey, in cooperation with the Faculty of Sciences, Charles University Prague has started to arrange the Antarctic Geological Research Programme. The main objectives of the processed summary of the available geological data (MIXA et al. 2002) and of the following implementing project were to postulate main topics for the Czech Geological Research Programme that have not been extensively addressed by other groups yet. The main search outputs have been established as follows:

- Fabric analysis of metamorphic evolution of the basement rocks using the AMS method combined with SEM-based techniques of microstructural analysis, Trinity Peninsula Group.
- Magmatic fabric within the Antarctic Peninsula batholith and possible modes of magmatic emplacement.
- Tectonometamorphic profile across the Antarctic magmatic arc (South Shetland Islands - Trinity Peninsula - James Ross Island).
- Study of sedimentary provenance based on sediment petrology, geochemistry, paleontology and age dating of detrital zircons by laser ablation ICPMS.
- Sequence stratigraphy of James Ross basin's Cretaceous deposits.
- Geomorphological and sedimentological record of the fossil and recent glaciations on James Ross Island and its correlation with glacial record from Prince Gustav Channel, its application for palaeoclimatological and palaeogeographical reconstructions of the area and for the dynamics and rheology of glaciers.

- Geomorphological research of rock glaciers, periglacial and paraglacial features (cryoplanation terraces, periglacial trimlines, valley asymmetry, weathering intensity, present nivation processes and formation of cirque-headed valleys) and their palaeogeographical evaluation.
- Organic industrial air pollutants – its concentration and degradation in the Antarctic environment.

Italian seismographic observatories in Antarctica

(poster p.)

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A real advancement of the knowledge of Earth structure and earthquake source mechanisms can only be achieved through an improved global coverage of state-of-the-art seismographs. The optimal distribution of seismographic stations is still far: the southern hemisphere is very irregularly covered, and Antarctica has only a few instruments in operation. Because of its location, then, Antarctica represents an observation point of special interest to global seismology. Also, seismology can greatly contribute to the knowledge of Antarctic neotectonics through the study of continental seismicity and lithospheric structure. The sporadic distribution of seismographic stations south of latitude -45 both restricts our knowledge of the Antarctic continent, and leads to a bias in the interpretation of global geophysical properties of the Earth. Installation of seismographic stations should therefore be a priority for an Antarctic program having access to infrastructure in the area. We present activities carried on in the framework of the Italian Antarctic program (Programma Nazionale di Ricerche in Antartide, PNRA).

A very-broadband seismographic station (international code TNV) has been installed at the Italian Base, at Terra Nova Bay, during the 1988-89 field campaign. The STS1-VBB sensors are housed inside an 8-meter long tunnel in granite in the neighbourhood of the base. Since 1991 the station is in year-round operation, with power provided in the winter by the unmanned system of the Base. Data are acquired locally in continuous mode. Through a satellite connection, it is currently possible to dial-up to the station and download state of health information, and short data segments.

Because of its position in the interior of the Antarctic continent, Dome C represents an extremely important vantage point for seismology. Its distance from the sea and wave-induced disturbance makes it a potentially very quiet site. Its distance from other stations make its interest high for global studies, for determination of continental lithospheric structure, and for detection of intra-plate seismicity. In the framework of the French-Italian Concordia project - supporting the building of a year-round Base and connected science projects - a permanent seismic observatory, and a small-aperture array, are planned. Preliminary measurements done during three summer campaigns resulted in the design of the characteristics of the observatory, which will start regular operations on completion of the Base, at the end of 2004.

Several national Antarctic programs have concentrated efforts on developing a regional seismographic network to further our understanding of geodynamic processes in the Scotia Sea region and its neotectonic evolution. The Italian PNRA and the Argentinean DNA support the Antarctic Seismographic Argentinean Italian Network (ASAIN) since the early nineties. The ASAIN consists today of four digital broad-band seismographic stations installed at Base Jubany (JUBA, South Shetland Is.), Base Orcadas (ORCD, South Orkney Is.), Estancia Despedida (DSPA, Tierra del Fuego) and Ushuaia (USHU, Tierra del Fuego). Besides enhancing regional seismicity maps and providing the basic information to in vestigate the tectonic settlement and the geodynamics of the Scotia Sea region, ASAIN stations optimize the global station coverage in very poorly instrumented areas such the extreme tip of South America and the South Scotia Ridge. During February and March 2003, remote data recovery tests from Despedida, Jubany and Orcadas stations using satellite telemetry techniques have been succesfully performed as a first step toward the upgrade of the ASAIN stations with remote access facilities.

Surface movement of stone-banked lobes and terraces on Rink Crag, James Ross Island, Antarctic Peninsula
(oral p.)

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A large ice-free area with widely develop periglacial landforms characterize the north part of James Ross Island. Significant climatic warming of this area was recently reported. The response of perma-frost and periglacial landform to the climatic change is expected to be recognized by long term monitoring.

Rink crag (c 400m a.s.l.) is situated on the northwestern part of the island. There are a lot of periglacial features such as rock glaciers, protalus ramparts, patterned ground and frost-crack polygons around and on the top of this crag.

Since 1995, air temperature, active layer ground temperature and maximum winter snow accumula-tion are measured there. Stone-banked lobes and stone-banked terraces in various sizes are wide-spread on the gentle slope toping this crag. The highest part of the crag is covered with a small, pre-sently retreating ice cap. The risers of the stone banked lobes and terraces developed immediately at the foot of the ice cap are low, about 50 cm high, meanwhile, they reach to 5 m on the lower part of the slope away from the ice cap. This high riser size is not common as of solifluction lobe on such gentle slope. Monitoring of marked stones on some stone banked lobes shows the superficial move-ment is rapid on the central upper part of the tread, whereas almost no movement is observed near riser.

Local seismicity detected by the Neumayer seismological network, Dronning Maud Land, Antarctica: tectonic earthquakes and ice-related seismic phenomena
(oral p.)

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Antarctica was believed to be an unusual continent regarding its apparent aseismicity. Nevertheless, this lack of seismic activity can nowadays be explained by the sparse instrumentation of the continent by seismic sensors. Since the deployment of the Neumayer seismological network, and in particular the small-aperture seismic detection array, several local seismic events could be identified. With this seismic antenna the number of detected Antarctic earthquakes increased significantly. In particular, two seismically active regions were identified along the Jutul-Penck-Graben and off Kapp Norvegia. The nature of this seismic activity is not yet fully understood. Especially, the Jutul-Penck-Graben region is of interest since the question arises if this is an active tectonic rift system or if the seismic activity originates or is influenced by post-glacial rebound movements. Better knowledge of hypocentral depths and focal mechanisms will contribute to the understanding of these mechanisms.

The discrimination between tectonic earthquakes and icequakes is a difficult task. Especially, the Jutul-Penck-Graben is the bed of the large Jutulstraumen glacier which generates numerous of icequakes due to its ice masses movements. Nevertheless, icequakes may be discriminated from earthquakes by their frequency contents or spectral characteristics.

The most spectacular events occured during a period of several weeks beginning in July 2000 with sustained seismic signals of several hours duration which were recorded by all stations of the seismological network stations. These strong amplitude signals were preceeded by two local earthquakes which could be localized with high accuracy offshore the continental margin. Wavenumber-frequency analysis of the Neumayer array recordings for the long-duration signals reveal the same backazimuth and slowness as the two earthquakes, suggesting the same source location. The spectral characteristics of these events are dominated by narrow spectral peaks with a fundamental frequency around 0.5 Hz and up to 14 integer harmonics. The spectral peaks slightly vary with time. This spectral behaviour could be observed in the same form at all four stations of the network with an aperture of 280 km.

The origin of these events is not yet clear. Sources of man-made, meteorological, or ionospheric origin can be excluded, since the seismographs are operating independently from each other, and meteorological and space weather conditions were quite normal. The duration of the events as well as the spectral behaviour require sustained, huge mass movement or flow to excite these events. Candidates for such large movements could be movements within or beneath the nearby end of the Jutulstraumen glacier or other ice-related movements, long-lasting landslides downslope the steep continental margin, or movements of magma. Especially the spectral behaviour shows features very similar to volcanic tremor. Consequently, we first thought about a volcanic origin of these events. Nevertheless, estimated azimuths of later occuring events showed complete different directions, suggesting a moving source. From QuickScat satellite radar backscatter images we could recognize the iceberg B9a as a possible source of the signals. Similar events could be observed on at least eight more occasions, where the estimated backazimuths followed the track of the iceberg. The originating mechanism of these tremors is not yet clear. But due to the strong spectral similarities of these signals to volcanic tremor, similar source processes may be suggested. Flow-induced vibrations in crevasse- and tunnel-systems inside the iceberg might explain the sources of these signals. This explanation, on the other hand, might give new insights to explain volcanic tremor generating mechanisms, which are far from being understood.

Myth of the Dufek Plume: Nd, Sr, Pb and Os isotopic and trace element data in support of a subduction origin

(oral p.)

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Mantle plumes provide an attractive and plausible mechanism for the break-up of supercontinents and the often-contemporaneous, and short-duration, generation of voluminous magmas in large igneous provinces (LIPs) (e.g., DAVIES 1988, SLEEP 1990, DALZIEL et al. 2000). Therefore, such a mechanism is being debated at present for the origin of the Dufek layered mafic intrusion and associated lavas of the Ferrar Magmatic Province (FMP), both in the Transantarctic Mountains, Antarctica, with the Shona, Bouvet and Discovery hotspots implicated as the culprits. Believed to be one of the largest bodies of its kind in the world, the Dufek intrusion is located in the Pensacola Mountains, just south of the Weddell Sea in what developed as a recurrently actived mobile belt adjacent to the East Antarctic craton. The intrusion is believed to have been emplaced into a Jurassic failed rift-arm and is geochemically linked with the hypabyssal and volcanic rocks of the FMP, a large igneous province generated in the Mid Jurassic during fragmentation of the supercontinent Gondwanaland. The intrusion is mainly gabbronoritic, but also contains thick layers of cumulate pyroxenite, anorthosite, leucogabbro and magnetitite, non-cumulate granophyre, and meter-scale late silicic dikes. Plagioclase and pyroxene separated from various rock types from the intrusion have initial $^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$ and Pb isotopic ratios that exhibit a wide range (e.g., $^{87}Sr/^{86}Sr = 0.70609 \pm 2 - 0.71656 \pm 1$; $^{143}Nd/^{144}Nd = 0.51213 \pm 1 - 0.51233 \pm 4$; and $^{207}Pb/^{204}Pb = 15.544 - 15.873$). These ratios can vary both between one mineral type in different rocks and between different mineral types in the same rock. Differences between minerals in the same rock become more pronounced toward the top of the intrusion, explicable by the assimilation of a small amount of the area's Precambrian to Permian metasedimentary rocks. A $^{187}Re/^{188}Os$ versus $^{187}Os/^{188}Os$ errorchron measured on magnetite separates from rocks in the upper sections of the intrusion yields an age of ca. 184 Ma, consistent with our published zircon U-Pb age for the intrusion. Most samples have $^{187}Re/^{188}Os$ >200, making initial $^{187}Os/^{188}Os$ ratios difficult to determine. However, a few samples with $^{187}Re/^{188}Os$ <200 scatter above the errorchron, which suggests significant crustal contamination. Even for samples exhibiting the least upper crustal contamination, there is little overlap, if any at all, between the isotopic ratios for the Dufek intrusion (and associated volcanic rocks) and those for the hotspots with which the intrusion has been linked. Chilled margins of FMP dikes and sills in the immediate vicinity of the Dufek intrusion, which we believe offer the best estimates for parental magma compositions, have primitive mantle normalized trace element abundance patterns nearly identical to those of Bushveld parental magmas (DAVIES et al. 1980) and West Pacific boninites. These characteristics are best explained by having a magma source of once-melted harzburgitic mantle subsequently enriched in large ion lithophile elements by subduction processes. While it is possible that a plume close by destabilized an already weakened East Antarctic cratonic margin causing further thinning of the Antarctic lithosphere, and hence promoting decompressional melting of the upper mantle, the geochemical evidence does not support magma production for the FMP directly from a plume. The upper mantle source region probably acquired the subduction signature exhibited by the Dufek intrusion and lavas in its immediate vicinity during Paleozoic and Mesozoic subduction along the proto-Pacific margin of Gondwanaland.

Cenozoic volcanism of the western Ross Embayment: any evidence for a mantle plume from isotope systematics?

(poster p.)

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The West Antarctic Rift System (WARS) is active since late Cretaceous, leading to the drift of West Antarctic crustal blocks from the main continental mass of East Antarctica. In particular the border of Ross Sea in northern Victoria Land shows a widespread rift-related Cenozoic magmatism (LE MASURIER & THOMSON 1990). This study documents the chemical and isotopic compositions of near-primary rift-related alkali-basalts and basanites from northern Victoria Land (Miocene-Recent). These lavas display major and trace elements distribution typical of basalts from oceanic islands (OIB), with prominent K and Pb negative anomalies in the Primitive Mantle-normalized multielement diagrams. The initial isotope ratios range from about $^{87}Sr/^{86}Sr = 0.70283$ to 0.70335 and $\varepsilon_{d(t)} = 4.8$ to 6.7. Helium determinations have been performed on separates of unaltered olivine (Fo_{92-65} and 2.0-0.4 mm). The isotope ratio varies from R/Ra = 2.2 to 5.1 (where R is the $^3He/^4He$ ratio and Ra the atmospheric ratio). Sr-Nd isotope systematics reveals the HIMU signature of the mantle source, that has been commonly assumed as evidence for the imprint of a mantle plume widespread beneath the whole Ross Sea Rift System. Such a deep component should have the $^3He/^4He$ signature of an undegassed primordial mantle (R/Ra>>9). $^3He/^4He$ determinations do not show any evidence of a deep mantle component in the source of NVL primitive magmas being R/Ra even lower than the MORB. Geochemical and geochronological data of Cenozoic plutonic and sub-volcanic rocks of Eocene-Oligocene age from northern Victoria Land underline a chronological-structural link between magmatic evolution, regional tectonics and plate dynamics (ROCCHI et al. 2002). These features suggest that magma genesis and emplacement are related to activity of inherited translithospheric faults (SALVINI et al. 1997), which promoted local decompression melting of an enriched mantle that has been veined during the amagmatic late Cretaceous extentional rift phase. New results, particularly He isotope data, which contrast with a dominant plume signature, lend further support to this model for WARS magmatism.

Le Masurier, W.A. & Thomson, J.W. (1990): Volcanoes of the Antarctic Plate and southern oceans.- Antarctic Res. Ser., AGU 48: 40-42.
Rocchi, S. Armienti, P. D'Orazio, M Tonarini, S Wijbrans, J.R. & Di Vincenzo, G. (2002): J. Geophys. Res. 107/B7: 10.1029/2001JB000515.
Salvini, F. Brancolini, G. Busetti, M. Storti, F. Mazzarini, F. & Coren F. (1997): J. Geophys. Res. 102: 24669-24696.

Soil characteristics in Byers Peninsula, Livingston Island, South Shetland Islands
(poster p.)

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The study of soils and other surface formations in Antarctic ice-free areas can give a record of past and present processes, being a source of information about changes in environmental conditions. However, this type of studies are rare in Western Antarctica. As a part of a broader study of the surface formations in maritime Antarctica that is being carried out by our group, a series of samples of soils from Byers Peninsula have been studied. Byers Peninsula is located in the western end of Livingston Island, South Shetland Islands, at about 62°37' S and 61°6' W, being, with 60 km^2, the larger ice-free area, in the archipelago.

The studied soil profiles are between 13 and 40 cm depth and correspond to different lithological and altitudinal contexts. The cores have been collected in different places in south-eastern Byers Peninsula. Three cores are from a transect between 88 and 70 m.a.s.l., along the slope of a glacially over-deepened basin where there is a lake, and another one from 60 m.a.s.l, being the four on a raised marine platform deglaciated about 4000 years BP. Another core is from a place on Holocene raised beaches (aprox. 20 m.a.s.l.). Permafrost and an active layer are present in the upper platforms, being it reflected in soil and geomorphological processes. The sourrounding rocks are mainly Upper Jurassic-Lower Cretaceous marine sandstones and conglomerates and Lower Cretaceous volcanoclastic materials. The surface detritic deposits in the area include microconglomerates, sandstones, lutites and fragments of andesitic basalts, cherts and calcitic veins.

A series of individual samples have been obtained from the cores according to textural and colour criteria. The general soil properties studied are pH, electrical conductivity, carbonate content, bulk density and moisture content, granulometric fractions and soil texture, soil fertility (organic matter, carbon, nitrogen and available phosphorous and potassium) and elemental composition.

The studied soils (Cryosols) are very stony, mainly in the upper part of the studied slope at about 88 m a.s.l. (Cryic Leptosols), and present a variety of textures, although silty loam are predominant especially in the last mentioned place, and sandy loam on the Holocene raised beaches. As general characters, the soils have low contents of organic matter (0.4-1.3 %), carbon (0.2-0.8 %) and nitrogen (< 0.1 %). Carbonate contents are very low (< 0.7 %), although in the deeper layers of the upper part slope at about 88 m.a.s.l. they reach 20 %. Electrical conductivity values do not exceed 0.2 dS m^{-1}. There are some variations in pH. Soils are slightly acidic on the Holocene raised beaches, slightly alkaline at intermediate altitudes and alkaline in the upper platforms. Soil bulk density ranges between 1.3 and 2.1 g cm^{-3}.

Regarding the elemental composition, major elements are Fe, Al y Ca, their concentrations in mg/kg range between 34229-58999, 25242-47636, and 6482-72195 respectively. Ca shows the highest variability. The ranges of Na, K, Mg are between 2000 and 21000 mg/kg, followed by Pb and Mn that vary between 300 and 2100 mg/kg. Ba, Zn, Sr y Li appear in lower concentrations between 36 and 325 mg/kg.

These results indicate that the general soil properties as well as the elemental composition differ among the soils in the morphoedaphic environments studied. It appears that the geochemical spatial variability and along the soil profiles are in close relation with parent materials and mineralogy. Changes observed in some soil properties may be due to water movement within the soil profile. In this environment, geomorphological (cryogenic) and physical processes of soil movement are of importance as observed along the transect slope at the upper platform where finer fractions increase at the bottom slope.

A compilation of geophysical data from the Lazarev Sea and the Riiser-Larsen Sea, Antarctica

(EANT workshop p.)

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The different models for plate tectonic reconstructions of the opening of the SW Indian Ocean and the separation of Gondwana are due to the lack of geophysical data. In 1995/6 BGR and PMGRE acquired two additional data sets (>7200 km MCS, gravity and magnetics) in the Riiser-Larsen Sea (RLS), Lazarev Sea (LS) and over the Astrid Ridge (AR). On the basis of these data a structural map and a sediment thickness map were compiled for the Antarctic offshore area between 10°W and 25°E. Major findings are:

- The volcanic continental margin of the LS characterized by the Explora Wedge extends eastward to the foot of the AR. This voluminous volcanic construction consists of two distinct units suggesting episodic emplacement.
- The magnetic data from the RLS in combination with aeromagnetic data from the Alfred-Wegener Institute for Polar Research (AWI, Bremerhaven) show strong positive anomalies which are interpreted as ocean-continent boundary. Extrapolating the spreading rate of the RLS (1.7 cm/a) we estimated 159 Ma as the time of drift onset.
- The oceanic crust of both the LS and the RLS is thicker than "normal" oceanic crust and shows strong indications for enhanced magmatic activity during accretion.
- The AR is separated by the Astrid Transform into a southern (older) and northern (younger) part. Each part shows several phases of strong volcanic activity.

VISA - validation, densification and interpretation of satellite data for the determination of magnetic field, gravity field, ice mass balance and structure of the earth crust in Antarctica using airborne and terrestrial measurements: concept and first results of a new project

(poster p.)

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The imbalance of the continental ice sheets in the polar regions is one important reason for temporal changes of the gravity field of the Earth. All processes which are responsible for the growing or decreasing of an ice sheet also cause temporal changes of the gravity field. Thereby, for instance, redistribution of masses between the ice sheets and the world ocean occurs. Such temporal variations of the earth's gravity field should be determined by new satellites with mission periods of up to five years. One expects among others specific statements especially on the status of the Antarctic ice sheet. A detailed knowledge of recent changes in Antarctica is of special importance not only for the modelling of the global sea level rise, but also for climate models.

The gravity missions CHAMP (launched July 15, 2000), GRACE (launched March 17, 2002) and GOCE will measure only an integrated gravity signal in the polar regions, which is influenced also by processes that are not linked with the mass balance of the ice sheets. Those processes especially comprise deformations in the lithosphere caused by postglacial rebound and tectonic motions as well as by (long-term) distribution changes of the atmospheric pressure as well as spatial variable firn densification processes.

A most precise identification and quantification of all signals influencing the gravity field is necessary in order to determine mass induced effects and thus minimize errors in the calculation of the mass balance of the ice sheet. Within the proposed project, recent theoretical error analyses for the anticipated results of the missions CHAMP, GRACE and GOCE will be validated by repeated terrestrial and airborne measurements. Only such additional and densifying near-terrestrial measurements in Antarctica will yield scientifically reliable statements about the recent mass balance of the Antarctic ice sheet.

A spacious test area in Dronning Maud Land / Antarctica as well as above the adjacent ocean are chosen to validate the satellite data. In Dronning Maud Land, geophysical, geodetic and glaciological measurements - comprising airborne and terrestrial gravity measurements, GPS and GPR surveys, sampling of firn cores and seismological recordings - are started and will be carried out with respective local and temporal resolution. Flight campaigns, which already have been carried out, are a sound basis for the proposed experiments.

Non-invasive mapping of hydrocarbon-contaminated sites using near-surface geophysical methods in the McMurdo Sound region of Antarctica

(oral p.)

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Hydrocarbon spills can cause extensive environmental damage and can last a long time in a pristine environment such as Antarctica. Even the process of sampling and remediation of a site can cause damage. The use of non-invasive, non-destructive near-surface geophysical methods, such as ground penetrating radar, have the potential to delineate hydrocarbon spills without further disturbing the site.

Fresh spills of hydrocarbon contaminants in temperate climates are electrically resistive and may enhance radar reflectivity (GREENHOUSE et al. 1993, BREWSTER & ANNAN 1994), or may reduce the reflectivity at the water table (DANIELS et al. 1995), depending on the contaminant. In contrast, some older spills appear to be conductive (SAUCK et al. 1998), possibly due to biodegradation (CASSIDY et al. 2001). Antarctica's cold polar climate should slow down contaminant degradation, but the response of hydrocarbon spills in this setting is complicated by other factors, such as the proximity of some sites to saline water. Ultimately, we need to address a number of questions about the detection of contaminants in Antarctica:

1) Is there an anomalous geophysical response from soils that are contaminated by hydrocarbons?
2) If there is an anomalous response present, is the anomaly more resistive or more conductive?
3) Can we delineate the lateral and vertical extent of hydrocarbon contamination, if present?
4) Does the anomalous response vary during the season? Does it vary from year to year? Does it vary with the age of the spill?

Four sites were surveyed during two research seasons (2000/2001 and 2001/2002) in Antarctica. We investigated seasonal and yearly variations in the geophysical response of the soils at Scott Base, the first site. The other sites - Marble Point, Bull Pass and Lake Vida - were each surveyed once during the second field season, to investigate sites with different soil, climatic and contamination conditions.

The dominant seasonal effect at Scott Base was an increase in average electrical conductivity during the thaw. Persistent resistive anomalies due to hydrocarbon contamination became more apparent and were better resolved during and after the thaw. Thus, surveys are best done in December and January, when contaminant anomalies are more apparent and favourable weather conditions make surveying easier.

The horizontal loop electromagnetic (HLEM) technique proved to be more successful than GPR in identifying contaminated regions. At Scott Base and Marble Point, HLEM detected resistive anomalies that correlated well with physical evidence of contamination. At Scott Base, GPR provided valuable information on subsurface features, such as bedrock and permafrost topography and buried channels, that may influence contaminant distribution, but did not exhibit any direct influence on the contaminant response. In contrast, GPR results can be directly correlated with contamination at Marble Point. A strong contrast in natural electrical properties at Bull Pass, and the nature of contaminant distribution, precluded delineation by either of the geophysical methods. The Lake Vida results may contain information on the location of contaminants, but due to the complicated local hydrogeology and near-surface geology, more research will be required. The net result is that, if the site conditions allow, HLEM and GPR techniques offer useful non-invasive, non-destructive alternatives for contaminated site assessment in Antarctica.

Brewster, M. & Annan, A.P. (1994): Geophys. 59: 1211-1221.
Cassidy, P.D., Werkema, D.D., Sauck, W., Atekwana, E., Rossbach, S. & Duris, J. (2001): J. Envr Engr Geophys. 6: 47-52.
Daniels, J.J., Roberts, R. & Vendl, M. (1995): J. Appl. Geophys. 33: 195-207.
Greenhouse, J.P., Brewster, M., Schneider, G., Redman, D., Annan, A.P., Olhoeft, G., Lucius, J.E., Sander, K. & Mazzella, A. (1993): The Leading Edge 12: 261-267.
Sauck, W.A., Atekwana, E. & Nash, M.S. (1998): J. Envr. Engr. Geophys. 2: 203-212.

Seafloor structure around the epicenter of the great Antarctic earthquake

(poster p.)

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The March 25, 1998 great Antarctic earthquake is one of the largest oceanic intraplate strike-slip events ever recorded. The mainshock occurred far from the nearest plate boundary and nearest recorded earthquake. The most of aftershock locations suggest E-W trending fault plane, which is almost perpendicular to the nearest fracture zones. However, the driving force of the great Antarctic earthquakes is still unknown. Detailed marine geophysical surveys of the area are needed to elucidate the cause of the earthquake.

A detailed swath bathymetry survey had been conducted around the main shock epicenter of the great Antarctic earthquake during Leg 2 of KH01-3 (R/V Hakuho-maru) in January 2002. We found a seamount with almost E-W tending lineaments just in the south of the epicenter of the mainshock. The strike of the fault plane deduced from aftershocks almost coincides with the trend of lineaments in the seamount. These E-W trending lineaments are most likely preexisting structures and seem to be normal fault related to the initial rifting between Antarctica and Australia. The great Antarctic earthquake may occur along the same trending lineaments in the foot of the seamount covered by sediments.

The gravity and magnetic data had been also collected along the ship's track in the study area. Clear positive magnetic anomalies are observed in the north of the seamount, but prominent magnetic anomalies are not detected in the seamount. In the north of study area, NE-SW trending magnetic anomalies are also observed. The feature of the free-air gravity anomalies in the south are different from that in the north bounded by the NE-SW trending magnetic anomalies. These may indicate that the nature of oceanic crust where the maincshock and aftershocks occurred is different from that in the north of NE-SW trending magnetic anomalies.

Seafloor spreading in the west Enderby Basin during initial breakup of Gondwana

(EANT workshop p.)

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The seafloor spreading evolution in the Southern Indian Ocean is key to understanding the initial breakup of Gondwana. However, marine geophysical data are sparse and the seafloor spreading history is still speculative in the southern Indian Ocean. To reveal the seafloor spreading in the west Enderby Basin, southern Indian Ocean, we use the lineaments deduced from the GEOSAT 10 Hz sampled raw altimetry data and magnetic anomaly lineations from the vector magnetic anomalies as well as satellite derived gravity anomaly map.

Tectonic lineaments with NNW-SSE strike, possibly indicating the fracture zone trend, are observed in the southern portion of the west Enderby Basin, in the east of Gunnerus Ridge, near the Antarctic Continent. Magnetic anomaly lineations, possibly belonging to the Mesozoic magnetic anomaly sequence, are recognized and they are almost perpendicular to the strikes of the tectonic lineaments. In contrast, NNE-SSW fracture zone trends and Mesozoic magnetic anomaly sequence have been detected in the west of Gunnerus Ridge near the Antarctic Continent.

Approximately NNE-SSW tectonic lineaments are dominant in the north of Gunnerus Ridge. However, WNW-ESE lineaments are observed in the south of Conrad Rise. In those areas, magnetic anomaly lineations, possibly belonging to the Mesozoic magnetic anomaly sequence, are also recognized and they are almost perpendicular to the strikes of the tectonic lineaments. Around 60°S, WNW-ESE tectonic lineaments almost normal to the major tectonic trends in the region are detected and interpreted as fossil spreading ridge system. These results suggest complicated initial breakup process of Gondwana in the West Enderby Basin.

Sediment composition changes and recycled palynomorphs as guides to past ice volume changes in the Amery Ice Shelf drainage system: Results from ODP Leg 188
(oral p.)

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ODP Site 1167 drilled a Plio-Pleistocene trough mouth fan composed mostly of debris flows deposited by slumping of subglacial debris that melted out at the shelf edge when the Lambert-Amery Ice drainage system grounded there. The 1167 core shows changes in sediment composition and recycled palynomorphs that can best be understood in terms of processes on a continental margin where glaciers have eroded well below sea level and caused progressive unroofing of sedimentary sequences and basement rocks. Such processes differ from those on non-glaciated mid-latitude continental margins where erosion is controlled principally by climate, tectonics, and sea level variations.

The Prydz Bay region of East Antarctica contains major sedimentary basins, the Prydz Bay Basin and Lambert Graben, set within the Precambrian basement. The basins have existed since the Carboniferous and contain preglacial sediments as young as Cretaceous-, Palaeocene and Eocene ages. Permian and Triassic sediments are known from outcrop on the edge of the Lambert Graben. Oligocene, Miocene and Pliocene glaciomarine sediments also crop out on the edge of the graben. Small glaciers now flow into the basin and erode these sediments but most erode predominantly basement. Where the major trunk glaciers converge into the Amery Ice Shelf in the southern Prince Charles Mountain, they have eroded to depths of 2.5 km below present sea level. The long sub-ice shelf Lambert valley shallows to 800-1000 m below sea level (mbsl) near the present front of the Amery Ice Shelf and 500-200 m at the shelf edge in Prydz Bay. Pre to early glacial sediments known from drilling in Prydz Bay are unfossiliferous red beds, Early to Late Cretaceous non-marine sediments, mid to late Eocene delta plain deposits and shallow marine muds. The red sediments that crop out on the floor of Prydz Bay are characterised by very low magnetic susceptibility. Known subcrop patterns in Prydz Bay suggest that an advance of a grounded glacier would erode progressively younger sediments. Thus larger ice volumes in the system during the Neogene should produce detritus with a high sedimentary-derived component such as sedimentary clasts, young palynomorphs and second-cycle clay minerals. Rather than a simple, progressive unroofing cycle of younger to older palynomorphs, recycled fossil assemblages will vary depending on where the maximum subglacial erosion is taking place. Further complications will arise depending on the proportion of ice from different parts of the basin hinterland and from blanketing of subcrop by till and glaciomarine sediments that may or may not be eroded by the next advance.

ODP Site 1167 shows a major change in clay mineralogy and clast composition at 217 mbsf. Below 217 mbsf, the clay mineral assemblage features abundant smectite (40-60 %). It drops rapidly above 217 mbsf, being less than 20 % above about 160 mbsf. Lonestones include a large number of sandstone clasts below 160 mbsf. Above that level, most clasts are igneous and metamorphic pebbles. Recycled Neogene and Palaeogene palynomorphs are found in the bottom of the hole whereas Jurassic and Permian spores are found throughout. Reflectance spectrophotometric analysis detected higher amounts of recycled organic matter, below ~210 mbsf. Magnetic susceptibility decreases from the base of the hole at 443 mbsf to 217 mbsf then shows a series of decreasing-upward cycles that are generally higher than values below 217 mbsf. Magnetite grains are finer below 217 mbsf than above. The compositional patterns below 217 mbsf. indicate that a large proportion of material was sourced from sedimentary rocks below 217 mbsf. and ice grounding was over the Prydz Bay Basin. Above 217 mbsf., the cyclic magnetic susceptibility values and suggests systematic episodic increases in basin-derived input, even though the overall composition of the sediment reflects a basement source. The available age data (nannoplankton and Sr isotope dates) suggest the horizon at 217 mbsf is around 1-1.2 Ma. The change at 217 mbsf may reflect a shift to overall smaller ice-volumes and reduced erosion volumes in the Lambert-Amery drainage systems. Such a reduction in ice-volumes may also explain the observation that most of the Prydz Channel Fan is older than mid Pleistocene age. Ice volumes since then may not have been adequate to fill the deep accomodation space on the continental shelf.

Cainozoic continental slope and rise sediments from 38°E to 164°E, East Antarctica
(poster p.)

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The Australian Antarctic and Southern Ocean Profiling Project has provided north-south seismic reflection transects approximately every 90 km along the East Antarctic continental margin from 38°E to 164°E. These data provide a unique overview of the broad scale depositional patterns around a large part of the Antarctic margin. Each line was examined and the younger Cainozoic section classified according to the sedimentary environment. The sedimentary environments recognised are:

- Submarine fans;
- Mixed contourite-turbidite drift sediments;
- Outcrops of older sediments now eroding;
- Distal abyssal plain deposits.
- Contourite drift and canyon complexes.;
- Thin plastered drifts;
- Prograding upper slope wedges;

We have recognised nine sedimentary provinces on the continental slope and rise, based on the relative proportions of these environments. These provinces are:

•Prydz Bay slope and rise.
The area seaward of Prydz Bay and the MacRobertson Shelf shows the thickest accumulation of sediments, comprising up to 6 km of mixed contourite-turbidite drift deposits. This accumulation is displaced westward of Prydz Bay, suggesting westward advection of sediment supplied from the continent via the Lambert Graben drainage system.
•Wilkes Land.
The Wilkes Land margin between 120°E and 140°E exhibits predominantly turbidite fan deposits with two very large slump deposits extending up to 270 km from the base of the continental slope. One of these slumps contains large coherent slide blocks.
•Western Enderby Basin (38°E-55°E)
The Enderby Land margin features a thick sedimentary sequence deposited relatively early in the margin history, that is now being dissected by large canyons.
•Eastern George V, eastern Bruce Rise and Princess Elizabeth Trough.
These areas exhibit thin contourite and basin floor deposits abutting steep, faulted scarps composed of continental basement and older sediments.
•Western Bruce Rise, western George V and western Wilkes Land Margins.
These areas display dissected contourite drift deposits on the upper rise and lower slope passing out into submarine fan and abyssal plain deposits.

The distribution of contourite deposits is controlled by sediment input from the continent and by the shape of the margin. Prydz Bay has provided a large amount of sediment over a long period producing the thickest sediment pile on the margin. Significant areas of contourite deposits have also formed on the western (down-current) side of Bruce Rise and Enderby Land which have acted to constrict the westward flow of sediment-bearing currents.

It has been suggested that major sediment inputs have taken place via the Wilkes sub glacial Basin, the Aurora Basin and Prydz Bay through the Lambert Graben. Our examination of the data implies that only Prydz Bay and Western Enderby Land have received large influxes of sediment with western Enderby Land being relatively inactive during the Neogene. Sediment thicknesses are still quite large when compared to the conjugate margin of Australia.

Phanerozoic denudation of George V Land, Antarctica, based on apatite fission track data
(poster p.)

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In contrast to northern Victoria Land with its spectacular escarpment of the Transantarctic Mountains, and to the hilly to mountainous eastern part of Oates Land, the neighbouring coastal areas of western Oates Land, George V Land and Terre Adélie are characterised by a flat to subdued morphology. Apatite fission-track analysis has been carried out on ten gneiss and granite samples from George V Land to establish the regional long-term landscape evolution. The apatite ages are very similar throughout, ranging between ~280 and ~240 Ma. No regional trend of the ages could be recognised. Instead, the variation of the fission track ages appears petrologically determined, with orthogneissic samples being systematically younger than granitic ones. Furthermore, two Ferrar dolerite samples from Scare Bluffs and Anxietey Nunataks (western Oates Land) gave a homogeneous cooling age of 171 ±9 Ma.

Applying a stable low cratonic geothermal gradient of 15–20°C, 3–4 km of regional denudation must have occurred in George V Land between ~300 and ~200 Ma. A coeval stage of increased long-range late Paleozoic denudation has been observed in eastern Oates Land (LISKER 2000). Concurrently, there evolved the Wilkes Basin between both areas as a as a highly extended terrane (FERRACCIOLI et al. 2001), and the terranes of northern Victoria Land (Wilson, Bowers, and Robertson Bay terranes) attached in a complex subduction/ accretion process.

The post-Triassic history of the George V - Oates Land coast is dominated by the emplacement of the Ferrar dolerites and the formation of the passive continental margin, both associated with the Gondwana breakup. Scare Bluffs and Anxietey Nunataks form, together with Horn Bluff, the westernmost Ferrar Dolerite outcrops in the Ross Sea sector of Antarctica. The short time interval between the effusion age of the dolerites (177 Ma) and their fission track age of 171 ±9 Ma on the one hand, and the wide regional distribution of high-frequency magnetic anomalies resembling tholeiitic sills within the Wilkes Basin (FERRACCIOLI et al. 2001) and of Ferrar Dolerites throughout western Oates Land on the other hand, indicate a sill emplacement within the sediments of the Wilkes Basin in a very flat crustal level and/or a surface effusion as large traps. In contrast to the neighbouring northern Victoria Land, the Gondwana breakup along the Terre Adélie-George V Land coast was not associated with significant denudation of the newly formed passive continental margin during the Cretaceous.

Lisker, F. (2002): Tectonophysics 349: 57-73
Ferraccioli, F., Coren, F., Bozzo, E., Zanolla, C., Gandolfi, S., Tabacco, I. & Frezzotti, M. (2001): Earth Planet. Sci. Lett. 192: 407-421

Mapping results obtained in central Dronning Maud Land, East Antarctica
(poster p.)

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During the international GeoMaud Expedition (1995/1996), organized by BGR, the area of central Dronning Maud Land (cDML) between 10° and 16°E has been mapped under geological, geophysical and glaciological aspects. Coevally, a photogrammetric survey covered cDML and black and white aerial photographs in the scale from 1:25000 to 1:33000 are now avalaible.

The geological mapping of the outcrops, now in the scale of 1:500000, and particularly geochronological studies reveal Upper Mesoproterozoic metavolcanic and metasedimentary rocks some 1.1 Ga in age. These rocks experienced Grenvillian high-grade metamorphism and deformation (1.0 Ga). Coevally metaplutonic rocks formed to an unknown extent. The Grenvillian rocks were pervasively reactivated during the Pan-African events, obliterating the Grenvillian structures completely. In the Orvinfjella the Pan-African metamorphic structures trend E-W to SW--NE. In the Wohlthatmassiv the Pan-African structural trend varies considerably. This Pan-African structural pattern has evolved within an overall sinistral transpressive regime which was complicated by the interaction with the rigid Grubergebirge anorthosite intrusion (Wohlthatmassiv). Furthermore, Pan-African metaplutonic rocks (mostly augen gneiss) have influence on the tectonic structure.

The metamorphic crust in cDML was intruded during the Pan-African events (600-500 Ma) by a huge amount of igneous rocks in discordant plutons ranging in composition from anorthosite to granitoid. These igneous complexes form the Pan-African DML igneous province, comprising more than 20 % of the crust. A major anorthosite intrusion (some 600 Ma) of the Grubergebirge predates and most of the discordant granitoids completes the Pan-African thermotectonic reactivation (metamorphism, tectonism and intrusion).

In ice covered areas (more than 80 %) the results of geophysical surveys allow a general view on the bedrock geology. The aeromagnetic survey delivered a detailed map of the total magnetic field which shows the general linear ENE-WSW trend of low-gradient (around 10 nT/km) anomalies in the metamorphic basement of the northern part of cDML. In the southern part of cDML isometric and irregular high-gradient highs (to 150 nT/km) reflect the outlines of discordant granitoids (with high magnetic susceptibility values acquired in the outcropping rocks). The Grubergebirge anorthosite is characterized by a conspicuous elongated magnetic low (amplitude: almost 1000 nT).

Gravity data show a general decrease of the Bouguer gravity from 50 to 100 mgal at the coast to -100 to –150 mgal inland at the southern fringe of the mountain chain located at the northern flank of the Wegener-Inlandeis.

Radio echo sounding data reflect a generalized picture of the subglacial morphology. In general, the glacial ice accumulated on the Wegener-Inlandeis flows northwards over low parts of a mountainous barrier in outlet glaciers through valleys between ridges, and then enter a piedmont glacier that flows northeastwards parallel to the northern margin of the Wohlthatmassiv (fore-Wohlthatmassiv glacier). To the north the ice spreads in a wide area in which the ice moves slowly (10 m/a) in areas of elevated bedrock surface and glaciers of relatively rapid ice movement. Further north of the bedrock high, the glacier "Potsdamgletscher" recently recognized flows around the east side of the Skaly IGA nunataks at high velocities (up to more than 60 m/a). Here in the north the bedrock surface over a large area south of the grounding line is below sea level, in some places even below –500 m.

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Ultra-high-pressure metamorphism at the palaeo-Pacific margin of Gondwana: the Lanterman Range in Antarctica
(oral p.)

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Ultra-high-pressure (UHP) metamorphism refers to a metamorphic process that occurs at pressure >2.5 Gpa corresponding to depths of >80 Km. The recognition of UHP is based on the identification of relict micro-inclusions of minerals such as coesite or microdiamond within rigid minerals such as garnet. The discovery of UHP metamorphism (CHOPIN 1984) had important consequences for the understanding of lithospheric plate convergence. Until now, UHP rocks have been reported in at least five continental areas.

In 1993, well preserved mafic eclogites were found (RICCI et al. 1996) in the Lanterman Range (northern Victoria Land) which represents a segment of the palaeo-Pacific margin of Gondwana. They occur in the Gateway Hills Metamorphic Complex (GHMC), a thin and discontinuous belt, located at the boundary between the Wilson and Bowers terranes and characterized by abundant mafic and ultramafic rocks which occur as lenses and pods within metasedimentary gneisses and quartzites. Geological, petrological and geochronological studies indicate that mafic, ultramafic and felsic host rocks underwent a common metamorphic evolution with an eclogite facies stage about 500 Ma ago at temperatures of up to about 850°C and pressures greater than 2.6 Gpa.

The UHP, supported by the finding of coesite relics within garnet of mafic rocks (GHIRIBELLI et al. 2002), is indicative of a metamorphism at depths greater than 80 Km. The discovery of coesite includes the Lanterman Range's mafic eclogites as the only Antarctic example among the rare UHP rocks of the world. Eclogite facies rocks have also been reported from the Nimrod Group (Central Transantarctic Mountains, GOODGE 1992), and from other segments of the Palaeo-Pacific margin of Gondwana (Tasmania, TURNER et al. 1995; eastern Australia, WATANABE et al. 1993). Despite some petrological and geochronological similarities between mafic eclogites of the Lanterman Range and those of the other Gondwana localities, UHP metamorphism in the Lanterman Range involves not only mafic rocks, but also ultramafic and felsic host rocks.

Moreover, contrary to other UHP felsic rocks of the world, the Lanterman examples preserve micro-structural and mineralogical features which allow to define not only the decompressive/ retrograde path, but also the initial prograde path from amphibolite facies up to the eclogite facies with $^{40}Ar/^{39}Ar$ ages on 3*T* phengite close to about 500 Ma (DI VINCENZO et al. 2001). The reconstructed clockwise P-T-t path of the UHP rocks of the Lanterman Range involves a steep prograde and retrograde PT path with the retrograde part showing a nearly isothermal decompression between the eclogite and amphibolite-facies stages. The lack of complete microstructural and mineralogical re-equilibration during the different stages and the very high dP/dT of both prograde and retrograde segments indicate that burial and exhumation were both rapid processes. Geochronological data indicate an average exhumation rate of 3-4 Km/My.

The Lanterman Range UHP metamorphism is until now the only area of the world which formed in a Pacific-type accretionary context (taking the Cambro-Ordovician Ross Orogeny as tectonic expression of the subduction of the palaeo-pacific plate under the Gondwana margin). It shows some peculiarities as the involvement of felsic host rocks, the clockwise P-T-t path and the exhumation rate similar to those reconstructed for the UHP localities related to major continent-continent (Alpine-type) collisional orogenies.

Chopin, C. (1984): Contrib. Mineral. Petrol. 86: 107-118.
Di Vincenzo, G., Ghiribelli, B., Giorgetti, G. & Palmeri, R. (2001): Earth Planet. Sci. Lett. 192: 389-405.
Ghiribelli, B., Frezzotti, M.L. & Palmeri, R. (2002): Eur. J. Mineral. 14: 355-360.
Goodge, J.M., Hansen, V.L. & Peacock, S.M. (1992): In: Yoshida et al. (eds.). Recent progress in Antarctic Earth Science: 203-209.
Ricci, C.A., Talarico, F., Palmeri, R., Di Vincenzo, G. & Pertusati, P.C. (1996): Antarctic Sci. 8: 277-280.
Turner, N.J., Black, L.P. & Kamperman, M. (1995): Geol Soc. Austr., Tasman Division, Contentius Iss. Tasmanian Geol., Sympos.: 51-56.
Watanabe, T., Leicht, E.C., Itaya, T. & Fukui, S. (1993): Terra Nova 5: 28.

