Expeditionsprogramm Nr. 75

FS POLARSTERN

ANT XXIII/4

ANT XXIII/5

Koordinator:
Dr. E. Fahrbach

Fahrtleiter:

ANT XXIII/4
Dr. K. Gohl

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Dr. W. Jokat

ALFRED-WEGENER-INSTITUT FÜR POLAR- UND MEERESFORSCHUNG
MITGLIED DER HERMANN VON HELMHOLTZ-GEMEINSCHAFT DEUTSCHER FORSCHUNGSZENTREN E.V. (HGF)

BREMERHAVEN, JANUAR 2006

EXPEDITIONSPROGRAM No. 75

RV POLARSTERN

ANT XXIII/4

10 February 2006 - 11 April 2006
Punta Arenas - Punta Arenas

ANT XXIII/5

13 April 2006 - 12 June 2006
Punta Arenas - Cape Town

Coordinator:
Dr. E. Fahrbach

Chief Scientists:
ANT XXIII/4: Dr. K. Gohl
ANT XXIII/5: Dr. W. Jokat

STIFTUNG ALFRED-WEGENER-INSTITUT FÜR POLAR- UND MEERESFORSCHUNG
MITGLIED DER HERMANN VON HELMHOLTZ-GEMEINSCHAFT DEUTSCHER
FORSCHUNGSZENTREN E.V. (HGF)

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ANT XXIII/4

10 February 2006 - 11 April 2006
Punta Arenas - Punta Arenas

Chief Scientist:
Karsten Gohl

ANT XXIII/4

1. FAHRTVERLAUF UND ÜBERBLICK

K. Gohl (AWI)

Am 10. Februar 2006 wird FS POLARSTERN von Punta Arenas (Chile) aus zu diesem vierten Fahrtabschnitt der 23. Antarktis-Expedition auslaufen. Enden wird der Fahrtabschnitt am 11. April 2006 ebenfalls in Punta Arenas. Dieser Fahrtabschnitt besitzt einen geowissenschaftlichen Schwerpunkt mit dem Ziel, sowohl die geodynamische Entwicklung als auch den sedimentären Aufbau der südlichen Amundsensee und der Pine Island Bay in Hinblick auf die Vereisungsgeschichte der Westantarktis zu untersuchen. Des Weiteren sind biologische Probennahmen aus der Wassersäule, ein kleines ozeanographisches Programm sowie eine Personen- und Frachtaufnahme bei den Stationen Rothera und Jubany vorgesehen.

Nach dem Verlassen der Magellanstraße wird das Schiff Kurs auf die britische Station Rothera (Adelaide Island) nehmen, wo eine Personenaufnahme stattfindet. Anschließend geht es in das erste Untersuchungsgebiet bei Peter I Island und entlang einiger *Seamounts* nördlich der Insel. Von den *Seamounts* sollen mit Hilfe der Kettensack-Dredge Gesteinsproben gesammelt werden, um das Alter und die Zusammensetzung dieser Vulkanite zu bestimmen. Auf Peter I Island werden eine GPS-Station und ein Magnetometer installiert, die für die folgenden Wochen Daten registrieren. Die GPS-Messung ist eine Wiederholung eines 1998 erstmalig vermessenen Punktes des Messnetzes der Westantarktis. Das Magnetometer dient als Basisstation zur Bestimmung von zeitlichen Magnetfeldvariationen während der Helikopter-Magnetikvermessungen auf diesem Fahrtabschnitt.

Die weitere Fahrtroute führt das Schiff in das Hauptarbeitsgebiet der südlichen Amundsensee und der Pine Island Bay. Dort werden in Abhängigkeit der Eisbedingungen seismische, bathymetrische und sedimentechographische (Parasound) Profile auf dem Schelf, Kontinentalhang und in der Tiefsee vermessen, um über eine Kartierung des Meeresbodens, der Sedimentsequenzen und des Grundgebirges (Basement) Aussagen über die tektonische und sedimentäre Entwicklung dieser Region zu machen. Von den obersten Sedimenten werden mit dem Kolbenlot Kerne an selektierten Lokationen entnommen. Falls sich über die Hydrosweep- und Parasound-Vermessungen Hinweise auf aufgeschlossenes Hartgestein bzw. vulkanisches Gestein ergeben sollte, wird an diesen Lokationen Proben mit der Dredge gesammelt. Einen weiteren Schwerpunkt nimmt die Befliegung der Pine Island Bay mit dem Helikopter-Magnetiksystem ein, mit dem möglichst flächendeckend große Bereiche der Bucht kartiert werden soll, um tektonische und vulkanische Einheiten zu identifizieren.

Die Hudson Mountains und mögliche weitere Nunataks in der Festlandumgebung der Pine Island Bay sind Anflugziele für geologische Beprobungsprogramme zur Untersuchung sowohl der vulkanischen Aktivität als auch der glazialen Spuren des westlichen Ellsworth-Lands des östlichen Marie-Byrd-Lands. Auch sollen hier GPS-Stationen installiert werden, um tektonische Deformationsbewegungen festzustellen.

Ozeanographische Verankerungen werden im Bereich der Pine Island Bay abgesenkt. Die Geräte sollen ein Jahr lang die Bodenströmungsverhältnisse messen und im Folgejahr von einer amerikanischen Expedition geborgen werden. Es ist auch geplant, mit Hilfe einer GPS-Station die tidenabhängige Vertikalbewegung des Schelfeises des Pine-Island-Gletschers festzustellen.