Chemistry of diamicts and glacial muds of the Sirius Group of the Transantarctic Mountains: a longterm continental record of East Antarctic climate and glaciation
(oral p.)

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Chemical analyses of 57 glacial muds and diamicts from the Sirius Group are evaluated to determine the origin and stratigraphic relations of geographically widerspread outcrops in the Transantarctic Mountains. Biostratigraphic control of glacial sediments is generally poor because of the low preservation of microfossils and dilution due to high sedimentation rates. Therefore, a chemostratigraphic approach is attempted to correlate the glacial record of the Transantarctic Mountains to the continental shelf record of the nearby Victoria Land basin. Drillcores in marine basins provide more continuous records of the glacial history of a nearby continent. However, continental glacial deposits carry more direct records of glaciation with better geographic coverage.

Sand minerological studies already indicated that the Sirius Group consists of two end member petrofacies, which can be related to deposition during different phases of glacial denudation of the Transantarctic Mountains (PASSCHIER 2001). The oldest Sirius Group sequence has a different morphostratigraphic distribution and a different petrochemical composition than the younger end member. The older sequence consists of erosional remnants of Sirius Group diamicts in the higher regions of the Transantarctic Mountains, overlying horizontal rock plateaus, spurs, and scoured surfaces. The younger sequence occurs within the glacial troughs that drain the present East Antarctic Ice Sheet.

Chemical analyses are extremely useful in determining the provenance and weathering history of fine-grained sediments (NESBITT & YOUNG 1982). The Chemical Index of Alteration (CIA), Ti:Al ratios, and K_2O/Al_2O_3 ratios are calculated to determine the amount of weathered materials, mud provenance, and sediment recycling of the sediments. The chemical results indicate that the older Sirius Group diamicts contain large amounts of weathered materials derived from erosion of fine-grained sedimentary rocks, weathered rock surfaces and soils. Glacial muds and diamicts from thick stratified Sirius Group successions in the glacial troughs have weathering ratios similar to unweathered crystalline basement rocks, indicating a dominance of fresh rock fragments and glacial flour with respect to clay minerals.

Two factors may have caused the difference in composition of the Sirius Group sediments: 1) stripping of products of chemical weathering from the source areas during the older glacial phase, exposing unweathered rock to younger glacial activity; and/or 2) rejuvenation due to tectonic evolution and a change in glacial drainage patterns during the younger glacial phase. Analyses of drillcores from the Victoria Land Basin indicate that chemical weathering prevailed in the Eocene with a steady decrease in chemical weathering products from the late Eocene to the late Oligocene (EHRMANN 1998, KRISSEK & KYLE 1998). The combined marine and continental records suggest that the Sirius Group was deposited during multiple phases of glaciation. The older phase of glaciation in the Transantarctic Mountains likely preceded or coincided with glacial expansion onto the Ross Sea continental shelf in the early Oligocene, whereas the younger glacial phase(s) probably postdate(s) the middle Miocene when the highest ranges of the Transantarctic Mountains became ice-free (cf. PASSCHIER 2001). Although tectonic processes probably also influenced the composition and distribution of glacial deposits, these results are also in agreement with early Oligocene, late middle Miocene and late Pliocene periods of global ice expansion inferred from chemical analyses of deep-sea records (LEAR et al. 2000).

Ehrmann (1998): Palaeogeogr. Paleoclimatol. Palaeoecol. 139: 213-231.
Krissek, L.A. & Kyle, P. (1998): Terra Antartica 5: 673-680.
Lear, C.H., Elderfield, H. & Wilson, P.A. (2000): Science 287: 269-272.
Nesbitt, H.W. & Young, G.M. (1982): Nature 299: 715-717.
Passchier, S. (2001): Sedimentary Geol. 144: 263-290.

Volcanic cone alignments and the intraplate stress field in the Mount Morning region, South Victoria Land, Antarctica

(oral p.)

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The intraplate stress field within Antarctica is largely unknown because of a lack of commercial drilling and the scarcity of recorded earthquakes with magnitudes that yield reliable focal mechanism solutions. Recent studies of drilling-induced fractures in drill core retrieved by the Cape Roberts Drilling Project, along with borehole breakouts identified by downhole logging, provided the first in situ stress data along the Transantarctic Mountains/West Antarctic rift system boundary. In order to define SHmax orientation elsewhere in the Antarctic interior, we have been conducting detailed mapping of young volcanic cones found within Cenozoic volcanic provinces. Volcanic cone alignments are considered to mark natural hydrofractures induced by pressurized magma; if magmatic pressures exceed the sum of the tensile strength of the surrounding rock and the least external compressive stress, a tensile fracture develops. In volcanic fields, magmatic hydrofractures form with an orientation perpendicular to the least horizontal stress (Shmin) and parallel to the greatest horizontal stress (SHmax). Eruptions along such stress-controlled fissures produce linear arrays of volcanic vents and cones, elongated cones, and dikes. These volcanic features can be mapped to determine the stress directions in an area.

Here we report on an analysis of a field of 170 basaltic cones on the northern flank of Mount Morning. Extensive ice cover precludes analysis of vents on the south-facing volcano slopes. We mapped the distribution and shape of the volcanic cones using a combination of SPOT 3 panchromatic satellite imagery (10 m ground resolution), RADARSAT and JERS radar imagery (30 m ground resolution), aerial photography, and field work. The elongation of elliptical cone rims can be directly related to the trend of the subsurface fissure that controlled cone emplacement. Volcanic cone alignments were defined based on elliptical cone trends together with circular cones that are proximal and along the same trend. In the absence of elongated cones, alignments were defined where cones occurred in clear visual alignments due to close spacing and/or coalescence. We found NE-trending and NNW-trending alignments, but that NNE-trending alignments predominate, an interpretation supported by a statistical approach called the two-point azimuth analysis (LUTZ 1986).
Since the volcanic cones occur in a field dominated by the large Mt. Morning volcano, a test is required to show whether cone alignments map a regional tectonic stress field, or only the stress field associated with the volcano itself. We utilized Nakamura's method to discriminate between an

isotropic or differential stress state. This method relies on the pattern of volcanic cone alignments, elongated cones and dikes, relative to the central conduit of a large volcano. In the absence of regional far-field stresses of tectonic origin, magmatic pressures from the central volcano dominate the stress field and a radial pattern of cones and dikes will form. A radial pattern can also form if the two horizontal regional stresses (SHmax and Shmin) have equal magnitudes. If horizontal stresses have significantly different magnitudes, then the overall trend of cones and dikes will form an hourglass shape, with the main crater of the stratovolcano at the center, where magmatic pressures predominate over the regional stress field. The long axis of the 'hourglass' will be oriented parallel to the maximum far-field horizontal stress. On Mt. Morning, we found that the trends of cone alignments and elongated cones generally curve in towards the central crater and assume a northeast trend at a greater distance from the crater, forming an hourglass pattern. This indicates that volcanism did not occur within an isotropic stress regime. Rather, it suggests that a regional stress (SHmax NE-SW and Shmin NW-SE) predominated over the localized pressure of the magma. The interpreted NE SHmax trend is oblique to the Cape Roberts in situ contemporary stress direction. This change may reflect spatial changes in the contemporary stress field. Alternatively, the cone alignments may reflect an older stress field that varied from the contemporary field.

The origin of pyroxenites and megacrysts in alkaline basaltic magmas from northern Victoria Land, Antarctica

(poster p.)

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Clinopyroxene-rich xenoliths and augite and kaersutite megacrysts are often found in the Cenozoic alkaline basalts of McMurdo Volcanic Group (northern Victoria Land, Antarctica). The ultramafic xenoliths and megacryst were collected in Mt Melbourne Volcanic Province respectively at Browning Pass, Baker Rocks (both sites are near the coast of the Ross Sea) and at the base of Mt. Overlord, about 80 km inland. Sixteen samples have been petrographycally examined and chemically analyzed, including trace element analyses of minerals by ion microprobe. Pyroxenites of all suites belong to Al-augite Group (FREY & PRINZ 1978) and include wehrlites and clinopyroxenites and rare dunites and olivine-websterite. Amphibole bearing nodules also occur. Moreover, between Baker Rocks xenoliths there are some composite xenoliths where wehrlite and harzburgite lithologies are in sharp contact. The samples usually show cumulitic textures and in only few cases deformation fabrics and polygonal texture occur. Mt. Overlord samples show widespread metasomatic effects, evidenced by clinopyroxene-amphibole replacement and by melts pools variably recrystallised. In the Browning Pass pyroxenites the metasomatic effects are incipient. Major and trace element compositions of bulk rock and minerals indicate that pyroxenites and megacrysts are related to associated alkaline magmas and they have been formed by a fractionation processes from McMurdo alkaline magmas.

The evaluation of the T-P equilibrium conditions for northern Victoria Land pyroxenites indicate a T $\approx$1200°C and P = 0.6-0.8 GPa and P = 0.8-0.9 GPa for Browning Pass and Mt. Overlord nodules respectively, pressure that roughly correspond to the base of the crust (20-25 km in the coastal area and up to 40 km in the Mt.Overlord area (MCGINNIS et al. 1985, TREHU et al. 1989). T-P estimation for Baker Rocks pyroxenites indicate deeper conditions of equilibration (T $\approx$1100°C and P = 1.5-1.7 GPa) that are consistent with T-P conditions for associated spinel peridotites. These data suggest for Baker Rocks pyroxenites an origin by crystallisation on the wall of conduit during magma rising. This hypothesis is supported by the occurrence of composite xenoliths. Thermobaric evaluation suggest that fractionation processes responsible of the Browning Pass and Mt. Overlord pyroxenites formation has occurred at the Moho level and thus the nodules may be regarded as resulting from underplating mechanism currently active the base of continental crust of northern Victoria Land.

Frey F.A. & Printz M. (1978): Earth Planet. Sci. Lett. 38: 129-176.
McGinnis L.D., Bowen RH., Erickson J.M., Allred B.J. & Kreamer J.L. (1985): Tectonophysics 114: 341-356.
Trehu AM., Holt T., Behrendt J.C. & Fritsch J. (1989): EOS 70, 43: 1344.

Development of viscous fingering patterns during mingling/mixing processes between mafic and felsic magmas: evidence from late Ross intrusives in northern Victoria Land, Antarctica

(poster p.)

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Late Ross intrusives in northern Victoria Land (Antarctica) display spectacular mingling/mixing phenomena between mafic and felsic magmas. Rocks are constituted by a huge amount of dark enclaves generated by disintegration of mafic dikes after they have been injected into the felsic magma, giving to the outcrops a net-veined appearance. Enclaves display a wide range of contact patterns with the host rock: margins range from sharp to progressively more irregular and amoeboid. In some cases disruption processes of the enclave boundary occurred, and droplets of the mafic magma are observed close to the enclave margins. The occurrence of droplets of the mafic magma is commonly associated with quite sharp contacts between the nearby enclave and the host rock.

Enclave margins have been quantified by measuring their fractal dimension (D) and length (L). These parameters increase as the roughness of the enclave margin increases and, hence, they are suitable descriptors to quantify margin irregularity. Results show that the more irregular margins have higher values of both fractal dimension and length, and, more in detail, there is a general exponential relationship between fractal dimension and length of enclave margins that are not associated with droplets of the mafic magma. Enclave margins associated with droplets have fractal dimension similar to the less irregular enclave margins not associated with droplets, but their lengths are considerably higher. On the whole the graph (D versus L) defines a sort of hysteresis cycle where, after the exponential increase associated with margins without droplets, there is a reversal trend with a decay of values of both fractal dimension and length of those margins associated with droplets.

The patterns exhibited by enclave margins strictly resemble viscous fingering patterns observed in analogue experiments during the displacement of a viscous fluid by another fluid having lower viscosity, and suggest that viscous fingering processes may have operated in the development of enclave margins. For such a reason, numerical simulations have been performed in order to test if the irregularity of enclave margins can be conceived as the product of viscous fingering dynamics. The viscous fingering processes have been simulated by utilising the Diffusion Limited Aggregation Approach, and simulated margins have been quantified by calculating their fractal dimension (D) and by measuring their length, as for the natural cases. Also in this case a clear exponential relationship can be observed between fractal dimension and the length of simulated margins with more irregular margins having higher values of both fractal dimension and length.

These results led us to conclude that viscous fingering dynamics were the main forces that acted during mingling/mixing of magmas in the studied cases. Furthermore, the association of less irregular margins with droplets of the mafic magma favours the hypothesis that after a first stage of viscous fingering between the mafic and the felsic magma, where there is an exponential increase of fractal dimension against the length of margins, interfacial tensions dominated leading to the emulsion of droplets of mafic magma within the felsic one, followed by a relaxation of enclave towards more regular margins.

The lacking of transition of enclave margins from viscous fingering to side branching and dendritic margins, the latter indicating a nearly solid state of the host magma during the intrusion of the mafic magma, suggests that after the initial thermal shock suffered by the mafic magma and the disruption of dikes, enclaves still behaved as liquid bodies.

Distribution of some elements in the rocks from Hurd Peninsula, Livingston Island

(poster p.)

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The investigated area is located along the western coast of Hurd Peninsula, South Bay of Livingston Island. The rocks belong to the Miers Bluff Formation (HOBBS 1968) and consist of interbedded turbiditic thick sandstones and mudstones. The MBF is generally overturned and dips to the NW. The Hesperides Point Intrusion is a small stock with sharp contacts with the MBF metasediments and is composed of gabbro, diorite and quartzdiorite (Kamenov 1997). The numerous different in age and composition dykes cut the rocks of MBF. Some of them are post-intrusive.

Sampling was carried out along profiles with direction 130°°° and distance between them 50-75 m. Over 300 samples are analyzed by atomic emition spectroscopy for 37 elements.

The maps showing distribution of Zn, Pb, Cu and Ag in the part of the investigated area are made. Some of the elements show considerable variation in their content: Ba - <300-3000 ppm, Ni - 10-50 ppm, Co - 5-30 ppm, Mo – 1-20 ppm, Cr – 30-1500 ppm, Mn – 70-2000 ppm, Ti – 1000-7000 ppm, Zr – 5-200 ppm, Sr - <70-2000 ppm, Ga – 20-100 ppm, Li - <70-100 ppm and Au - <0,003-0,02 ppm etc.

There is now clear relationship between the distribution of the studied elements and the setting of faults and fractures of the rocks.

Hobbs, G.J. (1968) : Brit- Antarctic Surv. Sci. Rep. IV: 47pp.
Kamenov, B.K. (1997) The Antarctic Region: Geological Evolution and Processes: 341-352.

Structure of Cumpston Massif, southern Prince Charles Mountains, MacRobertson Land, East Antarctica

(oral p.)

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One of the largest nunataks in the southern Prince Charles Mountains, Cumpston Massif, is divided by two distinct shear zones into three provinces, a northern granitic gneiss (basement), a sedimentary cover sequence, and a less deformed south-western granite. A north-south trending cross-section along the 15 km escarpment of Cumpston Massif on the PCMEGA expedition (Austral Summer

2002-2003) revealed thick sedimentary cover sequence tectonically overlying an older granitic basement. The contact between the two units is a east-west trending northern-dipping shear zone where extreme high strain has resulted in a 150-200 m thick sheared-out package of mafic, sedimentary and gneissic units with structural kinematics indicating a general top to the north thrusting. This top to the north thrusting is prevalent throughout the southern sedimentary sequences evident on shear zones and general fold asymmetry. Strongly deformed, the northern gneissic basement consists of tightly folded mafic dykes which plunge shallowly to the south-east/north-west with a general east/west trend and southerly dip to the enveloping surface. Tectonically overlying the basement is the very thick low-grade sedimentary sequences consisting of immature quartzites, meta-psammites, meta-pelites and mafic sills. Beautiful sedimentary structures are evident throughout with high development of cross-bedding, mud cracks and ripple marks indicating gentle deposition within a shallow water basin. Structure within the cover sequence reveals medium to tight large scale reclined folds plunging to the north-west. This parallels the general trend of the enveloping surface which dips steeply to the north-east. In sediments near the basement contact, thick mafic sills intrude parallel to the main foliation (S_0) and show varied degrees of deformation and contact metamorphism, yet are absent further south within the same sequence. A secondary later south-east trending, southern-dipping shear zone thrusts top to the south higher grade sediments over the relatively undeformed south-western granite. Possible association with this late south-dipping shear zone are micaceous pegmatite dykes which parallel this orientation, yet interestingly cross-cut the earlier north-dipping shear zones.

Volcanism and taphoflora of the Cretaceous - Tertiary interval, King George Island, Antarctica

(oral p.)

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The southwestern half of King George Island (north of the South Shetland Archipelago, Antarctica) is constituted by volcanic, pyroclastic and volcaniclastic rocks of probable Late Cretaceous-Early Tertiary age, with a rich fossil flora associated with lapilli tuffs, tuffs and breccias. Volcanic and volcaniclastic rock samples were studied and analyzed in areas of the Fossil Hill and Rocky Bay (Fildes Peninsula), where the basal lavas have yielded an age of 52 Ma (LI & LIU 1987, LI 1994) and 58-59 Ma (PARKHURST & SMELLIE 1983). In Zamek Hill, the K-Ar age of lavas varied between 77 and 66 Ma (BIRKENMAYER et al. 1983), in Thomas Point, between 51-49 Ma and 47 Ma (PANKHURST & SMELLIE 1983); and in Henequin Point, between 43.9 Ma (BIRKENMAYER et al. 1983) and 46-47 Ma (PANKHRUST & SMELLIE 1983).

Several facies were identified in the volcanic and volcaniclastic rocks: lava flows, pebble-sized breccias and lapilli tuffs, and coarse and fine tuffs. Petrographic and geochemical data suggest a predominantly basic to intermediate character for the volcanism, corresponding to basaltic andesites and andesites. The fossil floras (leaves and pollen grains) occur mostly in reworked volcaniclastic rocks, although they can also be present in lapilli tuffs. The remains of large tree trunks (on average, 0.60 cm in diameter and more than 1 m long) covered by a lava flow mark the termination of the interval with leaf, branch and seed impressions. This taphonomic behavior is repeated in the Tertiary, in which non-reworked volcanic rocks dominate. -The great variety of elements and the good preservation of the remains make the Zamek fossil flora unique in the Late Cretaceous, signaling the possibility of a younger age to these layers. This fossil flora is more diverse and bears larger *Nothofagus* leaves than the ones from Fildes Peninsula assigned to the this age.

The initial $^{87}Sr/^{86}Sr$ ratios of four samples from the Fildes Peninsula vary between 0.70337 and 0.70371. They indicate the mantle derivation of the magma, with little or no crustal contamination. The juvenile origin of the magma is confirmed by the similar positive εNd values (7.3-6.5). Geochemical diagrams depicting the behavior of trace and rare earth element pairs suggest that these rocks probably had similar magma sources and similar evolution, or were co-genetic. Considering the geochemical and isotopic data, along with the paleontological evidence provided by the fossil flora, it is probable that the studied volcanic rocks were emplaced during the Early Tertiary.

Birkenmayer et al. (1983): Studia Geologia Polonica 74: 7-72.
Li Haomin. (1994.): In: Y. Shen (ed.), State Antartic Committee, Monograph 3: 133-171.
Li, Z. & Liu, X. (1987): In: M.R.A. Thomson, J.A. Crame & J.W. Thomson (eds.), Geological Evolution of Antarctica: 487-491.
Parkhurst & Smellie (1983): Earth Planet. Sci. Lett. 66: 214-222.

The Miers Bluff Formation, Livingston Island, South Shetland Islands –part of the Upper Jurassic-Cretaceous depositional history of the Antarctic Peninsula

(poster p.)

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Until recently, the depositional age of the Miers Bluff Formation (MBF) outcropping in Hurd Peninsula, Livingston Island was poorly constrained. It was supposed to range in a wide time interval, between Late Carboniferous (?) and Early Jurassic (SMELLIE et al. 1984, MILLER et al. 1987, HERVE et al. 1991, HERVE 1992, WILLAN et al. 1994, YAN-BIN et al. 1999).

Our recent biostratigraphical and palaeontological studies lead to the crucial new data: first find of a macrofossil, Upper Tithonian ammonite species *Blanfordiceras* sp. (aff. *wallichi*) in non-in situ block (PIMPIREV et al. 2002), and calcareous nannofossils from in situ exposures of the MBF (STOYKOVA et al. 2002). The recovered calcareous nannofossils undoubtedly proved Campanian-Maastrichtian age for the upper part of MBF. These facts allow us to consider MBF as a result of the Late Jurassic-Cretaceous depositional and structural evolution of the Antarctic Peninsula. The MBF consists of turbiditic sandstone, mudstone, conglomerate and sedimentary breccia formally divided into Johnson Dock Member (JDM), Napier Peak Member (NPM) and Moores Peak Member (MPM) (SMELLIE et al. 1995, PIMPIREV et al. 2000, DIMOV & PIMPIREV 2002).

The lowermost part of JDM is composed of 320 meters of thick packages (up to 25 m) medium to coarse-grained amalgamated massive sandstones intercalating with few meters thick mudstone/fine sandstone. These sandstones represent turbidite fan deposits originate during a lowstand of the sea level. The specific lithological peculiarities of this part make possible its separation as a new basal lithostratigraphic unit. The lowermost strata of this unit (with Late Tithonian age, PIMPIREV et al. 2003) are partly synchronous with the Anchorage Formation (Byers Peninsula, Livingston Island), the Nordeskjold Formation (James Ross Island, Graham Land) and the Latady Formation (southeast Palmer Land). Age relation of the lower levels is possible with Zapata and Rio Mayer Formations in Magallanes basin, Patagonia and for the middle and upper part of the unit with the middle member of Tres Pasos Formation (turbidite fan deposits) in Cerro Cazador-Sierra Dorota area, southwestern Patagonia (MACELLARI et al. 1989).

The middle and upper part of JDM consists of interbedded thick sandstone and mudstones packages. The mudstone parts of the section are composed of alternating fine-grained thin sanstone-mudstone beds and thick massive mudstone strata possibly related with sea level rise. Part of this sedimentary succession has Campanian-Early Maastrichtian age (STOYKOVA et al. 2002), being partly synchro-

nous with Marambio Group (James Ross Island) and Williams Point beds (Livingston Island). The broad correlation is possible with the upper member of Tres Pasos Formation and Cerro Cazador Formation in southwestern Patagonia.
The uppermost members of MBF (NPM and MPM) have possibly Late Maastrichtian to Paleocene (?) age and represent the final regressive stage of the depositional history of the back-arc turbidite basin.

The altered volcanic sequence of the Mount Bowles Formation, which overlies the MBF, is supposingly Early Tertiary and correspond with the active volcanism well documented in the South Shetland Islands at that time.

Dimov, D. & Pimpirev, Ch. (2002): Rev. Bulg. Geol. Soc. 63: (in press).
Hervé, F. (1992): In: J. Lopez-Martinez (ed.), III Congr. Geol. de España / VIII Congr. Latinoamericano de Geol. Salamanca, 3: 19-30.
Hervé, F., Loske, W., Miller, H. & Pankhurst, R.J. (1991): In: M.R.A. Thomson, J.A. Crame & J.W. Thomson (eds.), Geological Evolution of Antarctica: 429-435.
Maccellari, C.E., Barrio, C.A. & Manassero, M.J. (1989): J. South Amer. Earth Sci. 2, 3: 223-239.
Miller, H., Loske, W. & Kramm, U. (1987): J. South Amer. Earth Sci. 1: 301-307.
Pimpirev, C., Dimov, D. & Miller, H. (2000): Polarforschung 66 (3): 1-5.
Pimpirev, Ch., Ivanov, M., Dimov, D. & Nikolov, T. (2002): N. Jb. Geol. Paläont. Mh., 6: 377-384.
Smellie, J.L., Liesa, M., Muñoz, J. A., Sabatt, F., Pallas, R. & Willan, R.C.R. (1995): Antarctic Sci. 7: 99-113.
Smellie, J.L., Pankhurst, R., Thomson, M.R.A. & Davies, R.E.S. (1984): Sci. Rep. Brit. Antarc. Surv. 87: 85 pp.
Stoykova, K., Pimpirev, Ch. & Dimov, D. (2002): J. Nannopl. Res. 24: 166-167.
Willan, R. C. R., Pankhurst, R. J. & Hervé, F. (1994): Antarctic Sci. 6: 401-408.
Yan-bin, S., Shu, O., Xi-guang, D. & Xiang-sheng, Z. (1999): In: D.N.B. Skinner (ed.): 8th Internat. Symp. Ant. Earth Sci., Abstracts: 278, Wellington.

High resolution stratigraphy of the Gustav Group, James Ross Island, Antarctica
(oral p.)

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The Cretaceous sedimentary succession exposed within the James Ross Island group is a key locality in the Southern Hemisphere for the understanding of Cretaceous palaeoclimate, biodiversity and environmental change. The sedimentary succession spans an interval of time, during which there were major changes in global climate, prior to the Cretaceous-Tertiary mass extinction. Established litho- and bio-stratigraphic schemes for the Gustav Group are well established, but increased stratigraphic resolution is required if we are to correlate events within the James Ross Basin with both other southern and northern hemisphere successions.

Previous studies recognised four major units within the Gustav Group: the Lagrelius Point, Kotick Point, Whisky Bay and Hidden Lake formations, which were thought to span the Barremian to Santonian. Revised dating control based on both palynological studies and Sr isotope stratigraphy, suggest that this succession actually ranges from the Aptian through to the Coniacian. To provide further stratigraphic resolution through the Gustav Group we have re-measured a key section through the Kotick Point, Whisky Bay and Hidden Lake formations, adjacent to Brandy Bay on northern James Ross Island. The mudstone-dominated Kotick Point Formation is conformably overlain by the locally conglomerate or sandstone-dominated Whisky Bay Formation. The boundary between the Whisky Bay and Hidden Lake formations reveals a very abrupt basin shallowing event from deep-marine submarine fan-slope apron environments below to tidal and storm-dominated sedimentation above.

Molluscan macrofossils have been collected throughout this >1500 m section, and samples have been selected from Sr isotope analysis, palynology and ammonite biostratigraphy. Together these integrated new data will enable us to provide a much higher stratigraphic resolution enabling correlation of the James Ross succession with northern hemisphere sections. In addition, increasingly, the Cretaceous of Antarctica is becoming a key reference section for Cretaceous sediments throughout the Southern Hemisphere.

Thyasira mounds from the Maastrichtian of Antarctica
(poster p.)

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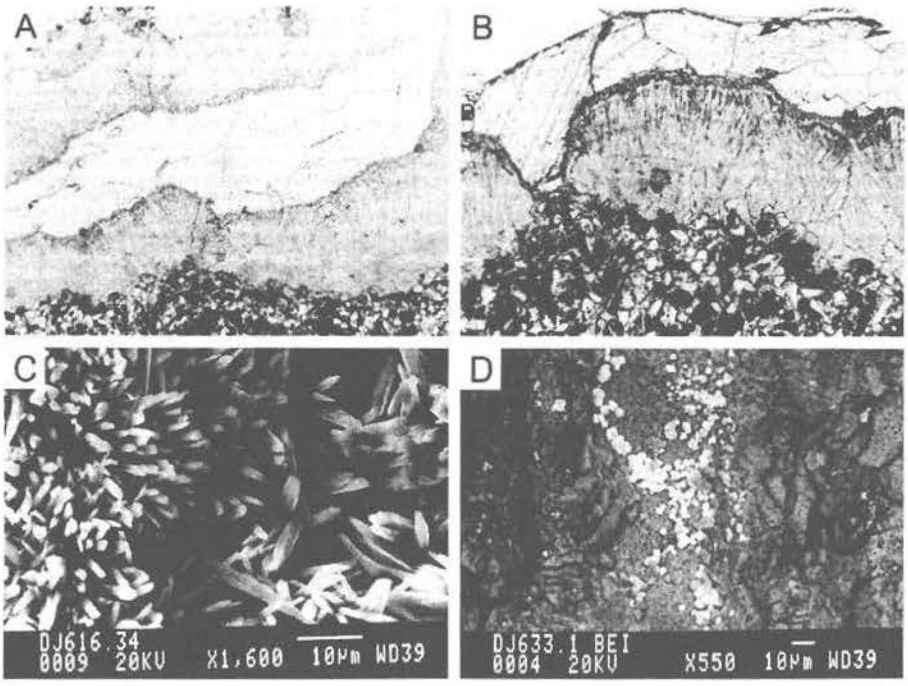
The distinctive lucinoidean bivalve, Thyasira townsendii occurs at a number of discrete levels within the extensive Maastrichtian succession within the James Ross Basin. Typically where it does occur it is exceptionally abundant. In the early Maastrichtian, four discrete carbonate mounds, composed almost entirely of Thyasira townsendii, have been mapped within the lower levels of the Karlsen Cliffs Member of the Snow Hill Island Formation on Snow Hill Island (Pirrie et al., 1997). The mounds are up to 50 m across at the base and up to 35 m in height and comprise individual Thyasira packed beds, 30-75 cm thick. Within these beds the bivalves are both in life orientation and are reworked. Laterally the Thyasira mounds terminate abruptly to the SE/SSE against dark grey sulphurous-smelling mudstones with abundant marcasite/pyrite concretions. In thin section, samples of the mound carbonates have numerous generations of radial fibrous high Mg calcite cements (Fig. 1a, b) locally postdated by sparry calcite cements. Under scanning electron microscopy, the radial fibrous high Mg calcite cements are exceptionally well preserved (Fig. 1c).



Diagenetic pyrite is also very abundant (Fig. 1d). Petrographically, the Snow Hill Island samples are directly comparable with previously described lucinoid bivalve coquinas from the Western Interior Seaway of the US, interpreted as representing seafloor methane vents (KAUFFMAN et al. 1996).

Based upon the field sedimentology, palaeoecology and diagenesis of these mounds, and their relationship to the associated organic and pyrite rich sediments, we interpret them to represent sea-floor methane seep communities, in which the thyasirid bivalves are chemosymbionts utilising sulphide-reducing bacteria. The extent to which the bivalves relied on chemosynthetic carbon sources is demonstrated by their carbon isotope signals. Elsewhere within the Maastrichtian stratigraphic record, influxes of thyasirid bivalves are interpreted as reflecting episodes of low oxygenation levels, during which the chemosybiotic thyasirids were able to flourish.

Kauffman, E.G., Arthur, M.A., Howe, B. & Scholle, P.A. (1996): Geology 24: 799-802.
Pirrie, D., Crame, J.A., Lomas, S.A. & Riding, J.B. (1997): Cret. Res. 18: 109-137.

What does seismic anisotropy say about northern Victoria Land geodynamics?
(poster p.)

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Teleseismic data recorded by temporary and permanent stations located in the Victoria Land region (Antarctica) are analyzed in order to identify the presence and location of seismic anisotropy. Thirteen temporary stations were deployed between 1993 and 2000 in different zones of the Victoria Land, starting from the area close to the Italian Terra Nova Bay Base in 1993 and then going both southward, south of the Davis Glacier and northward up to the Indian Ocean. To better constraint our study we included in the analysis data recorded by the two permanent stations located in the region: TNV (Terra Nova Bay,Italian Base) and DRV (Durmont D'Urville, French Base).

Seismic anisotropy is an indicator of the deformation occurring in the lithosphere and upper asthenosphere and it is mainly due to strain-induced re-orientation of highly anisotropic olivine crystals. A shear-wave incident to an anisotropic material splits into two polarized waves travelling with different velocities. Polarization direction and time delay between these two phases characterize the anisotropy. We used the method of SILVER & CHAN (1991) to determine splitting parameters from broadband SKS waveforms. This study reveals the presence of seismic anisotropy below the studied region.

In parallel with SKS shear wave splitting results, we also give an evaluation of the radial anisotropy from a joined inversion of regional and teleseismic Rayleigh and Love dispersion measurements. Moreover, surface wave tomography provides useful constraints to the vertical resolution and drawing a comparison between different approaches allows better locating anisotropy with depth.

The D-GOALS PROJECT, David Glacier: an outlook on Antarctic low seismicity

(poster p.)

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Seismic activity has been detected south and south-west of Terra Nova Bay, with a rough ESE-WNW alignment close to David Glacier, although the event locations are not very precise (BANNISTER & KENNETT 2002). Microseismicity of the Antarctic continent is not well known, and the relationship between glacial dynamics and tectonics is not yet well understood. During the 2003-2004 austral summer we will be undertaking a joint Italian-New Zealander field campaign using portable seismographs, to record new data that would complement the data from permanent observatories (TNB, SBA at Scott-Base, VNDA in the Dry Valleys) and the data already recorded by previous passive-array experiments.

We have mapped out the sites for nine broadband seismometric stations, in order to encircle the David Glacier area and guarantee a good azimuthal coverage between the two extreme sites, Larsen at the northernmost and Star Nunatack at the southernmost.

Our goal is to better determine event focal depths and focal mechanisms, by improving the location of low magnitude seismicity detected close to David Glacier, and to study the crustal structure in the region, by analysis of receiver functions. The origin and source mechanisms of the events is still not clear and new local data records will be strategic to discriminate between possible ice-quakes and tectonic earthquakes in the area.

Bannister S. & Kennett, B. (2002): Terra Antarctica 9: 41-46.

Russian reflection seismic investigations in subglacial Lake Vostok region: methodical features and the principle results

(poster p.)

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Before the 1990[th], there was only single ice thickness measurement produced by the reflection seismic. It was made at the Vostok Station (Central East Antarctica) by Soviet scientists. Its technique was complex and laborious. According to this method, the seismic shooting were produced in a borehole on the depth approximately 39 m. The receivers (vertical seismic array) were fixed into a borehole on depth from 2.5 down to 49 m.

New period of systematic Russian investigations by reflection seismic at the Vostok Station vicinity was started in 1995. At the initial stage of the work we were solving methodical problems of the seismic performance which could allow receiving good scientific materials at the minimal inputs. The principle complexity was in the source of the seismic waves. The seismic shootings into boreholes on the depth 100 m and deeper gave a good results. The same ones were received using the detonating cord which was located on the snow surface. The last method (as the most effective) started to be applied in the subsequent works. This method allowed collecting data which give information about characteristics of the Lake Vostok and its bottom.

The ice thickness determination near the borehole 5G-1 is the principle aim of the remote sensing investigations at the Vostok Station. It was important for the borehole drilling. The precise seismic measurements are impossible without information about velocity of the wave propagation in ice. These investigations were made in the borehole 5G-1 by the vertical seismic profiling. The measured velocity is 3810 m/s. The ice thickness in the vicinity of the borehole 5G-1 is 3750 and the ice thickness from the borehole bottom to the lake surface is 130 m.

There are two principle seismic boundaries were fixed during the seismic investigations over the Lake Vostok. The first one is the ice base and the second one is the lake bottom. The reflections from the water layer are the very intensive and characterized by high amplitude. There are two reflections located below from the lake surface. They observe on the seismic records which collected in the Vostok Station area. The first one is from the lake bottom. Modeling shows that the second one is the reflection from the western slope of the bottom. Reflections from the bottom are characterized by complicated interference pattern of the seismic waves and conditioned by roughness of the sub-water surface.

The Russian reflection seismic materials were collected in the southern part of the subglacial Lake Vostok mostly. There are more then 200 seismic shootings were made along 6 profiles: there are three sub-latitude, two sub-meridian and profile which were along the lake. There are two areas defined in the lake basin. The first one is shallow water area with the depths from 60 to 360 m which is in the southern part and 120 km north from the Vostok Station. The second one is deepwater area. It occupies all the other territory. The depth of the lake in the station vicinity is 680 m. Maximal measured water thickness was registered in area which in 37 km northwest from the station. Its depth is 1190 m.

Ice sheet, bed relief and morphological aspects of MacRobertson and Princess Elizabeth lands, East Antarctica: a synthesis of Russian and Australian data

(poster p.)

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The Lambert Glacier-Amery Ice Shelf system and the related Lambert rift valley are the major glaciological and geological components of a vast region of East Antarctica. For several decades Soviet (Russian) and Australian surveys have collected geophysical data from this region to provide a better understanding of the ice sheet and sub-glacial relief. Australian field work began with seismic investigations in the summer of 1957/58 and continued during the 1960s and early 1970s with glaciological and geophysical surveys. Geophysical investigations by Polar Marine Geological Research Expedition (PMGRE) stared in the austral summer of 1971/72 and continued to 1973/74 (17-19 SAE). Observations made during this period included radio-echo sounding (RES), reflection seismic and topographic mapping. During the ten years following the late 1980s further Soviet (Russian) and Australian airborne investigations were undertaken and the Australian program completed a 2500-km inland tractor traverse of the Lambert basin. The Soviet RES flights were particularly extensive and covered an area of approximately 300,000 km^2 with 5 km flight line spacing. Also, by 1994 the Australian RES instrumentation was upgraded to include digital signal processing. All geophysical data from these expeditions has now been integrated into a common database and a 1: 2,000,000-scale map series has been prepared within the framework of a co-operative project between PMGRE, Australian Antarctic Division and the Antarctic CRC.

Ice thickness in the Lambert drainage basin varies from a maximum of 3,400 m in inland regions to zero over the exposed rock peaks of the Prince Charles Mountains. The floating ice of the Amery Ice Shelf varies from a maximum thickness of about 2,800 m near the grounding zone at 73.3°S, to about 200 m at the northern calving front in Prydz Bay. The along-flow decrease in ice thickness is a result largely due to strain thinning, but between 73.3°S and 72°S high basal melting also plays a role. The sea-water cavity beneath the ice shelf has a thickness decreasing southward from about 500 m near the front to zero at the grounding zone. Over inland regions, the grounded ice thickness is controlled by bedrock morphology, surface slope and snow accumulation rate.

The dominant tectonic structure of the area is the Lambert rift valley which controls the flow direction of the Lambert Glacier and the Amery Ice Shelf. The central flow-line of the drainage system originates at Dome Argus, overlying the sub-glacial Gamburstev Mountains. The main stream of the Lambert Glacier crosses a number of transverse sub-glacial bedrock ridges before filling the deeply incised valley of the Lambert Rift Zone. This rift zone originates just north of Burke Ridge (74°40'S; 65°25'E) and extends northwards for more than 700 km in a direction of about 15 deg TN. For the first 250 km this has a width of about 40 km, but it then broadens rapidly to about 80 km. Over the next 450 km it continues to further broaden to a width of about 160 km at the front of the ice shelf. While the channel filled by the Lambert-Amery stream broadens to the north by a factor of 4, the depth to bedrock tends to decrease by a similar amount and a similar channel cross-sectional area is maintained throughout. While this channel was completely filled by the Lambert Glacier approximately 20,000 yrs. B.P., under the present warmer climatic conditions the northern part of the channel is filled partly by the floating Amery Ice Shelf and partly by the sub-shelf water cavity. In the region along the Mawson Escarpment the Lambert graben is fringed by steep above ice topography.

The Prince Charles Mountains, located to the west of the Lambert-Amery stream, are characterized by strong vertical and lateral partitioning. Here, a number of mountain massifs, escarpments and isolated summits (nunataks) rise above the ice surface. The RES data show that the elevation range from the base to the summit of the mountains varies from 500 m to 4000 m, with a tendency to increase towards the northwest. A low hill-plane with heights from -300 m to 0 m is situated north and south of the mountains, while to the southeast of the Lambert valley the bedrock comprises a sub-horizontal plain with an initial elevation of 100-200 m, rising to 500 m and then higher towards the Grove Mts..

Morphology of the Lake Vostok basin area (Central East Antarctica)

(poster p.)

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During the austral summer field seasons of 1995-2002 the Polar Marine Geological Research Expedition (PMGRE) within the framework of the Russian Antarctic Expedition (RAE) carried out ground-based geophysical investigations in the subglacial Lake Vostok area. The principle aims of the works are the lake contouring, ice thickness and bed relief mapping. Interpretation of these materials allows to study of the subglacial morphology and understanding of the geological structure of this area.

The dominated structure of this area is the Vostok basin. It has an oval-shaped configuration with sub-meridianal direction and complicated by relative not big bays, capes and peninsulas. The boundary of this structure is marked by edges of mountain ridges and other positive forms which envelope of this basin. Its size is approximately 310 x 100 km. The Vostok basin is subdivided into four main sub-structures: the lake plane, deep basin, system of different-level terraces and slope.

The lake plain is located in the northern part of the basin. It is represented by sub-horizontal gentle sub-water surface -930 m deep and approximately 150 km long. The deep basin has pear-shaped configuration with elevation from -1600 to -800 m. Its relative height is approximately 250 m and the size is about 30 x 55 km. System of different-level terraces is developed in the southern part of the Vostok basin mostly. These terraces are located on the -1270, -1040, -860, -600 and -460 m and have a different size: from one to 5-7 km long. The slope of the Vostok basin is around of the mentioned substructures. Its width is from the several km (the southern part of the basin) to several tens km (the central west and northern parts of the basin). Elevation of this substructure is from -1300 to 400 m and more. Its slope is approximately 17-22°.

Relief of the environment of the Vostok basin is very different. Its studying will continue in future field seasons. We intend that there are three principal morphological substructures outside the Vostok basin: flat plain, hilly plain, hilly land and mountain land. The flat plain is about sea level height and occupied the northern part close to the Vostok basin. The hilly plain is around the Vostok basin in the northwest, west and south. Its elevation is from 250 to 400 m. This substructure is characterized by weak dissected topography complicated by ridges and narrows with relative height about 150 m. The mountain land area is in the central part of the territory. Its height is 1000 m and more. There are several canons approximately 250 m deep there. Top surface 800 m height was fixed on the eastern slope of this area.

Response of subglacial Lake Vostok, Antarctica to tidal forcing

(oral p.)

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Lake Vostok, the largest of about 70 subglacial lakes in Antarctica is more than 250 km long and up to 50 km wide. It is covered by an about 4000 m thick ice sheet. Lake Vostok has come into the focus of a broadly based scientific community because of the possibility of preserved life isolated from the atmosphere for at least thousands of years.

The location of the Russian station Vostok on the southern tip of the lake favours the exploration of the lake as a logistic base and due to the ice core drilling which revealed samples of refrozen lake water. The lake has been investigated from different points of view: the topographical setting including ice thickness, water depth and bedrock topography, the flow regime of the overlying ice, chemical and biological analysis of lake water and circulation modelling of the lake water and water-ice-interactions.

In the modelling of the lake circulation the response of Lake Vostok to tidal forcing has not been taken into account so far. We present some theoretical considerations about the tidal signal which can be expected for Lake Vostok, together with observational evidence from different observation techniques. GPS measurements conducted in the southern part of the lake during the 47th and 48th Russian Antarctic Expeditions in the summer seasons of 2001/02 and 2002/03 revealed a vertical movement of the ice surface above the lake relative to the grounded surrounding area. This movement shows a clear tidal signature.

Whereas the GPS observations provide a time series of the tidal displacement at a distinct location, synthetic aperture radar interferometry (InSAR) yields the spatial pattern of the phenomenon as a difference of two distinct epochs. The deformation captures the whole lake surface within an InSAR scene indicating a wide grounding zone comparable to grounding zones of ice shelves.

Based on the theoretical expectations of the response of the lake to tidal forcing and the observational evidence we would like to emphasize the significance of these factors in the complex modelling of the water circulation within the lake.

Significance of a Transantarctic Mountain ice sheet on the Victoria Land Basin Rift Succession, Ross Sea, Antarctica

(poster p.)