Ein weiteres Untersuchungsgebiet liegt im Bereich der Marie Byrd Seamounts, von denen erstmalig Gesteinsproben mit der Dredge gesammelt werden sollen, um das Alter und die petrologisch-geochemische Zusammensetzung und damit die Entwicklungsgeschichte und

geodynamische Bedeutung dieses großen, aber in seiner Entstehung völlig unbekannten *Seamount*-Gebietes zu klären.
Probennahmen von Krill und Mikroben aus der Wassersäule sollen auf dem gesamten Fahrtabschnitt in regelmäßigen Abständen durchgeführt werden. An Bord sind ausführliche Experimente mit diesen Proben geplant, um die Futterabhängigkeiten und Biodiversität der Mikroben zu untersuchen.
Auf dem Rückweg aus diesem letzten Arbeitsgebiet wird FS POLARSTERN noch einmal Peter I Island anlaufen, um die GPS- und Magnetometerstationen zu bergen. Anfang April soll die Jubany-Station auf King George Island erreicht werden, wo eine Personen- und Frachtübergabe stattfindet und in der Bucht einige Sedimentkerne gezogen werden sollen, bevor es zurück nach Punta Arenas geht.

ITINARY AND SUMMARY

K. Gohl (AWI)

On 10th February, 2006, RV POLARSTERN will depart from Punta Arenas (Chile) to start the fourth leg of the 23rd Antarctic Expedition which will end on 11th of April 2006 in Punta Arenas. This expedition is focussed on geoscientific research with the goal to investigate the geodynamic evolution as well as the sedimentary structures of the southern Amundsen Sea and Pine Island Bay to help deciphering the glacial development of West Antarctica. In addition biological sampling in the water column, a small oceanographic program and the transport of persons and freight from Rothera and Jubany stations are planned.
After leaving the Magellan Strait, RV POLARSTERN will take course toward Rothera Station (Adelaide Island) where an exchange of some personnel will take place. The ship will then head to Peter I Island and will pass some seamounts north of the island during the course of which rock samples will be collected with a chain dredge to determine age and composition of these volcanics. A GPS station and a magnetometer will be installed on Peter I Island, to record data for the duration of the following weeks. By deploying the GPS it is intended to repeat the measurement of a point of the West Antarctic GPS net which had been measured in 1998 for the first time. The magnetometer serves as a base station to record temporal variations of the magnetic field during the helicopter-magnetic survey of this leg.
The ship will follow a track toward the main working area in the southern Amundsen Sea and Pine Island Bay. In this region and depending on ice conditions, seismic, bathymetric and sub-bottom (Parasound) profiles will be collected on the shelf, slope and deep sea in order to map the seafloor, the sedimentary sequences and the basement. These data sets will be used for a detailed analysis on the tectonic and sedimentary evolution of this region. On selected sites sediment samples will be taken with a piston corer. It is also planned to dredge hard-rock samples, if the bathymetric and sub-bottom mapping reveal zones in which hard-rocks are exposed. As a major component of the geophysical investigation, major parts of the Pine Island Bay will be surveyed with a helicopter-magnetic system in order to identify tectonic and volcanic units.
The Hudson Mountains and other Nunataks on the mainland around Pine Island Bay are sites of a geological sampling program for the investigation of volcanic activities as well as glacial erosion surfaces of the western Ellsworth Land and eastern Marie Byrd Land. GPS stations will be deployed for studies of tectonic deformation.
Oceanographic moorings will be deployed in the area of Pine Island Bay. The instruments will record bottom-current activity for about one year and will be recovered by an American expedition in the following season. The geodetic group plans to deploy a GPS instrument on the ice-shelf of Pine Island Glacier to measure tidal movements.

The next area of investigation will cover the Marie Byrd Seamounts from which dredge samples will be taken in order to determine their age of formation and petrological-geochemical composition. These samples and data will be used in a study on the evolution and geodynamic importance of this large seamount area in the Amundsen Sea the formation of which is hardly known yet.
It is further planned to collect krill and microbial species from the water column on several sites along the entire ship track of this leg. Experiments are planned on board which will help investigating the microbial food web and biodiversity in the Southern Ocean.
During the return track from this last working area, the ship will go close to Peter I Island to allow the recovery of the GPS and magnetometer stations. At the beginning of April, Jubany Station in King George Island will be called for person and freight transfer and for a collection of some sediment core in the bay before RV POLARSTERN will head back to Punta Arenas.