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Antarctic geological (1) and distal proxy (2,3,4) records indicate that some glacial activity may have been occurring in Antarctica as early as the Eocene. Glacio-climatic models, and some geological data, have glaciation initiated on highlands followed by expansion to larger ice masses until full continental-scale ice sheets formed, all forced with Milankovitch pacing (6,7,8). Early phases of glaciation were relatively temperate after which, glaciers became progressively colder (through subpolar/polythermal to full polar) from Oligocene through Pleistocene times (5). Geology also shows Cenozoic ice sheet margins were at times less extensive and that temperate glacial conditions may have existed, at least locally, with glacial margins retreated up fjords, which penetrated deep into the interior of East Antarctica (9,10,11,12,13,14). Mg/Ca ratios in proxy records (3) show average bottom water temperature probably cooled continually through the Cenozoic, with a slight slowing in the late Oligocene and early Miocene, agreeing with the Antarctic data above (perhaps diminishing concerns of Mg/Ca calibration reliability). The resulting second order trends in glacial volume changes through the Cenozoic of (3) really reflect changes in glacial volumes on Antarctica, because other ice sheet volumes were insignificant before 2-3 My ago. Antarctic glacial volume can be shown relative to the maximum Pleistocene volume of the Antarctic Ice Sheet (c 37.7 x 10^6 km^3; 7), indicating glacial volumes on Antarctica increased in early Oligocene, decreased in the late Oligocene to early Miocene and then increased again in late Miocene. Conceptualizations from glacio-climate models can then be used to define areas likely to have been exposed or covered by glaciers at different proportions of Antarctic glacier volumes. Consequently, for significant parts of the Cenozoic, especially the Miocene, but also during Oligocene and perhaps even the Pliocene, the most important influence on sedimentation in the Victoria Land Basin (VLB) was not a large East Antarctic Ice Sheet (EAIS) but a local Transantarctic Mountain Ice Sheet (TAMIS). TAMIS may have been similar in style to the Pleistocene Cordilleran Ice Sheet, although they occur in different tectonic settings. Such an ice sheet is likely to have been more responsive to small perturbations in climate and locally, marine termini may have fluctuated independently from climate forcing, in a similar way to Quaternary termini. Given that the VLB is a rift basin, it may have provided significant accommodation space for sediment, and thus potentially it can contain a high-resolution record of advance and retreat of TAMIS that will yield a record of short climatic changes. Tectonic subsidence in the rift basin also may be fast enough to take much of the sediment record out of the glacial erosion zone during the next advance. The eastward tilting half-graben creates a ramped shelf to the west, which can be fed by large glacial sediment fluxes from the TAM. During advance the ice sheet may have become pinned on the eastern footwall high. The VLB is a prime depocenter for these short-term records, whereas offshore in the Ross Sea, the main records of ice sheet expansion represent longer-term climatic shifts that forced major ice sheet expansion. With the VLB being able to trap much of the sediment flux from the TAM during glacial minima, farther offshore, the Ross Sea may remain starved of siliciclastic sediment to contain a condensed biogenic section. If thin, then that is easily eroded during glacial advance and retreat phases of the expanded ice sheets, when higher siliciclastic accumulation rates would occur above an erosional unconformity.

1- Hambrey, M.J. & Barrett, P.J. (1993): AGU Antarctic Res. Series 60: 91-124.
2- Zachos, J.C., Pagani, M., Sloan, L., Thomas, E. & Billup, K (2001): Science 292: 686-693.
3- Lear, C.H., Elderfield, H. & Wilson, P.A. (2001): Science 287: 269-272.
4- Billups, K. & Schrag, D.P. (2002): Paleoceanography 17(1).
5- Powell, R.D., Laird, M.G., Naish, T.R., Fielding, C.R., Krissek, L.A. & van der Meer, J.J.M. (2001): Terra Antartica 8: 207-216.
6- DeConto, R.M. & Pollard, D. (2002): Nature 421: 245-249.
7- Huybrechts, P. (2002): Quat. Sci. Rev. 21: 203–231.
8- Naish, T.R. & 32 others (2001): Nature 413: 719-723.
9- Hambrey, M.J., Barrett, P.J. & Robinson, P.H. (1989): DSIR Bull. 245: 19-47.
10- Hambrey, M.J., Ehrmann, W. & Larsen, B. (1991): ODP Leg 119 Sci. Res., J. Barron & B. Larsen (eds), College Sta. Texas: 77-132.
11- Webb, P.N., Harwood, D.M., Mabin, M.G.C. & McKelvey, B.C. (1996): Marine Micropal. 27: 273-297.
12- Wilson, G.S., Harwood, D.M., Askin, R.A. & Levy, R.H. (1998): J. Glaciol. 44: 437-447.
13- Hambrey, M.J. & McKelvey, B.C. (2000): Sedimentology 47: 577-607.
14- O'Brien, P.E., Cooper, A.K, Richter, C. et al. (2001): Proc. ODP, Init. Repts 188, http://www-odp.tamu.edu/publications/188_IR/188ir.htm.

Fluid inclusion characteristics of charnockite – granite suite in Mühlig-Hofmannfjella, central Dronning Maud Land, East Antarctica

(oral p.)

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The igneous charnockite and associated granite of Muhlig-Hofmannfjella in central Dronning Maud Land, East Antarctica, are presumed to be manifestation of magmatism during the Pan-African processes during Gondwana accretion. The charnockite and granite association is unique: They occur as closely intertwined irregular shaped bodies with distinct colour contrast; but the texture is continuous across the margins. Detailed petrography reveals that their mineral assemblage is markedly different. Hypersthene, ferrosilite, fayalite, diopsidic augite and biotite are the ferro-magnesium minerals in charnockite, while biotite and hornblende are the only ferromagnesium minerals in granite. The charnockite has signatures of a Charnockite Magmatic Suite (CMS) as well as that of A-type granite derived from fractionation of tholeiitic basalt. While presence of inverted pigeonite, high K, Ti and P, low Ca are indicative of CMS, the presence of ferrosilite and fayalite are features of A-type granite fractionated from a tholeiitic magma. Harker plots of SiO_2 vs. CaO, K_2O and TiO_2 for both granite and charnockite are almost identical.

The fluid inclusion study was carried out on selected samples of spatially associated charnockite and granite. The petrography of wafers indicated presence of abundant primary, secondary and pseudo-secondary mono-phase aqueous/carbonic, bi-phase (H_2O-CO_2) and multi-phase inclusion in both charnockite and granite. The size of inclusions varied from 0.65μ to 5.83μ. Primary inclusions were seen as isolated inclusions while early formed carbonic inclusions are seen as isolated negative crystal shaped ones, both along linear arrays and clusters. Suitable inclusions were selected from quartz and feldspar for microthermometric study.

The range of total homogenization temperature of the inclusions ranged from 135.2°C to 523°C, which corresponded to a salinity range of 0.16 to 32.75 wt.% NaCl equivalent. The Th CO_2 varied from -56.6° to -33.7°C. The histogram of temperature of total homogenization observed indicate three population peaks around 135-165°C, 225-285°C and 315-345°C. Various plots, Th vs. Tm ice, Th vs. CO_2 density and Th vs. salinity for both charnockite and granite are almost identical which indicate that a) increase in CO_2 density with cooling and b) fluid mixing at near constant salinity.

In the light of these results, it is surmised that although granite and charnockite occur in the field as distinct entities albeit closely associated, they share common crystallization history and hence their identical fluid characteristics. In such an event, the role of CO_2 is restricted to its effect during magma generation process and got trapped during cooling of the pluton. The controlling factors for crystallization of granite and charnockite (as separate bodies as seen in the field) are different. The ongoing studies suggest that it is the oxygen fugacity that played a dominant role during the solidification of the Mühlig-Hofmann pluton.

Petrological and geochemical study of Livingston, King George and Deception islands (South Shetland Islands, Antarctica): geodynamic evolution and magmatism

(poster p.)

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The South Shetland Islands are located along the northeastern Pacific margin of the Antarctic Peninsula. Most of the exposed rocks in this region belong to a continental volcanic arc as result of at least 200 Ma of Pacific Plate subduction below the continental margin of the Antarctic Peninsula. In addition there are outcrops of terrigenous and metasedimentary rocks. The Bransfield Strait is a recent backarc basin that separates the South Shetlands Islands from the peninsula. The aim of this contribution is to analyse the origin of different types of magmatism observed in the Shetland Islands, in order to determine the geodynamic setting of the magma sources. This research is based on detailed petrography and chemical analyses on selected rock samples collected during January 2001, at Livingston, King George and Deception islands.

A volcano-plutonic association was identified at Livingston Island (Hurd Peninsula), originated by magmas of different composition, between basalts and rhyolites, that belong to the calc-alkaline series. The predominant rocks are diorites, granites, andesites, dacites and rhyolites. They show mineralogical evidences of low grade metamorphism, varying from prehnite-pumpellyite to low-P greenschists facies. Nd^{143}/Nd^{144} and Sr^{87}/Sr^{86} values, complemented with Th/Yb:Ta/Yb ratios, indicates a supra-subduction origin in active continental margin for most of the analysed rocks. Some samples show, in addition isotopic ratios that may correspond to magmatism of oceanic volcanic arcs. Sampled rocks of southwestern King George Island are essentially basalts and subordinate basaltic andesites. Most of the analysed rocks correspond to the calc-alkaline series, although the less differentiated compositions have a transitional tholeiite/calc-alkaline affinity. The occasional transformation of some plagioclase to zeolites, which also fill vesicles together with quartz and calcite, indicates hydrothermal transformation conditions. However the samples do not shows evidences of metamorphism. Nd and Sr isotopic ratios and trace elemental patterns of these rocks reveal a genesis within a context corresponding to an oceanic island arc magmatism, with moderate crustal contamination, from a very depleted mantle source. In the Deception Island the rocks were sampled in Péndulo Bay and close to the Argentinean base. They are basalts and some basaltic andesites. Metamorphism and hydrothermal alteration were not detected in these rocks. The magmas originated from a non-depleted mantle source, within an intraplate extensive context and show little crustal contamination. Nd and Sr isotopic ratios and less mobile trace element ratios, indicate an intraplate tholeiitic vulcanism, probably developed in a backarc context.

The results of the geochemical analyses support some of the previous tectonic hypothesis proposed for this area, although we provide new insights into the evolution of the metamorphism. The magmatism of Livingston Island is probably related to the Mesozoic subduction of the Pacific Plate below the Pacific margin of the Antarctic Peninsula. King George Island magmatism may represent the Late Mesozoic-Cenozoic collision of a volcanic island arc, within the same tectonic setting. Deception Island represents the late volcanism developed in the extensional back-arc basin of Bransfield Strait. The rock samples of Livingston Island evidence, however, a low-grade metamorphic episode of burial type, not previously identified in this island. This metamorphism is similar to the one affecting the Mesozoic Andean volcanic rocks. The metamorphism is not observed in the volcanic rocks from Byers Peninsula of the same island, which are dated by K-Ar from Early Cretaceous to Palaeocene. This fact indicates that the calc-alkaline magmatism must have begun in Hurd Peninsula probably in pre-Cretaceous time, despite the oldest K-Ar ages now available from volcanic rocks of this area correspond to Late Cretaceous.

Cybercartography in support of Antarctic earth science

(poster p.)

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The Cybercartographic Atlas of Antarctica Project (TAYLOR & PULSIFER 2002) aims to create an innovative new product and methodology to compliment discovering, utilizing, presenting and distributing existing information and data about Antarctica to a wide variety of users, including scientists, decision makers and the general public. A central element of a cybercartographic approach is the use of emerging cartographic visualization techniques.

New sources of geospatial data are increasingly informing Antarctic Earth Science (JEZEK 1999). New forms of cartographic visualization are being developed to exploit geospatial databases (MEISNER et al. 1999). The use of cartographic visualization can be of particular value to the scientific community for a number of purposes including: visualization of information resources in a given knowledge domain; integration of very large, distributed databases; and spatiotemporal modeling of complex environmental phenomena.

This paper presents a review of research in the areas identified. Research focused on visualization for Antarctic science applications are highlighted. Several preliminary application prototypes are presented to demonstrate how visualization in a cybercartographic context may be used to support science in Antarctica. The paper concludes with a discussion of geospatial data infrastructure requirements for the visualization methods presented. Areas of future research are identified.

EN.REFLIST

Biostratigraphy of Holocene deposits in the southern part of Cosmonaut Sea, Antarctica

(poster p.)

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20 piston cores, from 0.3 m to 3 m long, have been collected in the south-western part of the Cosmonaut Sea (shelf and continental slope) during early Soviet Antarctic Expeditions (1960-1965) and reexamined recently using new analytical (lithological and micropaleontological) approaches. Three groups of microfossils were found in the bottom (presumably Holocene) sediments of this area: diatoms (species), radiolarians (1 specie) and foraminifers (species). Analyses of diatom assemblages was aimed to develop a Holocene biostratigraphy and to reconstruct depositional and palaeoecological conditions in this part of Antarctic margin.

The studied part of the bottom sediments contains mostly siliceous diatoms with rare radiolarians and foraminifers and are subdivided into three diatom assemblages exhibiting the distinct species variations through the section. The Lower Assemblage is dominated by *Chaetoceros* resting spores. The abundance of resting spores seems to be associated with neritic enviroments and their high production is related to the lastest stages of diatom blooms. The prevailing of *Chaetoceros* resting spores reflects the open water conditions and stable water masses. The Middle Assemblage is distinguished from the Lower one by lithology and diatom taxa. This Assamblage is characterized by predominance of *Chaetoceros* resting spores, *Nitzschia kerguelensis* and *N. curta*. Oceanic species *Nitzschia kerguelensis* is supposed to reflect the invasion of oceanic water masses and warmer climatic conditions. The Upper Assemblage is dominated by *Nitzschia kerguelensis* and sandy sediments suggesting unstable hydrological conditions.

Determination of the onset of oldest extensive Antarctic glaciation and seismic facies classification

(oral p.)

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The focus of this investigation is to examine the direct record of ice sheet expansion on the continental margin and then compare this to the proxy records to determine which proxy records best reflect the conditions on the continent and to attempt to gain insight on why others do not work well. Single-channel (SCS) and multi-channel (MCS) seismic data sets were collected during four cruises in the Ross Sea, Antarctica, in 1990, 1993, 1994, and 1996. It is hypothesized that the onset of major glaciation in Antarctica began in the late Oligocene-early Miocene. In order to test this hypothesis, stratigraphy in the MCS and SCS data were analyzed. After interpretation, a glacial sequence stratigraphic framework will be developed and seismic facies will be classified using a fuzzy logic classification scheme that concentrates on selected seismic parameters. This study will provide insight into the onset of glaciation and, via seismic stratigraphic classification, the link between the long-term record of Antarctic glaciation and its relationship with global sea level, paleoclimatology, and paleo-oceanography.

Alley, R.B., Blankenship, D.D., Bentley, C.R. & Lord, N. (1989): Marine Geology 86: 101-120.
Anderson, J.B. (1986): South African J. Sci. 82: 503-505.
Anderson, J.B. & Bartek, L.R. (1992): Antarctic Res. Ser. 56: 231-263.
Eyles, Daniels, J., Ostermann, L.E. & Januszczak, N. (2001): Marine Geology 178: 135-156.
Hambrey, M.J., Ehrmann, W. & Larsen, B. (1991): In: J. Barron, B. Larsen et al. (eds.), Proc. ODP, Sci. Rep. 119: 77-132.

Tectono-metamorphic history recorded in high-grade rocks from Filchnerfjella: implications for the transition between Grenvillian- and Pan-African-aged mobile belts in central Dronning Maud Land, East Antarctica

(poster p.)

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Dronning Maud Land (DML) was interpreted by GOSE et al., (1997) as part of the Coats Land-Maudheim-Grunehogna (CMG) block, a West Gondwana fragment. Plutonic rocks emplaced at ~1.0-1.1 Ga form the bedrock in central DML and were reworked during the ~550 Ma Pan-African orogeny (JACOBS et al. 1998). In contrast, rocks in the western DML, interpreted as part of the ~1.1 Ga Namaqua-Natal mobile belt, record only mild isotopic resetting between 415-680 Ma (MOYES & GRONEWALD 1996). In central DML, the Orvin ranges link the Wohlthat ranges to the east with the Mühlig-Hofmann and Gjelsvikfjella to the west. Filchnerfjella (7-8°E and 71°52'-72°07'S), part of Orvin ranges and whose geology is less known (RAVIKANT et al. 2000) compared to the adjacent ranges to its east (e.g. OHTA et al. 1990), would characterize the transition between the Grenvillian- and Pan-African-aged orogens and delineate the collision zone of the CMG with the East Antarctic Craton (EAC).

The oldest unit is a migmatitic gneissic Bt+Hbl±Grt granite (metaluminous, I-type) containing mafic granulite boudins, which has been intruded by firstly a foliated charnockite and later by Grt-bearing gneissic alaskite (peraluminous, S-type granite). Layers of Grt+Sil±Crd-bearing metapelitic granulite were sampled at contact of foliated charnockite and migmatitic granite and probably represent the earliest metamorphosed cover sequence. The rocks record imprints of two tectonothermal events, D_1/M_1 and D_2/M_2. The D_1 deformation led to the formation of S_1 foliation in the gneissic granite, their mafic granulite boudins, and foliated charnockite, and was the form surface deformed during D_2. The dominant layering and foliation in the migmatitic gneissic granite represents a composite $S_1//S_2$ fabric which trends E to ENE with moderate dips to the S. The D_2 deformation led to the formation of map-scale N-vergent F_2 folds overturned to the S, and the mesoscopic-scale S_2 foliation in the rocks. The Grt-bearing gneissic alaskite was emplaced syntectonic to D_2, and contain enclaves of mafic granulite and migmatitic gneissic granite. All the lithounits were folded by regional F_3 folds which are upright, nearly cylindrical and with axial trace trending E-W, controlling the present-day map-pattern

The retrograde P-T path inferred for the high-grade rocks comprises an early near isothermal decompression segment from near-peak granulite-facies conditions of ~8 kbar and >700°C (M_1 -stage) to ~4.5 kbar and ~715 °C (M_2 -stage), recorded in boudins of mafic granulite and metapelitic granulite. This was followed by near-isobaric cooling to lower temperatures (~550°C and ~4 kbar), and the retrograde P-T path is similar to that inferred from Gjelsvikfjella (BUCHER-NURMINEN & OHTA 1993). The uplift to lower crustal levels and retrogression to amphibolite-facies conditions occurred broadly syntectonic to D_2 deformation and influx of fluids, probably from crystallizing granite.

The gneissic granite in Filchnerfjella was probably emplaced ~1.1 Ga , as they are similar to tonalitic rocks of adjacent Conrad range which were dated by JACOBS et al. (1998). A Pan-African timing for the major M_2/D_2 event, linking $M_1$and M_2 metamorphic stages into a continuous path, would support reworking of the Grenville-aged rocks and confirm the transition between these differently-aged mobile belts. The M_1/D_1 and M_2/D_2 events could be interpreted as occurring during the final collision and uplift of the CMG with the EAC, and this zone from Shackleton Range through the central DML to the Lützow-Holm Bay, would delineate the southern margin of the CMG block.

Bauer, W. & Jacobs, J. (2000): Gondwana Res. 3(4): 557-559.
Bucher-Nurminen, K. & Ohta, Y. (1993): J. Metam. Geol. 11: 691-703.
Gose, W.A., Helper, M.A., Conelly, J.N., Hutson, F.E. & Dalziel, I.W.D. (1987): J. Geophys. Res. 102:7887-7902.
Jacobs, J., Fanning, C.M., Henjes-Kunst, F., Olesch, M. & Paech, H-J. (1998): J. Geoj. 106: 385-406.

Moyes, A.B. & Gronewald, P.B. (1996): Chem. Geol. 129: 247-256.
Ohta, Y., Tordubakken, B.O. & Shiraishi, K. (1990): Polar Research 8: 95-126.
Ravikant, V., Jayapaul, D. & Asthana, R. (2000): Sci. Rep., DOD Tech. Publ. 14: 211-243.

The SSCUA broadband seismic deployment, East Antarctica*
(poster p.)

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The SSCUA deployment is a multi-year experiment aimed at recording broadband seismic data at localities across a large region of Australian Antarctic Territory between Mawson and Casey stations and inland as far as 75°S. The aim is to discover the 'Seismic Structure of the Continent Under Antarctica'. In each of the three years of the deployment, six solar-powered instrument sets are located in a new region, with a station spacing of approximately 200 km.Stations are located on rock or in ice according to local conditions and run for approximately five months through the austral summer. They 'hibernate' when the light fades, and re-start the following spring.An observatory-style instrument has also been installed at Davis Station to run throughout the experiment and add to existing permanent seismic stations at Mawson (operated by Geoscience Australia) and Casey (Global Seismic Network).The seismic instruments are a dedicated Antarctic set managed by the Australian National Seismic Imaging Resource (ANSIR). All logistic support at the Australian Antarctic stations and in the field, using fixed-wing aircraft and helicopters, is provided by Australian Antarctic Division (AAD).

The high-fidelity waveform data will be employed in a variety of body-wave (e.g. READING et al. 2003) and surface-wave (e.g. YOSHIZAWA & KENNETT 2002) seismic methods.Finding the seismic structure of the lithosphere beneath each station will be an initial goal.Comparing results from several stations will then begin to delineate the boundaries between major tectonic provinces in East Antarctica to full lithospheric depth. Furthermore, combining the data from the SSCUA temporary deployment with waveforms recorded at the limited number of permanent seismic observatory stations on the Antarctic continent will enable improvements to be made in tomographic images of Antarctica and the surrounding Southern Ocean. In particular, it will allow heterogeneities in the mantle to be resolved on a sub-continental scale.Previous broadband seismic deployments, which also used a limited number of temporary stations, moving them to successive locations to eventually sample an extended region of the continent, were carried out in Australia during the 1990's (KENNETT 2003).It will therefore be possible to examine correlations between Antarctic lithospheric structure and that already determined beneath Western Australia.

For many decades, the interior of East Antarctica has remained the least accessible, least hospitable location on the planet. The nature of the continent beneath the ice has been inferred from visible rock around the Antarctic coastline (e.g. FITZSIMONS 2000) but the SSCUA deployment provides a means of elucidating the structure beneath this region by examining the regional seismic structure.Extensions of tectonic province boundaries beneath the ice will be made based on (albeit indirect) observation rather than extrapolation.The challenges inherent in such a deployment, well into the East Antarctic interior, are considerable but it is hoped that new results will dramatically add to the little information currently available on the interior of East Antarctica.

Fitzsimons (2000): J. African Earth Sci. 31: 3-23.
Kennett, B.L.N. (2003, in press): In: R. Hillis & D. Müller (eds.), The Evolution and Dynamics of the Australian plate, Spec. vol. Geol. Soc. Austral. & Amer.
Reading, A.M., Kennett, B.L.N. & Dentith, M.D. (2003, in press): Austral. J. Earth Sci.
Yoshizawa & Kennett, B.L.N. (2002): Geophys. J. Internat. 149: 118-133.

*Information on the SSCUA deployment is available on-line at http://rses.anu.edu.au/seismology/sscua.

AnSWeR: the Antarctic seismic Web resource http://rses.anu.edu.au/seismology/answer

(poster p.)

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AnSWeR, the Antarctic Seismic Web Resource, was developed in response to the growing interest in using seismological methods to investigate the crust and mantle of the Antarctic continent. It has been developed for use by two distinct groups of scientists:
1) Seismologists working in Antarctica or on Antarctic data;
2) The wider scientific community wishing to access information derived from seismic data.
While both groups will benefit from the pages listing relevant links and publications it is recognised that seismologists and other scientists have different requirements from such a resource.

Seismologists will find an index map of observatories, permanent stations, together with updated links and information on those observatories including how, and from where, to obtain waveform data. Temporary deployments are also displayed on a general map, together with basic information about the deployment and a link to each deployment web-site. The issue of making best use of data obtained using temporary deployments is addressed with a meta-data compilation, which will display operation time-windows of temporary stations, and additionally hypocentre lists of recorded events and information on how to request data. A technical page allows practical information, plans of deployed equipment housing, experience of different power generation methods, recorder and sensor operation to be shared amongst those working on similar experiments. At present, the site is restricted to broadband 3-component data and tectonic (i.e. non-volcanic) earthquakes, although this restriction may change if the demand is significant.

The wider scientific community will find a map of earthquakes (READING 2002), hypocentre locations for the Antarctic plate (1900-1999), and updates to that database for recent years.The map makes clear which hypocentres are considered "reliable" as the basis for inferences made regarding the occurrence of seismic deformation. Seismic velocity maps are available, often derived from tomographic inversion techniques and displayed as slices through the best-fitting models with coloured contours: blue for fast seismic velocities (often interpreted as "old" or "cold" material); and red for slow velocities (often interpreted as relatively "young" or "warm" material). These maps reveal some fundamental deep structure in the Antarctic continent (e.g. RITZWOLLER et al. 2001), the resolution is limited by the sparse nature of seismic data across the continent.Robust features are pointed out and alternative tomographic results displayed in the hope of disseminating the seismological results in a manner that is accessible to other disciplines. Finally, a page is devoted to stress indicators. Data is currently sparse but it is hoped that it will continue to be the most up-to-date compilation of robust neotectonic stress data - combining information from all sources.

It is envisaged that a core of active seismologists and those who regularly incorporate results from seismic data into their work will visit the site every month or so and contributed freely.In this spirit, there is also a news page that highlights relevant meetings, workshops, opportunities, planned experiments, current temporary deployments of seismic stations and new permanent observatory stations.

The site will probably develop quickly from its present, simple format as the quantity and complexity of information within the resource increases.You are most welcome to contact the site author with suggestions for the site.It is hoped that many seismologists and other Antarctic scientists will contribute news, a diverse range of data, metadata, other information and 'in-press' results on a regular basis.

Reading, A.M. (2002) In: J.A. Gamble et al. (eds.), Antarctica at the close of the Millenium, Royal Soc. N. Zealand Bull: 35: 479-484.
Ritzwoller, M.H., Shapiro, N.M., Levshin, A.L. & Leahy, G.M. (2001): J. Geophys. Res. 106: 30645-30670.

East Antarctica: seismic structure and seismicity

(oral p.)

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This presentation synthesises the sparse, but increasing body of geological, geochronological and geophysical information on the structure of East Antarctica and adds new determinations of lithospheric structure and an up-dated appraisal of the intraplate seismicity and likely stresses acting on this part of the continent.

The enduring concept of East Antarctica as the keystone of Gondwana with a very large Archaean province at its heart (e.g. TINGEY 1991) is now evolving as improved and more extensive geochronological results become available (FITZSIMONS 2000).Extensive belts of much younger rock cut

through vast regions previously regarded as Archaean or Palaeoproterozoic, suggesting that East Antarctica is better regarded as an amalgamation of provinces of differing ages with individual tectonic elements on a scale similar to its neighbours in Gondwana, South Africa, India and Australia. It seems that, prior to the assembly of Gondwana, it is inappropriate to regard East Antarctica as a solid block.

A number of seismological and other geophysical experiments are taking place, or have recently taken place, in key areas of central East Antarctica and allow an improved determination of East Antarctic structure in ice-covered regions.The revised paradigm presents tectonic structural targets suitable for investigation using broadband seismic methods such as those that have been successfully used in Australia (KENNETT 2003).Contrasts in East Antarctic deep seismic structure can be seen which are consistent with the existence of tectonic province boundaries.

The modern pattern of mantle heterogeneity beneath the Southern Ocean and the Antarctic continent (RITZWOLLER 2001), together with observed relative plate motions, may be used to infer the plate tectonic forces on East Antarctica. Experiments such as the SSCUA deployment enable an improved appraisal of seismicity, for example, that associated with the major physiographic feature of the Lambert Glacier.

Observed seismicity is very low (READING 2002, and current work) even taking the sparse distribution of seismic stations, and yet a very large earthquake occurring close to the Antarctic plate margin has now been identified as an exceptional intraplate event (ANTONIOLI et al. 2002).The stress regime operating across the continent appears to be unusual, even paradoxical, with no medium-size seismic events and (if the last 50 years or so is representative) a small number of exceptionally large events occurring near the plate edge.

Antonioli, A, Cocco, M., Das, S., Henry, C. (2002): Bull. Seismol. Soc. Amer. 92: 896-903.
Fitzsimons (2000): J. African Earth Sci. 31: 3-23.
Kennett, B.L.N. (2003, in press): In: R. Hillis & D. Müller (eds.), The Evolution and Dynamics of the Australian plate, Spec. vol. Geol. Soc. Austral. & Amer.
Reading, A.M. (2002): In: J.A. Gamble et al. (eds.), Antarctica at the close of the Millenium, Royal Soc. N. Zealand Bull. 35: 479-484.

Ritzwoller, M.H., Shapiro, N.M., Levshin, A.L. & Leahy, G.M. (2001): J. Geophys. Res. 106: 30645-30670.
Tingey, R.J. (ed.) (1991): The Geology of Antarctica, Oxford Monographs on geology and geophysics.

Gravity survey at the Oates Coast, East-Antarctica, in 1999/2000 (poster p.)

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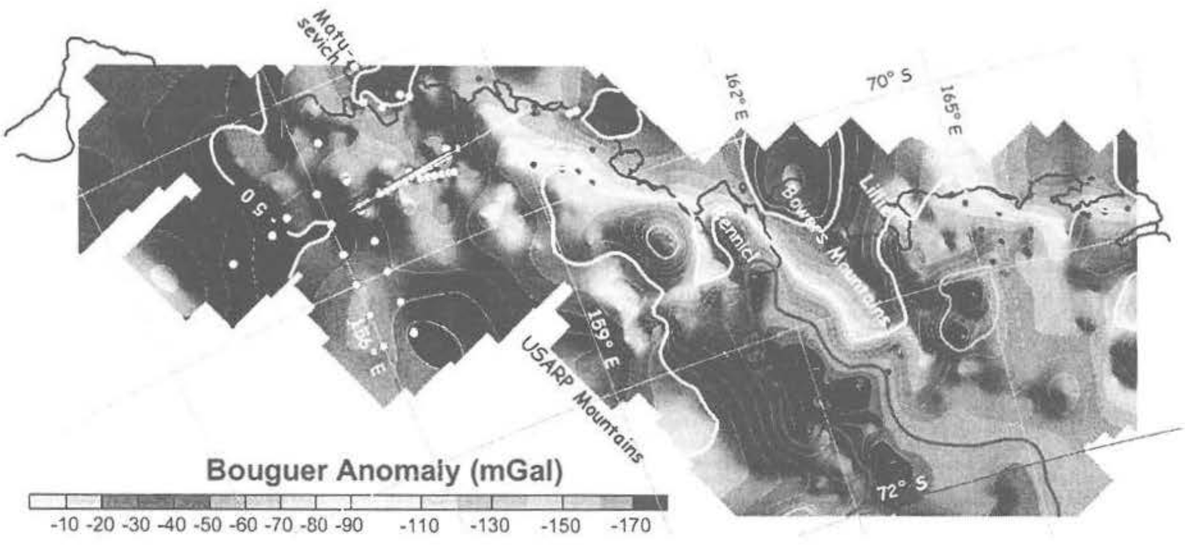
A regional gravimetric survey was conducted during the 1999/2000 Ganovex VIII / ItaliAntartide XV Expedition to the Oates Coast Area, East-Antarctica. Besides the actual determination of the force of gravity precise values for the coordinates of each of the gravity stations were determined by differential GPS (Global Positioning System) measurements. The results of airborne ice thickness measurements using the RES (Radio Echo Sounding) method, which were conducted during the expedition as well, could be used for the evaluation of the gravity data. Altogether 71 points were approached by helicopter and measured gravimetrically. The measurements were tied to stations with known absolute gravity values, which had been determined during previous Ganovex expeditions to the area.

Besides the conventional corrections, the thickness of the ice was taken into account. These results were added to the already existing data of former Ganovex expeditions and finally the Free Air and Bouguer anomalies maps were generated.

In the Bouguer map one notices the usual increase in gravity towards the coast due to the thinning of the earth's crust. In addition, gravity increases clearly along the coast towards the west, obviously steplike around 159/158°E and then once more around 155°E. An explanation with a changing crustal thickness must still be checked by isostatic models. The large glaciers Rennick and Lillie remain strong negative anomalies also in this complete Bouguer map, where the mass deficits due to the lower densities of the ice should be compensated by virtue the ice corrections applied. This can be explained only partly with lighter sediments at the glaciers' bases. At least for the strong minimum east of the middle Lillie Glacier the coincidence with a large intrusive body of obviously reduced density, but increased magnetic susceptibility, should be remarked. As a strong positive anomaly, however, rises the block of the Bowers Mts. between the two glaciers mentioned.

A remarkable, ample anomaly over the Matusevich glacier, which was discovered during the aeromagnetic survey, was also examined gravimetrically in more detail. The main anomaly has its cause probably in larger depth of some kms while the cause of a very strong, isolated anomaly farther to the west seems to be flattish and characterized by a peak in the sub ice topography.



Acquisition and analysis of aerogravity over subglacial lakes in East Antarctica
(oral p)

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Since 1994 researchers at the University of Texas Institute for Geophysics (UTIG) have utilized a light twin engine aircraft in Antarctica to make tightly integrated geophysical measurements including gravimetry. Over 200,000 line-km have been surveyed during seven field deployments, each lasting 3-4 months. Below we describe the acquisition and analysis procedures for these airborne gravity data as well as a study of the propagation of error for recent experiments over subglacial lakes in East Antarctica.

The UTIG airborne platform is a contracted DeHavilland Twin Otter instrumented with ice-penetrating radar, laser altimeter, magnetometer, and a gravimeter. Navigation systems include both uncorrected and differential CA code GPS and GLONASS. After the field season, positioning is determined via differential carrier-phase GPS, providing accuracy of about 0.1 rn. Measurements (other than GPS) are linked in a single data acquisition system with accurate time stamping provided by a GPS synchronized counter-timer. A ground instrumentation suite mirroring the airborne suite provides reference observations for the GPS and magnetometer data. The gravimeter utilized is a Bell Aerospace BGM-3 marine system, modified for airborne use. The BGM-3 provides measurements of vertical accelerations at 1 Hz, with verticality of the sensor maintained by a gyro-stabilized platform. Dual-frequency carrier phase GPS observations are made by three independent GPS receivers (both airborne and ground references) operating at 1 or 2 Hz. In order to maximize GPS data quality, GPS receivers of different design are used simultaneously. All GPS data sets are reduced using two different software packages. Up to 21 GPS solutions are available for each line. Selection is made through correlation of the high-frequency accelerations recorded by the gravity meter and those derived from the GPS positions. In some cases, this selection is guided by the data reduction process used for the laser altimetry. After inertial and other corrections are applied, a moving average filter with a tri-weight kernel width of 15 km (amplitude of 0.46 at 7.5 km) is applied in order to remove residual high-frequency noise. For most cases, this produces an agreement between repeated lines of <1.5 mGal rms difference and preserves small-scale gravity features.

In response to National Science Foundation proposals to study the architecture of the Transantarctic Mountains and subglacial Lake Vostok in East Antarctica, a team from the University of Texas Institute for Geophysics conducted the first comprehensive aerogeophysical surveys over subglacial Lake Concordia and Lake Vostok during the 1999/2000 and 2000/01 austral summers, respectively. The region surrounding Lake Concordia was sampled by 7 profiles with a 10 km separation whereas the Lake Vostok survey block was 165 x 330 km with a line spacing of 7.5 km with 11.25 km and 22.5 km ties.

The gravity measurements over Lake Concordia are sparse but the measurements over Lake Vostok, when gridded to produce a map of the free-air gravity field, show many correlations to the subglacial topography determined by radar sounding of the overlying ice sheet. Presently, we are using the radar determined ice thickness for both lakes as apriori information to invert the gravity profiles for mapping the bedrock topography where radar can not penetrate. We know well that these analysis are highly non-unique with uncertainties arising from several sources, viz., noise in the data, lack of apriori information, simplification of the forward model which is composed of known ice thickness over water with unknown water and sediment thickness lying over dense bedrock. Important objectives of the present work are (i) to visualize how error in the data propagates into the interpreted results and (ii) to understand how the distribution of apriori information can help to improve the results. To accomplish this, we use a global optimization technique to invert the gravity data in the two dimensions over Lake Concordia and three dimensions over Lake Vostok. Initially, simulated data is analyzed to quantify the effect of data error, as well as, wrong apriori information. Ultimately, an error analysis is performed for gravity data along profiles over Lake Vostok with 'single point' information ofwater and sediment thickness obtained from seismic measurements.

Mafic rocks at the Wilson-Bowers terrane boundary and within the Bowers Terrane: clues to the Ross geodynamics in northern Victoria Land, Antarctica

(oral p.)

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In northern Victoria Land, the boundary between Wilson and Bowers terranes is a key area for the comprehension of the geodynamics of the Ross Orogeny (CAPPONI et al. 1999). This area is characterized by the occurrence of abundant mafic volcanic and plutonic rocks (locally with variable metamorphic overprint). The occurrence of these rocks together with the significance of the Bowers Terrane itself place constraints to the geodynamic evolution of the region.

In the Lanterman Range, the Wilson terrane close to the boundary to the Bowers terrane is characterized by the occurrence of mafic and ultramafic rocks with a metamorphic grade ranging from amphibolite to greenschist facies, locally including lenses of well preserved medium-temperature eclogites and their variously retrogressed products with coesite relics (DI VINCENZO et al. 1997, GHIRIBELLI et al. 2002). All these mafic rocks are included within an amphibolite-grade metasedimentary sequence consisting of dominant gneisses and minor quartzites. The geochemical affinity is variable from E-MORB throughout T-MORB to orogenic calc-alkaline.

The Bowers terrane includes mafic volcanic rocks (Glasgow Volcanics) and metamorphosed volcaniclastic sediments (Molar Formation), whose age of deposition is middle-late Cambrian, on the base of paleontological evidence (COOPER et al. 1996). Geochemical data point out the occurrence of igneous material with a large variety of affinities, including N-MORB, E-MORB, T-MORB, arc tholeiite, calc-alkaline and OIB products. A mafic-ultramafic cumulate intrusive complex (Tiger Gabbro, ROCCHI et al. 1999) crops out at the SE termination of the Bowers terrane; the age of intrusion is close to 500 Ma. The geochemical affinity is orogenic calc-alkaline. As the Tiger Gabbro is in fault contact with the adjoining rocks of the Bowers Terrane, no constraints exist regarding the original country rock.

The largely variable geochemical affinities of the Bowers mafic rocks precludes that this elongated belt simply represents the remnants of a disrupted island arc. Rather, the variety of igneous rocks seems to be more typical of a marginal back arc basin in an extensional setting, likely associated with a primitive island arc. This arc-back arc system possibly was set up on a fore arc system undergoing extension. The striking similarity of the variety of geochemical signature between Bowers mafic rocks and the protoliths of eclogites and amphibolites suggests that scattered mafic rocks, included within continental material at the border between the Wilson terrane and the arc-back arc system (Bowers Terrane), could have been subducted/underthrusted at depths in excess of 90 km. The absence of any ophiolite suture, coupled with probable continental nature of the crust underlying the Robertson Bay terrane, suggests that underthrusting could have been generated by the impact of a "microcontinent" against the Bowers arc-back arc system at the border of the Wilson continental margin. After that, these deeply buried rocks suffered fast exhumation from 50 km at ca. 500 Ma to about 13 km at 490-486 Ma (DI VINCENZO et al. 2001).

Capponi, G., Crispini, L. & Meccheri, M. (1999) : Tectonophysics 312: 249-266.
Cooper, R.A., Jago, J.B. & Begg, J.G. (1996): N. Zealand J. Geol. Geophys., 39, 363-387.
Di Vincenzo, G., Ghiribelli, B., Giorgetti, G. & Palmeri R. (2001): Earth Planet. Sci Lett. 192: 389-405.
Di Vincenzo, G., Palmeri, R., Talarico, F., Andriessen, P.A.M. & Ricci, C.A. (1997): J. Petrol. 38: 1391-1417.
Ghiribelli B., Frezzotti M.L. & Palmeri R. (2002): Eur. J. Mineral. 14: 355-360.
Rocchi, S., Di Vincenzo, G., Tonarini, S. & Ghezzo, C. (1999): Abstracts 8th ISAES, Wellington, NZ, 270.

Igneous activity during the waning stage of the Ross Orogeny in Victoria Land
(poster p.)

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In Victoria Land, during the early Paleozoic Ross orogeny, extensive magmatic activity contributed to crustal growth and recycling before 500 Ma. At that time, in different sector of the orogen, evidence for orogen collapse and fast eclogite exhumation marks the inception of the postcollisional stage. The igneous activity at this stage led to the permissive emplacement of a variety of intrusive rocks of different composition in the sector of the orogen straddling the boundary of the East Antarctic Craton.

The Irizar Granite (GUNN & WARREN 1962) is a pink, unfoliated, equigranular, medium to coarse grained syeno-monzogranite (SiO_2 = 68-76 wt.%). It consists of pink alkali feldspar, smoky quartz, whitish plagioclase, biotite ± dark green amphibole. Pink aplitic and pegmatitic dykes and pods are frequent inside the granite. Miarolitic to drusy cavities are common in some outcrops, while microgranular mafic enclaves are rare and no metamorphic xenoliths have been found. The Irizar Granite crops out between Terra Nova Bay to the north and Tripp Island to the south, and intruded the Larsen granodiorite and the Gauss granodiorite (SKINNER & RICKER 1968).

The Irizar Dyke Swarm crosscut the Irizar Granite at different localities. The dykes are metre-thick, red-coated, and show a porphyritic texture with mm-sized euhedral phenocrysts of (sometimes smoky) quartz, pink alkali feldspar and (sometimes) biotite, set in a light grey to pink aphanitic groundmass. The dominant composition is syenogranitic, with SiO_2 between 70 and 77 wt.%.

The Inexpressible Syenite is a homogeneous unit made up of medium grained quartz monzonite and quartz syenite with biotite, amphibole and scattered clinopyroxene. The outcrops are restricted to the southernmost part of the Terra Nova Intrusive Complex. The silica content is between 60 and 66 wt.%.

The Vegetation Unit is a bimodal association, well represented in the Terra Nova Intrusive Complex (DI VINCENZO & ROCCHI 1999, ROCCHI et al. 2003), where lamprophyric melts (SiO_2 = 50-56 wt.%) are mingled-mixed with peraluminous leucogranitic melts (SiO_2 = 72-75 wt.%). Further south, the two facies are found mainly as separate tabular intrusions. Felsic dykes crosscut both the Irizar Granite and the Inexpressible Syenite. The silica content of the Vegetation mafic dykes varies from 50 to 58 wt.%. The emplacement ages of the four intrusive units are isotopically constrained at 495 Ma (Inexpressible Syenite), about 490 Ma (Irizar Granite and Dyke Swarm), and 475 Ma (Vegetation Unit).

The Sr-Nd isotopic features of these four postcollisional units are rather uniform: the Irizar Granite and the Irizar Dyke Swarm show $^{87}Sr/^{86}Sr(t)$ always between 0.707 and 0.710, and eNd(t) between -7 and -7.6. The only notable exception is the felsic component of the Vegetation Unit, whose $^{87}Sr/^{86}Sr(t)$ = 0.722 and eNd(t) ≈-10.4 point out a crustal source (DI VINCENZO & ROCCHI 1999). On the other hand, the distribution of major and trace elements show evidence of consanguineity only for the Irizar Granite and Dyke Swarm: their overlapping composition and common evolutionary trends are consisted with crystal fractionation processes. The Inexpressible Syenite show a highly potassic nature, and internal variations mainly arising from cumulus processes. The Vegetation Mafic Dykes show composition similar to calc-alkaline lamprophyres.

Thus, different sources were activated in overalapping locations at the border of the East Antarctic Craton in a short time span during the waning stage of the Ross orogeny.

Di Vincenzo, G. & Rocchi, S. (1999): Contri. Mineral. Petrol. 137: 15-35.
Gunn, G.M. & Warren, G. (1962): N. Zealand Geol. Surv. Bull. 71: 1-157.
Rocchi, S., Di Vincenzo, G. & Ghezzo, C. (2003, in press): Terra Antartica Publications.
Skinner, D.N.B. & Ricker, J. (1968): N. Zealand J. Geol. Geophys. 11: 1009-1040.

New seismic stratigraphy for the Weddell Sea
(EANT workshop p.)

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For more than two decades the Weddell Sea has been an target area for detailed high resolution seismic investigations. Especially in the more southern area in front of the Filchner Ronne Shelf and in the more eastern area along the Explora Escarpment numerous expeditions have been carried out, mainly by russian, norwegian and german institutions (HUEBSCHER 1994, OSZKO 1997). This existing network of MCSL profiles could be extended significantly by recent investigations of the Alfred Wegener Institute northward to the central deep sea basin and the eastern shelf of the Antarctic Peninsula (ROGENHAGEN 2000, JOKAT 2003). In the present situation the Weddell Sea is covered by several longdistant MSCL transects leading mainly north-south. These long profiles connect areas were distinct information on the age of the sediments is present (ODP 694 in the central part of the Weddell Sea, ODP 693 in the region of the Wegener canyon) or age information can be derived from the presence of high resolution aeromagnetic data (JOKAT et al. 2003).

This gives us the opportunity to correlate the existing seismic stratigraphic interpreation along the more coastal areas, e.g. the eastern margin of the Weddell Sea (MILLEr et al. 1990, OSZKO 1997) and the more distinct areas of the Weddell Sea. Along the network of MSCL Profiles several stratigraphic units were identified and tentatively correlatd. Five stratigraphic units, introduced by previous workers (HINZ & KRISTOFFERSEN 1987, MILLER et al. 1990), are extended along the MSCL Profiles in the Weddell Sea and interpreted. New aeromagnetic data, evaluated by JOKAT et al. (2003), helped in gathering more precise age information. By combining information on the age of the oceanic crust and the presence of stratigraphic units the seismostratigraphic model for the Weddell Sea was enhanced.