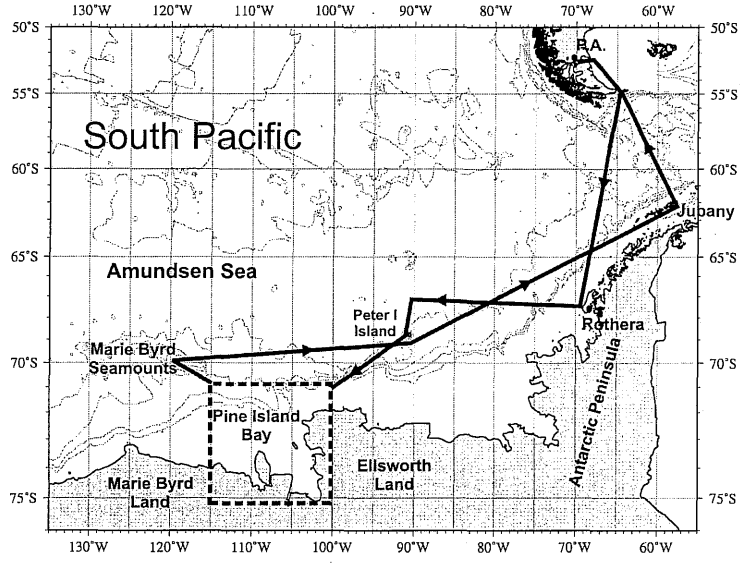

Abb. 1. Fahrtroute des FS POLARSTERN während der Expedition ANTXXIII/4. Das Hauptarbeitsgebiet bei Pine Island Bay ist als gestrichelt umrandete Fläche angegeben. Hier muss die Fahrtroute abhängig von den Eisverhältnissen bestimmt werden.
Fig. 1: Planned track of RV POLARSTERN expedition ANT XXIII/4. Hashed box indicates main working area in Pine Island Bay where ice conditions dictate the tracks.

2. CRUSTAL AND SEDIMENTARY STRUCTURES AND GEODYNAMIC EVOLUTION OF THE WEST ANTARCTIC CONTINENTAL MARGIN AND PINE ISLAND BAY

K. Gohl, G. Uenzelmann-Neben, G. Eagles, A. Fahl, T. Feigl, J. Grobys, J. Just, V. Leinweber, N. Lensch, C. Mayr, N. Parsiegla, N. Rackebrandt, P. Schlüter, S. Suckro, K. Zimmermann (AWI), S. Gauger (Fielax), H. Bohlmann (Isitec), G. Netzeband (University Hamburg), P. Lemenkova (VIG)

Objectives

Since the last glacial maximum the West Antarctic Ice Sheet (WAIS) with a base mostly beneath the present-day sea-level has experienced dramatic volume changes within short periods of time. Studies are urgently required to show how these short-term variations are related to volume changes in the older geological past. Next to the ice drainage basins of the Weddell Sea and the Ross Embayment, Pine Island Bay forms the third-largest outflow area for the West Antarctic ice-shield. The main ice streams from the WAIS into Pine Island Bay flow through the Pine Island and Thwaites Glacier systems, through which most of the glacial-marine sediments onto the shelf of Pine Island Bay and across the continental slope into the deep sea have been transported. Geophysical surveys of the sedimentary sequences and the underlying basement of the shelf and slope of the southern Amundsen Sea, Pine Island Bay and its adjacent continental rise would allow reconstructions of the formation of the tectonic and older sedimentary processes as well as to find out about the history of large-scale glaciation in West Antarctica. Accurate models of the geodynamic-tectonic evolution contain some of the most important parameters for understanding and reconstruction of the palaeo-environment. The following objectives will be addressed during ANT XXIII/4 as part of a cooperative project between the Vernadsky Institute in Moscow (Dr. Gleb Udintsev) and AWI:

- Identification of the boundaries between suspected crustal blocks and volcanic zones in Pine Island Bay. The glacier troughs and Pine Island Bay are thought to have developed along such tectonic boundaries. Heli-magnetic, gravimetric and deep crustal seismic (reflection and refraction/wide-angle) surveys in the Pine Island Bay area will provide the necessary data base.

- During and after separation from the Chatham Rise and Campbell Plateau (New Zealand), the continental margin of Marie Byrd Land developed as a passive margin, probably accompanied by intensive volcanism. The question is whether this volcanism occurred mainly during the rifting process or during post-rift phases, or whether it developed in relation to the West Antarctic rift system. Helicopter-magnetic mapping and deep crustal seismic profiling of the continental margin of Marie Byrd Land will provide data to develop models of the magmatic evolution.

- Recording of the sedimentary sequences across the shelf, slope and the continental rise, using reflection seismics, sub-bottom profiler (Parasound) and swath-bathymetry (Hydrosweep) in order to derive a sedimentation model.

- Mapping of the acoustic basement and its structure with seismic reflection methods to obtain the tectonic geometries and boundary conditions necessary to understand sediment transport and depositional processes.

Work at sea
It is planned to collect seismic, bathymetric and Parasound profiles across the shelf, slope and rise of the continental margin of the southern Amundsen Sea. This will be conducted in conjunction with the project *"The response of Quaternary climatic cycles in the south-east Pacific: development of the opal belt and dynamic behaviour of the West Antarctic Ice Sheet"* (Kuhn et al.) and the project *"Quaternary West Antarctic Deglaciation in the Amundsen Sea Embayment"* (Johnson et al.). The exact location of the profiles will be determined during the expedition with respect to ice conditions.
Closely spaced helicopter-magnetic lines will be flown to cover the area of Pine Island Bay as much as possible for a magnetic map of the region to be compiled. The exact location will be determined during the expedition depending on the ship position and flight conditions.

3. THE RESPONSE OF QUATERNARY CLIMATIC CYCLES IN THE SOUTH-EAST PACIFIC: DEVELOPMENT OF THE OPAL BELT AND DYNAMIC BEHAVIOUR OF THE WEST ANTARCTIC ICE SHEET

G. Kuhn, C. Hass, M. Kober, M. Petitat, T. Feigl (AWI), C-D. Hillenbrand (BAS), S. Krüger (Uni Leipzig), M. Forwick (Univ. Tromsø), S. Gauger (Fielax), P. Lemenkova (VIG)

Objectives
The reconstruction of the paleoclimatic and paleoceanographic development of the late Quaternary south polar ocean and adjacent continental areas in high temporal and spatial resolution is the main goal of our long-term study. During this expedition the sedimentary budget of biogenic and terrigenous components and their variability will be investigated. One objective of this leg is to continue the studies of former expeditions to gather more detailed paleoceanographic information on the eastern Pacific sector of the Southern Ocean for reconstruction of the distribution of water masses, frontal systems and sea ice, as well as information on high export productivity areas and their impact on global climate evolution. Thus, it will help us to broaden our understanding of the impact of environmental processes in the Southern Ocean on global climate. The second objective is to investigate the response of the West Antarctic Ice Sheet (WAIS) to Quaternary climatic changes. This ice sheet represents the most instable portion of Antarctic ice. The distribution pattern of the WAIS and its development can be deciphered from the sediment deposition in the study area. Previous investigations indicated that the WAIS collapsed once or multiple times during the past 0.75 million years. However there are also controversial findings. Since marine-geological records of glaciomarine deposition proximal to the WAIS are sparse, the exact timing and boundary conditions for such an event, which would result in a rise of the sea level of 5-6 m, are not yet known. The reconstruction of environmental conditions based on a multiproxy approach (this includes the investigations of sediment composition, microfossil assemblages and isotopic measurement of biogenic components) and its stratigraphic dating should substantially add to the knowledge of the WAIS history and its stability during a possibly warmer climate in the future.

Work at sea
It is planned to recover sub-bottom echosounder information and Quaternary sequences from the farther south-east Pacific (De Gerlache Seamounts) on the transit to the Amundsen

Sea and to sample glaciomarine sediments from the shelf, the continental slope and rise of the Amundsen Sea, and in and offshore Pine Island Bay. Coring the deposits in the Amundsen Sea would reveal an ideal tool for the reconstruction of past ice-volume changes in West Antarctica, because Pine Island Bay represents a so-called "exit gate" for WAIS. To expand these investigations of proximal glaciomarine environments it is planned to measure Parasound profiles at suitable water depths when RV POLARSTERN will deliver supplies to Dallmann Lab at Jubany Station located at Potter Cove. The time spent for the exchange of material via helicopter will be used for investigations within Potter Cove and outside Potter Cove in Maxwell Bay, and to take sediment cores and surface samples.

For the documentation and mapping of the sediment distribution in the research area the Parasound system will be used continuously. This system is permanently installed on RV POLARSTERN. Parasound-DS2 is a sediment echosounder system and collects digital, ultra-high resolution seismic data. It generates short signals of 2.5–5.5 kHz frequency (transmission power max. 70 kW) in a narrow beam by using the parametric effect (primary frequency 18 kHz, secondary frequency 20.5 - 23.5 kHz). A footprint size of only 7 % of the water depth provides superior lateral and vertical resolution compared to conventional 3.5 kHz echosounder systems. A two-channel receiver allows collecting the 18 kHz and the selected parametric frequency.

The data collected by means of such a sub-bottom echosounder together with the bathymetric data serve as fundamental elements for a mapping of the area and the selection of sediment sampling locations, thus establishing the basis for a successful completion of the planned studies. Such pre-site survey also helps to reduce the number of sampling locations to its appropriate minimum and thus helps to further minimize disturbances at the sea floor related to the sampling.

The sampling of Pliocene and Pleistocene sediments will be achieved by using piston and gravity corer devices for sediment coring and multicorer as well as box corer systems to collect surface sediments. Collection of sediment samples is planned at a total of 25 localities in the study areas.

On board the physical properties of sediment cores such as attenuation of gamma rays, p-wave travel time and magnetic susceptibility are measured with a Multi-sensor core logger (MSCL). From these data bulk density, velocity of compressional waves and magnetic volume susceptibility can be processed. The measurements are performed on unopened and partly on split cores. On a second logging tool colour scans of split cores and spectral colour reflectance are measured. With these logging data first indications about the lithology of the sediments can be found on board. By comparison with dated sediment cores of the region first tentative age models can be given. Then qualified cores can be selected for further sampling and investigations.

4. QUATERNARY WEST ANTARCTIC DEGLACIATION IN THE AMUNDSEN SEA EMBAYMENT

J. Johnson, C.-D. Hillenbrand (BAS), K. Gohl, G. Uenzelmann-Neben, G. Kuhn, C. Hass, M. Kober, M. Petitat, A. Fahl, T. Feigl, J. Just, N. Lensch, P. Schlüter, K. Zimmermann, N. Rackebrandt (AWI), H. Bohlmann (Isitec), S. Gauger (Fielax)

Objectives

The Amundsen Sea Embayment lies offshore from Pine Island and Thwaites glaciers, which exhibit the most rapid elevation change/ice thinning and grounding-line retreat in Antarctica. It has been suggested that this area might be the most likely site for the initiation of collapse of the two million km^2 West Antarctic Ice Sheet (WAIS), which would result in a global sea-level rise of 5 to 6 m. At present it is not clear to what extent the current retreat of WAIS grounding lines is part of the ongoing recession that started more than 14,000 years ago and to what extent it reflects more recent climatic changes. The marine record of Quaternary deglaciations in the Amundsen Sea Embayment, coupled with ice sheet models, can provide important clues to understanding the stability and climate sensitivity of the WAIS. Marine geological and geophysical data will be collected as part of a cooperation between the Britisch Antarctic Survey (Dr. Rob Larter) and AWI to determine:

a) the glacial maximum extent of the ice sheet,
b) the extent of fast ice flow in the former ice sheet, and controls on the location and onset position of fast ice flow,
c) the retreat history of the ice sheet,
d) whether or not the last ice sheet and its deglaciation are representative of events during earlier Quaternary glacial cycles.