Hinz, K. & Kristoffersen, Y. (1987): Geol. Jb. E37: 3-45
Huebscher, C. (1994): Reports Polar Res. 147.
Jokat, W. Et al. (2003, in press): J. Geophys. Res.
Miller, H. et al. (1990): Polarforschung 60: 33-38.
Oszko, L. (1997): Reports Polar Res. 222.
Rogenhagen, J. (2000): Reports Polar Res. 369.

Achritarchs in a thermo-metamorphosed sedimentary xenolith within Surgeon Island Granite (northern Victoria Land, Antarctica)

(poster p.)

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At the north-eastern end of the Robertson Bay terrane (northern Victoria Land, Antarctica) is the Surgeon Island granite (SIG), a 511-Ma (FIORETTI et al. 2001) deformed S-type pluton, the tectonic setting of which is still unclear. Direct geological relationships between the SIG and its country rocks are not exposed. A few xenoliths, probably representing country rocks, indicate that the SIG intruded a deformed (meta?)-sedimentary sequence. The depositional age (Lower Cambrian? Pre-Cambrian?) and tectonic setting of this sequence are at present totally unknown.

Evidence of the presence of organic matter in one of these xenoliths suggested a search for microfossils capable of providing chronological constraints.

The investigated sample is a compact, fine-grained, black, carbonaceous pelite. Under the microscope, the rock reveals thin original sedimentary beds and a discordant penetrative cleavage. Arenaceous layers are composed of dominant mono- and polycrystalline metamorphic quartz with undulose extinction, and subordinate plagioclase. Graphite is common. The rock has low K_2O/Na_2O, and plots in the field of Active Continental Margin in the tectonic discrimination diagram of ROSER & KORSCH (1986). The pelite is thermo-metamorphosed, with the development of neoblastic decussate biotite.

Dissolution of the sample in pure HF and HCl and concentration with heavy liquids ($ZnCl_2$) yielded a residuum in which a few achritarchs and probably cryptarchs (DIVER & PEAT 1979) were identified.

Among the achritarchs were: a composed vesicle, with a spine 5-6 μm long, with a branched termination ascribable to *Multiplicisphaeridium,* and a spherical vesicle 50 μm in diameter, with a punctate eilyma surface (1.5-2 μm thick) and a rounded, thickened opening (pylome) ascribable to Leiosphaeridaceae, which are probably cysts of Prasinophycean green algae belonging to *Tasmanites.* This specimen in particular shows some similarities with *Tasmanites bobrowskae* Wazynska 1967, whose first appearance is Lower-Cambrian.

Microfossils consisting of septate ellipsoid bodies and rounded granulated vesicles with pores were also found, and attributed to Cryptarcha, probably the Nematomorphitae and Sphaeromotphitae subgroups (DIVER & PEAT 1979).

Field relationships require the sedimentary xenolith to be older than 511 Ma. A precise classification of the identified achritarchs would be very useful in constraining the lower age of sedimentation of their host rock, and further investigations are being carried out for this purpose. It is worth noting that the presence of neoblastic biotite in the xenolith indicates that the achritarchs underwent temperatures as high as 400°C at least, so that, not surprisingly, most of them are not well preserved. Should the presence of *Tasmanites bobrowskae* be confirmed, it would have interesting implications for the whole geological framework of Surgeon Island.

Diver W.L. & Peat C. J. (1979): Geology 7: 401-404.
Fioretti A.M., Capponi G., Black L.P., Varne R. & Visona' D. (2001): EUG XI Strasbourg (F), p. 380.
Roser & Korsch (1986): J. Geol. 94: 635-649.

Structural trends and plate boundaries at the Pacific margin of Antarctica
(oral p.)

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Since the beginning of exploration of the Pacific coast of Antarctica by Russian expeditions in the mid-1950s, the location of the boundary between the East Antarctic Craton and the younger fold belts has been a subject of discussion. The Pacific coast from Cape Adare (Pennell Coast) to the Oates Coast and to Commonwealth Bay (George V Coast) 1200 km to the west was revisited during the 1999/2000 GANOVEX VIII expedition and explored using geological and geophysical methods. The area of investigation provides evidence for the accretion processes in Gondwana prior to and during the Ross Orogeny, as well as the break up of Gondwana and the separation of Australia from the Antarctic. Tectonic activity related to plate margin processes is still continuing, as demonstrated by seismic events.

Large scale structural as well as morphological features trend NNW -SSE to NW -SE. This is demonstrated by the trend of the Lillie, Rennick, Matusevich and Mertz glaciers, as well as by the direction of the "terrane" boundaries in northern Victoria Land, and some of the large scale aeromagnetic anomalies.

There are very few exposures along the George V Coast and geological information about the area is rather scarce. High-grade gneisses and charnockites (>2 Ga) occur west of the Mertz Glacier. Granites between the Mertz and Ninnis glaciers are possibly older than 1 Ga. The boundary between these shield rocks and the low-grade Berg Group rocks in the Berg Mts. 400 km east of these glaciers is concealed by ice and cover rocks, which by definition are part of the platform. The plate boundary between the shield and the platform may be within or near the western part of the Wilkes Basin (?graben). In the Matusevich Glacier (Oates Coast) area low-grade metamorphic rocks (Berg Group) and high-grade gneisses form the basement, which is thought to be part of the Wilson Terrane. Westward-directed thrusts related to the Paleozoic Ross orogeny separate the different blocks. A prominent aeromagnetic anomaly beneath the Matusevich Glacier coincides with a zone of mafic and ultramafic lenses observed in the gneisses exposed at the margins of the glacier. All major tectonic features show the NNW-SSE strike direction.

There is one large coast parallel offshore aeromagnetic anomaly perpendicular to the general trend. It is adjacent to the 100-200 m thick Fenar sills at Horn Bluff and Organ Pipe Cliffs and it might be caused by a thick pile of volcanic rocks. The Jurassic Fenar Sills of Horn Bluff, Organ Pipe Cliffs, SCAR Bluffs and Anxiety Nunataks are part of a larger complex of Fenar sills as infened from the magnetic pattern in this area. They were preserved within the Wilkes Basin, which must have formed after the Jurassic. The opening of the Southern Ocean between Australia and Antarctica probably influenced the formation of the basin and it might have formed at the same time and may show the same trend as the Rennick Graben.

The tectonic activity initiating the ocean-floor spreading between Australia and Antarctica, as well as the formation of the fracture zones (e.g., the Tasman FZ, Balleny FZ), is still continuing. They strike NW -SE towards the continent. Normally, fracture zones do not affect continental lithosphere. But during the GANOVEX VIII expedition right-lateral strike-slip faults and wide fault zones in approximately the same strike direction were observed in the Rennick, Matusevich and Mertz glacier areas. These right-lateral strike-slip movements were the dominating tectonic features and are still active today, as indicated by earthquakes in the lower Matusevich (1952) and Rennick (1972, 1999) areas. The Rennick earthquakes had epicentres at depths of 33 km and 23.5 km. The 1999 earthquake was registered during the GANOVEX VIII expedition (CATTANEO et al. 2001). The observations speak for an onshore continuation of fracture zones or related tectonic features, a topic which has to be discussed further.

Cattaneo, M., Chiappini, M. & De Gori, P. (2001): Terra Antarctica Rep. 5: 29-44.

500 Ma granitoids in East and West Antarctica: key to different plate tectonic settings
(poster p.)

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At about 500 Ma, granitoids intruded the East Antarctic Craton in central Dronning Maud Land (cDMG) as well as in the Ross Orogenic belt which formed an active continental margin bordering the Paleo-Pacific and which is exposed in the todays Transantarctic Mountains (TAM). Both granitoid provinces are different in geochemistry and in their plate tectonic setting. Subduction processes triggered the granite formation in the Ross orogenic belt. But which process started the granite formation in the within-plate position and is there a link between the active margin and the within-plate granitoid generating processes?

The granitoids in the TAM forrn an active continental margin magmatic arc more than 2000 km in length stretching from the Oates Coast to the Thiel Mts. They are an orogenic calc-alkaline suite of syn-tectonic to post-tectonic granitoids, mainly porphyritic biotite or two-mica granites, granodiorites and tonalites showing I-type and peraluminous S-type character. Westward directed subduction and terrane accretion is accepted for northern Victoria Land. In southern Victoria Land, transpressional tectonics in an oblique subduction setting and/or a collision are indicated.

The granitoids in cDMG (monzonites, syenites, granodiorites, related to charnockites) are unfractionated, undeformed, coarse crystalline, peraluminous to metaluminous, or subalkaline with a slight trend to alkaline. They are A2-type granitoids, representing lower continental or underplated crust generated in a within-plate position of the Gondwana continent.

Two contrasting plate tectonic settings are obvious. S-type und I-type granitoids occur at the plate margin in a compressive environment related to subduction. A2-type granitoids occur in an unorogenic within-plate position associated with a tensional regime rather than compression. We envisage the problem that the classical plate tectonics can not sufficiently explain "intra-plate" features. Other models must assist. Some features can best be explained by delamination of the lower lithosphere which allowed the asthenosphere to be juxtaposed to the thickened crust and to heat it up on a regional - or even continental scale. The process of decratonization may be caused after BLACK & LIEGEOIS (1993) either by an active margin with subduction processes destabilizing the crust and upper mantle, or the craton underwent an intense and frontal hypercollision. For the latter, we did not find sufficient arguments in cDML. It is therefore the coupling of subduction and delamination which is favoured to explain the varying magmatic activities at about 500 Ma. Subduction may trigger delamination (BLACK & LIEGEOIS 1993), but can also delamination start first and allow subduction to begin or to accelerate as slap-pull is active?

Black, R. & Liegeois, J.-P. (1993): J. Geol. Soc. London 150: 89-98.

A Cambrian palaeomagnetic pole for Antarctica – improving the poor palaeomagnetic database for Gondwana during the Palaeozoic
(poster p.)

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Gondwana which dominated the Earth's palaeogeography throughout the Palaeozoic is in a palaeomagnetic sense still the least well constrained of all Palaeozoic plates (BACHTADSE 1994, TAIT 2000). This problem is best demonstrated by two extreme models of the Palaeozoic drift history for Gondwana derived from the apparent polar wander paths (APWP): X-path after BACHTADSE & BRIDEN (1990) and Y-path after SCHMIDT et al. (1990). One of the main reasons for the ambiguity is the lack of reliable palaeomagnetic data for certain time intervals during the Palaeozoic. This statement is specially true for Antarctica (GRUNOW 1995, GRUNOW & ENCARNACION 2000). The IAGA Global Palaeomagnetic database (MCELHINNY & LOCK 1990) contains about 1000 references for the small area of Europe while it comprises only 300 for Gondwana including not more than 21 for Antarctica.

The 1995/1996 international GeoMaud and the 1999/2000 German-Italian GANOVEX VIII expeditions to Antarctica provided the possibility to collect rock samples for palaeomagnetic and related investigations in Central Dronning Maud Land (DML) and in northern Victoria Land (NVL), respectively, two sites on opposite sides in East Antarctica. Rocks with presumed Neoproterozoic to Jurassic ages have been sampled in both areas. This presentation will concentrate on the results obtained on Cambrian lamprophyres and coarse grained syenite bodies in DML and on late Cambrian to Early

Ordovician metasediments of the Leap Year Group in NVL. Results for the other rock types are given by ROLF & HENJES-KUNST (1998), ROLF & HENJES-KUNST (in press) and ROLF (submitted).

Palaeomagnetic measurements including partial demagnetization techniques and rockmagnetic investigations yielded stable palaeodirections, which could be used to calculate two Cambrian Poles for Antarctica. Both palaeopoles (DML: 6°/15°; 8°; NVL: 16°/13°; 6°; Latitude/Longitude in an African reference frame; A95) coincide with a Cambro-Ordovician palaeopole from Sør Rondane (11°/8°; A95 5°: ZIJDERVELD 1968, GRUNOW 1995). The primary nature of the Leap Year Group pole is confirmed by a semi-fold test and supported by a low-temperature rockmagnetic experiment, which confirms, that our stable magnetic component is not influenced by Morin transition (possible remagnetization of hematite at -15°C). The coincidence of two poles derived from opposite sides in East Antarctica indicates that in late Cambrian to early Ordovician times DML and NVL have been in a similar relative position to each other as today. This suggests that these areas of present day East Antarctica were already consolidated as part of Gondwana in early Palaeozoic times. Comparison with other early Palaeozoic poles for East Antarctica and Gondwana still gives room for different models concerning the palaeogeographic situation of Gondwana (GRUNOW & ENCARNACION 2000, KIRSCHVINK et al. 1997) in Early Palaeozoic times, showing the need for further, well established palaeomagnetic poles for Antarctica and Gondwana, respectively.

Bachtadse, V. (1994): unpubl. Habil-Schrift Univ. München, 30 pp.
Bachtadse, V. & Briden, J.C. (1990): In: W.S. McKerrow & C.R. Scotese (eds), Palaeozoic Palaeogeography and Biogeography: 43-48.
Grunow, A.M. (1995): J. Geophys. Res. 100(B7): 12.589-12.603.
Grunow, A.M. & Encarnación, J. (2000) Tectonics 19(1): 168-181.
Kirschvink, J.L., Ripperda, R.L. & Evans, D.A. (1997): Science 277: 541-545.
McElhinny, M.W. & Lock, J. (1990): Geophys. J. Internat. 101: 763-766.
Rolf, C. (submitted): Terra Antartica.
Rolf, C. & Henjes-Kunst, F. (1998) J. African Earth Sci. 27(1A).
Rolf, C. & Henjes-Kunst, F. (2003, in press): Geol. Jb. E56.
Schmidt, P.W., Powell, C.M., Li, Z.X. & Thrupp, G.A. (1990) Tectonophysics 184: 87-100.
Tait, J., Schätz, M., Bachtadse, V. & Soffel, H. (2000): In: W. Franke, V. Haak, O. Onken & D. Tanner (eds.), Orogenic Processes: Quantification and Modelling in the Variscan Belt, 179: 21-34.
Zijderveld, J.D.A. (1968): J.Geophys. Res. 73(12): 3773-3785.

Within-vent processes of explosive basaltic eruptions in the Ferrar Group, South Victoria Land

(poster p.)

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Violent eruptions represent an important natural hazard for human populations near active volcanoes. To progress toward effective eruption predictions, we need to understand the internal processes taking place during these violent eruptions. Such processes are not well known, especially for discontinuous eruptions, those involving discrete explosions and intermittent ejection of material. In these cases, debris may fill the vent between explosions, and this may result in eruptive styles or even fragmentation mechanisms significantly different from those of "open-vent" (debris-free) conditions.

An outstanding example of such a debris-filled vent complex is exposed at Coombs Hills, South Victoria Land, as part of the Mawson Formation (Jurassic), which underlies the Kirkpatrick flood basalts of the Ferrar Group. At Coombs Hills, the vent complex is unusually large and well exposed, and shows great internal variability. Detailed mapping during the 2002/03 field season has revealed three principal types of structureless, poorly sorted pyroclastic rocks: (1) the host for the other two facies, a lapilli-tuff comprising clasts of both juvenile basalt and Beacon Supergroup country rocks (accidental clasts); (2) circular vertical pipes of tuff-breccia containing abundant accidental clasts; and (3) irregular-shaped tuff-breccia zones rich in juvenile fragments, accompanied by in situ peperite domains and pods of coherent glassy basalt. Vertical cross-cutting tuff-breccia zones are interpreted as remnants of individual ephemeral volcanic conduits within the larger vent complex.

Subterranean tephra jets propelled by phreatomagmatic explosions probably excavated these conduits in wet, unconsolidated debris, themselves the product of previous eruptions. The explosions, which are the equivalent of energetic fuel coolant interactions (FCI), would be triggered by arrival of basaltic magma from depth or by shock waves from other blasts. They would generate variable proportions of accidental versus juvenile material, depending on their location in the vent (e.g., within pre-existing mixed debris, versus within "intact" country rocks). Particles from the temporary conduit walls would also be entrained by tephra jets, leading to recycling of pyroclasts, and finally producing the volumetrically-dominant heterolithologic lapilli-tuff. The mapped accidental-rich tuff-breccia pipes would represent the last explosions in "intact" (unmixed) country rocks, whereas the irregular juvenile-rich zones accompanied by peperite and basalt pods would be the product of less energetic interaction of magma and water-saturated debris.

Cenozoic right-lateral strike-slip faulting in North Victoria Land: an integrated structural, AFT and $^{40}Ar/^{39}Ar$ study

(oral p.)

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In recent years, increasing efforts have been devoted to the comprehension of the West Antarctica Rift System (WARS) evolution, in order to solve the long-standing plate tectonics problems involving the Meso-Cenozoic East-West Antarctica separation history. After an initial phase of orthogonal extension (Cretaceous) during the main phase of separation between Antarctica and Great New Zealand, a major tectonic re-organisation occurred during the Cenozoic (from ~50 Ma), when the western sector of the Ross Sea region (Ross Sea and Victoria Land) within the WARS was overprinted by right-lateral transtensional shearing into an overall oblique rifting scenario. In order to provide kinematic and time constraints on the modalities through which north Victoria Land was involved into the West Antarctica extensional province, we present an integrated structural and geochronological study performed along two major NW-SE-trending Cenozoic fault systems, the Lanterman and Priestley fault systems. Apatite fission track (AFT) analysis is used to constrain the age of the late-stage deformation history affecting the brittle crust along the trace of the Lanterman Fault. Our data sets provide evidence for a major Cenozoic (starting from. ~40-50 Ma) denudation event, associated to a major NW-SE dextral shearing event. Younger AFT ages, between ~30 and ~50 Ma, are systematically obtained from samples collected along the shoulders of the NNW-SSE-trending Rennick Graben. Much older AFT ages (up to ~110 Ma) are obtained away from the Rennick Graben shoulders. Distributed and partitioned right-lateral strike-slip faulting is also recognised as responsible for the opening and evolution of the Rennick Graben, which is thus interpreted as a localised Cenozoic tectonic depression generated as a regionally-sized displacement accommodation area of NW-SE-trending dextral strike-slip shearing. In situ ^{40}Ar-^{39}Ar laserprobe analyses on fault-generated pseudotachylytes are used to constrain age of faulting along the Priestley Fault. An injection vein yields concordant ^{40}Ar-^{39}Ar ages clustering within 33.5-34.0 Ma, interpreted as formation ages. A direct structural connection is then established between Cenozoic denudation, activation and connectivity of the dextral strike-slip fault systems in north Victoria Land during the Cenozoic.

Late Quaternary climate variability recorded by micropalaeontological and geochemical data from the western Ross Sea slope

(poster p.)

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Two gravity cores, ANTA99-c23, ANTA99-c24 from the Ross Sea continental slope have been investigated from their organic carbon content and palaeontological features (radiolaria and diatoms). The aims of this investigation are to evaluate whether organic carbon in relation with diatom and radiolarian abundance can be used as a good proxy for palaeo-productivity and climate change.

Sedimentary organic matter provides a variety of indicators that can be used to reconstruct records of marine paleoenvironmentals and paleoclimates. Infact both production and preservation of organic matter are affected by environmental change (MEYERS 1997). Detailed organic carbon analyses in both cores show clear fluctuations of paleoproductivity related to climatic oscillations during the Late Quaternary. In particular in core ANTA99-c24 peaks in organic content could be related to the last interglacial periods (isotopic stage 1, 3, 5e). Similar results, even if with minor accuracy are recorded by the core ANTA99-c23.

Qualitative and quantitative analyses on diatoms fraction can highlight changes in surface waters productivity and properties of water column, linked to climate variations (LEVENTER ET AL. 1996, SJUNNESKOG 2002).

Radiolarians are present and generally well preserved throughout core ANTA99-c24 except for lower portion. A total 88 radiolarian taxa (most of them at a species level) have been recognised in a preliminary study on 40 samples collected from ANTA99-c24.

Relative abundance of *Cycladophora davisiana* have been determined in core ANTA99-c24 as stratigraphic tool according to MORLEY & HAYS 1979, MORLEY 1980, 1986.
Preliminary investigations on diatoms and radiolarian abundance allowed to subdivide both cores in different levels showing oscillations in paleoproductivity well related with organic content data.

Leventer, A., Domack, E.W., Ishman, S.E., Brachfeld, S., McClennen, C.E. & Manly, P. (1996): Geol. Soc. Amer. Bull. 108: 1626-1644.
Meyers, P.A. (1997): Org. Geochem. 27: 213-250.
Morley, J.J. & Hays, J.D. (1979) Earth Planet. Sci. Lett. 44: 383-389.
Morley, J.J. (1980): Mar. Micropal. 5: 205-214.
Morley, J.J. (1986) In: W.F. Ruddiman, R.B. Kidd et al., Init. Rep.DSDP 94: 889-894. Washington, D.C.
Sjunneskog C. (2002): Acta Univ. Upsaliensis: 1-29.

Do transform faults propagate and terminate in East Antarctica continental lithosphere?
(oral p.)

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Geological, geophysical and geodetic data indicate that plate interiors are associated to a much higher level of neotectonic activity than hitherto realised Intraplate strike-slip faulting and lithosphere buckling during plate convergence, density imbalances produced by oceanic ridges, continental margins and plateau uplifts, and flexural unloading of the lithosphere, are geodynamic processes commonly used to explain the occurrence of significant deformations far from plate boundaries. We illustrate the Cenozoic geodynamic framework at the northeastern edge of the Antarctic plate, where we believe there is strong evidence for the occurrence of post-rift strike-slip deformation belts including both the intraridge (transform) and out-of-ridge segments of fracture zones, and their collinear onshore strike-slip fault systems. Deep basins originated along the main traces of these impressively long strike-slip belts, where strong earthquakes have been recorded, including the 1998 Balleny event (8.2 Mw), which is one of the larger intraplate earthquake ever detected. The residual horizontal displacement at the tip of these intraplate strike-slip belts is accommodated by a lithosphere-scale horsetail array of transtensional basins, where subcrustal magmatism has been triggered. This tectonic architecture cannot be easily reconciled within the classical principles of the plate tectonics theory, that does not predict any strike-slip movement along fracture zones once they pass outboard of their associated ridge segments and away from the plate boundary. We believe that onshore and offshore geological and geophysical features at the northeastern edge of the Antarctic plate provide robust evidence supporting the idea that important intraplate deformations can be produced in passive margin environments by the post-rift activity of strike-slip deformation belts transferring differential spreading at constructional plate boundaries into the plate interiors. The intraplate accommodation of oceanic transform shear provides an efficient alternative geodynamic scenario for explaining seismicity, magmatism and basin opening in passive margin environments.

Coastal morphology of a fast uplifting coast. Characteristics and implications. The Antarctic Peninsula, Isl. Greenwich, South Shetland
(poster p.)

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One of the scientific prospects of the VIII Ecuadorian expedition and summer stay in the Pedro Vicente Maldonado Station of Fort Williams Cape (Greenwich Island) was dedicated to morphologic observation along the coast. The interest was both the quantification of the post-glacial uplift in this area, and the identification of the morphologic patterns able to characterise a fast uplifting coast. The eustasy since the last glacial period (PIRAZZOLI 1991), as well as the fact that the Antartic peninsula belongs to an active margin submitted to vertical tectonic motion, suggests that there is few probability of encountering relict coastal morphology from the previous interglacial period (TRENHAILE 2002).

The shallow coasts: In their ARAYA & HERVÉ (1966) studied the coastal morphology of Greenwich Island and pointed out the presence and wide extension of beach ridges. These ridges characterise relatively flat areas, where important supplies of detritus is available from the hinterland, because long-shore sedimentary transport is relatively limited. In Fort Williams Cape the detritus of beach ridge comes from two valleys issued from the lower slopes of the Quito Glacier, and located NW and NE of the cape. The stepped succession of beach ridges gives a picture of the successive shorelines, while the area was uplifted. The more recent ridges are parallel to the present shoreline, and their elevation fits with the maximum sea level during summer. The combination of sediment supply and coastal protection by ice fragments can explain the occurrence of wide inter-ridge low, as suggested by ARAYA & HERVÉ (1966). This interpretation suggests that the successive position of beach ridges is related to climatic variation. About five successive main beach ridges are observed on the Fort Williams Cape, the higher at an elevation of 15 m.a.s.l. (the level of upper tides during summer). The second ridge from sea level is located at an elevation of 4.8 m.a.s.l., and contains a wale bone that has been ^{14}C dated of 1314-1592 cal. yr BP. This gives a mean uplift rate of 3 mm to 3.7 mm/yr. An extrapolation of the mean uplift rate suggests that the higher ridge was formed about 4065 to 5000 yr BP.

The rocky coasts were observed in the lower geologic unit (Santana & Dumont, this volume), between Fort Williams and Ambato capes. Despite a relatively easy to erode material no wave cut platform is observed in relation to the most important beach ridges, located only some hundred of meters eastward. The only wave cut platform is observed near the present sea level, at an elevation of only 30 or 40 cm over the maximum se level. This level can fit with the present sea level during storm, or to a platform formed only one or one and half hundred of years before, due to the mean rate of uplift.

Ice coast: Comparison of the coast in front of the Quito glacier between 1990 (aerial photos) and 2001 gives evidence of 270 m in the axis of the glacier and 160 on the edges. This gives respective mean annual retreat of 24.5 m and 14.5 m. This observation is coherent with recent data on the main reduction of the ice cap (ALLEY & BINDSCHADLER 2001).

The observed coastal morphology suggests that the successive steps of beach ridges are more probably related to climate variation than relative variation of the uplift process. The formation of the first wave cut platform is no older than 1 or 1.5 century, suggesting that it may fit with a relative slow down of the uplift due to the recent sea level rise, that may partly or totally counterbalance the isostatic uplift.

Alley, R.B. & Bindschadler, R.A. (2001): Antarc. Res. Ser. 77: 1-11.
Araya, R. & Hervé, F. (1966): Publ. Instituto Antártico Chileno, No 8: 76 pp.
Pirazzoli, P.A. (1991): World atlas of Holocene sea level changes, Elsevier.
Trenhaile, A.S. (2002): Marine Geol. 185: 341-361.

Geology around the Ecuadorian station Pedro Vicente Maldonado (Greenwich Island) and Dee Island, Antarctic Peninsula

(oral p.)

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One of the purposes of the VIII Ecuadorian expedition in the Greenwich Island of the South Shetland was to make a detail geological study of the surroundings of the Pedro Vicente Maldonado Scientific Station.

Extended areas of the Fort Williams Cape, where the Ecuadorian Scientific Station is located, and Punta Ambato Cape are exposed respectively at the down eastern and northern slopes of the Quito Glacier during the austral summer. Also Dee Island separated from the previous area by the English Channel is widely exposed. Geology and structure of the three areas look homogeneous. The resulted observations are coherent with the descriptions made previously by ARAYA & HERVÉ (1965, 1966) from areas located to the east, and regional consideration and local observations from Dee Island by SMELLIES et al. (1984).

Two units were identified. The lower one is characterized by a relatively soft morphology, with cliff and slopes looking ruined buildings and walls. It comprises basaltic flows cut by dikes and domes. Hydrothermal processes are important.

The upper unit is more massive, with flat platforms overlooking steep cliffs. It comprises alternatively homogeneous or prismatic basaltic lava flow intercalated by volcano sedimentary layers of ash and volcanic breccia. Conglomerate are observed at the top of volcanic sequences, i.e. in Ambato Cape. Silicified wood fragments are associated with the breccia facies, in particular in Punta Fort Williams, suggesting catastrophic destruction of forest environment. Both units are considered as lateral equivalent of the Coopermine Formation of upper Cretaceous age.

The regional structure is sub-tabular, but some striking trends of the table's borders emphasise regional structures trending NW-SE (Dee Island) and NE-SW (Punta Fort William). Detail structural observations suggest that the NW-SE structures represent tension fractures filled by volcanic dykes, with associated NNW-SSE left-hand and W-E right hand smaller faults. A more recent event is characterised by brittle faults evidencing a NS to NNE-SSW shortening. This event gives the morphologic pattern of the Fort William Cape, a trend characterised by left hand strike slip faults. Due to his different pattern of fault and fracture, post-dating the observed volcanic event of the area, this N-S shortening may be correlated with the recent and partly post-volcanic history of the Antarctic Peninsula.

Araya, R. & Hervé, F. (1965): Sociedad Geologica de Chile, Resumenes N°10: 1-3.
Araya, R. & Hervé, F. (1966): Publ. Instituto Antártico Chileno, No 8: 76 pp.
Smellies, J.L., Pankurst, R.J., Thomson, M.R.A. & Davies, R.E.S. (1984): Brit. Antartic Surv. Sci. Rep. 87: 85pp.

Temporal variations of the geoid due to present and past glacial changes in Antarctica
(poster p.)

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We present first results based on forward modelling of signatures related to present and past variations of the Antarctic ice sheet. Our calculations are organized in four steps involving models of increasing complexity. Model 1 implements present ice-mass changes acting on a rigid earth. In model 2, the rigid earth is replaced by an elastic earth, which partially compensates the present glacial changes. Model 3 employs aviscoelastic earth and, therefore, allows for a global glacial history. Finally in model 4, the sea-level equation is added in order to simulate the redistribution of ocean water during and after deglaciation. We predict the present rates of radial displacement and geoid change in Antarctica and discuss whether the signals are sufficiently large to be detected by terrestrial GPS stations or by the GRACE satellite mission.

Experimental study of Fe-Mg exchange reaction between orthopyroxene and spinel and its application to a geothermometer

(poster p.)

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The Fe-Mg exchange reaction between orthopyroxene and spinel has been investigated at pressures 9-13 kbar and temperatures 900-1200°C using a piston-cylinder apparatus for the natural rock system. In the present experiment, we used a phlogopite-bearing granulite (TM981229-03E; MIYAMOTO et al., 2002) collected at Howard Hills, Napier Complex, East Antarctica. This granulite consists of orthopyroxene, sapphirine, spinel, K-feldspar, plagioclase, phlogopite and rutile, and the bulk Mg/(Fe+Mg) is 0.81. The pulverized granulite was fused to make a glassed sample for starting materials at 10 kbar and 1670°C for two minutes in a graphite capsule using a piston-cylinder apparatus. We prepared two types of starting materials: (1) glass; and: (2) a blend of 90 parts by weight glass and 10 parts by weight the pulverized granulite. The ground starting material (c 10-50 μm in grain size) was put into an inner molybdenum-foil capsule within an outer Pt tube, edges of which were welded by carbon arc.

And then, we carried out annealing experiments at 9 kbar and temperatures of 1100°C, 1000°C and 900°C to investigate textures of mineral reaction under isobaric cooling condition. We found orthopyroxene and spinel crystallized within liquid from glass at 9 kbar and 1200°C. This run product was used in an additional experiment at 9 kbar and 1100°C. In the additional experiment, a phase assemblage of orthopyroxene + spinel + biotite + rutile + liquid was obtained. In the same way, the assemblage synthesized at 1100°C was used in the experiment at 1000°C. Moreover, the assemblage obtained at 1000°C was annealed at 900°C. The phase assemblages at 1000°C and 900°C were also orthopyroxene + spinel + biotite + rutile + liquid.

We found the Fe-Mg distribution coefficient of coexisting orthopyroxene and spinel:

$$K_D = (X_{Mg}/X_{Fe})^{Opx}(X_{Fe}/X_{Mg})^{Spl}$$

is temperature-dependent. The equilibration temperature is approximated as follows:

$$T\ (°C) = 3492/(\ln K_D + 2.21) - 273.$$

This empirical equation was applied to some Antarctic granulites and associated rocks. We estimated the metamorphic temperatures of their rocks as 765-854°C.

Miyamoto, T., Yoshimura, Y., Motoyoshi, Y., Grew, E.S., Dunkley, D.J. & Carson, C.J. (2002): Abstr. NIPR Symp. Antarct. Geosci. 22: 61 p.

Landform and cryogenic features of volcanic-rock landscape of Keller Peninsula, Admiralty Bay, Antartica

(oral p.)

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The Keller Peninsula is an ice-free area situated in the Admiralty Bay, in King George Island, formed by volcanic rocks (basalts, andesites, dacites, tuffs and agglomerates) of ages ranging from Jurassic to Late Tertiary, as part of the Andean orogenic belt. The manifestation of physical weathering in Keller, like elsewhere in the Maritime Antartica is extreme due to a combination of factors: relatively high moisture availability, very low temperatures, fractured volcanic-rock substrates and mountainous topography. The absence of any glacial outlet coming from inland areas of Keller Peninsula hinterland means that most till and related deposits are derived from short-ranged glacial erosion from the upper parts of the peninsula. In this work, we examine the main cryogenic features and landforms of this area.

In the volcanic-rock regolith of Keller Peninsula, a number of cryogenic processes leads to physical breakdown, sorting and fine-particles increase. The most important factors are freezing-thawing cycle, ablation, frost and gelifluction. Frost action causes the formation of a thin silty, crusting layer at the suface, especially on andesitic to basaltic materials, but also on acid tuffs and palagonite. These features are particularly frequent in the area just below the Birknmajer Peak Glacial Cirque, where basalts are dominant.

During the summer, the permafrost within the soil regolith can be observed at varying depths. In areas along channels of melting water, hollows and depressions, where accumulations of fine materials are greater, the intensity of freezing-thawing cycles is marked. This causes tonguing of sucessive short-distance, lobate moraines as well as active surface geliturbation by melting water down the regolith.

In sloping areas, soil creep and regolith gelifluction occurs, being readily distinguished by the redistribution of Usnea- covered gravels and rock fragments at distances of hundred of meters far from the source areas, where Usneaceae cover rock-stable crests. The summer flow of water-saturated regolith is greater in palagonite and andesitic tuffs, due to finer particle sizes, but occurr even in basaltic materials with larger rock fragments. Soil and regolith creep appears to be a slow movement process, as many areas of basalt dykes cutting tuffs ant other andesitc lithologies show only short-range redistribution of rock fragments downslope as thin moraines. Thus, it appears that most rock fragments present at mid to high levels of Keller Peninsula are, in fact, the results of in situ physical breakdown of rock substrates.

Gelifluction was found to be an important process for sheet redistribution of soil/regolith materials downslope, particularly where subsurface melting water is abundant. This process of soil movement seems to be greater in acid tuffs and andesitic lithologies, where regolith are usually deeper, and surface rock-fragmentation is of limited importance. On the other hand, Gelifluction is less in basalt and other mafic lithologies, due to a greater stonyness of the surface. Gelifluction accounts for the devolopment of lobate crescentic sheets of stony pavement, at mid and downslope positions.

We have also observed that soil creep (and solifluction) is controlled by some structural features of the bedrock, such a fault-lines, presence of unconformites, dykes and, especially near the coast, by uplifted (isosthatic) marine terraces and "structural tabular terraces". The cryogenic landscape, therefore, is considerably "stable" and little long-range redistribution of debris is actually on going.

Nutrients bioavailability of ornithogenic cryosols on volcanic rocks from Admiralty Bay, King George Island, Antartica

(poster p.)

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Ornithogenic soils are commonly observed on marine terraces of volcanic rock sediments across Admiralty Bay in King George Island. These cryogenic soils are strongly affected by sea-land transfer of nutrients by Penguins (Pygoscelidae), mostly Adélie, and skuas (*Catharacta spp.*) activity, through guano inputs in rookeries during their summer reproduction cycle. In these soils, a particular and complex process of deep soil phosphatization occurs, as described in some detail by TATUR & BARCZVK (1985). In order to investigate the relationship between soil formation, phosphatization and age of rookery occupation, a toposequence of ornithogenic and other associated soils were sampled and studied along levels of Marine Terraces and Moraines in Rakusa Point, Admiralty Bay; area 1 soils in or around present day rookeries, soils of former rookery sites with abundant lichen and moss coverage and; area 2 soils of highland areas without distinct ornithogenic influence.

We analysed the availability of nutrients (P, Ca, Mg, K, Na, Fe, Mn, Cu) and selected heavy metals in order to assess the influence of seabird inputs, its biogeochemical cycle within the cryosols and to evaluate differences associated with topography and landscape development. The extraction procedures were based on standard international methodologies (PAGE et al. 1982, EMBRAPA 1997).

In the uppermost soils a granular structured soil underlies a stony pavement of 10 cm, with some cobbles or with small gravels. The A2 pedon, a shallow soil with some sparse *Usnea-Colobanthus-Deschampsia* vegetation cover, displayed evidence of former Skua activity (nesting) with small, scattered bone fragments. Levels of Na are high (range 1260-1440 mg/dm^3), due to salt-spray sea inputs and little leaching due to local aridity. These soils are comparable to polar desert soils of Antartica inner dry valleys, where salinity is high. In the uppermost soils, levels of Ca, Mg and Na are greater, pH is high (6.6-7.0) and Al levels are lower than downslope soils. Vegetation is virtually absent, apart from a few crustose lichens. The granular structure appears to be associated with fine particle flocculation due to salinity. Close to the scarpment soils have less Ca, Mg and K levels, high available Al and P, due to increasing weathering and sea-birds droppings, rich in organic P. The landscape is very much like those described in the arid land area of continental Antarctica by CAMPBELL & CLARIDGE (1987).

Upland soils, developed on present-day or former Penguin rookeries, are readily distinguished from non-ornithogenic soils by several features, such as: low pH (range 3.8-5.8), very high P contents, high Al availability, and varying amounts of exchangeable Ca, Mg and K. The areas of former penguin rookeries present fossil soils with clear ornithogenic features. Here, P levels are greater near the present-day rookery (range 700-1800 mg/dm^3), due to occasional dropping of Skuas guano, as in the case of well-drained positions. The P distribution is fairly regular with depth being greater closer to the present Penguin colony. Exchangeable Al levels are higher in the uppermost ornithogenic soil, with decreasing levels downslope; Hence, a greater part of P should be in the form of low cristallinity Al-P phases, corroborating the findings of TATUR & MYRCHA (1985).

Soils located on marine terraces further away form the present colony show much lower P values (range 60-820 mg/dm^3), and evidence of P transformation and leaching with depth, where exchangeable Al forms are abundant. In these soils, pH are higher, with much greater Ca and Mg values and less exchangeable K, due to limited input from sea-bird droppings (mainly Skuas) and greater soil development. Higher Ca can also be related to a till richer in basaltic rock fragments in this area, compared with present rookeries, where andesitic fragments are more commonly observed.

In the soils localized near the Penguin rookery, the ornithogenic influence is much greater. At 50 m.a.s.l., intense phosphatization was recorded and available P levels are exceedingly high, reaching 4150 mg/dm^3 in subsurface. In the same area, a soil covered by stones and coarse gravel and less vegetation cover of lichen, mosses and *Deschampsia*, has also very high P levels, reaching 4270 mg/dm^3 in the subsurface.

At the lowest level of the toposequence, marine terraces are also phosphatized, but less pronounced. In a soil on gravel/cobbles of the storm marine terrace which receives percolates and outwash from the Penguin rookeries upland, P levels are considerably lower (300-600 mg/dm^3) compared with the in situ ornithogenic areas upslope. The K and Al levels are high (500-780 mg/dm^3 of K), indicating soluble leachetes containing Al, K and P dowslope, being dammed at the lowest level by the gravel beach terraces. However, most P is leached back to the sea, as indicated by the whitish tongues on rocks along the sequence down to the sea level.

The high levels of available P in the soils studied may be related with the utilization of the Melich-1 acid solution, which extracts preferably P-Al forms. The use of the Olsen extractor is recommended, specially for the non ornithogenic soils in order to assess the availability of P-Ca forms.

In the uplands with no vegetation cover and no ornithogenic influence, P levels are much lower and the soils are aridic, with high pH, Na, Ca and Mg values, associated with a granular structural desintegration. Downslope, the soils are ornithogenic, with surprisingly high exchangeable Al, very high P, low pH and lower amounts of Na, but varying K levels, associated with birds droppings and lateral concentration downslope.

Soil P availability seems to be an important factor controlling vegetation development. Plants are present only where moisture is sufficiently high to promote percolation, leaching and weathering, and the microenvironment is more protected with reference to wind ablation. Most importantly, primary energy flow through the system should be warranted by appropriate solar exposition (northern, northeastern, northwestern).

Primary productivity of ornithogenic soils are much higher than non ornithogenic counterparts; eutrophication of upland marine terraces are due to both *Pygoscelis adeliae* rookeries and *Catharacta spp*. nesting in the vicinity, expanding the P anomalous area.

Soil development, vertical and lateral movement of bioavailable nutrients is enhanced by ornithogenesis. A close interplay between ornithogenesis, plant diversity and biomass production exists. The acidolysis promoted by biological activity in areas of Penguin rookeries is extreme, and capable of enhancing soil development in these Antarctica oases of Admiralty Bay.

Vertical crustal deformations in Dronning Maud Land, Antarctica. Observations versus model predictions

(oral p.)

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During the last decade a variety of observations have been carried out in central Dronning Maud Land, East Antarctica, in order to investigate geodynamic and glaciologic phenomena. Of special interest is the interaction of recent and historic ice mass changes and the vertical crustal deformation, which is characterized by the rheological properties of the Earth, especially of the crust and the upper mantle.

A GPS network was established which covers the mountain range south of the Schirmacher Oasis, extending over a distance of about 200 km. The observation points were set up at bedrock, using a special bolt. A first observation campaign of the entire network was carried out in 1996, while the second campaign took place in 2001. For both campaigns, a GPS station in the Schirmacher Oasis was used as reference. This observation strategy enables to form baselines for the GPS analysis and eventually to infer the height change of each mountain site with respect to the reference station. The comparison of these two GPS campaigns yielded a relative height change of about +2 mm/year.

Besides these GPS observations further geodetic measurements have been carried out, which provide information on the height change and flow pattern of the glacier region between the Schirmacher Oasis and the mountain range. Here, e.g. a distinct blue ice area south-east of the oasis can be described by an ablation of 5 to 15 mm WE/year.

These geodetic information may help to constrain the recent isostatic uplift pattern, the recent and - using additional dating information - past ice sheet configuration in central Dronning Maud Land. Coupling the geodetic data with these additional constraints on recent and past ice mass changes allows a self-consistent glacial load history to be investigated. A spectrum of viable load histories will be examined and the respective isostatic deformation signature will be computed, using a flat earth approach. We discuss how to constrain combinations of the regional load history in Dronning Maud Land and the deep earth rheological response.

First model computations will be represented and discussed, aiming to reconcile the modelled vertical uplift signature and the observations.

Past (and future) collapse of the West Antarctic ice sheet: redux

(oral p.)

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The question of stability and future behavior of the West Antarctic Ice Sheet (WAIS) has come full circle. In the 1970s it was suggested (e.g., Hughes, Mercer, Thomas) that the large ice shelves act to buttress interior ice, and that if these ice shelves were to disintegrate, the "cork would be out of the bottle" and interior, grounded ice streams would surge, resulting in rapid ice sheet "collapse." Studies in the late 1980s and 1990s de-emphasized the ice shelves, instead focusing on ice streams and basal conditions. Recent dramatic warming-induced collapse of large parts of the Larsen Ice Shelf offered an opportunity to witness the effects of ice shelf collapse on interior feeder glaciers. ANGELIS & SKVARCA (2003) have identified synchronous surging of these glaciers, seemingly in accord with the early ice shelf buttressing theories. These observations are reinvigorating the concerns regarding WAIS stability and its susceptibility to rapidly collapse.

The potential for future WAIS collapse is best gauged by establishing a history of such behavior. Geological analysis of marine and glacial sediments on the Antarctic continental shelves have provided evidence of at least 2 "warm" pelagic events at extreme southern latitudes.

Quaternary pelagic diatoms were found in subglacial tills from beneath the Ross ice streams (SCHERER et al. 1998). These diatoms were interpreted as representing open marine conditions during the late Pleistocene, indicating WAIS disintegration. Using global climate records and sea-level proxies as a guide, Marine Isotope Stage 11 (MIS-11) was suggested as the most likely age of this event.

The Cape Roberts Project recovered a 2 m thick Pleistocene carbonate-rich sedimentary sequence that indicates an interglacial period characterized by extreme (relative) warmth, including greatly reduced sea-ice. Such conditions are interpreted as indicating an absence of ice shelves and collapse of interior West Antarctic ice. This deposit is extremely well dated. Diatoms, strontium and argon isotopes, and paleomagnetic stratigraphy has unequivocally dated the deposit as 1.07 Ma (base of the Jaramillo Chron), which corresponds with MIS-31.

MIS-11 and MIS-31 are recognized as unusual warm events in global records, but deep-sea data alone cannot be used to explicitly identify WAIS collapse. Only with coordinated geological investigation of Antarctic continental shelf deposits and focused modeling efforts can the linkage between global climate and climate forcing, ocean circulation, and the West Antarctic Ice Sheet be established.