Work at sea

It is planned to collect high-resolution seismic reflection, Parasound and Hydrosweep data at least along two profiles running from the continental slope to 75°S, and at least along two profiles running parallel to the continental margin in the mid-shelf area. The seismic data will reveal to what extent underlying geological features have controlled the location of glacial troughs, whether or not these troughs have changed location through time, and whether or not there are any unusual depositional units that could represent past events of ice sheet collapse. If lower resolution seismic profiles are collected on the cruise to study the deeper structure of the margin, it is proposed to utilize the uppermost parts of these profiles, together with Hydrosweep and Parasound data collected along them, to provide additional constraints on the Quaternary glacial regime. The Hydrosweep and Parasound data will show the extent of glacial morphological features on the continental shelf, and the distribution and thickness of till sheets left behind during the last deglaciation. In addition to seismic and sonar data, the collection of a suite of piston cores, gravity cores and multi-cores to investigate changes in sediment delivery to, and sedimentary processes on the continental slope is planned.
The RRS James Clark Ross (JCR) (chief-scientist Robert Larter) will visit the same area in January and February 2006 as part of the British Antarctic Survey's Quaternary West Antarctic Deglaciations (QWAD) project, and will carry a vibrocorer to collect cores of up to 6 m long from glacial sediments on the continental shelf. The objectives of this coring programme are to

a) improve constraints on the timing of glacial retreat across the shelf,

b) determine the physical properties of former subglacial tills, both in the main glacial trough and on the adjacent banks,

c) investigate the nature of sediments in deep troughs that have been interpreted as tunnel valleys carved by subglacial meltwater.

If the JCR cruise is successful in reaching the coring targets on the shelf, it is suggested that the main aim of sediment sampling on RV POLARSTERN should be to use the piston corer to recover long cores from the continental slope. If the JCR cruise is not successful in recovering the planned suite of cores from the shelf, it would be useful to attempt to collect cores from some of the target locations using the coring equipment on RV POLARSTERN. It will be important to maintain close liaison during the season to ensure that complementary sets of data and samples are collected on the two cruises.

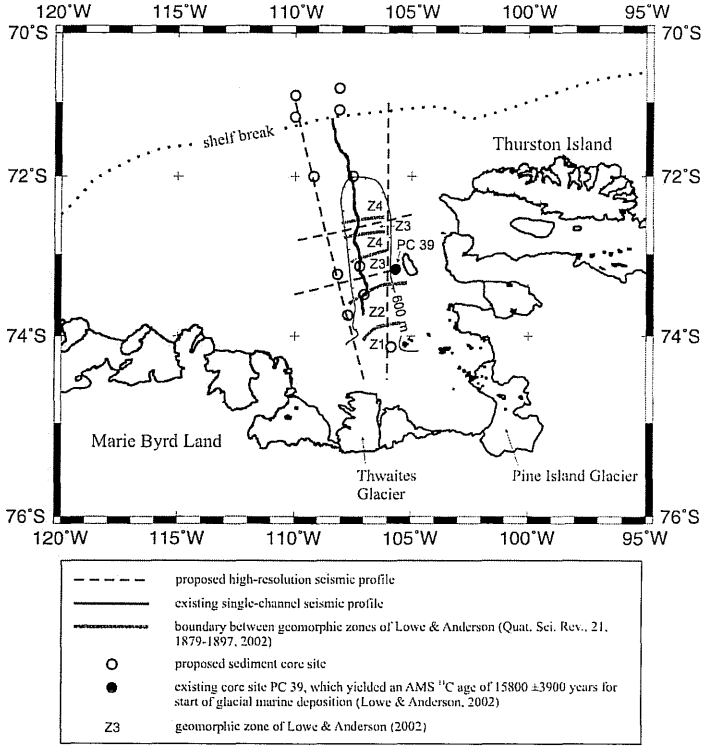

Fig. 2: Planned seismic profiles for Quaternary deglaciation studies in Pine Island Bay

5. ORIGIN AND EFFECTS OF MAGMATISM AT THE MARIE BYRD SEAMOUNTS AND OTHER SEAMOUNTS

F. Hauff, S. Hauff (IfM-GEOMAR), R. Werner (Tethys), A. Veit (Univ. Jena)

Objectives

The Marie Byrd Seamounts are a large submarine volcanic province located in the southern Amundsen Sea between ~68° and ~71°S and ~114° and ~131°W. The individual volcanoes rise up to 3,000 m above the surrounding seafloor at depths of ~3,500 – 4,000 m. Mapping of two of the Marie Byrd Seamounts on former cruises revealed flat-topped, guyot-type seamounts with several small volcanic cones on their tops and flanks. These observations may suggest that (1) the Marie Byrd Seamounts once formed island volcanoes which were eroded to sea level and subsequently subsided to their present position, and (2) that they have been formed during several periods of volcanic activity. The origin and geological history of the Marie Byrd Seamounts, however, remains enigmatic. On RV POLARSTERN cruise ANT XXXIII/4 we will carry out bathymetric (depth) mapping and the first systematic rock sampling of the Marie Byrd Seamounts. Minor mapping and rock sampling is additionally planned at the De Gerlache Seamounts and at seamounts close to Peter I. Island. Over the next two years shore-based investigations of volcanology, geochemistry, and geochronology will be carried out on the collected samples. The data from the geological studies and the bathymetric data acquired during the cruise ANT XXXIII/4 will be used to constrain the age, magma sources and evolution of the volcanism which has formed the Marie Byrd Seamounts.

Why is it important to learn more about the Marie Byrd Seamounts? By contrast to the majority of the volcanoes on Earth, which are located at plate boundaries (i.e. the circum Pacific volcanoes), the Marie Byrd Seamounts were formed by volcanism within a plate. Since the introduction of plate tectonics, intraplate volcanism has generally been attributed to continental rifting (e.g., East African volcanoes) or mantle plumes (e.g., Hawaii, Reunion, Canary Islands), which are believed to bring hot mantle material from the Earth's interior - possibly from as deep as the boundary between the Earth's core and lower mantle at 2,900 km depth – to the base of the lithospheric plates, causing extensive volcanic activity. Recently, however, a global debate has developed on the origin of intraplate volcanism (the so-called "Great Plume Debate") in response to increasing problems in explaining intraplate volcanism in many areas (in particular in the southern Pacific region). The Marie Byrd Seamounts appear to be a typical example for such enigmatic intraplate volcanism, since their wide and irregular distribution and their location on oceanic crust are difficult to explain by just referring to the „classic" models for the origin of intraplate volcanism. The investigation of the Marie Byrd Seamount volcanism should therefore provide new insights in the magmatic and geodynamic processes which cause intraplate volcanism.

Another important question is if the volcanism in the area of the Marie Byrd Seamounts originated by tectonic or magmatic processes which are related to the break-up of the Cretaceous supercontinent Gondwana (consisting of Africa, South America, Antarctica, Australia, India, and the New Zealand micro-continent). Marie Byrd Land, for example, was attached to the New Zealand micro-continent 110 million years ago. The break-up of Gondwana began with the separation of Africa and South America beginning about 130 million years ago. The separation of New Zealand and Australia from Antarctica at approximately 105 million years ago represents the final phase of the break-up of the Gondwana supercontinent into the present-day continents. The Marie Byrd Seamounts, located on oceanic crust off the shelf of Marie Byrd Land may represent a relict of the final phase of the Gondwana break-up. Our investigations may therefore also contribute to a

better understanding of geodynamic processes which cause continental break-up and to the reconstruction of the plate tectonic evolution of the southwest Pacific.

Work at sea

According to the ANT XXIII/4 cruise schedule, we are planning to carry out reconnaissance mapping and sampling at the De Gerlache Seamounts and at seamounts close to Peter I Island for approximately one day at the beginning of the cruise and approximately 7 days systematic mapping and sampling of selected volcanoes of the Marie Byrd Seamounts subsequent to the studies in the Pine Island Bay. General station areas for our studies will be chosen based on bathymetric maps derived from gravity data or, whenever available, on swath mapping, magnetic, and seismic data gained on former cruises. The selected volcanoes will be partly or completely mapped using the Hydrosweep DS-2 multi-beam echo sounding system installed onboard RV POLARSTERN. Subsequently the volcanoes will be sampled using chain bag dredges. Chain bag dredges are similar to large buckets with a chain bag attached to their bottom and steel teeth at their openings, which are dragged along the ocean floor by the ship or, preferably, the ship's winch. Depending on their morphology the volcanoes will be dredged on steep slopes, at noses and small ridges, scarps, plateau margins or at small cones located on their flanks and tops. This procedure will be mainly applied to avoid thick sediment cover.

Once onboard, a selection of the rocks will be examined and grouped according to their lithologies and degree of marine weathering. The immediate aim is to determine whether material suitable for geochemistry and age dating has been recovered. If suitable samples are present, the ship moves to the next station. If they are not, a decision on whether to attempt a second dredge haul at the same locality or to move on to the next station is made weighing the importance of obtaining samples from this station against the available time. Fresh blocks of representative samples will then be cut and further processed to remove manganese and/or to extract volcanic glass (if present). Each of these sub-samples, together with any remaining bulk sample, will be described, labelled, and finally sealed in plastic bags for transportation. Further studies on land will involve processing and interpretation of the multi-beam data, volcanological and petrographic examination of rocks, analyses of crystals and volcanic glass using a electron microprobe (EMP), determination of major and trace element geochemistry by X-ray fluorescence spectrometry (XRF) and inductively coupled plasma mass spectrometry (ICP-MS), analyses of radiogenic isotope ratios by thermal ionization mass spectrometry (TIMS) and multi-collector ICP-MS, and radiometric dating of suitable samples by the $^{40}Ar/^{39}Ar$ technique.