Sedimentation processes on the continental rise of the western Bellingshausen Sea, West Antarctica

(oral p.)

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Since the beginning of glaciation of West Antarctica, changes of glacial and interglacial periods affect the sediment supply across the shelf and onto the deep sea. Along the slope and rise of the continental margin of the Antarctic Peninsula, Cenozoic sediments were deposited which development was influenced by ice sheet fluctuation and mass transport processes. Thus, both the sediment stratigraphy and the physiography of the sea floor reflect the history of the West Antarctic ice sheet as well as processes that transport, erode and deposit sediment along the outer shelf, slope and rise of the continental margin.

We present interpretations of multichannel seismic reflection data produced along and across the sparsely investigated continental rise of the western Bellingshausen Sea. The along-slope profile AWI-20010001 (Fig. 2) shows a division in two major sedimentary units 1 and 2, whereas unit 2 is subdivided in two minor units. The lower unit 2b is characterised as "Low-deposition Stage", representing the pre-glaciation stage and consist of both terrigenous and pelagic sediments. Unit 2a reflects the onset of the glaciation on the continental shelf and can be termed as "Transition Stage". The uppermost unit 1 is made of terrigenous sediment material transported by shelf ice across the shelf edge. Evidences for the sediment supply via shelf ice are a high sedimentation rate, erosional channels across the lower slope and huge slides of sediment bodies, which indicate a high water content. Furthermore, the correlation with profile AWI-94003, orientated perpendicular to the slope, shows that the boundary between units 2a and 1 coincides with the base of a sediment wedge that consists of strong prograding shelf sequences, a strong evidence for shelf ice deposits. Thus, the boundary between units 2a and 1 indicates the advance of shelf ice up to the shelf edge, where transported sediment material was deposited. The onset of this advance along the margin of Antarctic Peninsula occured approximately in the mid to late Miocene. However, an exact dating of the onset along this margin is difficult due to the far distance to the closest ODP Drill Sites 1095 and 1096.

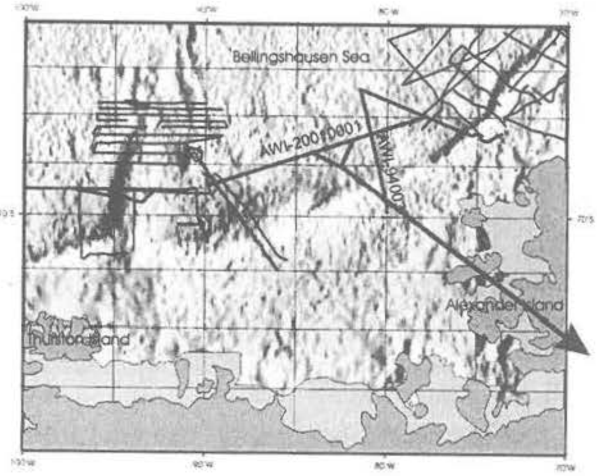

Fig 1: Overview of seismic reflection profiles in the western Bellingshausen Sea, West Antarctica, incl. lines of BAS, OGS and Vernadzky Institute

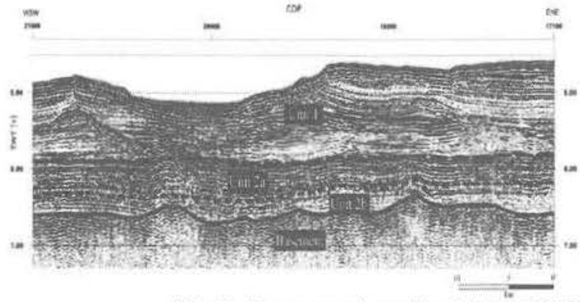

Fig 2: Segment of profile AWI-20010001

Both ocean floor physiography and the structure of sediment mounds show influences of ocean currents. Two tremendous sediment depot centres can be identified on the rise in the western Bellingshausen Sea. The easterly depot centre shows evidence for an ancient along-slope and westward flowing bottom-current which is still active as recent measurements prove. Contrary to that, the westerly depot centre shows more characteristics of a trough mouth fan and less of an influence by bottom currents.

This new seismic line links previously data sets of the eastern Bellingshausen Sea and the Amundsen Sea and contributes to a better understanding of the sedimentation processes along the West Antarctic margin.

The early opening history of the South Atlantic: breakup, volcanism, and seafloor spreading in the light of new seismic and magnetic data

(EANT workshop p.)

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The breakup of the South Atlantic commenced in the Early Cretaceous north of the Falkland Plateau and propagated rapidly northward. Extensive marine geophysical surveys of the BGR (reflection and refraction seismics, gravity and magnetics) off Argentina reveal details of the late rift and early drift phases and the variability of the associated processes along the margins.

The main questions that will be discussed are the distribution of breakup associated volcanics and the timing of rift- and drift-related processes. Our dense net of MCS profiles off Argentina shows that the volcanic activity that resulted in the emplacement of seaward-dipping reflector sequences (SDRS) was subject to considerable variation along the margin. At the latitude of the Valdez Peninsula a transition from a mostly uniform thick SDRS wedge in the North to several distinct wedges in the South could be observed. There are indications that further to the South the volume of volcanics decreases significantly.

There is also a typical succession of structural features from the continent to the ocean like synrift grabens in the continental crust, the main wedges of SDRS, outer smaller wedges of SDRS and a typical 'outer volcanic high' that can be interpreted as the last phase of anomalous volcanic activity before the emplacement of normal oceanic crust. Refraction seismic measurements on one line also indicate the presence of high-velocity lower crustal (underplated?) bodies below the SDRS.

The new magnetic data from the Argentine margin reflect some of the seismic features like the main wedges of SDRS which cause a distinct positive anomaly (anomaly G) and the transition into normal oceanic crust with typical sea-floor spreading anomalies. The data could be used to determine the youngest excessive volcanic activity and the timing of the transition to normal sea-floor spreading.

Fewer seismic data exist for the conjugated South African margin off Cape Town. However, a magnetic map could be compiled for this area that shows a very similar pattern of magnetic anomalies as compared with the Argentine map. A reinterpretation of the magnetic lineations reveals considerable spreading rate variations for the earliest phases of normal spreading after the emplacement of SDRS. The anomalies also image the propagation of the breakup from South to North. The general pattern of the magnetic anomalies strongly suggests that also on the South African margin the volume of volcanism decreases to the South.

Trace and REE fractionation in medium-P intermediate to mafic migmatites: effects of mineral composition and P and T on trace and REE distribution

(poster p.)

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The Rayner Complex (Kemp Land) is a Proterozoic mobile belt at the margins of the Archaean Napier Complex in East Antarctica. It exposes superb outcrop with a variety of wide spread similar rock types on the coastline of medium-*P* granulite facies rocks. This LA-ICPMS based study aims to study the partitioning of REE and trace elements in peritectic minerals formed during high-*P* melting of mafic assemblages. P/T-conditions vary from $T \geq 700°C$ and $P \leq 7.3 \pm 0.5$ kbar at the Colbeck Archipelago in the east to $T = 800\text{-}850°C$ and $P \approx 10$ kbar at the Oygarden Islands in the west. This tilted exposure provides an opportunity to study the influence of *P* on the distribution of trace and REE during the formation of leucosomes. The variation of rock types in local areas also provides a possible comparison of trace and REE distribution between different settings of coexisting minerals (e.g. peritectic phases in leucosomes, such as garnet, clinopyroxene or orthopyroxene). Zoning of trace and REE in reactant and/or product monitors the influence of participating minerals, which might be involved at different times and result in steps in the zoning pattern. The role of trace minerals like Zircon, Monazite, Xenotime and Apatite, which are known to contain a substantial amount of the trace and REE content of the bulk rock composition, also needs to be carefully considered.

Modelling of atmospheric water vapour in Antarctica using GPS

(poster p.)

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The atmospheric water vapour content plays an important role for a better understanding of the Antarctic precipitation and climate changes. High-quality records are hard to obtain, because of the extreme climate conditions and the sparse number of research stations. Datasets from the Global Positioning System (GPS) are a cost-effective, weather-independent alternative to increase the number of water vapour records in Antarctica.

The different physical properties of the atmosphere cause a time-delay of the microwave-signals from the GPS-satellites along their way to the GPS-ground antenna. To calculate the precipitable water vapour content from GPS-signals, it is necessary to estimate the Zenith Neutral Delay (ZND) of these signals. This neutral refraction is caused by the dry air, the water vapour, the clouds and the rain. The ZND can be divided into a dry and a wet part. The dry part is called Zenith Hydrostatic Delay (ZHD) and the wet part Zenith Wet Delay (ZWD). The ZHD can be modelled using the surface pressure values measured at the GPS antenna. The ZWD is the difference between the ZND and the ZHD and can be converted into the Precipitable Water Vapour (PWV) content applying the mean temperature of the atmosphere (SCHÜLER 2001). Using datasets from ground-based GPS-stations, the PWV can be calculated in a tropospheric-column with a diameter between 7 and 15 km around the station. Furthermore it is possible to estimate the horizontal gradients or the PWV along the satellite signal (Gendt et al. 2002). In this work, the GPS-files from several Antarctic and Sub-Antarctic permanent AWI- and IGS-stations were evaluated with the GPS post-processing software GAMIT developed at the MIT (Massachusetts Institute of Technology). The modelled PWV-contents are compared with the PWV-contents calculated from different measurement-methods like radiosonde measurements and satellite remote sensing measurements.

The main goal of the presented analysis is to verify the utility of ground-based GPS-measurements in estimating the PWV content, especially under the extreme Antarctic climate conditions. Using this method of modelling the PWV, it is possible to model entire time periods of PWV and to analyse the behaviour of the PWV for a time period in correlation with other meteorological events like precipitation. A further goal of this analysis is the comparison of the measurement-method using ground-based GPS-stations with other methods and to perform the modelling of the tropospheric water vapour by combining all methods.

Gendt, G., Dick G., Göbell, S., Ramatschi M., Reigber, C. & Tomassini M. (2002): Nutzung von SaPos-Referenzstationen zur Wettervorhersage und Klimaforschung.- Abstracts 4. SaPos-Sympos. 2002: 103-113.
Schüler, T. (2001): On Ground-based GPS Tropospheric Delay Estimation.- Unpubl. PhD Thesis, Universität d. Bundeswehr München.

The influence of Antarctic isolation on productivity patterns at the Eocene-Oligocene transition

(poster p.)

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The Eocene-Oligocene transition is marked by large plate tectonic events, rapid shifts in climate, and change in oceanography. The opening of the Tasman and Drake Passages enabled an establishment of an initial Antarctic Circumpolar Current. Tectonic and oceanographic isolation of Antarctica affected a full Antarctic glaciation in the early Oligocene. The world's clime changed from "greenhouse" to "icehouse". Deep waters of the world' s oceans and surface waters in high latitudes cooled and caused a reconstruction of ocean circulation. Changes in global climatic and ocean circulation cause productivity patterns. Ocean productivity is of particular interest for the global carbon cycle. At several DSDP/ODP sites in southern high latitudes and equatorial oceans have been investigated to determine productivity patterns from the Middle Eocene up to the 0ligocene. To estimate paleoproductivity, several proxies, including benthic foraminifera distribution, benthic foraminifera accumulation rates, characteristics of planktic faunas, sedimentological parameters e.g. carbonate, opal, and organic matter accumulation, and carbon isotopes have been used. The aim of the reconstruction is a comparison of productivity in southern high latitudes and equatorial oceans, and a first attempt at a global synthesis of changes in ocean productivity.

111 southern high latitudes benthic foraminifers abundance increase and a seasonal high productivity fauna (THOMAS & GOODAY 1996) in the late Eocene up to the early Oligocene indicates a shift to higher and seasonal productivity. The change to higher productivity is also documented in higher opal and lower carbonate accumulation. Carbonate concentration decreases over the Eocene-Oligocene transition, while opal accumulation increases, caused by an increase in siliceous plankton. In equatorial oceans, we have no indications for a shift to higher productivity at the Eocene-Oligocene transition. Siliceous plankton abundance does not change significant and benthic foraminifera assemblages have no indices for a seasonal fauna. In the eastern equatorial Atlantic carbonate and organic matter accumulation give evidence for lower productivity in the middle of the Lower Oligocene (WAGNER 2000).

Changes in productivity at the Eocene-Oligocene transition took mainly place in the southern high latitudes. Here we had the start of the oceanographic reconstruction with the main cooling of bottom and surface water. The frontal system of the initial Antarctic Circumpolar Current with its upwelling system caused higher productivity. Because of the geographical position we can expect seasonality. In equatorial oceans productivity patterns were more constant and changes could be occurred in the middle Lower Oligocelle. The southern high latitudes alld the equatorial oceans had a different timing in productivity patterlls with different shifts. The productivity patterns at the Eocene-Oligocene transition had not been a simple global change to higher productivity. In fact it was a complex development, depending on geographical position.

Thomas, E. & Gooday, A.J. (1996): Geology 24: 355-358
Wagner, T. (2002) : Palaeogeogr. Palaeoclimat. Palaeoecol. 179: 113-147

The periglacial morphodynamic system in the South Shetland Islands, western Antarctica
(oral p.)

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The South Shetland Islands comprise eight main islands aligned SW-NE between the Bransfield Strait and the Drake Passage on Maritime Antarctic. 10 % of the archipelago emerged land are ice-free surfaces, being under a cold maritime climate with the annual isotherm -2°C close to the sea level. There are evidences of intense recent and present periglacial activity, being the related landforms and processes developed on glacial features and deposits and on extensive raised marine landforms and deposits. Periglacial landforms distribution has been studied in the archipelago by means of mapping and inventory of the existing landforms and deposits. A total of 13 geomorphological maps at scales between 1:10000 and 1:25000 of different peninsulas and capes along the archipelago have been compiled. Spatial and altitudinal distribution of periglacial landforms have been considered, as well as associations between different landforms and their relation to the presence of permafrost and other processes. A series of transects have been made along different slopes considering the relationships of landforms distribution with topography, lithology, grain size and the presence of permafrost and active layer. Rock glaciers in the archipelago have also been studied. In several places cores and vertical electric sounding have been obtained, giving additional information about the presence of ice and the permafrost distribution.

27 different types of periglacial landforms related to gelifluction, gravitational and active layer processes have been identified in the South Shetland Islands. Most of the landforms are associated to active layer and, in a second place, to gelifluction and gravitational processes. Landforms associated

to active layer (mainly patterned ground and stone fields) suppose 72 % of the total periglacial features. An altitudinal distribution of processes has been identified: below 10 m.a.s.l. periglacial landforms are mainly debris talus and cones; weathering, cryoclastic and gravity processes are dominant between sea level and 15-20 m.a.s.l.; and patterned ground is dominant between 20 and 100 m a.s.l. and the most common feature on the periglacial morphogenetic system in the archipelago, being gelifluction processes very common on slopes up to 60 m.a.s.l.

Two subsystems characterized by particular landforms and processes associations can be distinguished into the periglacial morphodynamic system: platforms and slopes. On the platforms morphodynamic subsystem frost action related to active layer, cryoturbation and frost shattering are the dominant processes. From 15-20 m.a.s.l. to 50 m.a.s.l., weathering, patterned ground, gravity processes and fine sediments accumulations by washing are dominant. Up to 50-60 m patterned ground is the most common landform on platforms. In the other hand, on slopes frost shattering, gelifluction, rock fall, frozen body flow, nivation, debris and mud flows, cyoturbation and slides are the dominant processes. Considering associations of periglacial landforms and processes seven morphodynamic types of slopes can be distinguished, being related to the presence of continuous permafrost and water availability in summer. Different sediment transfer systems can also be distinguished according to local conditions regarding lithology, climate, topography, water availability, permafrost, active layer, hydrological and morphodynamic processes and surface deposits characteristics.

The study of the distribution of periglacial processes and landforms gives useful information related to the presence of permafrost, being interesting to be considered on the study of past and present day environmental changes.

Ten years progress of Syowa Station, Antarctica as a global geodesy network site
(oral p.)

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SHIBUYA (1993) made a review of the solid-earth geophysics program by the Japanese Antarctic Research Expedition (JARE) at Syowa Station, Antarctica, and summarized the status of each observation component at the year of 1993. VLBI was in the planning stage yet, AG team just arrived for the first measurement, SG observation also just started. GPS was yet in a campaign mode.

After 10 years, with continuing support from the geodetic society of Japan, Syowa Station has now become one of the key stations for global geodynamics in the southern hemisphere. VLBI has been continuing for six years, permanent GPS for eight years with pre-registration stage of four years to IGS, DORIS for ten years of two generations (on a tower and on a pillar), TT-70 SG for ten years and now worked for replacement to a new CT SG without depending on the helium liquefier, AG 4 times during summer seasons between 1992 and 2003, BPG for more than 20 years at the same location. JARE program will maintain all these components, together with other monitoring systems such as broadband seismometer, magnetic variographs, etc. Syowa 11 m antenna also acquired many SAR scenes from JERS-1 and ERS-1/-2 tandem orbits, covering approximately 3/4 of the East Antarctic ice sheet, and about 20,000 scenes are now under processing.

We will present main results from the above observation components, especially in relation to the importance of parallel observations to correlate seasonal/annual variations. Detection of time variable gravity fields by GRACE will be a challenging topic for the coming decade in relation to the mass balance of the Antarctic ice sheet, especially the Shirase Glacier region. The ground truth survey flights for airborne geophysics (gravity, magnetics, ice-echo sounding) are planned around the Syowa Station area in collaboration with the Alfred Wegener Institute. Outline of the plans will be discussed in relation to the comparison/calibration procedures with the Syowa reference marks.

Tourmaline pegmatites in Schirmacher Oasis, East Antarctica

(poster p.)

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Schirmacher Oasis contains metamorphic rocks of granulite and amphibolite facies forming the supra-crustal Proterozoic complex of mountains on Queen Maud Land (Humboldt Complex). Among these, veined and dike formations different in age and composition are very common. Recently, twelve veined formations of different age have been distinguished, three of them being pegmatitic and containing: 1. Tourmaline, 2. Garnet-containing, 3. Mica.

Tourmaline pegmatites are the oldest of the above. They cut accross metabasite bodies and dolerite dikes. In turn, they are intersected by garnet-containing pegmatites and Mesozoic dolerite dikes (Ferrar Formation). Therefore, their age varies between the late Panafrican metamorphism (500 million years) and Mesozoic trap activity (180-200 million years). In our view, the establishment of the tourmaline pegmatite formation is associated with the closing of the Panafrican activity stage.

Tourmaline pegmatites are spread in a fairly uniform manner in the Oasis. By mode of occurrence, two groups are distinguished:
1) subconcordant, containing metamorphic host rocks and
2) crosscutting, steely dipping veins of NW strike.
Thickness of veins ranges from centimeters to 5 m (in bulges) and sometimes, they are traced for dozens of meters along strike. Quartz - feldspathic (with microcline prevailing) pegmatitic rock contains biotite and tourmaline, with garnet, muscovite, amphibole, magnetite, pyrite and beryl being less frequent.

The unique pegmatitic vein was discovered on Aerodrome Mount. It occurs in the biotite-garnet gneiss sequence. Its thickness ranges between 1-2 and 10 m and it is traced for 80 m along strike. The vein is gently crosscutting. In the highest bulge zone (10m), it contains a biotite (xenolith?) glimmerite unit. The rocks of the unit are formed by large-crystal biotite containing garnet-feldspathic aggregates (~5-10 %). Accumulations of enormous crystals with tourmaline content reaching 10-15 % of the glimmerite volume are just associated with biotite glimmerites. Frequently, tourmaline makes segregated accumulations of major crystals. A black (scherl) tourmaline crystal may be from 0.5-1 cm to 50-60 cm long with thickness up to 15 cm. Fairly often finely faceted crystals occur. Tourmaline is definitely of metasomatic origin. Its metacrystals had developed capturing and replacing scales of biotite, garnet, and less frequently, amphibole. Sometimes, crystal facets carry skeleton forms of the replaced biotite.

Laboratory studies have defined the zoning of tourmaline growth, its chemical composition and that of microinclusions.

ACE: Antarctic Climate Evolution

(poster p.)

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ACE is a new, international research initiative to study the climate and glacial history of Antarctica through palaeoclimate and ice-sheet modelling investigations, purposefully integrated with geological evidence for past changes. The Antarctic ice sheet has existed, according to many researchers, for approximately 35 million years, but it has fluctuated considerably and has been one of the major driving forces for changes in global sea level and climate throughout the Cenozoic Era. The spatial scale and temporal pattern of these fluctuations has, however, been the subject of considerable debate. Determination of the scale and rapidity of the response of large ice masses to climatic forcing is of vital importance, because ice-volume variations lead to changing global sea levels on a scale of tens of metres or more. It is thus important to assess the stability of the cryosphere under a warming climate (IPCC 2001), particularly as ice-core records have yielded evidence of a strong correlation between carbon dioxide in the atmosphere and palaeotemperatures. This concern is justified when carbon dioxide levels are compared with those of the past. Since Antarctica is a major driver of Earth's climate and sea level, much effort has been expended in deriving models of its behaviour. Some of these models have been successfully validated against modern conditions. Modelling the past record of ice-sheet behaviour in response to changes in climate (inferred from sedimentary facies and seismic data), palaeoceanographic conditions (inferred from palaeoecology and proxy ocean climate indicators) and palaeogeography (as recorded in landscape evolution) is the next step. The ACE programme aims to facilitate research in the broad area of Antarctic climate evolution. The programme will link geophysical surveys and geological studies on and around the Antarctic continent with ice-sheet and climate modelling studies. These studies are designed to investigate climate and ice sheet behaviour in both the recent and distant geologic past, including times when global temperature was several degrees warmer than today.

The goal of ACE is to advance the study of Antarctic climate and glacial history, by:
(1) encouraging and facilitating communication and collaboration between research scientists working on any aspect of the evolution of Antarctic climate and ice sheets. This will be achieved by organizing workshops and symposia to present new results, exchange ideas, share/compile information and plan modelling and field operations;
(2) providing advice for the research community on the types of geoscience data required and available for ice-sheet and palaeoclimate models, and the likely sampling locations to acquire such data;
(3) providing assistance as needed on technical issues related to field and laboratory programs and to ice-sheet and palaeoclimate modelling studies;
(4) promoting data access and data sharing via data-contributions to the SDLS and Antarctic data centres to facilitate and expedite data syntheses needed for developing new field programs and enhancing palaeoclimate models; and
(5) summarising and reporting the results of these efforts to the scientific and wider community on an ongoing basis at workshops, symposia, and in the primary literature.

ACE is not yet an official SCAR program. At SCAR XXVII in July 2002, however, ACE was provided with funding for a two year planning period prior to the establishment of ACE as a sanctioned international research initiative operating under the SCAR umbrella.
<http://www.ace.scar.org/>

Inclusion patterns in porphyroblasts of a subduction complex at Elephant Island, West Antarctica
(poster p.)

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A subduction zone was established along the northwestern margin of the Antarctic Peninsula during the Mesozoic/Cenozoic, related to fragmentation of Gondwana. As a result several remnants of subduction / accretion complexes crop out at islands north of the Peninsula. Elephant Island is one of the most complete examples of these. It is composed of metamorphic rocks with metamorphic ages in the range 90-110 Ma. In the northern part of the island grey, blue and green phyllites predominate. They belong partly to the blueschist facies and pass progressively to greenschist and amphibolite facies associations southwards, where grey schists and amphibolites predominate. Centimetric to metric metachert, calcsilicate and marble layers are locally intercalated within the phyllites and schists.

This metamorphic gradient permitted, through the recognition of isograds, to establish seven metamorphic zones. In zones 4 to 7 albite and almandine garnet porphyroblasts are common. These contain inclusion patterns that permit to assess the time relationship between porphyroblast growth and deformation phases D1 and D2, respectively resposable for superposed foliations S1 and S2 and associated folds. The principal objective of this contribution is to analise these microstructures in order to improve the understanding of tectonometamorphic processes in subduction zones.

Three deformation phases affected the area. D1 is interpreted as related to the southward subduction of paleo-Pacific ocean floor, whereas D2 represents the gradual stagnation of this process, finishing in oblique sinistral transpression. D3 encompasses several late structures, such as kink bands and local faults, probably related to uplift and, possibly, to the present configuration of microplates. Remnants of bedding or other primary layering are essentially parallel to the slaty cleavage S1, defined by chlorite, white mica and epidote. S1 is tightly folded in D2 folds with a subvertical axial plane foliation (S2), that may have the morphology of crenulation cleavage or transposed schistosity and is the principal foliation of the area. These D2 folds plunge gently to the west with axes parallel to a L2 stretching or mineral lineation.

About 90 samples of the schists were analysed under the microscope in thin sections cut orthogonal to S2. Most thin sections are also perpendicular to D2 fold axes, but some are parallel. Four samples were also examined through thin sections cut parallel to S2. In practically all these samples S2 is a crenulation cleavage at an angle with S1//S0. The inclusion trails in the porphyroblasts define an internal foliation (Si) that is generally continuous to S1.

The mapping of curved inclusion patterns across D2 folds shows that the straight sections in the central parts of the albite porphyroblasts follow roughly the general D2 fold, only more openly. Sigmoidal patterns were identified in individual porphyroblasts that show S-type asymmetry in the right hand limbs and Z-type asymmetry in the left hand limbs of the antiformal folds. In the hinge zones a millipede pattern is frequently observed. The patterns with straight inclusions in the central part of crystals suggest that porphyroblast growth may have started before D2 (intertectonic D1-D2), but initiation early syn-D2 in zones not yet folded cannot be ruled out. Most garnet porphyroblasts have a straight inclusion trails and show a similar relation with D2 folds, defining even more open folds. However, close examination of several porphyroblasts with sigmoidal patterns reveals no asymmetry change in alternating limbs of D2 folds, indicating that the garnet is pre-D2. Several garnet porphyroblasts with snowball patterns or garnets included in albites that show a significant angle between their Si orientations reinforce the interpretation of pre-D2 grow and probably at least in part syn-D1.

We conclude that albite porphyroblasts started to grow shortly before D2 or during the early stages of D2 folding. They continued to grow until D2 folds and S2 were well developed, but finished to grow before the end of D2. The garnet porphyroblasts studied (zone 4 to 6) grew late to post-D1 and pre-D2.

Geochemical variation in Robertson Bay Group of North Victoria Land and correlation with Greenland Group of West Coast, South Island, New Zealand

(oral p.)

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On the western side of South Island of New Zealand, the latest Cambrian-Ordovician Buller Terrane is represented by a widespread and uniform turbidite succession, the Greenland Group. On the basis largely of age and lithological similarity, Greenland Group has been correlated with the Robertson Bay Group of North Victoria Land, Antarctica, the two forming parts of an extensive turbidite apron along the Pacific Australian-Antarctic Gondwana margin (COOPER & TULLOCH 1992, NATHAN 1976).

Both Greenland Group (GG) and Robertson Bay Group (RBG) typically consist of alternating beds of quartzose, greenish-grey sandstone and mudstone; calcareous concretions and lenses are a common minor lithology in the southern part of Greenland Group and throughout Robertson Bay Group. The sandstones contain abundant quartz of several varieties (GG-30-40 %), sodic plagioclase (GG <15 %; RBG <13.5 %), metasedimentary and minor volcanic rock fragments (GG <25 %; RBG <22 %), and up to 50 % (GG) and 66 % (RBG) matrix. Detrital muscovite intergrown with chlorite after biotite (<5 %) is a constant component (CHRISTIE & BRATHWAITE 2003, ROSER et al. 1996, WRIGHT 1981).

With Greenland Group, there is a spatial chemical variation defining three sub-sets, southern, central and northern. Compared to the central and northern sets, the southern sandstones are markedly enriched in CaO and Sr. SiO_2 -K_2O/Na_2O signatures cluster near the divide between passive margin (PM) and active continental margin (ACM) fields, the southern set lying partly within the ACM field. SiO_2/Al_2O_3 ratios mostly range from 4.5-7, indicating a small degree of sedimentary maturation. K_2O/Na_2O ratios are 1-2.6; Rb/Sr ratios are 0.5-3.2 /<2.2 in the south but 1.4-3.2 in the central set); FeO/Fe_2O_3 ratios are 2.9-8.5, averaging 4.2. Plots of SiO_2-Al_2O_3 and Ba-K form sublinear clusters, whereas Rb-K and SrCa plots are linear, reflecting single potassic and calcic phases. Provenance discriminant plots (ROSER & KORSCH 1988) cluster in the recycled (quartzose) field, trending into the intermediate igneous field. However, in the discriminant function plot of BHATIA (1983), Greenland Group lies mainly in the PM field but the southern samples cross over into the continental arc (CA) field, trending from PM to ACM. (Fe_2O_3+MgO)-TiO_2 provenance plots also cluster within in the CA field.

Several geochemical parameters differentiate samples form east of the Rennick Glacier (ER) from those of the Morozumi Range to the west (Mz). All Robertson Bay Group samples lie within the field of Greenland Group on a SiO_2-K_2O/Na_2O diagram, but the Mz samples lie within the ACM rather than the PM field. Compared to ER rocks, Mz samples have lower SiO_2/Al_2O_3 and Ca, but higher Sr, Rb, Al_2O_3, Na_2O, and Ba. For RBG as a whole, K_2O/Na_2O ratios are 0.5-1.7; Rb/Sr ratios are 0.3-1.3; FeO/Fe_2O_3 ratios are 1.7-5.6, averaging 3.6. Plots of SiO2-Al2O3 and Ba-K form sublinear clusters, with Mz corresponding to the central GG set and ER to the southern GG set. Sr-Ca (for ER) and Rb-K plots are linear as for Greenland Group, but Mz samples cluster at higher Sr values. Discriminant function analysis places the ER samples within a recycled quartzose provenance in the precise position of Greenland Group, but the Mz samples lie in the felsic field trending from a quartzose to an intermediate igneous provenance, and in the CA field discrete from the ER and Greenland Group samples. (Fe_2O_3+MgO)-TiO_2 provenance plots also cluster in the CA field, trending into the ACM field.

Although there are differences, e.g. Robertson Bay Group from east of the Rennick Glacier has similar Sr levels to the southern Greenland Group but lower Rb, in general, the eastern samples closely correspond to the southern set of Greenland Group, whereas the Morozumi Range samples are significantly different.

Bhatia, M.R. (1983): J. Geol. 91: 611-627.
Christie, A.B. & Brathwaite, R.L. (2003): Min. Depos. 38; 87-107.
Cooper, R.A. & Tulloch, A.J. (1992): Tectonophysics 214: 129-144.
Nathan, S. (1976): N. Zealand J. Geol. Geophys. 19: 683-706.
Roser, B.P., Cooper, R.A., Nathan, S. & Tulloch, A.J. (1996): N. Zealand J. Geol. Geophys. 39: 1-16.
Roser, B.P. & Korsch, R.J. (1988): Chem. Geol. 67: 119-139.
Wright, T.O. (1981): Geol. Jb. B41: 127-138.

Surface stability and contraction crack development on various forms of ground ice in the Dry Valleys, Antarctica
(oral p.)

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The Dry Valleys of Antarctica are among the oldest undisturbed landscapes in the world. The cold, hyperarid conditions lead to unsuitable conditions for vascular plants, limited weathering, and considerable salt accumulation. Despite the dry conditions, one ubiquitous component of Dry Valley landscapes is subsurface ice. Subsurface ice is fundamentally interesting because: it is shielded from the modern atmosphere and survives much longer than surface ice; it may contain long archives of past climate and atmospheric conditions; it contains ancient viable bacteria; and it plays an important role in landscape development (flowing into flats; permitting tensile stresses to develop on large scales to form patterned ground; forming extensive ablation till surfaces). This ice seems especially puzzling where it underlies surfaces that are generally believed to have been stable for up to millions of years. Our recent findings indicate that these surfaces underlain by ground ice have dynamic processes that tend to disrupt the surfaces and soils on time scales that may be as short as 10s of thousands of years. To provide a better understanding and a basis for modeling the annual dynamics of contraction cracks, we installed linear transducers connected to data loggers at three sites in Beacon Valley and Victoria Valley in 1998, and have continuously monitored displacements across cracks since that time. In addition, we monitor the micrometeorology, soil temperature, soil thermal properties, and other physical parameters. The total annual crack opening due to thermal contraction of polygons ranges from 0.5 cm to nearly 2 cm, and lags air temperature. The contraction cracks open during cooling as the ice-rich ground contracts and expands as the ground warms. The net annual crack divergence reflects the amount of fines that fall into the cracks thereby preventing full closure.

Current rates of net crack divergence (~1 mm a^{-1}) and polygon sizes (~10 m) suggest that the near-surface layer of polygons would be completely resurfaced, in a period of tens of thousands of years, while rocks remain at the surface indefinitely as sand-wedges grow beneath them. The continuous injection of fines into contraction cracks has created a sand-wedge complex that has inflated the surface over 8 m. Our findings suggest that landscape surfaces with well-developed polygonal patterned ground in the Dry Valleys are relatively active, which contrasts with suggestions that these surfaces have been undisturbed for millions of years.

Polygons underlain by massive ice bodies display the greatest annual thermal contraction-expansion with cracks opening nearly 2 cm each year. Despite this large movement, the net annual displacement of the rods spanning these contraction cracks is nearly zero, or even slightly convergent. This surprising finding suggests that either sublimation of the ice is keeping pace with sand wedge growth, or that the ice is deforming during polygon development in such a fashion as to cause the rods to tilt inward. If sublimation is causing the net convergence, the surfaces must be substantially younger than previously reported (SUGDEN et al 1995). We are currently developing models of contraction crack growth coupled with ice sublimation and surface topography development.

Our findings improve understanding of polygon development mechanisms and activity under various types of ground ice. The surface expression of polygonal patterned ground is clearly seen by DEMs developed from recent high-resolution LIDAR mapping and, by inference, can be examined using high-resolution topography in other regions on Earth and on Mars (SLETTEN & HALLET 2003).

Sugden, D.E., Marchant, D.R., Potter, N. Jr., Souchez, R.A., Denton, G.H., Swisher, C.C. III & Tison, J.-L. (1995): Nature 376: 412-414
Sletten, R. S. & Hallet, B. (2003 in press): J. Geophys. Res-Planets.

Eruptive setting of the Miocene-Recent James Ross Island Volcanic Group
(oral p.)

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The later Cenozoic (late Miocene (<10 Ma) - Recent) history of the James Ross Basin is represented onshore only by the James Ross Island Volcanic Group (JRIVG). It comprises a 1.5 km-thick sequence of alkaline basalts erupted mainly at Mount Haddington, and interbedded sedimentary rocks. The JRIVG dominates the geology of the island yet it has been almost entirely neglected since the only previous comprehensive survey in the late 1950's. Since 2001, the JRIVG has been the subject of a major palaeoenvironmental investigation led by the British Antarctic Survey. The initial results of that study are described here. Only the volcanic rocks are discussed. The associated sedimentary units, which are far more widely distributed throughout the JRIVG than previously realised, are described in a companion paper at this meeting. A comprehensive dating programme (by $^{40}Ar/^{39}Ar$) also forms part of the investigation, together with a study of the diagenetic mineral compositions (to identify a compositional palaeoenvironmental signature). Preliminary results of the different investigative strands will also be presented at the meeting.

Previous investigations of the JRIVG suggested that it accumulated in a marine setting with widely varying former sea levels. Proposed stratigraphical correlations assumed a relatively simple history of vertical movements. Thus, it was suggested that the oldest sequences were preserved close to sea level and younger ones at successively greater elevations. Unfortunately, published isotopic dating (by the K-Ar method) has not supported this simple history, and the period coincides with a known interval of glaciation, thus raising the possibility of eruptions being subglacial.

Eruptions of the unusually long-lived Mount Haddington volcano were widely spaced in time, overwhelmingly effusive, volumetrically large and formed multiple superimposed lava-fed deltas. From our fieldwork it is now known that each effusive phase is separated by glacial sedimentary rocks and moulded and striated unconformities, consistent with a glacial eruptive environment. In addition, the volcanic lithofacies architecture, particularly variations in passage zone elevations (the passage zone is a "fossil water level", the junction between "topset" and "foreset" beds), indicates that effusion typically commenced within an ice sheet that draped the island but ended prograding into the sea. The former ice sheets were wet-based and predominantly only a few hundred metres thick. A palaeogeography similar to today is suggested, comprising a volcano blanketed in ice and surrounded by sea. Conversely, at least two effusive periods coincided with substantially thicker ice sheets (> 600 m), which presumably expanded much further out onto the continental shelf than occurs at present.

Aerogeophysical survey over the drainage basin of the Rutford Ice Stream, West Antarctica

(poster p.)

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During the 2001-2002 field season a British Antarctic Survey Twin Otter aircraft equipped with ice sounding radar, gravity and magnetic sensors explored the onset region of the Rutford Ice Stream, West Antarctica. The onset region of an ice stream is the area where the ice flow regime changes from the slow flow associated with the inland ice sheet to the fast flow characteristic of ice streams. The new airborne survey is a component of a multi-disciplinary geophysical programme (TORUS: Targeting the Onset Region and Under-ice Systems) aiming at understanding what factors control the location and dynamics of the onset region of ice streams. Previous aerogeophysical observations collected over central West Antarctica suggest that subglacial geology may exert a significant influence on the onset of an active West Antarctic Ice stream (BELL et al. 1998). Specifically, onset regions there have been associated with sediment-filled rift basins (STUDINGER et al. 2001).

To assess subglacial geology over the drainage basin of the Rutford Ice Stream we present the first results of the recent TORUS aerogeophysical survey. A total of approximately 9,500 km of line data were collected at an average height of 1500 m along 15 lines, with 10 km spacing. The airborne ice sounding radar system achieved greater penetration of deep ice by using a 4 μs linear frequency modulated pulse in addition to a standard short 2 μs pulse. A further enhancement was achieved by coherent stacking. At a nominal aircraft speed of 60 m s^{-1} the spatial sampling interval was 25 m. The processed data were combined with previous data collected in 1997 and with BEDMAP data to produce new grids of 5 km resolution for the surface elevation and ice thickness. The bed elevation grid shows that the Rutford Ice Stream likely occupies a major tectonic feature. Much of the ice stream is constrained by a deep bedrock trough, bounded by the Ellsworth Mountains on its west flank and Fletcher Promontory to its east. The thickest ice measured was 3100 m. It occurs at the head of the Rutford Ice Stream, where the bed elevation is over 2200 m below sea level. The vertical relief of 7 km in a horizontal distance of less than 40 km is consistent with the existence of a major fault-bounded Ellsworth Mountains block.

Aerogravity measurements were acquired with a modified LaCoste and Romberg air/sea gravimeter. The aircraft acceleration was calculated from dual frequency, carrier phase measurements using geodetic receivers. Free-air gravity anomalies were calculated, and a low-pass filter was applied to the data. Cross-over analysis indicates the free-anomaly field is accurate to 3.7 mGals for wavelengths greater than 9 km. Aerogravity data collected to the north of the new survey area show that at least 5 km of crustal thinning occurs beneath the Evans Ice Stream, one of the two other major ice streams in the area (JONES et al. 2002). Models of the Bouguer gravity anomaly field computed from the new TORUS survey data will be used to test the hypothesis that the Rutford Ice Stream is also imposed upon an extensional structure. Total field aeromagnetic data were acquired using Cs-magnetometers. Standard processing was implemented using microlevelling in frequency domain (FERRACCIOLI et al. 1998). The resulting aeromagnetic anomaly map clearly images the marked contrast between the high-amplitude positive anomalies of the Precambrian Haag Nunataks microplate (MASLANYJ & STOREY 1990) and the quiet patterns of the Ellsworth Mountains block. Across the northern border of this Precambrian block, a sharp aeromagnetic gradient coincides with the footwall of the Evans Ice Stream rift, as inferred from aerogravity (JONES et al. 2002). The new aerogravity and aeromagnetic data are used to discuss possible relationships between the Rutford Ice Stream and the southern border of the Haag Nunataks block.

Bell R.E., Blankenship, D.D., Finn, C.A., Morse, D.L., Scambos, T.A., Brozena, J.M., Hodge, S.M. (1998): Nature 349: 58-62.
Ferraccioli F., Gambetta, M. & Bozzo, E. (1998): Geophys. Prospecting 46: 177-196.
Jones, P. C., Johnson, A.C., von Frese, R.R.B. & Corr. H. (2002): Tectonophys. 347: 25-41.
Maslanyj, M.P. & Storey, B.C. (1990): Tectonics 9: 1515-1532.
Studinger M., Bell, R.E., Blankenship, D.D., Finn, C.A., Arko, R.A., Morse, D.L., Joughin, I. (2001): GRL 28: 3493-3496.

Structural evolution of the Ford Ranges, Marie Byrd Land, from kinematic analysis of brittle minor structures (oral p.)

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Brittle faults and shear fractures pervade Ford granodiorite and Byrd Coast granite, the isotropic plutonic rocks that comprise ~70 % of the bedrock exposed in the Ford Ranges of Marie Byrd Land (MBL). The minor structures provide valuable geometrical and kinematic information in this region where glacier ice conceals major fault zones. They record Cretaceous continental extension at the eastern margin of the Ross Sea rift, with little indication of younger tectonism.

Data collected in 1998 and 1999 include attitudes of mafic dykes, faults, shear fractures and joints. Mafic dykes, 1-10 m thick, typically strike NNW, with steep dips. Brittle shear zones marked by striated shear surfaces, cataclasis or gouge exceeding 15 cm thickness, and/or measurable offset exceeding >2 m are classified as faults. Shear fractures are discrete slickenside surfaces restricted to a single plane with <3mm of gouge. In the FR, faults and shear fractures typically have moderate to moderately steep dips (45-75°), with down-dip to moderately oblique striae. Dominant strike directions are WNW, NW and NE. The first two trends coincide with E-W and NW-SE trends of ranges and bed topography. Kinematic criteria associated with fault striae show normal dip slip and normal oblique slip. NE-striking planes are near-vertical with shallow-plunging striae (<12° plunge) and sinistral kinematics, preferentially developed along zones in the eastern and central Ford Ranges. All structural attitudes were measured with respect to geographic north at scattered outcrops between 143° to 155°W (a range of 12° of longitude). To overcome the "longitudinal convergence problem" at high latitude and undertake regional synthesis for comparison to structural/geophysical data from other Antarctic regions, the data are converted to the coordinates of the Antarctic navigational grid (AGN) according to the modular conversion: AGN strike = MOD [(latitude position at study site + strike of structure with respect to true north), 360]. The formula is generally applicable as a conversion to the polar coordinate system. AGN data can be compared directly with aeromagnetic and other geophysical trends plotted in polar stereographic grid coordinates.

Mafic dykes range in age from 142.0 ±0.7 Ma to 96.15 ±2.08 Ma ($^{40}Ar/^{39}Ar$ analyses by New Mexico Geochronology Research Laboratory), are cut by brittle faults, and provide the earliest brittle structural record of regional strain. The mean dyke trend is N12W (AGN22E); a direction that corresponds with a dominant aeromagnetic lineation, suggesting structural control of magmatism. The dykes reflect tensile opening oriented along an azimuth of ~080-260, orthogonal to the dyke margins. The dyke ages overlap in time with isotopic ages determined for Byrd Coast granite (STOREY et al. 1998, SIDDOWAY et al., in review), identified by WEAVER et al. (1992) as an A-subtype emplaced in a continental rift environment. Thus, the dykes may reflect the opening direction during the initial phase of rifting in MBL, and form part of the regional system of 110-100 Ma dykes of coastal MBL (STOREY et al. 1999).

ESE-WNW-striking normal-sense structures are next-youngest. They cut mafic dikes but are in turn cut by NW-striking, normal- and normal-oblique-sense shears. Kinematic solutions (Marrett and ALLMENDINGER 1990) provide a record of ~NNE-SSW followed by NE-SW crustal stretching (LUYENDYK et al. in review). During the latter stage, NE-striking strike-slip transfer systems accommodated a component of the strain, separating domains of predominant normal faulting. Aeromagnetic fabric shows a strong correspondence with the NE-orientation of strike slip faults, suggesting juxtaposition of contrasting rock types across transcurrent boundaries. E-W and NW-SE orientations are also evident in the aeromagnetics. Thermochronology from the Ford Ranges indicates that faulting and crustal extension were completed by 67 Ma; thus, regional structural and geophysical trends were established during Cretaceous time and have not been significantly modified by younger events.

Luyendyk, B.P., Wilson, D. & Siddoway, C. (2003, in press): G^3.
Marrett, R.A. & Allmendinger, R.W. (1990): J. Struct. Geol. 12: 973-986.
Pankhurst, R., Weaver, S.D., Bradshaw, J.D., Storey, B. & Ireland, T. (1998): J. Geophys. Res. 103: 2529-2547.
Siddoway, C., Baldwin, S., Fitzgerald P., Fanning C.M. & Luyendyk B. (in review): Geology.
Storey, B. et al. (1999): J. Geol. Soc. London 156: 659-671.
Weaver, S. D. et al. (1992:: Trans. Royal Soc. Edinburgh 83: 281-290.

The deep-water East Antarctic continental margin, from 38-152°E: overview of a new integrated geophysical data set
(oral p.)

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In the Antarctic summers of 2000/01 and 2001/02, the Australian Government acquired a major new deep-water geophysical data set on the margin of East Antarctica from 38-152°E, covering almost one-third of Antarctica's continental margin. The data set comprises more than 20000 km of high-quality deep-seismic data, with coincident gravity, magnetic and bathymetry data. In addition, 99 refraction sonobuoys were successfully deployed along the seismic profiles, of which 69 gave velocities for the main crustal layer, and 19 gave Moho arrivals. A further 3500 km of high-speed seismic data recorded inboard of the deep-seismic lines generally only supply information on the shallow sedimentary section due to the small source size. The deep-seismic lines extend from the mid to lower continental slope out to oceanic crust at an average separation of 90 km along the margin and have an average length of about 320 km. As well as providing excellent definition of the sedimentary section, the data also show structure as deep as the base of the crust, particularly over the outermost part of the continental margin.

The data set covers two overlapping sectors of the East Antarctic margin: that from 38-98°E was formed by the separation of Greater India from Antarctica, commencing in the Valanginian, while that from 90-152°E was formed during the separation of Australia and Antarctica, commencing in the early Campanian (83 Ma). In the overlapping central sector (90-98°E) structuring is particularly complex due to the proximity of the India-Antarctica-Australia triple junction. The western and eastern spreading histories are very different in age, azimuth and spreading rates, and these differences are strongly reflected both in the structures of the deep-water continental margin and in the character and structuring of the adjacent oceanic crust of the Enderby and Australia-Antarctic Basins.

The western sector, from Enderby Land to Princess Elizabeth Land, is further divided into two distinct areas lying offshore from Enderby Land and offshore from Prydz Bay. The gross pre-breakup structure in both areas is probably similar, with a sharp continent-ocean boundary (COB), landward of which is a continent-ocean transition (COT) zone that appears to be heavily overprinted by volcanics. These interpreted volcanics obscure details of structuring within the COT and, further landward, within the likely zone of thinned continental crust. The volcanics probably result from seafloor spreading in the Enderby Basin in the Early Cretaceous and, in the east, from the Kerguelen hotspot which was active from the mid-Cretaceous. The main difference between the two areas is in the accumulation of post-rift sediments, which are only 1-3 km thick off Enderby Land, but up to 7 km thick north of Prydz Bay where they are largely derived from the Lambert Glacier, Antarctica's largest outlet ice stream.

The central overlap sector, offshore from Princess Elizabeth, Wilhelm II and Queen Mary Lands, is largely dominated by the complex fragments of ocean crust that formed during both episodes of continental separation. In addition, this sector includes Bruce Rise, one of Antarctica's few marginal plateaus and a conjugate feature to the Naturaliste Plateau off SW Australia.

Structures in the eastern sector, from Queen Mary to George V Lands, strongly reflect the non-volcanic nature of the extension between Antarctica and Australia and the slow (mechanical) seafloor spreading that characterised continental separation from the early Campanian until the onset of fast spreading in the Eocene. In the east, the margin is influenced by the strong strike-slip component of motion between Tasmania, off southeast Australia, and George V - Oates Lands.

The characteristics of the eastern sector include: 1) the existence of a broad (50-100 km wide) continent-ocean transition (COT) zone that underlies the inner edge of the deep ocean basin over an along-strike distance of about 1000 km; 2) marked thinning of the continental crust within and landward of the COT, due to a combination of mainly brittle deformation the middle crust landward, and more plastic deformation of the lower crust oceanward; and 3) thick pre-, syn- and post-rift sediments that are at least 6 km thick and concentrated in the COT zone. The pre-breakup and crustal sections are similar to those beneath the conjugate southern Australian margin, while the large thickness of post-breakup sediments off Antarctica reflects the volume of sediments that have been shed from the Antarctic landmass.

Cambrian rift-related magmatism in the Ellsworth and Transantarctic Mountains: tectonic implications for the Paleo-Pacific margin of Gondwana

(oral p.)

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The tectonic setting of the paleo-Pacific margin of the East Antarctic craton was dominated during Cambrian times by subduction with formation of a wide range of calc alkaline volcanic and plutonic rocks. However, Middle Cambrian volcanic rocks in the Ellsworth and Pensacola mountains and in the central part of the Transantarctic Mountains are indicative of a rift environment that may either be intracontinental or related to rifting in a suprasubduction zone setting.

Middle Cambrian sedimentary rocks in the Ellsworth Mountains (CURTIS et al. 1999) host thick mafic volcanic and sub volcanic rocks with subordinate suites of evolved rock types. The mafic suite is geochemically varied, ranging from MORB-like to shoshonitic and lamprophyric compositions. The mafic rocks are interpreted as representing melts derived from more than one mantle source emplaced in a continental rift environment. The MORB-like basalts were emplaced near the rift axis, and melts from lithospheric mantle emplaced on the rift shoulder. Similar rocks are present within the Pensacola Mountains and have been related to both Cambrian (MILLAR & STOREY 1995) and Neoproterozoic (STOREY et al. 1992) rifting in a continental environment.

In contrast to the Ellsworth Mountains, Cambrian volcanic rocks in the Queen Maud Mountains in the central part of the Transantarctic Mountains are dominated by massive dacite lava flows, and a bimodal assemblage of basalts and rhyolites (WAREHAM et al. 2001). The dacites are interpreted as partial melts of continental crust. The basalts are transitional between normal midocean ridge basalts and enriched MORB. Similar to the Ellsworth and Pensacola mountains, the most likely tectonic setting was in an extensional rift environment although in this case it may have been behind an active volcanic arc.

This presentation will review Middle Cambrian magmatism in the Ellsworth, Pensacola and central part of the Transantarctic Mountains and relate it to a tectonic model for the evolution of the Paleo-Pacific margin of Gondwana during Cambrian times.

Curtis, M.L., Leat, P.T., Riley, T.R., Storey, B.C., Millar, I.L. & Randall, D.E. (1999): Tectonophysics 304: 275-299.
Millar, I.L. & Storey, B.C. (1995): J. Geol. Soc. London 152: 417-420.
Storey, B.C., Alabaster, T., Macdonald, D.I.M., Pankhurst, R.J. & Dalziel, I.W.D. (1992): Tectonics 11: 1392-1405.
Wareham, C.D., Stump, E., Storey, B.C. Millar, I.L. & Riley, T.R. (2001): Geol. Soc. Amer. Bull. 113: 360-372.

New data related to Holocene landform development and climatic change in James Ross Island, Antarctic Peninsula

(oral p.)

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Survey of some relict and active landforms at the Lachman and Rink crags surroundings contributes to better approach the Holocene morphoclimatical evolution of this currently deglaciated NW sector of James Ross Island.

Six Holocene mainly land grounded glacier advances were delimited there: the oldest occurred 6700 - 6400 ^{14}C yr BP; the second 4700 - 4200 ^{14}C yr BP; the third shortly after 3900 ^{14}C yr BP; the fourth remains undated; and finally there are two small advances, probably associated to the early and late Little Ice Age episodes. The last two glacier advances are in some cases followed by ice cored rock glacier formation.

During the last decades the significant climatic warming registered in the NE region of Antarctic Peninsula produces some changes on periglacial and glacial related landforms in the surveyed areas of James Ross Island. On Rink Crags an increase of water supply, provided by a retreating small ice cap, increases gelifluction and enables the development of stone banked terraces. The same climatic amelioration stops protalus rampart formation, favoring protalus lobe development around Cerro Triple. During the last 10 years many conical depressions spread out on the spatulate surface of Lachman II ice cored rock glacier, menacing to collapse this feature.

Geophysical models for the tectonic framework of the Lake Vostok region, East Antarctica (poster p.)

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Aerogeophysical and seismological data were used from the first modern geophysical survey in the interior of East Antarctica to develop a conceptual tectonic model for the development of the Lake Vostok region. The model is constrained using three independent data sets: magnetic, seismologic, and gravimetric. A distinct change in the aeromagnetic anomaly character across Lake Vostok defines a crustal boundary. Depth to magnetic basement estimates image a 400-km-wide and more than 10-km-deep sedimentary basin west of the lake. Analysis of teleseismic earthquakes suggests a relatively thin crust beneath Lake Vostok consistent with predictions from kinematic and flexural gravity modeling. Magnetic, gravity, and subglacial topography data reveal a tectonic boundary bisecting East Antarctica. Based on our kinematic and flexural gravity modeling, this tectonic boundary appears to be the result of thrust sheet emplacement onto an earlier passive continental margin. No data presently exists to date directly either the timing of passive margin formation or the subsequent shortening phase. The preserved thrust sheet thickness is related to the thickness of the passive margin crust. Because a significant amount of time is required to erode the thrust sheet topography, we suggest that these tectonic events are Proterozoic in age. Minor normal reactivation of the thrust sheet offers a simple mechanism to explain the formation of the Lake Vostok Basin. A line of five earthquakes along this tectonic boundary indicates that active tectonics may continue today. The existence of a major crustal boundary in the Antarctic interior provides significant new constraints on the Proterozoic architecture of the East Antarctic craton.

Ice flow, landscape setting, and geological framework of subglacial Lake Vostok, East Antarctica (poster p.)

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Lake Vostok, located beneath more than 4 km of ice in the middle of East Antarctica, is a unique subglacial habitat and may contain microorganisms with distinct adaptions to such an extreme environment. Melting and freezing at the base of the ice sheet, which slowly flows across the lake, controls the flux of water, biota and sediment particles through the lake. The influx of thermal energy, however, is limited to contributions from below. Thus the geologic origin of Lake Vostok is a critical boundary condition for the subglacial ecosystem. We present the first comprehensive maps of ice

surface, ice thickness and subglacial topography around Lake Vostok. The ice flow across the lake and the landscape setting are closely linked to the geologic origin of Lake Vostok. Our data show that Lake Vostok is located along a major geologic boundary. Magnetic and gravity data are distinct east and west of the lake, as is the roughness of the subglacial topography. The physiographic setting of the lake has important consequences for the ice flow and thus the melting and freezing pattern and the lake's circulation. Lake Vostok is a tectonically controlled subglacial lake. The tectonic processes provided the space for a unique habitat and recent minor tectonic activity could have the potential to introduce small, but significant amounts of thermal energy into the lake.

Sub-ice geology inland of the Transantarctic Mountains in light of new aerogeophysical data

(oral p.)

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New gravity, magnetic and subglacial topography maps have been compiled from aerogeophysical data across the Transantarctic Mountains between McMurdo and Dome C. The gravity, topography and magnetic data outline the boundaries of several geologic and tectonic segments. The coherent pattern in gravity, magnetic data and mesa topography suggests a subglacial extent of the Transantarctic Mountains 400 to 500 km inland of the last rock outcrops. Gravity modeling and Werner deconvolution of magnetic data rule out the possibility of several kilometers of sediment infill in the Wilkes Subglacial Basin. The absence of a flexural basin together with crustal thickening beneath the Transantarctic Mountains make the possibility of flexurally uplifted crust as shown in previous models unlikely. A flexurally uplifted crust would have the opposite gravity effect as observed in our data. A coinciding structure in gravity models and magnetic source depth estimates near the eastern shoulder of the Adventure Subglacial Trench has been interpreted as a 5-km-thick and more than 100-km-wide sedimentary infill. The crustal structure, observed gravity anomaly and the offset between the topographic trench and the sediment infill make a simple rift scenario for the Adventure Subglacial Trench unlikely. The crustal structure is more consistent with a compressional scenario as observed at the edge of the East Antarctic Craton in North Victoria Land.

Geological investigation of the Byrd Glacier discontinuity: progress report and working hypothesis

(oral p.)

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The Byrd Glacier discontinuity is a major tectonic boundary crossing the Ross orogen, with crystalline rocks to the north and primarily sedimentary rocks to the south. Our field and laboratory study of rocks to the south of Byrd Glacier include the following observations and interpretations: Byrd Group is comprised of Lower Cambrian Shackleton Limestone, Starshot Formation, and Douglas Conglomerate. We have established a stratigraphy for the widespread Shackleton Limestone in excess of 2000 m, including four informal members. Near the top of the formation is an ash bed, which has been U-Pb zircon dated at 512 ±5 Ma, consistent with Botomian fossils reported elsewhere. Shackleton Limestone is conformably overlain by sandstones and shales of the Starshot Formation. Pillow lavas mark this carbonate to clastic transition. Douglas Conglomerate is both conformable with Starshot Formation and unconformably overlies Shackleton Limestone, indicating that deformation within the Byrd basin had begun before final deposition of the Byrd Group. In the northeastern corner of the area around Mt. Madison, we have mapped lower-amphibolite-grade Selborne Group, and subdivided it into two formations, Madison Marble and Contortion Schist. The boundary between the two formations is marked by a thick sequence of metabasalt. We conclude that Byrd Group and Selborne Group are correlative. The recognition that Selborne Group is related to the sedimentary sequences south of Byrd Glacier, and finds no equivalents to the north, demonstrates that the Byrd Glacier discontinuity formed the northern limit of the Byrd basin during the Early Cambrian. Shackleton Limestone is folded around ENE axes parallel to the trend of Byrd Glacier, increasing in ductility and fold tightness toward the glacier. Isolated, steeply plunging, asymmetric folds indicate a component of right-lateral deformation within the Shackleton Limestone. A set of felsic dikes orthogonally crosscuts the main Shackleton folds. One of these was observed to be offset also with a right-lateral sense. U-Pb zircon dating of one of the dikes gave an age of 493 ±5 Ma. In the Selborne Group, bedding (S0) and cleavage (S1) (in many places indistinguishable) strike with the same ENE orientation as the primary folding in Shackleton Limestone. F1 mesofolds plunge throughout a steep ENE plane indicative of sheath folding. At places a crenulation cleavage (S2) overprints the S1 foliation. Metamorphic studies indicate that S1 formed during the metamorphic peak under lower amphibolite/low P conditions, and S2 developed under greenschist conditions. Madison Marble is intruded by a pluton of post-tectonic, biotite granite, and a swarm of muscovite-bearing granitic dikes. U-Pb zircon dating of the pluton provides a crystallization age of 492 ±2 Ma. Cooling of the Selborne Group is recorded by an Ar-Ar date of 485 ±3 Ma on amphibole, and a tight cluster of muscovite and biotite dates in the range 460 ±3 Ma. These data indicate that the main deformation had ceased by 492 Ma and that plutonism and cooling of the area occurred during the Early Ordovician. Dike emplacement in the Shackleton Limestone was essentially synchronous with plutonism in the Selborne Group, with indications of some subsequent, right-lateral movement parallel to Byrd Glacier.

In view of known plutonism in southern Victoria Land as old as 550 Ma, and intrusion of granite in the Darwin Glacier area at ~515 Ma, synchronous with deposition of upper Shackleton Limestone, our working hypothesis is that north-directed subduction led to the collision of a terrane (Beardmore microcontinent) carrying Shackleton Limestone during the Botomian to Middle Cambrian, with the suture located beneath Byrd Glacier.

Late Cretaceous-Cenozoic Antarctic deformation predictions from South Pacific and global plate reconstructions (oral p.)

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Data from oceans around Antarctica constrain its deformation history:

1. Direct identification of seafloor, with well understood creation/deformation age and geometry, that is continuous with continental deformation e.g. Adare Trough.
2. Reconstruction of conjugate features that have had different post-creation deformation histories. Systematic misfit constrains the deformation. Reconstructions of the New Zealand and Australian margins are presented that show limited post 80 Ma deformation in the eastern Ross Sea.
3. South Pacific plate-motion closure. Sufficient data exist from Tasman Sea, Indian Ocean, and Pacific seafloor to make predictions regarding Antarctic deformation (ie. predicted from cumulative misfit in the model).
4. Global models of plate motion and hotspot migration. Although total Late Cretaceous-Cenozoic Antarctic plate motion is relatively small (300-500 km), the finite rotation parameters that best describe it are modest rotations about a local axis. When incorporated into global or South Pacific plate-motion circuits, this results in very significant predicted motions at mid-low latitudes. When combined with global convection models it is shown that Antarctic deformation provides the most plausible explanation for most misfit in Late Cretaceous-early Cenozoic global plate-motion models.

Metamorphic evolution of the Selborne Group, and implications for the Byrd Glacier discontinuity, central Transantarctic Mountains, Antarctica (poster p.)

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A major part of our field work in the Byrd Glacier region in summer season 2000/2001 focused on the Selborne Marble (SKINNER 1965) in the Mt. Madison area, a unique locality of amphibolite-grade metamorphic rocks at the NE tip of an extensive very-low grade domain including the Byrd Goup. Because of its varied lithostratigraphic content we propose to elevate the Selborne Marble to group status, the Selborne Group, comprised of two informal formations, Madison Marble (muscovite ± dolomite marble) exposed throughout the eastern half of the area and transitional to the Contortion Schist (biotite – muscovite ±quartz-calcite schist) at the western half. The Selborne Group lithological assemblage also contains variably deformed metabasalts – forming thick lenses aligned parallel to an apparently conformable contact between Selborne Marble and Contortion Schist - and lenses of metaconglomerate (including clasts of metalimestones, metacherts and folded phyllites), which are hosted in Contortion Schist. In the Mt Madison area and NE slopes, the Selborne Group is intruded by a swarm of muscovite-bearing granitic dykes and by a previously unknown Km-size pluton of biotite granite. A variably developed contact metamorphism related to these intrusions is documented by widespread late growth of biotite and/or muscovite in the schists and of scapolite and/or vesuvianite in the marble. Madison Marble has at places a prominent compositional banding with calcite-dominated white layers and calcite-dolomite gray layers. Application of the calcite-dolomite geothermometer

(Anovitz and Essene, 1987) to several samples from the summit area of Mt Madison gives T values in the range between 500-550°, indicating T conditions at the greenschist/amphibolite facies boundary. The two white and gray varieties are closely comparable to the Shackleton Limestone, which gave maximum calcite-dolomite T of c 425 °C, using samples taken from the area W of Couzens Bay (i.e. the nearest outcrops to the Selborne Group), which provide evidence of low-grade conditions at the metamorphic peak, consistent with their association with biotite-zone metapelites and albite-actinolite-epidote metabasalts. In comparison with Byrd Group equivalents, the metabasalts in the Selborne Group are much more deformed and usually show a marked schistosity defined by Mg-hornblende carrying actinolite cores, which warps around albite porphyroclasts with oligoclase corona. However, low-strain volumes also occur and they retain abundant amygdules and structures suggestive of pillows. The overall mineralogical, microstructural, and thermobarometric data indicate a polyphase metamorphic evolution spanning an early low-grade stage, documented by epidote-albite-actinolite paragenesis, though peak conditions under low pressure amphibolite facies (hornblende-plagioclase (oligoclase) assemblages), to a minor retrogression (chlorite and actinolite rims around hornblende). Microstructural study of interlayered schists indicates that regional metamorphism was accompanied by two cleavage-forming episodes (S1, S2), with S1 fabrics formed during metamorphic peak at lower amphibolite/low P conditions, and S2 crenulation cleavages developed under greenschist facies conditions.

The lithostratigraphy and metamorphic evolution of the Selborne Group sharply contrasts with the tectonometamorphic and lithological setting documented N of the Byrd Glacier, where garnet-bearing migmatitic gneisses, and minor quartzitic paragneisses and Ca-silicate rocks (Horney Formation auct.) includes an early high-grade stage (generation of garnet-bearing leucosomes at minimum 650 °C), followed by minor retrogression under lower grade conditions. This evidence and the close lithostratigraphic matching between Selborne Group and Byrd Group have important implications for the Byrd Glacier discontinuity which can be intrepreted as a first-order crustal tectonic boundary during the geological evolution of the paleo-Pacific margin of Gondwanaland in Antarctica.

Anovitz, L.M. & Essene, E.J. (1987): J. Petrol. 28: 389-414.
Skinner, D.N.B. (1965): N. Zealand J. Geol. Geophys. 8: 292-303.

Magnetic petrology of the Ross Orogen in Oates Land, East Antarctica
(poster p.)

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A pilot study on the magnetic petrology of basement rock units in the Ross Orogen in Oates Land (Antarctica) was carried out as part of an ongoing petromagnetic project developed in the frame of the 1999/2000 GANOVEX VIII - ItaliAntartide BACKTAM Expedition.

Susceptibilities of migmatitic gneisses, the dominant lithology, are generally low (ilmenite ±graphite-bearing rocks), with the exception of two occurrences (magnetite+/-green spinel-bearing rocks) at Harald Bay and Burnside Ridge. Similar low values are typical for most Granite Harbour Intrusives, except for the variably mylonitic Exiles Ntks granite and the Archangel Ntks. gabbros and pyroxenites, which are among the most magnetic rock types in the area. Metamorphosed mafic and ultramafic rocks, occurring in outcrop as volumetrically minor bodies (lenses of dm to 10 m size) are variably, but generally about one order of magnitude more highly magnetic than country gneisses.

Petrological investigations on representative samples indicate that nearly pure or low-Ti magnetite is the only ferrimagnetic phase, irrespective of lithologic type, and magnetic susceptibility values are always positively correlated to the modal amount of magnetite. The rare occurrence of magnetite in the opaque mineralogy of migmatitic gneisses in Oates Land indicate that appropriate chemical and fO_2 conditions were only locally attained in the region, and microstructural evidence indicate that magnetite possibly formed at different metamorphic stages during the post–peak decompressional path at high T and/or the retrograde path.

In variably magnetic ultramafic and mafic lenses magnetite (almost pure to low-Ti) typically occurs as very fine grained opaque inclusions in secondary hornblende and/or chlorite. This evidence indicates that a relevant proportion of magnetite is of secondary origin and related to amphibolite grade or lower grade metamorphic processes. Moreover in mafic rocks, investigated samples suggest a possible relation between the degree of structural reworking (mylonitization) and increase in magnetic susceptibility, reflecting the formation of nearly pure or low-Ti magnetite as a late phase replacing ilmenite and associated to both biotite, in places chloritized, and hornblende.

Titanomagnetite and exolution features are documented in the gabbros from Archangel Ntks. in which the decrease of magnetite content is inversely correlated to the extent of sub-solidus late-magmatic re-equilibration (replacement of pyroxene by hornblende). Similar microstructural evidence of re-equilibration during cooling was also found in the high magnetic magnetite-bearing mylonitic hornblende-biotite granites from Exiles Ntks.

All high magnetic rock units represent potential petrologic sources of regional crustal magnetic anomalies in the Oates Land region as revealed by aeromagnetic surveys. Particularly the Exiles Ntks magnetite-bearing granites are clearly marked by aeromagnetic anomalies forming a small part of the "Matusevich Anomaly", a prominent magnetic anomaly, co-linear with the Matusevitch Glacier. The gabbros as exposed in the southestermost Archangel Nks can be correlated with a distinct high-amplitude anomaly which occurs at this location and delineates the extent of the gabbroic intrusion itself. Significant volumes of the metamorphosed mafic/ultramafic rocks, may account for the high-frequency anomaly chains flanking the main part of the Matusevich Anomaly in the Lazarev Mts..

The Mertz Shear Zone, George V Land: implications for Australia-Antarctica correlations and East Antarctic Craton-Ross Orogen relationships (poster p.)

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Adelie Land and westernmost George V Land are key regions for precise correlations of Paleoproterozoic terrains across the Southern Ocean between Australia and Antarctica (OLIVER & FANNING 1997). Similarly relevant geological information is stored in the so far comparatively less investigated coastal outcrops and nunataks of central/eastern George V Land, east of Commonwealth Bay and in the region between Mertz and Ninnis Glaciers. These outcrops were visited by the authors during the second leg of the GANOVEX VIII-BACKTAM 1999/2000 expedition (KLEINSCHMIDT & TALARICO 2000, ROLAND et al. 2000).

A major result of our field investigations in the Mertz Glacier area (Correll Ntk., Aurora Pk., Mt. Murchison) was the finding of a prominent mylonitic zone (the "Mertz Shear Zone", MSZ), with steeply dipping c NNW-SSE oriented foliation planes and shear sense indicators indicating dextral sense of ductile shear. Enderbitic orthogneiss, often retrograded and transformed into hornblende-biotite augen gneisses, and minor sillimanite-garnet felsic granulites, mafic granulites and amphibolites are the main lithologies of the MSZ. The MSZ comprises a series of progressive and overprinting shear structures, which developed during changed metamorphic conditions (from early low P granulite grade to lower amphibolite and greenschist facies grade) but all with similar kinematics (dextral shearing).

The MSZ is located within the mainly ice-covered boundary zone between two domains with different lithological assemblages, age and metamorphic evolution. Preliminary petrological results in the two domains suggest a contrasting PT evolution across the MSZ: a low-P high-T metamorphic event is documented in the area between Mertz and Ninnis Glaciers (eastern domain), which include Ross-age (c 500 Ma) granitoids (FANNING et al. 2002); in contrast, a decompressional trajectory from high-P granulite-grade conditions is recorded in the rock units along the western margin of the Mertz Glacier (western domain), where a complex Late Archean to Paleaeproteozoic evolution is documented, apparently without evidence of Ross-orogenic tectonic or thermal reactivation (FANNING et al. 2002).

The "western domain" is composite, including the low-grade Cape Hunter phyllite, the amphibolite facies Cape Denison granitic orthogneiss and amphibolites, and mylonitic partially retrogressed felsic and mafic granulites from Madigan Ntk. and the Watt Bay area (Garnet Point, Pigeon Rocks). Watt Bay paragneiss/metabasite unit records a polyphase metamorphic evolution, including at least three stages, from high-P granulite grade conditions, through low-P upper amphibolite/granulite grade, to low-T amphibolite and greenschist facies conditions.

The "eastern domain" (including the coastal exposures between Mertz and Ninnis glaciers) mainly consists of different varieties of biotite ±muscovite-cordierite granitoids, in places slightly foliated. Metamorphic rocks are here represented by 1) up to several metre thick rafts of upper amphibolite facies paragneiss (Penguin Point area) and 2) distinctly lower grade, contact metamorphosed schists occuring as small (metre to decimetre in size) xenoliths (eastern Ainsworth Bay).

Comparison with the coastal region of southern Australia (Eyre Peninsula) indicates that the ductile MSZ (polyphase evolution and structural position) closely matches the main features of the pre-1610 Ma Kalinjala Mylonite Zone within the Gawler Craton (FOSTER & EHLERS 1998), a major dextral tectonic and lithological boundary up to 300 km in length and up to 4 km in width, separating Archaean and Early Proterozoic metasediments to the west, from Middle Proterozoic orthogneisses and granites (Lincoln Complex, 1850-1750 Ma) to the east. The Antarctica/Australia bridging by means of the Mertz and Kalinjala Shear Zones would fit perfectly with the correlation given by OLIVER & FANNING (1997).

In conjuction with ongoing radiometric investigations (^{40}Ar-^{39}Ar) on MSZ mylonites and closer petrological comparisons with the Gawler Craton, the geological and petrological dataset of George V Land will provide the essential background to investigate the significance of the MSZ in the context of both Gondwana reconstructions and intra-Antarctic geological setting, particularly the East Antarctic Craton internal structural setting and the East Antarctic Craton / Ross Orogen tectonic relationships.

Fanning, C.M., Menot, R.P., Pecaut, J.J. & Pelletier, A. (2002): Abstracts 16th AGC, Adelaide: 67, 224.
Foster, D.A. & Ehlers, K. (1998): J. Geophys. Res. 103 (B5): 10177-10193.
Kleinschmidt, G. & Talarico, F. (2000): Terra Antartica Rep. 5: 109-115.
Oliver R.L. and Fanning C.M., 1997. Terra Antartica Publications: 163-172
Roland, N.W., Henjes-Kunst, F., Kleinschmidt, G. & Talarico, F. (2000): Terra Antartica Rep. 5: 57-65.

Seismic study of the northwestern boundary of the Scotia Plate on the Argentinean continental margin

(poster p.)

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In the central northern side of the Fueguian Andes, the structures of the external thrust front propagate through to the Magallanes thin-skinned foreland fold-and-thrust belt. In onshore areas, the main structures consist of a system of N-verging, ESE-WNW-trending, asymmetric folds-and-thrusts, originated by a mostly N-S Late Cretaceous to Tertiary shortening. Within the surveyed area the tectono-stratigraphic sequence is dominated by marine sequences of the Rocas Verdes marginal basin (Yaghan Formation) and minor outcrops of its volcaniclastic substrata that constitute an imbricate wedge thinning northwards. The overlaying syntectonic sedimentary wedge consists of the siliciclastic succession of the Magallanes foreland basin. The Magallanes-Fagnano Fault System (MFS), interpreted as the result of shear stresses produced along the transcurrent South America-Scotia plate boundary, is a E-W left-lateral strike-slip fault with an extensional component that overprints the contractional structures and is responsible for the main depression of the Lago Fagnano.

About 1200 km of multichannel seismic reflection profiles were acquired off the Atlantic coast of the Tierra del Fuego Island. The profiles cut across the South America-Scotia plate boundary, a transform margin which traverses in an E-W direction the Island. In the area located to the north of Isla de los Estados, the N-S trending seismic lines show a complex superposition of different tectonic structures, with extensional, compressional and transtensional features. The profiles shows the seismic geometry of the deep duplex with buried leading edge is geometrically similar to the structures exposed in the western part of the Island (ALVAREZ MARRÓN et al. 1993, KLEPEIS & AUSTIN 1997). The model geometry of passive roof thrusts and back-thrust that develop the triangle zone north of the Lago Fagnano area is well constrained with the geological field data and well marked by the shear zones seismic reflectors. The geometry of the MFS is reveled by the seismic images in the Atlantic off-shore as well as in the Magallanes Strait (LODOLO et al. 2002a,b) where half-graben basins can be associated with the same deformation event. The near parallelism among the younger (transtensive) and older (contractive) lineaments, suggests that the development of the transtensional structures may have reactivated pre-existing weakened zones formed by the shortening. On the basis of acoustic fabrics and seismic discontinuities four main units have been recognized; from bottom to top they are: the acoustic basement (Seismic Unit 1), which is overlain by a unit (Seismic Unit 2) which displays a tabular geometry and some reflector packages of high amplitude; this unit might be related to the volcanic and volcaniclastic sequences of Tobífera/Lemaire Fms. The Seismic Unit 3 displays an irregular shape and internal reflector configurations of moderate amplitude and continuity and low- to moderate frequency; the onshore Yaghán/Beauvoir Fms could be the surface equivalent of this unit. The uppermost Seismic Unit (4), located between the ocean floor and the 0.5 sec twt, displays a fairly uniform thickness, it is clearly distinguished from the underlying unit by the low frequency of reflectors with low- to moderate amplitude and continuity. The Unit 4 may be correlated with the Tertiary sediments of the Magallanes foreland basin which were involved in the fold and thrust belt.

Alvarez-Marrón, J., McClay, K.R., Harambour, S., Rojas, L. & Skarmeta, J. (1993): Bull. Amer. Ass. Petrol. Geol. 11: 1904-1921.
Klepeis, K.A. & Austin, J.A. (1997): Tectonics 16: 755-776.
Lodolo, E., Menichetti, M., Tassone, A., Geletti, R., Sterzai, P., Lippai, H. & Hormaechea, J.-L. (2002a): EOS Transactions 83(1): 1-6.
Lodolo E., Menichetti, M., Tassone, A. Sterzai, P. (2002b): Europ. Geophys. Soc. Stephan Mueller Spec. Pub. Ser. 2: 1-16.

Active margins of Antarctica and Gondwana: Evidence for the existence of the Pacific convection cell since the Cambrian

(oral p.)

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The active Gondwana margin comprises several orogenic belts which can provide evidence for the development of the pre-Jurassic Proto-Pacific. Like the present Andes, all these orogens are of the accretionary type formed by subduction at an active continental margin. The accretionary mechanism is distinct from the collisional orogenesis with its accompanying closure of the related ocean.

Suture zones are preserved in both types of orogens, in the collisional orogens between the two colliding continental plates, in the accretionary orogens between the continental and the oceanic plate. These zones usually contain good evidence for the pre-orogenic plate setting.

The Early Paleozoic Ross Orogen, half as long as the present Andes, is well exposed in the Transantarctic Mountains. There is ample evidence for its active margin setting, i.e.subduction-related plutonism, inboard/outboard asymmetry, high pressure metamorphism, ophiolites, oceanic crustal slivers and accreted terranes. The main common feature of the orogen is its magmatic arc, comprising large calc-alkaline granitoid bodies which were formed around 500 Ma ago.

The continent/ocean suture has been identified during joint German-Italian field investigations in North Victoria Land (TESSENSOHN & RICCI 2003). The suture which separates the inboard granitic arc from two outboard sedimentary terranes is characterized by the occurrence of a narrow belt of medium to high pressure metamorphic rocks, lenses of ultramafic rocks in the form of cumulates, layered gabbros and eclogites and a system of outward-directed thrusts. The occurrence of arc granites directly at the suture suggests that part of the arc has been tectonically eroded. There is no evidence for a continent/continent collision and therefore the accretionary setting is well preserved.

The Ross Orogen has its counterparts in Australia (Lachland Fold Belt) with a similar continental margin setting (GRAY 1997) and South America (Sierras Pampeanas, PANKHURST & RAPELA 1998). Later orogens developed in different segments along the active Gondwana margin include the Devonian Tasman Orogen of Tasmania, the Carboniferous New England Orogen of Australia, the Permo-Triassic Gondwanide Orogen of Antarctica, South Africa and South America, a not too well known Jurassic volcanic belt in Antarctica and South America, and, finally, the Andean Orogen of South America and Antarctica. As all these are accreted orogens, they indicate an orogenic cyclicity different from the Wilson cycle. Subduction obviously stopped after arc formation and accretionary orogeny and was later episodically renewed in different segments of the continental margin. All this indicates the continuous existence of a long living oceanic cell from the Cambrian to the present.

Gray, D.R. (1997): In: Orogeny Through Time, Geol. Soc. Spec. Publ. 121: 149-177.
Pankhurst, R.J. & Rapela, C.W. (eds.) (1998): Geol. Soc. Spec. Publ. 142: 1-383.
Tessensohn, F. & Ricci, C.A. (eds.) (2003 in press): Geol. Jb. B91.

Landsat thematic mapper satellite image mapping in the Transantarctic Range from the Nimrod Glacier to northern Victoria Land at the US Antarctic Resource Center
(poster p.)

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Satellite image maps at the 1: 250000 to 1: 25000 scales are being processed for areas of the Transantarctic Range to provide a mapping base to support scientific field activities in the predominantly ice and snow-free areas of that part of Antarctica. The digital processing to produce these image maps has required developing and using unique types of ground control points, and correcting digital elevation models. The Landsat thematic mapper data, which provide near- and middle-infrared information necessary for geologic discrimination, were enhanced by being merged with SPOT high resolution visible panchromatic data to generate 1: 25000 scale image maps and with Landsat thematic mapper panchromatic band to generate 1: 50000 and 1: 100000 scales image maps. This merged data sets have become a satisfactory compilation base, with their 5 or 7.5 meter cells, for a geographic information system.

The scarcity of available ground control points in the Antarctic environment and their difficult location identification have been supplemented by the collection of coordinates for clearly identifiable topographic or geologic features. The high-quality ground control points and the use of satellite platform modeling make it possible to correct and shift the contour data from 1: 50000 scale and 1: 250000 scale topographic maps and thus use more accurate digital elevation models during terrain and geometric corrections of the satellite data sets.

The south Ross Sea region, the Darwin Mountains and the Churchill Mountains areas are almost completed and northwards with the Prince Albert Mountains region will be processed in 2004. Each identified regional area corresponds to one digital data base set and one 1: 250000 scale image map and is subdivided in four or six 1: 100000 scale quadrangles. The 1:250000 scale quadrangles and some of the most important 1: 100000 quadrangles are also offset printed with graticules, full colar information and toponyms and so are some of the 1: 25000 or 1: 50000 scale quadrangles of Ross Island and the Dry Valleys area; all other quadrangles are only available digitally and can be "plotted on demand".

Seismic evidences of gas hydrate in the South Shetland margin, Antarctica
(poster p.)

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The regional distribution of bottom simulating reflectors (BSRs) generated by gas hydrates and free gas trapped below the hydrate stability zone provides an important clue to their origin, which is always in some way related to the geological setting of the area of occurrence. In order to improve the interpretation of the genesis of these hydrocarbon gas accumulations, a question must be asked on which degree of accuracy the spatial distribution of gas in either phase and its volumetric abundance have to be known. Previous studies in the South Shetland margin (Antarctica) indicate that a free gas zone is present below the BSR with variable thickness and a variable velocity (TINIVELLA et al. 2002). Moreover, there is a strong correlation between the free gas content in the pore space and the strength of the BSR.

A strong BSR was identified on multi-channel seismic reflection profiles acquired during the austral summers 1989/1990 and 1996/1997 in the investigated area. We show the results, obtained by using two methods, in selected parts of the available seismic lines, with the purpose to enhance the seismic images of the BSR and the base of the free gas reflector (BGR) and to estimate the quantity of gas present in the sediments. We used two approaches to determine the velocity and the depth imaging of the top and bottom of the free gas zone: a tomographic inversion and an iterative procedure. The iterative procedure is used to better constrain the free gas velocity layer when the pre-stack data have low signal to noise ratio.

In the tomographic procedure, we identified the acoustic discontinuities in the pre-stack domain and determined the relative travel time for various source-receiver positions. The velocity model is obtained by the inversion of the picking.

In the second procedure, the picking of the main reflectors was made in the post-stack data. First, we obtained the stack section after an accurate stacking velocity analysis, a dip-move out correction and a post-stack migration. Then, the pre-stack depth migration was applied to reconstruct the velocity field and, in this case, the input data was corrected only by spherical divergence, absorption compensation, and a row filter.

We used the common image gather (CIG) analysis, to determine the velocity model of the structures. The analysis was performed along selected interpreted reflector to reconstruct the velocity field above and below the free gas zone. In fact, the standard inversion needs the picking of the pre-stack data of the reflectors, that, in the case of the BGR, is no continuous and evident along the entire section. So, with our procedure, we picked the reflectors in the stack (migrated or not) section in time domain.

The algorithm uses Seismic Unix routines (COHEN & STOCKWELl 2001). During this iterative procedure, we have introduced two possibilities: to analyse the CIG vertically (i.e. at several location along the section) or horizontally (i.e., along the selected reflector). This last approach is particularly useful to check the lateral coherence of the interface. We also applied a datumig to the pre-stack data at a plane below the seafloor. So, the maximum offset shot-receiver, in the geometry acquisition (about 3000 m), is enough to solve the velocity field. We supposed no vertical gradient inside the layers.

The final pre-stack depth migrations of the selected lines furnish a good image of the BSR and the BGR, confirming the goodness of the velocity field, in the free gas layer too. Finally, the velocity fields are used to estimate the quantity of gas hydrate and free-gas trapped in the pore space, by applying a theoretical approach that relates the seismic velocity to the gas hydrate and free gas concentration (TINIVELLA 1999). These estimates furnish information about the distribution and the quantification of gas hydrate and free gas in the margin.

Cohen, J.K. & Stockwell, Jr. J.W. (2001): Center for Wave Phenomena, Colorado School of Mines.
Tinivella, U. (1999): Boll. Geof. Teor. Appl. 40: 19-30.
Tinivella, U., Accaino, F. & Camerlenghi, A. (2002): Mar. Geophy. Res. 23: 109-123

Multidisciplinary surveys for the crustal structure of the Lützow-Holm Complex, Enderby Land, East Antarctica: SEAL 2000-2002

(oral p.)

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Lithospheric evolution of the East Antarctic shield is one of the keystones for understanding continental growth process during the Earth's evolution. Architecture of the East Antarctic craton and the surrounding areas would be characterized by a comparison with lithospheric structure of the other Precambrian terrains by deep seismic surveys. A geoscience program named "Structure and Evolution of the East Antarctic Lithosphere (SEAL)" is carrying out since 1997 austral summer as part of the Japanese Antarctic Research Expedition (JARE). Several geological and geophysical surveys were conducted including a deep seismic refraction / wide-angle reflection survey in the Lützow-Holm Complex (LHC), western Enderby Land, East Antarctica. The LHC had been experienced a high-grade metamorphism during the Pan-African orogenic event, where is considered to be the collision zones in the last stage of the formation of Gondwana.

In the austral summer in 2000 and 2002, two big seismic surveys were carried out on the continental ice sheet of the Mizuho Plateau in the LHC by SEAL program. In both surveys, more than 170 geophones were installed on the plateau totally 190 km in length. A total of 8300 kg dynamite charges at the fourteen seismic shot points on the ice sheet gave enough information concerning the deep structure of a continental margin of the LHC. These surveys had revealed that the Moho depth was more than 40 km with the velocities of the surface layer, the middle crust, the lower crust and the mantle, about 6.2, 6.4, 6.7 and 7.9 km/s. Moreover, the clear reflected waves from the lower crust and the Moho were observed on all the record sections. In this presentation, we review the subsurface structure of the LHC by several geophysical approaches, such as the seismic first arrival and wide-angle analyses, gravity measurements, GPS positioning and also the radio-echo soundings to detect the precise bedrock elevation around the seismic traverse routes. Then the multidisciplinary crustal model of the LHC will be presented including geological evidence to estimate the evolution process around the coastal outcrops.

Gravimetric survey for the crustal density structure of the Lützow-Holm Complex, Enderby Land, East Antarctica: SEAL 2000-2002

(poster p.)

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In these several decades, the Japanese Antarctic Research Expedition (JARE) has been put an emphasis on the geophysical prospects for the Mizuho Plateau, western Enderby Land, East Antarctica. The Plateau locates in the early Paleozoic Lützow-Holm Complex (LHC), where a regional metamorphism had occurred in 550 Ma as a Pan-African orogenic event. "Structure and Evolution of the East Antarctic Lithosphere" (SEAL) program have been carrying out in a framework of JARE in recent few years. In this program, geological and geomorphological field surveys, paleo-magnetic and geomagnetic measurements, seismic and gravity investigations were operated in the western Enderby Land area.

The gravity survey was carried out in JARE-41(2000) and -43(2002) to obtain a three dimensional crustal model of the Mizuho Plateau, deduced from the detailed gravity anomalies. The gravity measurements were conducted by a SCINTREX (CG-3M) gravity meter at about 1 km-interval along the survey lines. The number of the stations was 312 and the total number of the measurements was 414, respectively. Free-air and simple Bouguer gravity anomalies based on gravity disturbance along the survey lines were obtained by use of both data of surface elevation from GPS positioning and the bedrock elevation from radio-echo sounding. The simple Bouguer gravity anomaly was calculated by assuming the layered structure to fit the observed Bouguer anomaly. In this presentation, we show the subsurface density structure of the LHC by gravity anomalies together with the other geophysical approaches, such as the seismic first arrival and wide-angle analyses, GPS positioning and also the bedrock elevation from radio-echo soundings.

Tectonic evolution of the Trinity Peninsula Group and correlatives

(oral p.)

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A comparison is made between several outcrop areas of the Trinity Peninsula Group (TPG), based on recent fieldwork along the southeastern shore of the Antarctic Peninsula, at Sobral Peninsula, Mount

Bradley, Long Island, Botany Bay, View Point and Mount Cardinal, and earlier observations at Hope Bay and Cape Legoupil. The Miers Bluff Formation at Livingston Island and the Greywacke Shale Formation on the South Orkney Islands are considered to be correlatives to the TPG and are also included in this review. The TPG is mainly composed of subgreenschist facies feldspathic sandstone and mudstone turbidites, with local occurrences of conglomerates, pebbly mudstones, chert and pillow basalts. A new occurrence of basaltic rocks from Botany Bay revealed a composition of alkaline basalt, possibly related to an intraplate oceanic island or fracture zone setting, similar to earlier reported pillow basalts from the same region. Red and green chert, constituting packages of up to several meters thick, also from Botany Bay, yielded radiolarians of unidentified age and one conodont fragment that was dated as Early Triassic (Smithian; Wolfgang Kiesling, pers. com.). This age is in reasonable agreement with published Triassic fossil ages from Cape Legoupil, the South Orkney Islands and from the Miers Bluff Formation on Livingston Island. A maximum age is defined by unpublished detrital zircon ages (Ian Millar, pers. com.) from Hope Bay that show a significant peak in the Permian. A minimum age is given, in the Botany Bay and Hope Bay areas, by the Lower Jurassic Botany Bay Group, that overlies the TPG unconformably. The tectonic setting of the TPG during sedimentation has been interpreted in the literature as an inactive continental margin or a fore-arc basin, with N to NW directed paleocurrents. However, recognition of considerable soft sediment deformation of complete turbiditic cycles at View Point favour an active trench environment for at least part of the succession and the presence of radiolarian chert and pillow lava indicate an oceanic environment rather than a classical fore-arc basin. The deformation and metamorphism that afected the TPG must have taken place during the latest Triassic or earliest Jurassic. Deformation affected the sedimentary pile to variable degrees. In the Hope Bay area the metasediments are only about 30° tilted, but in most other areas bedding is steep or overturned, with a general NE-SW strike. Tight to isoclinal folding, attributed to D1 deformation, with an incipient S1 slaty cleavage, is common at outcrop scale but does not seem to repeat larger scale packages. This interpretation is based on the fact that north of Botany Bay a package with an apparent thickness of about 25 km displays most of the steeply north-dipping layers as facing south, which makes an interpretation of increase in apparent thickness by isoclinal folding improbable. Instead, stacking of tracts of metasediment until an apparent stable, slightly overturned position, seems more probable. This tectonic style, including the local recognition of "broken formation", favours deformation in an accretionary wedge, related to subduction of paleo-Pacific ocean floor. In the Cape Legoupil area different tectonic domains, limited by faults and also interpreted as tracts, show different deformation intensity and a variable number of deformation phases. Stretching lineations are, in general, not developed, but a coarse sandstone layer at Long Island shows strongly prolate strain ellipsoids. Local D2 deformation caused refolding about subvertical axes, with steep NW striking axial planes. A subvertical E-W megashear zone of at least one km wide, with sinistral displacament, outcropping at View Point, is also attributed to this phase, that is interpreted as related to sinistral strike-slip movements parallel to the paleotrench. The metamorphism of the TPG is poorly constrained because of its very low grade. In most places only white mica, chlorite, quartz, albite and calcite can be recognised as newly grown phases. In the southern part of the Cape Legoupil area slightly higher grade conditions produced stilpnomelane and actinolite. White micas from this area showed epizone Kubler indices and b_0 lattice values indicative for medium to high pressure. At Powell Island in the South Orkney Islands, the Graywacke Shale Formation shows a gradual increase in metamorphism to upper greenschist facies, with biotite and almandine garnet. The inversion of biotite and garnet isograds and the b_0 lattice values of white micas point to relatively high pressures during this metamorphism.

Lithospheric stress due to ice mass change and its implication to the March 25, 1998 Balleny Island earthquake

(poster p.)

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A large Mw = 8.1 earthquake occurred off the northeast coast of Antarctica near the Balleny Island region on March 25, 1998. This event was one of the largest intraplate earthquakes ever recorded. It was argued by various authors that the subevents aligned along the nodal plane trending east-west direction, which indicates that the earthquake occurred along this east-west, left-lateral, strike-slip fault. Although the earthquake is located near transform faults of Australian-Antarctic ridge, this fault mechanism does not match with the strike of those transform faults. Also the northeast-southwest compression in hypocenter area is opposite to the stress orientation of the earthquakes that occurred along the transform faults. This is implausible to relate the fault mechanism of this earthquake to the plate motion of nearby transform faults.

Tsuboi et al. (2000) have shown that this fault mechanism is consistent with the crustal motion of the Antarctica derived from the Earth's response to present-day and past ice mass changes in Antarctica (JAMES & IVINS 1998). Here, we quantitatively examined the regional earthquake potential associated with postglacial rebound of the Antarctic lithosphere. We calculated the stress change caused by the ice mass change in the same manner as those calculated in JAMES & IVINS (1998) with the viscosity 1021 Pa sec, and 120 km thick elastic lithosphere. We then calculate a change in the effective Coulomb stresses. This is similar to the procedure adopted by modelers of earthquake stress transfer and adapted to lithospheric rebound. The stress changes occur in a background tectonic stress orientation at 75°E.

Our results show that the Coulomb stress change becomes significantly negative (promoting seismicity) around the 1998 earthquake region, which indicates that the ice mass change can be a possible cause of the earthquake. Our results also imply that the thickness of the lithosphere can be an important parameter to the quantification of the stress change caused by the ice mass change.

Tsuboi, S., Kikuchi, M., Yamanaka, Y. & Kanao, M.2(000): Earth Planets Space 52: 133-136.
James, T.S. & Ivins, E.R.(1998): J. Geophys. Res. 103: 4993-5017.

Carbonic fluid inclusions in osumilite- and sapphirine-bearing ultrahigh-temperature granulites from Bunt Island in the Napier Complex, East Antarctica

(poster p.)

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Late-Archean ultrahigh-temperature (UHT) metamorphism of the Napier Complex is characterized by the presence of dry mineral assemblages such as orthopyroxene-sillimanite-quartz-garnet, sapphirine-quartz, and osumilite-orthopyroxene-garnet-sapphirine. Stabilization of such dry granulite assemblages at UHT condition requires low H_2O-activity prevailed during peak P-T conditions, since most of the crustal components such as pelitic, psammitic, and granitic rocks will undergo hydrous melting at elevated H_2O-activities during high-grade metamorphism. Fluid inclusions in metamorphic rocks provide one of the potential tools in obtaining direct information on the nature, composition, and density of fluids attending metamorphism. Here, we therefore attempted a fluid inclusion study on osumilite- and sapphirine-bearing assemblages in aluminous granulites from Bunt Island in the Napier Complex.

The melting temperatures of fluid inclusions trapped in garnet and quartz lie in the range of -56.8 to -57.8°C, close to the triple point for pure CO_2 (-56.6°C). Homogenization of the CO_2–rich fluids into the liquid phase occurs at temperatures in the range of -35.4 to 24.7°C. This translates into CO_2 densities in the range of 0.788 ~1.084 g/cm^3. The estimated CO_2 isochore for high-density inclusions in garnet intersects the P-T trajectory of Bunt Island at around 10 kbar at 1050°C, which corresponds to the peak metamorphic conditions of the region derived from mineral phase equilibria (OSANAI et al. 2001). Our results suggest that a CO_2-rich fluid was present during the peak UHT metamorphism of Bunt Island, where osumilite and sapphirine were stable minerals. The textural characteristics of the high-density inclusions as primary, isolated clusters within the cores of mineral grains are consistent with their entrapment during the growth or textural equilibration of the peak mineral phases. CO_2 inclusions with lower density occurring in quartz and garnet provide isochores that intersect the P-T path at <7 kbar and <950°C, indicating volume and density reversal during retrograde metamorphism.

Recent fluid inclusion data from the Napier Complex indicate that high-density (0.9-1.1 g/cm^3) CO_2 dominated as the ambient fluid species during UHT metamorphism of sapphirine-bearing granulites in Tonagh Island of Amundsen Bay area (TSUNOGAE et al. 2002). Occurrence of primary CO_2-rich fluid inclusions from more than one locality of the Napier Complex probably suggests that carbonic fluid played an important role on the origin of the UHT rocks in the Napier Complex. The presence of carbonic fluids could have aided in buffering H_2O-activity and stabilizing the anhydrous mineral assemblages. The CO_2-rich fluid, if infiltrated from lowermost crust or mantle, could have transported heat to the Napier rocks and given rise to UHT granulite-facies metamorphism of the Napier Complex.

Osanai, Y., Toyoshima, T., Owada, M., Tsunogae, T., Hokada, T., Crowe, W.A. & Kusachi, I. (2001): Polar Geosci. 14: 1-24.
Tsunogae, T., Santosh, M., Osanai, Y., Owada, M., Toyoshima, T. & Hokada, T. (2002): Contrib. Mineral. Petrol. 143: 279-299.

Agulhas Ridge, South Atlantic: the peculiar structure of a transform fault
(EANT workshop p.)

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Transform faults constitute conservative plate boundaries, where adjacent plates are in tangential contact. Transform faults in the ocean are marked by fracture zones, which are long, linear, bathymetric depressions. One of the largest transform offsets on Earth can be found in the South Atlantic. The 1200 km long Agulhas Falkland Fracture Zone (AFFZ), formed by this, developed during the Early Cretaceous break-up of West Gondwana.

Between approx. 4°S, 16°E and 43°S, 9°E the Agulhas Falkland Fracture Zone is characterized by a pronounced topographic anomaly, the Agulhas Ridge. The Agulhas Ridge rises more than 2 km above the surrounding seafloor. The only equivalent to this kind of topographic high, as part of the AFFZ, is found in form of marginal ridges along the continental parts of the fracture zone, namely the Falkland Escarpment at the South American continent and the Diaz Ridge adjacent to South Africa. But the Agulhas Ridge differs from both the Falkland Escarpment and the Diaz Ridge in the facts (1) that it was not formed during the early rift-drift phase, and (2) that it separates oceanic crust of different age and not continental from oceanic crust.

A set of high-resolution seismic reflection data (total length 2000 km) and a seismic refraction line across the Agulhas Ridge give new information on the crustal and basement structure of this tectonic feature. We have observed that within the Cape Basin, to the north, the basement and sedimentary layers are in parts strongly deformed. We observe basement highs, which point towards intrusions. Both the basement and the sedimentary sequence show strong faulting. This points towards a combined tectono-magmatic activity, which led to the formation of basement ridges parallel to the Agulhas Ridge. Since at least the pre-Oligocene parts and, locally, the whole sedimentary column are affected we infer that the renewed activity began in the Middle Oligocene and may have lasted into the Quaternary. As an origin of the renewed tectono-magmatic activity we suggest modifications in spreading rate and direction as a result of the Discovery hotspot chain activity starting ~25 Ma (KEMPE & SCHILLING 1974) and the significant deceleration of the African plat since at least 19 Ma (O'CONNOR et al. 1999).

Kempe, D. & Schilling, J.G. (1974): Discovery Tablemount basalt: Petrology and geochemistry.- Contrb. Mineral. Petrol. 44: 101-115.
O'Connor, J.M., Stoffers, P., van den Bogaard, P. & McWilliams, M. (1999): First seamount age evidence for significant slower African plate motion since 19 to 30 Ma.- Earth Planet. Sci. Lett. 71: 575-589.

Middle Holocene raised marine beaches from Potter Peninsula, King George Island, South Shetland Islands, Antarctica
(oral p.)

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Middle Holocene raised marine beaches 15.39-16.7 m and 2.17-2.77 m on the coasts of Potter Peninsula, SE side of the entrance to Maxwell Bay, King George Island/Isla 25 de Mayo (KGI), South Shetland Islands (Antarctica), were dated to c 5500 cal yrs BP and c 7500 cal yrs BP, respectively, on the basis of radiocarbon dating on penguin (*Pygoscelis* sp) bones (del VALLE et al. 2002, 2003) (Tab. 1).

Tab. 1: Middle Holocene raised marine beaches from Potter Peninsula: observations abstract. The mean relative seal level (R.S.L.) at deposition time was estimated taking into account that KIRK (1991) argue for a modern

Locality / Age (cal years BP)	Altitude of raised marine beach sediments (m.a.s.l.)	Estimated relative sea level at time of deposition (m.a.s.l.)
Raised beaches from "Pingfo I" locality (62°15'26.483"S, 58°37'08.530"W, 17.3 m a.s.l.) – 500 m to the NNW of Stranger Point (del Valle et al. 2002)		
c. 5510 – 5430 (range 5610 – 5270)	15.39 / 16.7	11.4 / 12.7
Raised beach from "Pingfo II" locality (62°14'20.73" S, 58°48'21.00" W, 3.77 m a.s.l.) – southern coast of Potter Cove (del Valle et al. 2003)		
c. 7562 – 7414 (range 7678 – 7242)	2.17 / 2.77	-1.4 / -1.6

storm (marine wave-wash) limit of 4 m above sea level (a.s.l.) for southern Victoria Land, East Antarctica. The original conventional radiocarbon dates from del VALLE et al. (2002 and 2003) are corrected and calibrated for the marine-carbon reservoir effect using a ΔR = 700 ±50 years (EMSLIE 2001), and the University of Washington Radiocarbon Calibration Program Rev. 4.3 based on STUIVER & REIMER (1993).

In the time/height diagram for the last 10 ka at Maxwell Bay area (King George Island) proposed by PALLÀS et al. (1997, fig. 5), the observation from "Pingfo I" locality plots well between the expected maximum relative sea level (R.S.L.) curve and the ICE-3G predicted R.S.L. curve, whereas the observation from "Pingfo II" locality, southern coast of Potter Cove, is out of range because of the very low R.S.L. estimated at its deposition time (Tab. 1).

The observation at "Pingfo I" locality (Tab. 1) broadly coincides with the rate of emergence in the South Shetland Islands proposed by PALLÀS et al. (1997, page 867). The estimated R.S.L. (-1.4/-1.6 m) at the fossil beach from "Pingfo II" locality is about 10 m lower than the expected minimum R.S.L. at its deposition time (c 7500 cal yrs BP), suggesting that the tectonic uplift in the southern coast of Potter Cove was probably abnormally high before 7500 cal yrs BP. The fossil beach from "Pingfo II" locality covers raised marine sediments with mollusc shells in growth position, which were dated to c 9600 cal yrs BP (del VALLE et al. 2003). This dating allows to constrain the maximum age of the early Holocene uplift in Potter Cove.

del Valle, R.A., Montalti, D. & Inbar, M. (2002): Antarctic Science 14: 263-269.
del Valle, R.A., Montalti, D., Inbar, M. & Boaretto, E. (2003): Antarctic Science (submitted).
Emslie, S.D. (2001): Antarctic Science 13: 289-295.
Kirk, R.M. (1991) In: D. Gillieson & S. Fitzsimmons (eds), Quaternary Research in Australian Antarctica, Canberra: 85-106.
Pallàs, R., James, T.S., Sàbat, F., Vilaplana, J.M. & Grant, D.R. (1997): In: C.A. Ricci (ed.), The Antarctic region: geological evolution and processes, Siena: 861-868.
Stuiver, M. & Reimer, P.J. (1993): Radiocarbon 35: 215-230.

A new tract-based interpretation and evidence for accretion during sinistral transpression of the Trinity Peninsula Group, Antarctic Peninsula

(oral p.)

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The Triassic Trinity Peninsula Group is the main tectonostratigraphic unit at the northern end of the Antarctic Peninsula. It consists of a 500 x 100 km complex of sub-greenschist facies, feldspathic sandstone and mudstone turbidites. Pillow basalts, conglomerates and non-basaltic volcanic rocks are important components of limited distribution. New fieldwork strongly suggests that the Trinity Peninsula Group is an accretionary complex, consisting of lithologically distinct tracts accreted during oblique sinistral subduction along the palaeo-Pacific margin of Gondwana.

The current study set out to resolve ambiguities over palaeo-subduction direction and to examine a distinctive suite of Archaean- and Ordovician-clast bearing conglomerates at View Point. New structural data shows unequivocally that accretion progressed from modern-day northwest, i.e. from the palaeo-Pacific. Clear evidence of soft sediment deformation was identified, supporting a subduction accretion origin for the Trinity Peninsula Group. Palaeocurrent data from laminated units in the View Point conglomerate indicate sediment transport from modern day south, i.e. towards the palaeo-trench.

Two phases of deformation are recognised affecting Trinity Peninsula Group rocks prior to deposition of the Lower Jurassic Botany Bay Group. Trinity Peninsula Group bedding generally dips steeply north to northwest. D_1 is interpreted here to be associated with subduction accretion, and forms tight to isoclinal asymmetric folds with weakly developed slaty cleavage. Cleavage ranges from parallel to bedding and isoclinal fold axes to transecting F_1 fold axes up to 30° clockwise in plan, suggesting sinistral transpression during deformation. Fold plunges are variable, but vergence is generally to the north, i.e., towards the Pacific. D_1 is associated with development of minor, soft-sediment deformation-related, broken formation. D_2 represents a large-scale episode of ductile to brittle-ductile sinistral shear, overprinting D_1 structures and associated with development of km-wide zones of broken formation. D_2 structures include steeply plunging gentle to open folds of D_1 structures, with a penetrative cleavage, oblique to bedding, developed in pelitic layers.

Zones of broken formation appear to form boundaries between Trinity Peninsula Group tracts of different lithological composition. The zone at View Point is characterised by intense cataclastic to brittle-ductile deformation producing a "broken" structural style. Neither bedding nor regular cleavage can be measured. Lenticular and rounded remnants of sandstone layers, varying in size from few centimetres to 50 metres diameter, are randomly distributed in a mudstone matrix. Only locally can a rough anastomosing east–west cleavage be observed, surrounding less deformed lenticular zones.

Overall, identification of these zones suggests that the Trinity Peninsula Group can be subdivided into tracts, like other large accretionary complex terranes in Europe, Asia, and Oceania. However, tracts in the Trinity Peninsula Group are solely based on lithological composition because palaeontological and age information are sparse.

Morphologic and stratigraphy stacking pattern from an active to passive margin at the end of the SW extreme of the South Shetland Trench, Antarctic Peninsula*
(poster p.)

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Multichannel seismic (MCS) profiles and swath bathymetric data have been used in order to analyse the morphologic and stratigraphic evolution at the SW end of the South Shetland Trench in the Antarctic Peninsula. The continental margin varies from an active margin in the South Shetland forearc to a passive style southwestwards. The two segments are separated by two morphostructural highs where the active margin ends. The first one locates located in the shelf break is called the "Shelf Transition High" whereas the second one located seawards in of the slope is identified as "Base-of-Slope Transition High" (JABALOY et al. 2003) and separates the continental rise from the trench.

In the passive margin the shelf break is observed at 450 m mean water depth. The outer shelf has a mean slope of around 0.2° towards the shelf break. The middle shelf is the shallowest part of the margin, with a depth that may reach 300 m. The inner shelf is deeper and it reaches 750 m water depth due to the development of erosive glacial troughs. The slope can be divided into two adjacent sectors. The NE slope segment is characterized by a staircase geometry influenced by the structure of the basement and it is less subsident and progradational than the southwestern sector. The southwesterrn slope is a homogeneous steep slope where mass-gravity processes dominate while the base of slope at 3000 m water depth is slightly undulated and gradually transitional towards the basin floor. The Shelf Transition High elongated in a NE-SW direction, marks the transition between the passive and active margins, with a shelf break at about 275 m depth. The continental slope is steep with 31° of mean slope, dominated by erosional processes. In this sector, the oceanic basin floor has depths between 2900 to 3650 m. The active margin segment is characterised by the development of a trench and an accretionary prism. The shelf shows thick aggradational sequences with a shelf break about 375 m deep and an uplifted outer shelf that is slightly tilted landwards until a 750 m deep tectonic depression. The middle shelf is shallower (about 150 m deep) and uplifted by a main antiform. The floor of the inner shelf is a nearly subhorizontal erosional surface, slightly deeper. The continental slope is characterised by a reduced accretionary prism, with a strong mean dip (15°), where an incipient mid-slope depression is developed. The upper slope shows scarps with 300 m of relief. The lower slope ends at 4400 m water depth in the floor of the near-horizontal trench fill deposits.

The seismic stratigraphy of the continental margin show two major seismic units with different acoustic responses and stacking patterns in the several provinces of the margin. The "Lower Major Seismic Unit" (LU) is composed of three depositional sequences: MS-7, MS-6 and MS-5. The top of the LU is a major discontinuity marked by an irregular high-amplitude reflector named Middle Reflector (MR) Discontinuity. The "Upper Major Seismic" (UU) has several internal discontinuities marked by regional high-amplitude reflectors that we have termed UR3, UR2 and UR1, from bottom to top, that separate four depositional sequences (MS-4 to MS-1). The LU is observed in the entire area at the base of slope, with the exception of seaward of the Shelf Transition High, where only the upper major is identified. The LU is characterized in the base of slope by a weak reflective response, locally with transparent configuration. The depositional sequence MS-7 is observed only overlying the igneous oceanic basement, southwest of the C Fracture Zone. MS-6 and MS-5 depositional sequences can be observed capping directly the igneous basement. On the shelf and slope the LU has a low reflective acoustic response with a local transparent configuration. The discontinuities inside the LU separate reflectors identified by an aggradational to divergent stacking pattern. The internal reflector of MS-7, MS-6 and MS-5 usually on-laps the discontinuity at their base. The UU has a very reflective acoustic response in the base of slope, characterised by medium- to high-amplitude reflectors that are laterally continuous. They can be observed throughout the base of slope and in the trench. The UU in the shelf and slope is characterised by discontinuous reflectors of intermediate to high amplitude. In relation with the seismic stacking pattern of every sequence, the MS-4 is aggradational to progradational, whereas the MS-3 is progradational. Moreover, the MS-2 is an aggradational to progradational sequence and the youngest MS-1 sequence shows an aggradational pattern. MS-1 and MS-2 sequences identified in this margin can be directly correlated with sequence S1 of LARTER et al., (1997) and BARKER & CAMERLENGHI (2002). MS-3 and MS-4 sequences can be correlated respectively with the S2 and S3 sequences of these authors.

Barker, P.F. & Camerlenghi, A. (2002): Proc. ODP, Sci. Results 178: 1-40.
Jabaloy, A., Balanyá, J.C., Barnolas, A., Galindo-Zaldívar, J., Hernández-Molina, F.J., Maldonado, A., Martínez-Martínez,J.M., Rodríguez-Fernández, J., Sanz de Galdeano, C., Somoza, L., Suriñach, E. & Vauquez, J.T. (2003): Tectonophysics 6869: 1-27.
Larter, R.D.; Rebesco,M. Vanneste, L.E.; Gamboa; L.A.P. and Barker, P.F., 1997, Antarctic Research Series, 71: 1-27.
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Holocene sea-level changes in Bunger Oasis, East Antarctica, as inferred by diatom assemblages in four sediment cores from modern bays and inlets

(poster p.)

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The Bunger Oasis, the largest coastal ice-free area in East Antarctica, is surrounded by ice masses from all sides. It comprises terrestrial landscapes and marine bays and inlets (epishelf lakes). The latter, filling deep tectonic depressions in the oasis bedrock relief, are connected with each other and with the open ocean beneath the Shackleton Ice Shelf and partly floating outlet glaciers. Differences in the state of these basins throughout the deglaciation history of the oasis are partly caused by their glacial surroundings, influencing the local climate, the degree of ice coverage and the sediment supply. The bathymetries of the basins and the amount of ocean-water penetration, relative to the fresh-water supply, strongly depend on relative sea-level changes. Therefore, comparative geochronological and paleoecological analyses of sediment sequences from different marine bays are useful tools to reconstruct past marine events in the oasis. Four sediment sequences, sampled in three basins of different modern environments, were radiocarbon dated and analysed for their diatom assemblages, since diatoms are particularly sensitive to fluctuations in the ecology of the basins.

Sedimentation in all three basins commenced during early Holocene time, when oceanic waters had started to penetrate into the oasis, causing floating and collapsing of local ice masses. Relative sea-level rise proceeded until the middle Holocene, evidenced by a distinct dominance of marine diatom taxa and by the occurrence of open-ocean species.

From the middle Holocene, a combination of relative sea-level fall and local environmental impacts led to gradual changes in the ecology of the basins. In Rybiy Khvost Bay, the water depth was lowered but free access of oceanic waters from the north persisted, leading to standart sea-water salinity and full marine biota. No indications for proximal ice masses are found. In Transcriptsii Bay, sea-level fall hampered the water exchange with oceanic water masses below the Edisto outlet glacier to the west. Fresh-water supply led to a stratified water column, which today is characterized by ogygenated waters of less than 1 ‰ salinity above 80 m depth, and anoxic waters with salt contents of 26 to 34 ‰ below that depth. A perennial ice cover on Transkritsii Bay due to the adjacent glacier caused low biogenic production, reflected by very low diatom contents in most samples. The Izvilistaya Inlet had no larger ice masses in its catchment; it exhibited a semipermanent ice cover. Sea-level fall gradually reduced the size of the gateway between the inlet and Transcriptsii Bay via a shallow sill. Simultaneous discharge of water from Figurnoye Lake finally led to fresh-water conditions since late Holocene times.

The general tendency of a relative sea-level lowering since the middle Holocene, clearly expressed in the diatom assemblages, possibly has been interrupted by a short-term rise. This is indicated by a simultaneous occurrence of open oceanic species in all four cores within the period 1000 to 2000 yr BP.

Metadata for Antarctic spatial data: Towards ISO 19115 compliance

(oral p.)

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Spatial databases form a core component of a SCAR distributed data network for Antarctic environmental data because most of these data have a spatial component. The new distributed geoprocessing technologies facilitate scientific collaboration through efficient and automated data and information exchange and through services that enable distributed data processing and data mining. A prerequisite to fully use the power of these new technologies is a sound framework of specifications. At the very heart of such a framework is a specification on how to describe meta data. Only recently ISO 19115, the ISO standard for spatial meta data, has matured into an international standard. It is now the task of each information community to extend the abstract ISO standard to cater for the specific needs of the respective community. The Geospatial Information Group within SCAR's Geosciences Standing Scientific Group (SCAR GIG) is investigating into the development of such a community profile for science in Antarctica. The challenge is to develop a community profile that lends itself to an easy integration of the variety of existing, mostly sparse and more than often not well documented metadata records but still matches the needs of distributed processing technologies. KGIS (SCAR King George Island GIS) is one of the projects run by SCAR GIG. The project provides a highly integrated geographic database for use in multi-disciplinary applications. Nine countries collaborated to establish the KGIS data base. Due to the variety of institutions that provided data to the project the data base is an excellent test bed for the first steps towards an ISO 19115 compliant meta data profile for Antarctic spatial data.

Characteristic problems encountered with ISO 19115 and its application on a typical Antarctic spatial database like KGIS are described and possible solutions are proposed. These investigations might stimulate a discussion on a SCAR endorsed ISO 19115 compliant meta data profile.

The effects of biogenic silica on sediment compaction on the Pacific margin of the Antarctic Peninsula

(oral p.)

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In this work we present evidence of how small to moderate amounts of biogenic silica in fine grained Cenozoic deep sea sedimentary sequences can severely affect the physical properties and consequently the slope stability of continental rise sediment drifts of the Pacific margin of the Antarctic Peninsula.

Two sites drilled within the Ocean Drilling Program (ODP) Leg 178 were considered; seismic reflection, downhole logging, geotechnical and mineralogical data have been analyzed from the two drilling sites. Log properties revealed anomalous down-hole trends in porosity, density, water content, and p-wave velocity that survived cross-checks among different methods of detection and cleaning of possible errors and artifacts. In essence, it was recognized that the sedimentary succession drilled in hemipelagic sediment drifts of the proximal continental rise is mostly undercompacted as outlined by constant, if not increasing, porosity with depth. A number of studies, mostly originated from DSDP-ODP scientific drilling in high-latitude seas, describe how biogenic silica, if present in large amounts (oozes) affects physical properties of marine sediments (HEIN et al, 1978, BRYANT & RACK 1990, LONSDALE 1990, TRIBBLE et al. 1992 among others). We ascribe the observed anomalous consolidation trends to the presence of biogenic silica even with a small to moderate amount, including its diagenetic alteration as detected by seismic and geochemical methods. Biogenic silica prevents consolidation, causing interstitial fluids trapping in the sediments. When silica diagenesis allows sediment to consolidate, the release of fluids affects stability of the submarine slope. We further speculate on the potential of physical properties as basin-wide indicators of biogenic silica abundance in sediments. Anomalous sediment consolidation should be considered when studies of sediment budget and basin analysis are undertaken on fine grained diatom-bearing sediments from high-latitude margins.

Bryant, W.R. & Rack, F.R. (1990): In: P.F. Barker, J.P. Kennett et al. (eds.), Proc. ODP, Sci. Res. 113: 201-223.
Hein J.R., Scholl D.W., Barron J.A., Jones M.G. & Miller J. (1978): Sedimentology 25:155-181.
Londsdale M.J. (1990): In: P.F. Barker, J.P. Kennett et al. (eds.), Proc. ODP, Sci. Res. 113: 27-37.
Tribble, J.S., MacKenzie, F.T., Urmos, J., O'Brien, D.K. & Manghnani, M.H. (1992): Amer. Assoc. Petrol. Geol. Bull.,76(6): 792-804.

Late Quaternary environmental histories of the Amery Oasis, East Antarctica, and Taylor Valley, southern Victora Land

(poster p.)

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In the context of long-term studies to the climate and environmental histories of ice-free coastal regions (oases) of Antarctica an Australian-German expedition to the Amery Oasis, northern Prince Charles Mountains, and an American-German expedition to the Taylor Valley, southern Victoria Land, were carried out during the austral summers 2001/02 and 2002/03, respectively. The overall goal of these studies, using mainly sediments from existing lakes as a natural climate archive, is to understand reactions of the environment at the margins of the Antarctic ice sheet on past global climate fluctuations, and to develop scenarios for their future reactions on climate changes.

The Amery Oasis and the Taylor Valley are of special significance within these long-term studies, because both oases could have existed, according to previous studies, already during the Last Glacial Maximum. In addition, the location of the Amery Oasis provides a unique opportunity to reconstruct the history of the Lambert Glacier/Amery Ice Shelf system, which is the largest glacier system in the world. At Taylor Valley in the southern Victoria Land, the outlet presumably was blocked by the northwards advanced ice shelf during the Last Glacial Maximum. Thus, the proglacial Lake Wash-burn was damed up in the lower valley. The existing lakes are supposed to be remnants of this proglacial lake.

During the Amery Oasis expedition 2001/02 the recovered sediments from three different lakes in three different regions amount to a total of c 20 m. The basis of the limnic sediments was reached in all three lakes. The postglacial sediments of Lake Terrasovoje, a 31 m deep lake in the northern part of the study area, are composed mainly of algae mats and moss layers. This enables to establish a reliable chronology by radiocarbon dating, and to reconstruct the regional climate history by past changes in the lake biopro-ductivity. Three sediment cores from different locations at Radok Lake likely reflect postglacial catchment changes. The sediments of Beaver Lake, which is hydraulically connected with the ocean underneath the Stagnant and Charybdis Glaciers, are of special interest, because they probably document changes in the relative sea level history. These changes are indicated in subaquatic terraces along a bathymetric profile in the western part of the lake.

During the Taylor Valley expedition from October to December 2002 a total of about 33 m of sediment was recovered from three different lakes along the valley. At Lake Hoare and at both east and west lobes from Lake Bonney, the maximum core length was 3 m. The core from East Lobe Bonney is almost exclusively built-up by salt cristals, whereas the sediments from the other lakes mainly consist of clastic matter. In the sediments of Lake Fryxell interspersed layers of organic matter enabled to obtain an almost 10 m long core. According to the sedimentation rate calculated in former studies, the lower part of this core might consist of proglacial Lake Washburn sediments.

Advances in SHRIMP geochronology and their constrains on understanding the tectonic evolution of Larsemann Hills, East Antarctica

(EANT workshop p.)

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The granulite facies metamorphic rocks in the Larsemann Hills play an important role in the understanding of development of Prydz Bay high-grade metamorphic terrains. The paucity of precise ages for the metamporphic rocks of the Larsemann Hills hinders tectonic correlations and understanding of crustal development. In order to advance our understanding of the deep crustal processes responsible for these granulites,it is essential to establish the age(s) of accretion of the protoliths and their subsequent tectonothermal history.

Thick unit of mafic-felsic composite orthogneiss was interpreted as a possible bimodal metavolcanic unit from geochemical data. U-Pb SHRIMP zircon and Sm-Nd data both felsic gneiss and mafic gneiss reveal a direct record of the pre-granulite facies history of the Larsemann Hills region. New Sm-Nd data of mafic gneiss indicate that the rocks-forming ages of mafic gneiss at 1050 ±120 Ma (Initial $^{143}Nd/^{144}Nd$ = 0.51127 ±0.00012). The c 1100 Ma protolith history is still recorded in some zircons crystals. the mafic-felsic composite gneiss has experienced two major episodes of granulite facies metamorphism,one at c 990 Ma (M1) , the other at c 550 Ma (M2). Syntectonic Grovness Enderbite give ages of c 990 Ma. Subsequent metamorphism is recorded at 530Ma. The latter metamorphic event reached granulite facies.

The geochemistry of the pelitic granulites of the Larsemann Hills suggests the arkosic to shaley nature of the protolith. The rocks are characterized by a high maturity index. The geochemical criteria imply passive continental margin nature.Metasedimentary gneisses contain a population of zircons with ages in ca.1100 Ma. zircons rim have ages in the range 584-500Ma.

The metamorphic evolution of the different lithological units as deduced from the SHRIMP zircon work and Sm-Nd data is summarized in Tab. 1.

Tab. 1: Summary of the lithological and metamorphic evolution as determined by U-Pb SHRIMP zircon analyses and Sm-Nd data

Pan-African	Cambrian	Dalkoy granite	~501Ma
		pegmatite	~504Ma
		Progress granite	~516Ma
		Leucogranite	~524Ma
		D3:N-S extension event,	
	Neoproter	D2:WNW-directed thrusting event, M2:granulite facies	665? 584-494Ma
Grenvillian	Mesoproterozoic	Syntectonic enderbite	~990Ma
		D1:Interleaving of mafic-felsic gneiss and sedimentary, M1:granulite facies	~990Ma
		Metasedimentary rocks (pelite,psammites,quartzite etc.)	
		Bimodal volcanic rocks	~1100Ma

The geochronological data from the Larsemann Hills and adjacent region is readily correlated with published data from the Mawson Coast, northern Prince Charles Mountains and Rayner Complex in the east Antarctic, and the East Ghats of India (BOGER et al. 2000). All yield syn-orogenic ages of between 990 and 900 Ma. 990-900 Ma orogenesis has been recognised in the Larsemann Hills-northern Prince Charles Mountains- Mawson Coast- Rayner Complex- Eastern Ghats provinces in East Antarctica and India. The new data provide impotant constraints in reconstructions of the supercontinent Rodinia.

Boger, S.D., Carson,C.J., Fanning,C.M. & Wilson, C.J.L. (2000): Precambrian Res. 104: 1-24.
Carson, C.J., Dirks, P.H.J.M., Hand, M., Sim, J.P. & Wilson, C.J.L. (1995): Geol. Mag. 132: 151-170.
Carson, C.J., Fanning, C.M. & Wilson, C.J.L.(1996): Austral. J. Earth Sci. 43: 539-553.
Dirks, PH.G.M. & Hand, M., (995): Austral. J. Earth Sci. 42: 157-172.
Fitzsimons, I.C.W., Kinny, P.D. & Harley, S.L. (1997): Terra Nova 9: 47-51.
Fitzsimons, I.C.W. (2000): Geology 28: 8820-8879.
Fitzsimons, I.C.W. (2000): J. African Earth Sci. 31: 3-23.
Hensen, B.J. & Zhou, B. (1995): Geology 3: 225-228.
Wang, Yanbin., Liu Dunyi., Williams, I.S. & Ren Liudong (2001): Gondwana Res. 4: 4,820.
Zhao,Y., Liu, X.H., Wang, S. & Song, B. (1997): Episodes 20: 122-127.

Accretion of the Cambrian Bowers Terrane arc to the Gondwana Margin, northern Victoria Land: evidence from conglomerate provenance

(oral p.)

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The Bowers terrane is composed of a mafic volcanic arc assemblage of intra-oceanic geochemistry, interbedded with marine mudstones (Sledgers Group). The arc assemblage is conformably overlain by late Middle to early Upper Cambrian marine mudstones, sandstones, and conglomerates of the Mariner Group. In turn, the latter is unconformably overlain by quartz arenites of the Leap Year Group in a regressive sequence of increasing continental affinity. Clearly the Bowers terrane volcanic arc accreted to the Gondwana continental margin prior to the deposition of these passive margin sediments.

At the Carryer Glacier, the Sledgers Group volcanic-marine mudstone sequence is in fault contact with the Carryer Conglomerate which contains volcanic clasts derived from the former. Based on clast compositions and stratigraphic position, the Carryer Conglomerate is correlated with marine conglomerates (e.g. Southend Conglomerate) of the uppermost Mariner Group on nearby Reilly Ridge which contain Upper Cambrian trilobites. The Carryer Conglomerate is a red, polymict, clast-supported conglomerate with interbedded, cross-stratified, sandstone lenses and channel structures. The depositional environment is that of a mixed-bedload braided river in an arid climate.

Individual beds in the Carryer Conglomerate and the equivalent units on Reilly Ridge contain up to 15 % igneous clasts. Geochemical data on the igneous clasts can be used to characterize the petrological nature of the source area(s). The igneous clasts are dominantly granitoids of I- and S-type affinity together with felsic to intermediate clasts of probable hypabyssal origin. Using SHRIMP U/Pb zircon dating, Carryer Conglomerate I-type clasts gave crystallization ages of 504 ±4, 505 ±6, and 508 ±6 Ma with minor inheritance between 600 and 2015 Ma. Ages from an S-type clast ranged from 480-2830 Ma and probably all represent inheritance. The conglomerate from the underlying Sledgers Group mafic volcanic sequence also contains I-type granitoid clasts, one of which gave a crystallization age of 511 ±7 Ma with minor inheritance at 545 and 585 Ma.

All the crystallization ages obtained are typical of the Ross Orogen, and inheritance ages are characteristic Gondwana margin signatures. We conclude that the accretion of the intra-oceanic Bowers terrane arc to the Gondwana continental margin occurred prior to the deposition of the Carryer Conglomerate (Upper Cambrian) which represents the burial of the arc by continental detritus from the deeply eroded Ross Orogen. Slightly older granitoid clasts in the Sledgers Group volcanic sequence indicate the approach of the arc terrane prior to accretion.

Integration of Antarctic Pliocene marine and low-mid latitude sequence stratigraphic-stable isotopic data

(oral p.)

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Glacial-deglacial cycles and glacio-eustatic sea-level shifts of up to 100 rn and more have been interpreted in low and midlatitude Pliocene marine margin sequence stratigraphic and deep sea stable isotopic data. One might, therefore, expect close correlation of these events and episodes with the Antarctic Pliocene glacio-stratigraphic record, regardless of whether Antarctic glacial events were the primary driving force, or areaction associated with hypothesized Northern Hemisphere ice sheet perturbations in the case of the late Pliocene. The most completely documented Antarctic Pliocene marine stratigraphic records are from present day continental margin settings in the Antarctic Peninsula (Cockburn Island), McMurdo Sound- Transantarctic Mountains (Victoria Land Basin, Wright, Taylor and Ferrar Paleofjords), and Amery Graben-Prydz Bay (Amery Oasis, and Larsemann and Vesttold Hills). Thickest Pliocene sedimentary successions occur in drillholes from late Neogene fjords, e.g. DVDP 10 (-90 rn) and 11 (-160 rn), and CIROS 2 (-97 rn). At other localities, remnant drillhole and outcrop successions are <20 m. Thin beds of diamicton, conglomerate, sand-mud, some with shell-rich beds, are the dominant lithofacies. Lithofacies contacts are abrupt and inter-unit hiatuses of varying duration common. Extensive and thicker Pliocene stratal packages punctuated by widespread reflectors (?ice grounding generated unconformities) have been seismically delineated offshore in all three Antarctica regions. Several drillholes have penetrated these successions but chronostratigraphy is not robust. Geological and geophysical interpretation of inshore and offshore Pliocene successions suggest alternating glacial episodes of grounded ice sheet-ice shelf expansion through continental drainage systems and across continental shelves, and deglacial episodes of sedimentation during ice retreat to and inland of continent coastal margins. Chronostratigraphic control is provided by radiogenic dating of volcanic eruptives and ash, diatom biostratigraphy, and magnetostratigraphy. Pliocene diatom zones have durations of 300- 700 kyrs (HARWOOD & MARUYAMA 1992, WINTER & HARWOOD 1997), with higher resolution dating possible by use of overlapping ranges and other chronostratigraphic tools. Because of infra-Pliocene variable sedimentation patterns, erosional truncation at unconformities, and late Quaternary subaerial erosion of outcrop tops, time represented in specific successions is some fraction of designated zonal durations. Although detailed cyclostratigraphic stacks have not been documented in inshore marine Pliocene strata, successions are potentially related to sixth order orbitally driven glacial-deglacial phenomena. Extreme highstand/onlap and lowstand/offlap episodes deduced from offshore New Jersey-Alabama (GREENLEE & MOORE 1988) and Enewetak Atoll (WARDLAW & QUINN 1991) data are closely coincident in time with the interglacial successions and unconformities/hiatuses in Antarctic Pliocene marine records. Sixth order eustatic sea-level tluctuations in late Pliocene successions of Wanganui Basin-NZ (NAISH 1997, NAISH & KAMP 1997), and attributed to Northern Hemisphere ice sheets, may also have an ice sheet provenance in Antarctica. Further, bathymetric increases in the Wanganui Basin of 100-150 rn at 3.0 Ma and 200-300 rn at 4.3 Ma (i.e., before the advent of northern ice sheets) were explained as tectonic in origin (KAMP et al. 1998). However, as both events coincide with highstands in New Jersey-Alabama and Enewetak records and also are coincident with times of widespread deglaciation, marine transgression and sediment accumulation in Antarctica, some part of these values may have an origin in Antarctic glacial history. Future recovery of much more complete high resolution records from Antarctica' s continental shelf basins is likely to permit correlation with sixth order Pliocene glacial-deglacial chemostratigraphy, such as provided at Site 846 (SHACKLETON et al. 1995). It is also possible that specific numbered extreme isotope-based depletion and enrichment events at Site 846 may be linked to specific peak deglacial-glacial (sea level highstand/lowstand and marine transgression/regression) episodes in the Antarctic inshore Pliocene. If global Pliocene eustatic sea-level excursions of the degree cited here are associated with land-based Antarctic ice sheets, it follows that there is a robust argument for significant 3rd to 6th order ice sheet volume draw-down and recharge, as well as changing geographic ice sheet extent in some regions of Antarctica.

Greenlee, S.M. & Moore, T.C. (1988): SEPM Spec. Pub. 42: 329-353.
Harwood, D.H. & Maruyama, T. (1992): Proc. ODP, Sci. Res. 120: 683-733.
Kamp, P.J.J., Journeaux, T.D. & Morgans, H.E.G. (1998): Sedimentary Geol. 117: 165-192.
Naish,T. (1997): Geology 25: 1139-1142.
Naish, T. & Kamp, P.J.J. (1996): Sedimentary Geol. 110: 237-255.
Shackleton, N.J., Hall, M.A. & Pate, D. (1995): Proc. ODP, Sci. Res. 138: 337-353.
Wardlaw, B.R. & Quinn, T.M. (1991): Quat. Sci. Rev. 10: 247-258.
Winter, D.M. & Harwood, D.H. (1997): The Antarctic Region, Terra Antartica Publ: 985-992.

Petrology, textures and geochronology of metamorphic rocks from the Antarctic Peninsula - a compilation

(oral p.)

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The dynamic reconstruction of the geological history of the Antarctic is a challenging task because individual outcrops are scattered over large geographical distances, and structural relationships are obscured by thick layers of ice. The Antarctic Peninsula is considered to be an example "par excellence" for testing tectonic processes along active continental margins: The traditional view of the Antarctic Peninsula is that it formed part of the palaeo-Pacific margin with active east-directed subduction from Mesozoic to Tertiary times. This is inferred to have formed a magmatic arc complex, in which volcanic and plutonic rocks were distributed widely along the length of the peninsula (LEAT et al. 1995). However, recent discoveries suggest that the Antarctic Peninsula is composed of at least (two possibly exotic) terranes, one of accretionary complex origin and the other a possible microcontinental arc, in transpressional contact with para-autochthonous rocks of the continental Gondwana margin (VAUGHAN & STOREY 2000).

In this work, we present the first pressure and temperature data from metamorphic rocks distributed along the spine of the Antarctic Peninsula. These data will be integrated with other geological parameters such as composition, structural information and time for quantifying the dynamic of tectonic processes along the continental margin of Gondwana and to constrain a coherent model of the deformation of the margin. In the past, the connection of pressure, temperature, texture and age was weak due to limited information from metamorphic rocks of the Peninsula. However, recent studies have provided coherent pressure and temperature data from metamorphic regions distributed along its length. From these regions, ages of accessory minerals (zircon) and of main components (garnet) will be linked to the corresponding P-T evolutions and textures. This will help to constrain the margin dynamics and contribute to our present understanding of the building of the Antarctic Peninsula.

Leat, P.T, Scarrow J. H. & Millar, I.L. (1995): Geol. Mag. 132: 399-412
Vaughan, A.P.M. & Storey, B.C. (2000): J. Geol. Soc. London 157: 1243-1256

Geodetic observations to study ice surface deformation in the area of the Vostok core location

(oral p.)

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The Russian station Vostok is situated above the southern tip of the largest subglacial freshwater lake in Antarctica. Therefore the borehole 5G1 at Vostok Station has an unique location. Drilling was stopped at a depth of 3623 m approximately 120 m above the ice/lake interface in January 1998 to avoid contaminating the lake's water. The last part of the core revealed samples of refrozen lake water. The ice core represents a climate archive of the last 420000 years. The knowledge of ice flow velocity and the local strain field at the borehole is an important factor for the interpretation of the core. Additionally it could be an useful information for technological aspects of the drilling itself.

Extensive geodetic observations were carried out in the vicinity of Vostok Station during the summer seasons of the 47th and 48th Russian Antarctic Expedition. Precise GPS measurements as well as classical terrestrial observation techniques were applied to study the ice velocity field in this area.

A local control network in the vicinity of the borehole 5G1 was established in December 2001. It consists of two concentric ring polygons with 12 control points in total. The borehole is situated in the centre of the network. The extension of the outer ring polygon is 2.5 km in diameter. The control network was observed for the first time in January 2002 and re-observed one year later. The intercomparison of the network geometries at epoch 2002 and 2003 is used to determine the local horizontal deformation field applying the theory of infinitesimal strain. As one result the semimajor and semiminor axis and the orientation of the strain ellipse for the core location 5G1 will be presented.

Furthermore GPS observations were carried out at distinct sites in the area of the southern tip of Lake Vostok. The spatial distribution of these sites considers the specific situation of that region. The sites are located on floating ice, within the grounding zone and on grounded ice. The measurements allow the determination of annual surface flow rates in a reference frame fixed to the Antarctic plate. Additionally they provide precise ground truth for regional investigations using remote sensing techniques.

Ice marginal processes and landforms in the southern Prince Charles Mountains, East Antarctica

(oral p.)

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Understanding the complex interaction of glacial, glaciofluvial and mass transport processes at the ice margin is essential in the investigation of past glaciations from ice marginal sediments. However, these processes are poorly understood in polar regions, particularly amongst inland nunataks, where marginal sediments and landforms are essential in the determination of paleo-ice profiles.

This study investigates how these processes vary amongst the differing climate, topography and basal thermal regime of selected nunataks of the southern Prince Charles Mountains, located approximately

500km from the coast. Ice levels vary from <200 m.a.s.l, to >1200 m.a.s.l. Sediments and landforms were examined in the field, and samples collected for subsequent laboratory analysis to determine the depositional processes active at each location.

Mass transport processes were heavily influenced by topography and climate. Rockfall, rock avalanches and snow avalanches were abundant and produced large quantities of supraglacial sediment in areas with steep slopes. Levee-debris flows were present on steep to moderately steep slopes where snow collected above sediment accumulations. Mudflows were common in all terrain where liquid water was present. Sublimation was effective only in shaded, high altitude areas.

Ice marginal lakes and streams were observed in all areas studied, although they were larger, more abundant and/or more vigorous in the warmer low lying or north to west-facing areas. Resedimentation by glaciofluvial processes was abundant at low altitude. Lake sediment and shoreline development was restricted by oscillation of the glacial margin. Suspended sediment concentrations in both lakes and streams were variable.

Climate and topography were able to account for all variation in marginal sediment and landform associations in the region, despite the probable difference in basal thermal regime between the Amery ice shelf, ice streams and ice sheet in the region. The low-elevation assemblages were also more consistent with the "sub polar" glaciers of Spitsbergen than the "polar" glaciers of the McMurdo Dry Valleys.

Fossiliferous Miocene marine strata from the inland Antarctica: molluscs and microfossils from the Battye Glacier Formation, northern Prince Charles Mountains

(poster p.)

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The Battye Glacier Formation (~130 m-thick), Pagodroma Group, exposed in the northern Prince Charles Mountains of East Antarctica contains fossiliferous sediments that indicate ice-distal marine conditions had existed 250 km inland from the current Amery Ice Shelf edge in the late Miocene. Two lithological members were identified in the formation: a brown, sand-rich Upper Member and a grey and muddier Lower Member, reflecting past variation in proximity to the terminus of the Lambert Glacier (now flowing into the Amery Ice Shelf). Ice-distal, glacimarine, diatom-bearing mud (up to 7-12 % biogenic silica) and in situ articulated molluscs occur in the Lower Member. Three stratigraphic intervals of diatom-bearing mud are recognised from glacially reworked clasts and from in situ strata informally referred to as the McLeod Beds and 'Bed A'. The diatom-bearing mud also contains sponge spicules and minor silicoflagellates and ebridians. Marine diatom biostratigraphy constrains the age of the beds between 10.7 and 9.0 Ma (Late Miocene). Abundant benthic diatoms in the beds suggest deposition had occurred within shallow euphotic water depths in an ice-distal setting.

Preliminary results from the Trans-Antarctic Mountains Seismic Experiment (TAMSEIS)
(oral p.)

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In November, 2001, we installed 43 broadband PASSCAL seismic stations extending from the Ross Sea to the East Antarctic Plateau in order to investigate the lithospheric structure beneath the Trans-Antarctic Mountains (TAM) and East Antarctica. The experiment consists of three components:1) A 1400 km linear array of 17 broadband seismic stations extending from the central regions of the East Antarctic craton to the TAM 2) an intersecting 400 km dense linear array of 16 broadband seismic stations extending from the coast across the TAM in the Dry Valleys region. 3) 11 broadband stations in coastal regions within 300 km of Ross Island. The seismographs will remain deployed until the 2003-2004 season. Data from this experiment will be used to address two outstanding questions:

1) What mechanism is responsible for the uplift of the TAM? Many mechanisms have been proposed, including delayed phase changes, simple shear, lithospheric flexure, andtransform-flank uplift, all of which make assumptions about upper mantle structure beneath and adjacent to the mountain front.
2) What lithospheric structure is responsible for the topography and high modal elevations of the East Antarctic Craton? Previous proposals have included unusually thick continental crust and buoyant upper mantle.The stations were serviced in January and November, 2002, and operated well from October-March.Station enclosures and many of the sensor enclosures are heated, increasing instrument reliability.

Preliminary data analysis includes anisotropy determinations from SKS splitting.These measurements show a consistent and widespread pattern of about 1 s splitting and NE-SW fast directions beneath the Trans-Antarctic Mountains near Ross Island. It is not yet clear whether this anisotropy results from a relect lithospheric fabric related to the Ross Orogeny or Cenozoic TAM mountain building, or to mantle flow patterns around the East Antarctic Craton.A high level of local seismicity (m_b 2-4) was also recorded, with numbers as high as 5-10 events per day. Most of these events are located in the general locations found by BANNISTER et al. (2002), either in the David glacier region near Terra Nova Bay or the Mulock glacier region south of Mt. Discovery. Very little seismicity is found in the Dry Valleys region. The high seismicity rate, very shallow depths (< 5 km), and locations beneath glaciers near the crest of the TAM suggest that these events may be associated with ice flow, rather than local tectonics.

Horizontal crustal motions in the Antarctic interior: Comparison of GPS measurements and post-glacial rebound model predictions
(oral p.)

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GPS measurement of bedrock motions in southern Victoria Land are compared to horizontal motions predicted by a suite of post glacial rebound (PGR) models in order to discriminate between horizontal motions caused by active rifting and those caused by PGR. The crustal motion measurements have been made over the Transantarctic Mountains Deformation (TAMDEF) GPS network between 1996 and 2002. This network extends approximately 500 km north-south and 350 km east-west. It spans the Terror Rift in the western Ross Sea including an area of recent volcanic loading and the active Mt. Erebus volcano. The West Antarctic Ice Sheet grounding line retreated through this region between 12000 and 6000 years before present.

A local "East Antarctic craton" reference frame is formed by averaging the motions of stations on the inland, polar plateau flank of the Transantarctic Mountains. The average motion of the inland sites is 14.4 mm/yr towards 149°E. When this motion is removed from all network sites, a differential motion of coastal and offshore sites with respect to East Antarctica is resolved. Most of the resulting relative motions are towards the east-northeast at rates between 1 and 4 mm/yr. There is a more complicated pattern of motion in the south. Offshore sites are moving more rapidly eastwards than the coastal sites. The direction of motion is perpendicular to the coastline and to mapped faults that cut the seafloor. This is consistent with tectonic extension and opening of the Terror Rift.

To test whether the motions are purely tectonic or are influenced by PGR, a suite of models have been calculated using the D91 and ICE-3G ice sheet histories. The models are run with a range of thicknesses for the elastic lithospheric (20 km to 170 km) and a range of lower mantle viscosities (lX1019 to 2X1022 Pa seconds). Thin lithosphere models tend to have localized response areas, whereas thicker lithospheres have a more regional response to ice load changes. Low-viscosity lower mantle models exhibit little or no modern response to ice sheet changes since the last glacial maximum because the crust has already compensated completely. For high-viscosity lower mantle models, viscoelastic rebound in response to ice load changes since the last glacial maximum is still occurring. Model predictions for horizontal motions due to PGR are similar in orientation to those measured by the GPS network, but rates are lower. Tectonic motion over the region seems likely, as neither geologically plausible or end-member Earth models produce crustal motions of the magnitude measured by GPS.

Construction of low power continuous operating remote GPS stations in southern Vicoria Land

(poster p.)

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In early 2001 the Ohio State University (OSU) and US Geological Survey (USGS) designed and installed a low-power continuous operating remote station (CORS) upon bedrock at the Cape Roberts Peninsula of southern Victoria Land, Antarctica. The GPS receiver, a Javad model Legacy-E, was sponsored by Land Information New Zealand (LINZ). The CORS station is tied to the nearby tide-gauge operated by LINZ. The station is situated upon a T AMDEF project benchmark that has been tied to the IGS reference station at MCM4 on Ross Island.

The station has been used to:

3) Provide a tie to a permanent tide gauge to remove the effects of crustal motion upon apparent eustatic sea level curves calculated from the tide gauge.
4) Provide a source of GPS data troll which to continuously calculate a baseline over McMurdo Sound and the southern end of the Terror Rift.

5) Provide information to evaluate tropospheric effects on GPS measurements in this part of Antarctica.
6) Provide a means to evaluate the quality of data from MCM4.
7) Support goals of the SCAR GIANT and ANTEC initiatives for optimally spaced GPS stations around Antarctica.
8) Provide co-location with other geodetic observatories at Cape Roberts (tide gauge, seismic station and absolute gravity benchmark).
9) Demonstrate the use of high quality low power instruments to operate for as much of the year as possible.
10) Field test low power hardware under extreme conditions.

In late 2001, the system at Cape Roberts was upgraded. The mark II version of this station used a low power Javad model Euro-80 OEM GPS receiver with a SCIGN Radome equipped Ashtech choke ring antenna. Total power consumption was reduced from -6.7 watts to -2.4 watts. Using special firmware, the receiver was configured to output only those data necessary for translation into the RINEX format. The reduced data set is necessary due to the 512 Mb limit of the internal compact flash card storage system. We use a bank of four forty-watt solar panels to charge twelve eighty-six amp hour batteries while the sun is above the horizon. In January 2002 two more mark II systems were installed for a total of three mark II stations currently operating in southern Victoria Land. Two of them are at low elevation, at less than 400 m in altitude, while the third is installed next to the East Antarctic Plateau Ice Sheet at an elevation of about 1800 m. Cape Roberts mark I system ran until early May 2001 and then resumed recording in mid-September 2001. Since then data logging has been continuous. Although the other two remote stations survived the harsh Antarctic winter and data were successfully logged, operations were not continuous for various reasons. The mark III version, an upgrade to be installed in late 2003, is projected to include al Gb flash card, a satellite modem and a meteorological station, which will help monitor the apparently strong temperature inversion that occurs between the sites during the polar winter.

New stations will be deployed at Franklin Island, Lonewolf Nunatak and Westhaven Nunatak to strengthen the regional reference frame for enhanced continuity in repeat measurements for the high accuracy deformation monitoring projects.

Ultra high resolution acoustic study of the deglacial and post-glacial sediment drape in the western Bransfield Basin, northern Antarctic Peninsula: implications for ice retreat

(poster p.)

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The Western Bransfield Basin (WBB) is occupied by a large bundle structure deposited during the Last Glacial Maximum by an ice stream flowing from Gerlache Strait to Boyd Strait (CANALS et al. 2000). Bundles are ice-bed contact till deposits whose surface consists of sets of convex-upward, elongated, parallel to subparallel ridges (CANALS et al. 2000, TULACZYK et al. 2001). Located in the northern Antarctic Peninsula, at water depths between 500 to 1200 m, the WBB bundle is up to 100 km long and 14 to 21 km wide. According to Stokes and Clark (STOKES & CLARK 2001), the WBB bundle is the most complete record of its type documented to date.

Ultra-high resolution topographic parametric source (TOPAS) acoustic profiles are used to examine the thickness and acoustic facies variations of the deglacial and postglacial drape on top of the WBB bundle (WILLMOTT et al. in press). Acoustic facies analysis suggests that the sediment drape is composed of hemipelagic particles from a combination of ocean surface primary productivity and subglacial sediment-laden outflows from a retreating ice stream front. Deposits from mass wasting processes dominate the sediment infill of the depressions on both sides of the convex upwards bundle, as revealed by the presence of lens-shaped bodies with transparent acoustic facies interfingered and alternating with laminated facies. In this context we hypothesize that the areas of thickest drape mark the earliest decoupling, assuming that the post-glacial sedimentation rate is uniform.

Three segments are distinguished in the bundle drape of the Western Bransfield Basin from North to South. Drape is thickest in the deepest central segment and thins to zero towards the entrance to the inner Gerlache Strait, in the southern segment. On the basis of this observation, we infer that the ice-sea bed decoupling started first on the deepest central segment, followed by the northern segment in the vicinity of Boyd Strait. The southern segment, off the mouth of the inner Gerlache Strait, has a thinner drape, thus indicating that it was the last to be ice-cleared. The development of an ice-free sea surface followed the same succession.

Our study shows that ice stream retreat may be far from linear, and it is strongly controlled by seafloor and iceshed topography. Ongoing studies on long sediment cores will allow precise determination of the ages of retreat phases of the Gerlache-Boyd ice stream and will provide clues to compare its evolution with the regional deglaciation history.

EN.REFLIST

A regional structural interpretation of the southern Prince Charles Mountains, East Antarctica

(oral p.)

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The southern section of the Prince Charles Mountains has traditionally been considered to encompass the Ruker terrane a region that is transected by a younger brittle fault pattern that is related to the evolution of the Lambert Rift system. However, regional-scale shear zones are prevalent throughout this terrane and are associated with abundant meso- to macro-scale folds and the development of high-strain zones along distinct crustal-scale boundaries. In the Ruker terrane the Archaean and Palaeoproterozoic granitic basement rocks and metasediments preserve a remarkably similar sequence of deformation events but are tectonically overlain by a Palaeoproterozoic sedimentary basin that is dominated by a simple upright cleavage and east-west trending folds. The structures observed in the basement to this sedimentary basin appear to comprise at least two crustal regimes that are similarly orientated with east-west trending fold axes developed under mid-amphibolite facies metamorphic conditions. The older of the two basement crustal regimes is distinguishable by the presence of large linear mafic dykes that cross-cut the dominant structural features, whereas the younger crustal regime is characterized by an absence of mafic dykes but preserves late syn-tectonic felsic dykes that also intrudes the overlying sedimentary basin. Orogenesis in the Ruker Terrane occurred during three events, the earliest occurred at ~3170 Ma and was followed by a subsequent period of deformation that occurred between ~2780 Ma and ~2650 Ma. In contrast, the sedimentary basin and significant portions of the crustal sequences were reworked during the Palaeozoic between 550-490 Ma.

These events, the regional-scale structural trend of these major units and their boundaries and the later brittle fault patterns can be related to the Russian reconnaissance gravity and aeromagnetic data.

Major positive regional anomalies are observed along the southern boundary of the Palaeozoic sedimentary basin in the Ruker terrane that is associated with a banded iron formation. The Archaean aged portions of the Ruker Terrane are mainly associated with low-amplitude anomalies in a low-gradient area. Whereas the reworked crustal sections are largely characterized by negative anomalies produced by Palaeozoic granites intruding Palaeoproterozoic granite-gneiss–schist sequences.

Formation of bedrock plateaus within the Ross Sea embayment, Antarctica, by marine erosion in Late Tertiary time

(poster p.)

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Ice penetrating radar (mostly airborne) and marine seismic surveys have revealed plateaus and terraces beneath parts of the Ross Embayment including the West Antarctic ice sheet, the Ross Ice Shelf, and the eastern Ross Sea. These surfaces cover many thousands of square kilometers and are separated by bedrock troughs cut by the West Antarctic ice streams. Elevations of the plateaus vary from about 100-300 m below sea level (bsl) near the Edward VII Peninsula in the eastern Ross Sea to about 500 m.b.s.l. near the Transantarctic Mountains. Airborne geophysical surveys over a 350 by 450 kilometer area of western Marie Byrd Land (MBL) (WILSON et al. 2000) mapped one of the largest plateaus, a 300 km by 100 km level surface at about 250 m.b.s.l. at the boundary between the Ross Embayment and MBL. We interpret these surfaces as remnants of a continental shelf formed by wave erosion when the coastal regions of Antarctica were relatively free of ice. The generally flat and level nature of the surfaces that are near the same depth over large distances supports an interpretation of an origin by marine rather than glacial erosion. Marine seismic reflection profiles over one of the plateau remnants in the Eastern Ross Sea west of Edward VII Peninsula show thin, flat-lying glacial marine sediments draped with angular unconformity over gently dipping RSS2 sediments of Early Miocene age. Combining this age constraint with ice sheet and global sea level histories (HAQ et al. 1987) suggests that the shallower plateaus were last eroded in the early Middle Miocene, about 15 Ma, prior to formation of the modern West Antarctic ice sheet. The plateau surfaces might be correlated to Ross Sea unconformities including RSU5 and RSU4 (DESANTIS et al. 1995).

The plateaus along the Siple Coast, with depths around 400 mbsl, do not rebound to close to sea level for simple models of removing the current ice load. One possible explanation of the present depths consistent with forming the plateaus near sea level is that a model for removal of extremely thick early Holocene ice, such as ICE-3G (TUSHINGHAM & PELTIER 1991), is approximately correct, and current bedrock depths are at least 200 m below isostatic equilibrium. Free Air gravity anomalies of about -30 milligals in the region (GREISCHAR et al. 1992) are consistent with it being depressed below isostatic equilibrium by at least this amount. Another possibility is that western MBL lithosphere was heated in Oligocene time due to substantial extension or intensified mantle plume activity. Subsequent cooling has caused a moderate amount of crustal subsidence since then.

DeSantis, L., Anderson, J.B., Brancolini, G. & Zayatz, I. (1995): in A.K. Cooper, P.F. Barker & G. Brancolini (eds.), AGU Antarctic Res. Ser. 68: 235-260.
Greischar, L.L., Bentley, C.R. & Whiting, L.R. (1992): In: D.H. Elliot (ed.), Contributions to Antarctic Research -III, AGU Ant. Res. Series 57: 105-155.
Haq, B.U., Hardenbol, J. & Vail, P.R. (1987): Science 235 1156-1167.
Tushingham, A.M. & Peltier, W.R. (1991): J. Geophys. Res. 96: 4497-4523.
Wilson, D.S., Luyendyk, B.P., Siddoway, C.S. & Davis, M. (2000): EOS Transactions, AGU Fall Meet. Suppl., 81:F405.

Integrated chronostratigraphic calibration of the Oligocene-Miocene boundary at 24.0 ±0.1 Ma from the CRP-2A drill core, Ross Sea, Antarctica

(oral p.)

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An expanded Oligocene-Miocene boundary interval recovered in the Cape Roberts Project CRP-2A core from beneath the Ross Sea, Antarctica, has yielded a high-resolution integrated chronostratigraphy that has, in turn, enabled a new, more direct, calibration of magnetic polarity and biostratigraphic events. The Oligocene-Miocene boundary interval in the CRP-2A core comprises three ~60-m-thick, rapidly deposited (>0.5 m/k.y.) sedimentary sequences (sequences 9, 10, and 11). In sequences 10 and 11, single-crystal, laser-fusion $^{40}Ar/^{39}Ar$ analyses of anorthoclase phenocrysts from two tephra horizons independently calibrate the CRP-2A magnetic-polarity stratigraphy and age model. Sequences 10 and 11 encompass subchron C6Cn.3n, which is dated at 24.3 ±0.1 to 24.16 ±0.1 m.y. Sequence 9 is interpreted to encompass subchron C6Cn.2n and the Oligocene-Miocene boundary, which is in turn, dated at 24.0 ±0.1 Ma. These ages are ~0.2 m.y. older than those of the geomagnetic polarity time scale (GPTS) calibrated from seafloor-spreading ridges and ~0.9-1.3 m.y. older than the newly proposed astronomically calibrated ages. We contend that the discrepancy with the astronomically calibrated ages arises from a mismatch of three 406 k.y. eccentricity cycles or a 1.2 m.y. modulation of obliquity amplitude in the astronomical calibration of the Oligocene–Miocene time scale.

Using flexural modelling and geophysical data to define Neogene stratigraphic drilling targets in moat basins beneath the McMurdo Ice Shelf

(oral p.)

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Previous drilling efforts in McMurdo Sound (MSSTS, CIROS, and CRP drilling) have recovered stratigraphic sequences in which Neogene records are either absent or very incomplete. The lack of Neogene strata is thought to be a result of extensive erosion from Neogene grounding episodes of the Ross and McMurdo Ice Shelves and outlet glaciers from the Transantarctic Mountains. Further south, however, in southernmost McMurdo Sound, loading of the crust by the volcanoes of the McMurdo Volcanic province has provided a complex system of km scale flexural moat basins at the juncture of the McMurdo and Ross ice shelves. These moat basins have accumulated and subsequently protected sediment from further erosion since the beginning of loading in the early Miocene. Here, we present new, concordant, geophysical and model data that link stratigraphic sequences and basin fill in crustal depressions beneath the McMurdo Ice Shelf to the discrete volcanic loads of the McMurdo volcanic province. Comparison of 3D elastic plate models of the combined volcanic loads of Ross Island with bathymetry and gravity data indicate that the bulk of the McMurdo volcanic province was emplaced on relatively weak lithosphere (elastic thickness, Te, of ~7.5 km). Such weak lithosphere predicts relatively narrow, but deep moat basins around discrete volcanic centres. Multichannel seismic data collected across several of these moat basins indicates progressive flexural loading by volcanoes resulting in a shift in the sedimentary depocentre. Distinctive angular unconformities in the seismic records can be linked to loading horizons predicted by the flexure models. Consequently, discrete stratal components identified in seismic refection records can also be linked to specific loading events. The results demonstrate a cumulative Neogene stratigraphic sequence beneath the McMurdo Ice Shelf that may be as much as three kilometres thick.

New Rift History for the Southwestern Ross Sea, Antarctica

(poster p.)

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The margin of the West Antarctic Rift System has long been seen as a couple, with the formation of the Victoria Land rift basin linked to the uplift of the adjacent Transantarctic Mountains rift shoulder. Coring near the basin margin adjacent to the Transantarctic Mountains has changed this simple view. Here we reassess Victoria Land Basin rift history and architecture based on new data obtained by the multinational Cape Roberts Project (CRP) drilling program (CAPE ROBERTS SCIENCE TEAM 1998, 1999, 2000) and on new analysis of seismic stratigraphy and structure in the southwestern Ross Sea. The CRP recovered an aggregate of 1500 m of Cenozoic strata and cored 100 m into Paleozoic Beacon sandstone forming the rift basin floor. In order for earliest Oligocene strata to rest directly on the Devonian sandstones at the floor of the Victoria Land Basin, a period of substantial erosion must have occurred, during which post-Devonian Beacon Supergroup and Jurassic dolerite intrusions and basaltic lavas were stripped away. Initiation of Victoria Land Basin rifting was in the earliest Oligocene (~34 Ma), beginning ~20 m.y. later than the main phase of TAM uplift interpreted from apatite fission-track data (FITZGERALD 1992). If Eocene (or older) rifting initiated TAM uplift, then the rifting must have occurred further to the east, in the central Ross Sea. Early rifting (~34-29 Ma) was characterized by diffuse faulting and rapid subsidence in local graben depocenters. This rifting overlaps with the timing of seafloor spreading in the Adare Trough in the Southern Ocean (CANDE et al. 2000), but initiated later, which may suggest that the Southern Ocean spreading propagated into the Antarctic interior. In the late Early Oligocene (~29 Ma) a rift reorganization occurred, with development of an east-tilted half-graben controlled by a boundary fault system in the Ross Sea, not along the TAM margin. A broad thermal subsidence occurred subsequent to ~17 Ma, with substantial accumulation in the central basin and stratal overlap across basin margins. Superimposed on this stage is a younger faulting episode, with steep faults cutting through most of the basin fill and commonly reaching the seafloor. This is correlated with the transtensional deformation episode documented by SALVINI ET AL. (1997), which may be Miocene to recent in age.

Cande, S.C., Stock, J.M., Müller, R.D. & Ishihara, T. (2000): Nature 404: 145-150.
Cape Roberts Science Team (1998): Terra Antartica 5: 1-187.
Cape Roberts Science Team (1999): Terra Antartica 6: 1-173.
Cape Roberts Science Team (2000): Terra Antartica 7: 1-209.
Fitzgerald, P.G. (1992): Tectonics 11: 634-662.
Salvini, F., Brancolini, G., Busetti, M., Storti, F., Mazzarini, F. & Coren, F. (1997): J. Geophys. Res. 102: 24669-24696.

The SCAR ANTEC Initiative: Exploring Neotectonic Processes in Antarctica

(oral p.)

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Antarctica provides a unique laboratory to explore the influence of tectonics on ice sheets, sea level and climate processes. Conversely, we can investigate the influence of the ice sheets on continental-scale crustal motions, on the stress and strain regimes in the lithosphere and on rates and volumes of magmatism. The SCAR ANTEC (Antarctic NeoTECtonics) initiative is designed to promote and coordinate multidisciplinary research relevant to Antarctic neotectonics, including convening workshops and symposia to promote promising research directions and encouraging new research initiatives where coordinated deployments can achieve new 'leaps forward' in our understanding of Antarctic geodynamics.

The ANTEC program is promoting a range of interdisciplinary research, including the following goals:

• Discrimination between glacial and tectonic kinematic signals:
- Where are there crustal boundaries – active or ancient?
- Where is active tectonism occurring?
- What are the patterns and rates of glacio-isostatic motions?
• Mapping the structure and stress regime of the Antarctic lithosphere and asthenosphere
- How does the thermo-mechanical structure of the crust and mantle vary laterally within East and West Antarctica?
- What is the relationship between seismicity, ice loading and active tectonics?
- What is the stress field across Antarctica: are there unique driving forces?
• Understanding Neogene and active volcanic processes
- How do mantle processes (plumes?) and tectonism control volcanism?
- What is the relationship between glaciation and volcanism?
- What is the nature of active volcanism?
• Investigating the coupling between tectonics, climate and erosion
- What are the rates, styles and mechanisms of uplift and erosion around Antarctica?
- What is the history of the Antarctic ice sheet and implications for changing glacial loads, surface uplift and relative sea level?
- What is the interplay between tectonic, climatic, and glacial influences during landscape evolution?

To answer these questions, ANTEC is helping to coordinate international efforts to carry out experiments at unprecedented scales across the continent, including:
• GPS and seismic deployments, including autonomous remote stations enabled by new technologies.
Coordinated programs of geological and geo/thermochronological studies, geophysical surveys, and drilling (offshore and through the ice sheet to bedrock).
• Advances in modeling of glacio-isostatic adjustment, stress regimes, and coupled ice sheet-climate systems.
• Integration of the wealth of new data from satellite missions with Antarctic campaign measurements.
Investigation of surface processes and tectonic geomorphology using new mapping technologies (LIDAR, ice-penetrating radar), new chronological tools, and assimilation of new surface information into modeling.

A semi-circumantarctic view (40°E – 120°W) of the past 30 ka Southern Ocean development
(poster p.)

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Paleoceanographic and -climatic research has documented that processes occurring in the Southern Ocean and in the large Antarctic ice sheets play a crucial role in defining and shaping Earths climate. Correlation of the high-resolution records point to an "out of phase" relationship of the southern and northern hemisphere pointing to a transmission mechanism linked to changes in Atlantic thermohaline circulation (ATHC). However, the uniform occurrence of this mechanism, the so-called "bipolar seesaw", has recently been challenged and there is indication from coupled atmosphere-ocean climate models that the different sectors of the Southern Ocean may not react equally related to changes in ATHC. Additional hints on non-uniform climate response in the different sectors of the Southern Ocean come from Antarctic ice cores. Potential causes of this pattern may include differentiations a) between thermohaline circulation loops in the Atlantic, Indian and Pacific Ocean basins, b) of the melt water import into the Southern Ocean sectors and c) of the development and configuration of the Ross and the Filchner-Ronne Ice Shelves, each strongly influencing formation of cold water masses and sea-ice. To test such hypotheses we compare high-resolution paleoceanographic time-series that document the past 30 ka from sediment cores recovered in different sectors of the Southern Ocean. The core sites are located south of the Polar Front at c 40°E (Core PS2606-6, western Indian sector), 30°W (PS1786-1, western Atlantic sector) and at c 120°W (PS58/271-1, central Pacific sector) and thus cover a half section of the Southern Ocean. Our climate records document summer sea-surface temperatures, sea ice extent and phytoplankton productivity regimes derived from the diatom record. Age models are based on a combination of AMS^{14}C dating and diatom biofluctuation records. We focus on the determination of the timing and environmental conditions at the climate evolution steps between the coldest last glacial and the onset of the Holocene Neoglaciation. This includes the determination of the last deglaciation history at and the involved cold rebounds (e.g. the Antarctic Cold Reversal). To resolve the Southern high-latitude response and involved mechanisms at broader scale we also compare our records with previous results obtained from the eastern Atlantic sector, as well as with climate records obtained from Antarctic marine near-shore and lacustrine deposits, and from ice cores (e.g. EPICA, Byrd).

Reflection imaging of the crustal structure beneath the Mizuho Plateau, East Antarctica: SEAL – 2000, -2002
(oral p.)

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The "Structure and Evolution of the East Antarctic Lithosphere (SEAL)" project has been carried out to focus on the lithospheric structure of the early-Paleozoic crust of the Lützow-Holm Complex (LHC), Enderby Land, East Antarctica since 1996-1997 austral summer season in the framework of the Japanese Antarctic Research Expedition (JARE). Seismic exploration was conducted on the Mizuho Plateau, LHC, during the 1999-2000 and 2001-2002 austral summer seasons by JARE-41 and -43, respectively. Two survey lines were planned on the Mizuho Plateau to obtain the three dimensional model. Seismic shot records were obtained with clear arrivals of the later reflected phases by a total amount of 8300 kg dynamite charges at the 13 explosions. 300 seismic stations programmed on timer operation were installed. The purpose of this study is to investigate detailed structure of the lower crust, upper mantle and the Moho discontinuity in view from refraction and reflection by using explosive seismic waves. The obtained seismic records show the clear onsets of the first arrivals in a distance range of less than 100 km from each large shot. In particular, seismic waves traveling through the ice sheet and the dispersed surface waves are distinctly observed. Some later phases are also detected.

We used reflection analysis (band-pass filter, static correction, Normal Move Out, Auto-gain-control) for 13 shot records, and obtained two single-fold section. The reflection profile shows the several reflections around the Moho discontinuity from the both survey line. In the results of JARE-43, the Moho reflector was observed 13-14 s of two way travel time (TWT) in the single-fold section. A depth of the Moho reflector was estimated to be approximately 43-44 km at the both ends of this survey line. The reflector from the top of lower crust was shown in 9-10 s of TWT, and the depth of this reflector was located at 32-35 km. These observed several reflectors between the Moho discontinuity and the top of lower crust were corresponding with the lower crustal reflectivity reported from various continental terrains. We exhibit for the spatial distribution of reflectors from the upper and the lower crust. The reflection profile of S-wave is obtained by using reflections of S-wave. We discuss about the Vp/Vs ratio by comparison with P-wave profile and S-wave profile.

Seismological characteristics of the Moho beneath the Mizuho Plateau, East Antarctica: SEAL – 2000

(poster p.)

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Seismic exploration was conducted on the Mizuho Plateau, East Antarctica, during the 1999-2000 austral summer season by the 41st Japanese Antarctic Research Expedition (JARE-41). Seismic shot records were obtained with clear arrivals of the later reflected phases by a total amount of 3,300 kg dynamite charges at the seven explosions along the Mizuho traverse route of 180 km in length. The purpose of this study is to investigate characteristics of the Moho discontinuity in view from a reflective nature by using explosive seismic waves. First, we used the mirror image method for the travel time data of Moho reflected waves (PmP phases). Optimal image points were determined to minimize root-mean-square residuals between the observed and the calculated travel times by an iterative grid search at 1 km interval. The depth of the reflected Moho and the averaged incident angles were determined by taking the P wave velocity of the crust as a parameter. The obtained Moho depth and the associated dipping angle were well correlated with those from the previous reflection study. The amplitude spectrum analysis was also applied to obtain the difference in peak frequency of the spectrum between PmP phases and the direct P phases. Observed spectral ratio of the reflected PmP phases against the direct P phases indicate the spectral peaks at 9.5, 19.0 Hz and the spectral trough at 13.8 Hz, respectively. This pair of the spectral peaks and trough could be explained by assuming the existence of a thin reflected layer of 690-860 m thickness just beneath the Moho discontinuity. The thin layer may have relatively lower velocities of 7.0-7.8 km/s than those of the

surrounding uppermost mantle. These relatively low velocity layers around the Moho are considered to be composed of such as clino-pyroxenite and/or pyroxene-hornblende gneiss from a comparison with the high-pressure laboratory measurements of the metamorphic rocks from the Lützow-Holm Complex.

In-situ Tests of the Antarctic Penetrator on the Mizuho Plateau, East Antarctica: SEAL-2002

(poster p.)

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A seismic exploration experiment was conducted on the Mizuho Plateau, East Antarctica, during the 2001-2002 austral summer by the 43rd Japanese Antarctic Research Expedition (JARE-43) as part of the 'Structure and Evolution of the East Antarctic Lithosphere (SEAL)' program. As both end portion of the planned survey profile was believed to be located in the crevasse areas, we had to develop the seismometers which could be installed without depending on the oversnow vehicles. A dropping-type seismometer from helicopters, what we call here "Antarctic penetrator", has been developed for the above purpose.
The mechanical specifications of the Antarctic penetrator are as follows: length in 94.5 cm and total weight in 14.5 kg, respectively. A fin of the cylinder shape with 230 mm diameter and 300 mm in length was attached at the tail. A vertical-component seismometer with a natural frequency of 3 Hz was equipped in the head of the penetrator. A radio telemeter modem (1.2 GHz, 10 mW) with a 10 cm antenna for the command transmission/receiving was installed in the tail part of the penetrator in order that the recovered seismic signal data could be stored in a portable computer on the helicopter. The power supply was the super-lithium batteries of 7V-132Ah.

We prepared 22 Antarctic penetrators. They were dropped from a height of 400 m from the AS355 helicopter. However, for some electronic troubles, we could not apply them to the actual data acquisition of explosion signals. Then, we carried out several running tests and could acquire invaluable data that could not be obtained in the environment in Japan, such as declination angle of the body into the surface snow layer, magnitude of impact shock, daily temperature variation of the body in the snow. These data were useful not only to further development of the Antarctic penetrator, but also to the development of the touchdown-type geophysical equipment on the Antarctic ice sheet.

Seasonal water column properties at Marian Cove, West Antarctica: regional warming in the Antarctic Peninsula

(poster p.)

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The Antarctic Peninsula has warmed by several K over the past several decades, ice shelves have retreated over the peninsula, and sea-ice extent has decreased over the Bellingshausen Sea. On the contrary, the interior of the Antarctic continent has exhibited weak cooling, and sea-ice concentration has increased and the length of the sea-ice season has increased over much of eastern Antarctica and the Ross Sea. Marian Cove, a small fjord (4.0 km length, 1.0-1.3 km wide) in King George Island of the northern Antarctic Peninsula, has also experienced spectacular retreat of tidewater glacier (for example, about 1.0 km from 1956 to 2001 at Marian Cove); in particular, abrupt glacier retreat of 569 m from 1994-2001. After 1997 KARP (Korea Antarctic Research Program) during most of summer season, CTDT (Conductivity/-Temperature/Depth/Transmissivity) measurements at ice-proximal zone were conducted to investigate the character of water column properties. With this results, the examination through annual CTDT measurements (2000) shows that surface water of southern Polar Front come into the cove in summer and the cold and saline water of Bellingshausen Sea occupied whole water column in winter. We suggest that due to topographical situation of Antarctic Peninsula, strong westerly wind forcing in summer is accompanied by intrusion of warm surface water (>1.0°C) (corresponding to surface water of southern Polar Front) as well as a southerly migration of the January 0.0°C, resulting in regional warming unlike to other places (eastern Antarctica and the Ross Sea). Recent abrupt glacier retreat and collapse of ice-shelves in this area are likely to be related to the sustaining wind forcing (north-west sector) in fall after 1994. Therefore, seasonal pathway and origin of water mass at this region will play an important role to explain atmospheric circulation and further regional warming.

Holocene diatom ooze deposits from mass sedimentation of Weddell Sea ice-edge blooms along the Antarctic Slope Front

(poster p.)

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The formation of monospecific diatom layer in the Antarctic bays and fjords is generally considered to result from an higher settling flux of diatom valves caused by greatly enhanced biological productivity on the chemically proliferous and hydrographically stable surface water during warmer season. A second possibility is that the monospecific diatom layer formed by horizontal concentration of diatom valves as a consequence of a physical feature of water column such as an eddy or chimney, which entrains a diatom bloom towards a point above the area of ooze accumulation. Here, we report an evidence for deep-water convection at the Antarctic Slope Front on the continental margin in the northwestern Weddell Sea and associated convergent and mass sinking of ice-edge blooms to form monospecific diatom layer in the eastern Bransfield Strait. These remarkable monospecific diatom layer deposits should enable quantification of ancient deep-sea fluxes and the study of short-term climatic fluctuations during the late Holocene.

Role of the circum-East Antarctic Orogen in the East Gondwana Assembly

(oral p.)

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The Grenville-aged coastal areas of the East Antarctic shield are recently suggested to be the collage of three different segments separated by two major Pan-African sutures (FITZSIMONS 2000). This idea was promptly followed by several studies of continental reconstruction supported by palaeomagnetic data, suggesting the Pan-African assembly of East Gondwana (e.g., POWELL et al. 2001).

However, data and discussions to discard the classical model including the continuation of the Grenvillian-age Circum-East Antarctic Orogen (CEAO, YOSHIDA 1995) surrounding East Antarctica are insufficient. Throughout the area including Wilkes Land, Prydz Bay area, Enderby Land, Lützow-Holm Bay area and Dronning Maud Land, there are indications of Grenvillian events with an age range of ca 1.2-0.9 Ga. The age range of ca 1.2 to 1.0 Ga is considered to reflect the different timing of culmination of orogenic events in differnet segments of the CEAO. Ca 1.0-0.9 Ga detected in the Rayner Complex of Enderby Land and Northern Prince Charles Mountains may reflect the intrusion of late orogenic granitic rocks, and the ca 1.4-1.3 Ga events in the eastern part of the SW Australia-Wilkes Land sector is considered to be the early events in the CEAO only developed at this sector (YOSHIDA et al. 2003). During the Pan-African period, considerable part of the CEAO suffered extensive tectonothermal events, which are concentrated in two belts possibly forming two Pan-African orogens transecting East Gondwana. However, there are several data showing the occurrence of Grenvillian rocks within these orogens, and further, there is no Pan-African ophiolite in these orogens except in the Shackleton Range of the Transantarctic Mountains, suggesting a possibility of the principally intracratonic signature of these Pan-African orogens in East Antarctica (YOSHIDA et al. 2003).

Thus, there is as yet no robust data to discard the classical idea that the proto-East Antarctica existed at the time of the Grenvillian period, and that the CEAO developed at this period. This result throws doubt on the recent proposal of the Pan-African assembly of East Gondwana.

Fitzsimons, I.C.W. (2000): Geology 28: 879-882.
Powell, C. McA, Pisarevsky, S. & Wingate, M.T.D. (2001): Gondwana Res. 4: 736-737.
Yoshida, M. (1995): Geol. Soc. India Mem. 34: 25-45.
Yoshida, M., Jacobs, J., Santosh, M. & Rajesh, H.M. (2003 in press): Geol. Soc. London Sp. Pub. 206.

Neoproterozoic Accretionary tectonics of the Prydz Belt, East Antarctica: Implications for the Assembly of the East Antarctic Craton and Gondwana
(poster p.)

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For a Precambrian craton composed of composite terranes and belts, which experienced complex polyphase deformation and metamorphism, the final tectonothermal event is more significant than the earlier ones in the light of plate tectonics, because the final tectonothermal event resulted from amalgamation of the craton. Although a working hypothesis of polyphase deformation and metamorphism is widely applied to a high-grade terrane, discernment of its final tectonothermal episode is vital to understand its geological history. In the last decade, an increasing body of evidence has revealed important "Pan-African" orogenics in the East Antarctic Craton (ZHAO et al. 1992, DIRKS et al. 1993, SHIRAISHI et al. 1994, CARSON et al. 1996, FITZSIMONS et al. 1997, FITZSIMONS 2000, BOGER et al. 2001), which shakes the previous notion that the East Antarctic Shield formed ca.1000 Ma to its very foundation. That eastern Antarctic terranes, or blocks and other Gondwana blocks assembled in early Paleozoic to form Gondwana supercontinent has been accepted as a current working hypothesis (e.g. FITZSIMONS 2000, ZHAO et al. 2003). Therefore, a poorly understood gap left in Neoproterozoic for the geological history of the East Antarctic Craton should be considered to be expounded. In this paper, we discuss probable Neoproterozoic tectonism in the Prydz belt, East Antarctica based upon the SHRIMP U-Pb ages for detrital zircons from paragneisses and composite orthogneisses of the Larsemann Hills and the Grove Mountains.

Generally, prior to a collision of two continental blocks there must have been significant accretion for the blocks, which can be preserved in their collisional mountain belt. Recognition of accretionary tectonism is, therefore, a key to an understanding of the geological history immediately before the collision. However, it is very difficult to discriminate because most of rocks exposed in East Antarctica were highly metamorphosed and intensely deformed, much of original information of their protoliths has been masked by later high-grade metamorphism and deformation. Despite those above, the crystallization ages of detrital zircons from paragneisses and composite orthogneisses can constrain their depositional age in Neoproterozoic, which is backed by Nd model ages (T_{DM}) obtained (cf. ZHAO et al. 2003).

The sign of Neoproterozoic zircon crystals could be found in the SHRIMP results by KINNY et al. (1993) and CARSON et al. (1996). Our SHRIMP U-Pb analyses of zircon crystals from composite orthogneisses (G212-3 and 7104-3) confirm Pan-African metamorphism ages at 530 ±12 Ma and 546 ±12 Ma, and crystallization ages for zircon grains ranging from 665 ±16 Ma to 889 ±28 Ma and from 647 ±14 Ma to 1095 ±24 Ma, but about half of them scatter in late Neoproterozoic. Our SHRIMP U-Pb measurements of zircon grains from borosilicate-bearing paragneisses (7209 and7207-8) of Stornes Peninsula and those of paragneisses from Mirror Peninsula also yield a Pan-African metamorphism age at 517 ±10 Ma and detrital zircon crystallization ages ranging from 639 ±14 Ma to 935 ±19 Ma. Those above and the geochemical features of the gneisses demonstrate that the Neoproterozoic history contributes greatly to accretionary tectonism of the Prydz belt, East Antarctica. The assembly of the East Antarctic Craton was completed in the Pan African event, and the East Antarctic Craton is a Pan-African age collage rather than a keystone of East Gondwana during Neoproterozoic.

Boger S.D, Wilson C.J.L. & Fanning C.M. (2001): Geology 29: 463- 466.
Carson,C.J., Fanning, C.M. & Wilson, C.J.L. (1996): Austral. J. Earth Sci. 43539-553.
Dirks, P.H.G.M., Carson, C.J. & Wilson, C.J.L. (1993): Antarctic Sci. 5: 179-192.
Fitzsimons, I.C.W., Kinny, P.D. & Harley, S.L. (1997): Terra Nova 9: 47-51.
Fitzsimons, I. C. W. (2000): Geology 28: 879-82.
Hensen, B. J. & Zhou, B. (1995): Austral. J. Earth Sci. 42: 249-258.
Kinny, P. D., Black, L. P. & Sheraton, J.W. (1993): Antarctic Sci. 5: 193-206.
Shiraishi, K. et al. (1994): J. Geol. 102: 47-65.
Zhao, Y. et al. (1992): In: Recent Progress in Antarctic Earth Science: Tokyo, TERRAPUB, 155-161.
Zhao, Y. et al. (1995): Precam. Res. 75: 175-188.
Zhao et al. (2003): GSL Spec. Publ. 206: 231-245