6. DETERMINATION OF VERTICAL AND HORIZONTAL DEFORMATIONS OF THE EARTH'S CRUST IN WEST ANTARCTICA BY GPS OBSERVATIONS

R. Dietrich, A. Richter (TU Dresden)

Objectives

The determination of the recent deformation pattern in Antarctica plays an important role for the investigation of the glacial history and the tectonic situation. East Antarctica and West Antarctica show considerable differences in the deformation regime. Horizontal motions at continental scale can be interpreted within the concept of global plate kinematics. The question has to be answered how far the plate-tectonic pattern of West Antarctica is coherent

to that of East Antarctica. The planned GPS measurements should help to determine possible recent horizontal deformations in the area of investigation. Vertical motions can be interpreted as ice-induced deformations, but also as deformations caused by neotectonics. Ice-induced deformations are caused by ice mass changes during the course of the glacial history, but also during recent times. In West Antarctica, these ice mass changes are of much greater magnitude than in East Antarctica, so that the load effects result in larger vertical deformations (factor 10). Especially the area of investigation with the Pine Island and Thwaites glaciers shows the largest ice mass imbalance in the entire Antarctic. Geodetic satellite positioning by GPS enables the precise determination of coordinates of properly marked points on bedrock. If repeated measurements are carried out, vertical and horizontal motion rates can be inferred with an accuracy in the sub-centimetre level.
In the area of investigation (Thurston Island, Pine Island Bay) several locations should be established and observed by GPS for a time period of (at least) seven days. Additionally, a station at Peter I Island (first observed in 1998) will be re-observed. From the analysis of the GPS data we will infer vertical motion rates which will serve as independent information for the validation and improvement of models on the mass balance as well as on the glacial history in the region of Pine Island Bay. The GPS results on horizontal motions will help to interpret the recent tectonic situation in the area of investigation. Additionally, several locations on floating ice (ice shelves, Pine Island glacier tongue) should be observed by GPS in order to determine ocean tides and float regime. These locations should be established temporarily and in close coordination with the observation regime of the bedrock sites and the available logistics.

Work at sea

- Deployment of the GPS station at Peter I Island, recovery at the return from Pine Island Bay,

- Establishment of up to six sites on bedrock in the region of Thurston Island, Pine Island glacier and Thwaites glacier (see overview map, regions A to F), observation duration: typically 7 days,

- Actual locations will be chosen according to the conditions and time schedule of the helicopters as well as in close cooperation with the other land operations (geology, seismology).

- Observation of up to four locations on shelf ice / glacier tongue in the area of Pine Island Glacier (according to the ice conditions), observation durations: as long as possible (typically 14 days in order to separate the main tides).

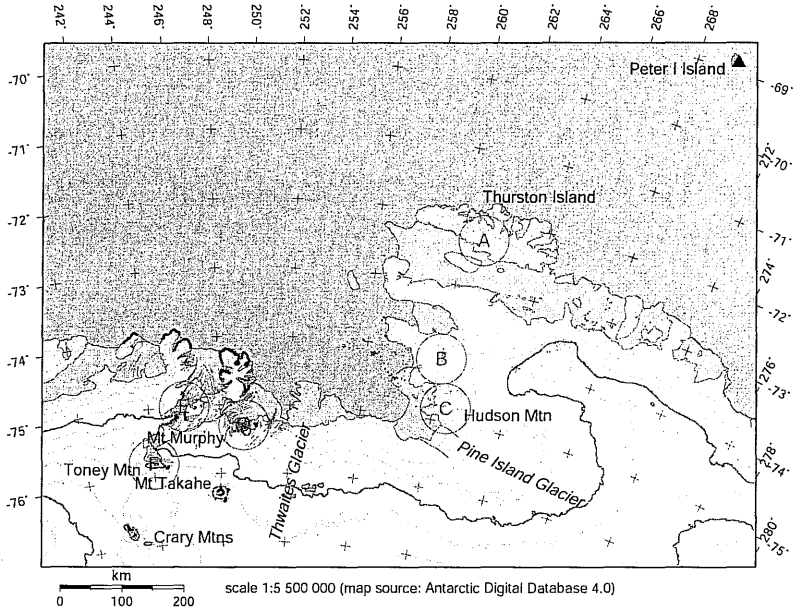

Fig. 3: Overview map of the area of investigation with proposed observation locations on bedrock (A-F)

7. VOLCANOLOGY AND PETROLOGY OF THE HUDSON MOUNTAINS VOLCANIC FIELD AND ITS INTERACTION WITH THE WEST ANTARCTIC ICE SHEET

R. Werner (Tethys), K. Daniel, A. Veit (Univ. Jena)

Objectives

In combined application of volcanological, mineralogical, geochemical and geochronological analyses it is intended to characterize the spatial and temporal development of the remote and thus poorly known Cenozoic Hudson Mountains Volcanic Field as well as the petrogenesis of its magmas. The Hudson Mountains Volcanic Field (HMVF) is located in western Ellsworth Land, West Antarctica, at 73°45' - 74°55'S and 98°20' - 100°30'W. With a width of about 60 km it stretches N-S for about 160 km along the Walgreen Coast and is accessible via Amundsen Sea into Pine Island Bay only in late Antarctic summers. The volcanic field parallels the continuation of the Udintsev Fracture Zone, along which the

eastern end of the Campbell Plateau moved away from West Antarctica since 84 Ma. It also parallels the boundary between the two geodynamic microplates of Marie Byrd Land and Thurston Island Block.
HMVF is formed by a large number of nunataks (>50) formed by small, only slightly eroded cones (some with shallow but well-defined craters) in glaciated Ellsworth Land. It comprises three larger and more eroded stratovolcanic cones (Teeters Nunatak 617m, Mount Moses 749m, Mount Manthe 567m) that are reported to consist of palagonite tuff and olivine-phyric basaltic lava flows by the only international scientific team (led by K.E. La Prade in 1968) that visited the remote volcanic field yet. Most volcanological (subglacial facies analyses) and chemical data (e.g. REE and isotopes) are still missing that would allow petrological interpretations and a comparison with the known volcanic fields within West Antarctica.
The main objectives of this helicopter supported geology project are:

1) Tephrostratigraphy: HMVF is No. 1900-028 in the "List of active volcanoes of the world" within the Global Volcanism Program based on information of possible presence of steam as well as satellite data that suggest an eruption at Webber Nunatak in 1985. However, the late map of the coastal areas of West Antarctica and the Amundsen Sea shows a large stratovolcanic conal structure at Shepherd Dome with a central depression instead of a domal structure as described by the field party in 1968. It is therefore assumed that the eruption did not occur at Mount Webber, whose flat form of hyaloclastites seems to be unchanged, but rather at Shepherd Dome. We will locate the position of the eruption and study in detail the tephra layers that must occur within snow and ice-profiles in order to describe the type of the eruption as well as the composition of the erupted magma, in order to deduce its source and intracrustal evolution by petrographic and chemical rock and phenocryst analyses.

2) Paleoclimatology: The interaction of magma with ice results in glacivolcanic eruptive products that can be recognized by unique petrographic and lithologic criteria. The field studies will thus enable us to use this information as a paleoclimatological tool for inferring earlier paleo-ice presence and thickness. Geochronological analyses will provide the time frame for the reconstruction of the paleo-ice dynamics.

3) Geodynamics: we intend to test the model of southward trending volcanic activity with its possible effects on the stability of Pine Island Glacier by deducing the erosional stage of nunataks through mapping stratigraphic successions and by mapping products of paleo- and recent hydrothermal activity; if volcanism is younger in the south, this would be of major relevance for the mobility and stability of the Pine Island Glacier, the fastest glacier in West Antarctica, that passes the volcanic field in the south and thus may be underlain by recent and future loci of eruptions. Field observations will also permit to identify a possible alignment of volcanic centers in order to deduce motions of the lithosphere relative to magma sources. We aim to watch out for lithospheric xenoliths in order to gain information on the lithologic composition of the pre-volcanic basement and the lithospheric mantle of Western Ellsworth Land.

4) Igneous Petrology: we will sample magmatic rocks of the nunataks in a reconnaissance program and apply modern lab techniques of trace element and isotope analysis in order to set up the base of chemical information for petrologic interpretations. We may thus be able to verify whether the Hudson Mountains

volcanic field is part of the Marie Byrd Land Province or an isotopically unique Ellsworth Land Province.

8. ASSESSING TIMING OF QUATERNARY DEGLACIATION IN THE PINE ISLAND/THWAITES GLACIER AREA, USING COSMOGENIC SURFACE EXPOSURE DATING

J. Johnson, T. O'Donovan (BAS)

Objectives

The Pine Island and Thwaites glaciers exhibit the most rapid elevation change/ice thinning and grounding-line retreat in Antarctica. It has been suggested that this area may be the most likely site for the initiation of collapse of the two million km^2 West Antarctic Ice Sheet (WAIS), which would result in a global sea-level rise of 5 to 6 m.

The strongest evidence that the present-day WAIS may be prone to collapse would come from a record of well-dated observations of changes in the extent and thickness of the ice sheet earlier in the Quaternary. Some authors have used marine geological data to infer that part of the WAIS collapsed at least once during the last 600 ka, but others have disputed this. The BAS QWAD (Quaternary West Antarctic Deglaciation) project aims to combine evidence from both the marine and terrestrial geological record of Quaternary deglaciations in the Pine Island Bay region. This will be vital in understanding deglaciation history of this area, and will also enable us to put the more recent changes in the WAIS into a long-term context.

On this cruise, I propose to collect samples from glacial erratics lying on bedrock surfaces, for cosmogenic surface exposure dating. Surface exposure dating gives us the length of time these rocks have been exposed on the surface to cosmic rays rather than being covered by ice. Nunataks in the Pine Island Glacier area will be sampled at different elevations, in order to construct an age versus elevation record that will be used to constrain the vertical thinning of the ice sheet through time. These terrestrial cosmogenic dates will complement radiocarbon dates from marine sediments (to be obtained on a BAS cruise to Pine Island Bay in early 2006), which will be used to assess the lateral retreat of the WAIS across the continental shelf. Further BAS-supported fieldwork in this area is planned for 2007/8.

Work plan

Helicopter support will be shared with that of the GPS and rock sampling programmes of Prof. Reinhard Dietrich and Prof. Lothar Viereck-Götte, so specific sites will be negotiated with them. The most interesting outcrops for assessing the rate of thinning of the ice sheet are those in the Hudson Mountains. Exposure ages of erratic boulders from the Southern Hudson Mountains (e.g. Webber Nunatak, Mount Manthe and Evans Knoll) will tell us about the surface profile of Pine Island Glacier, whereas those in the Central Hudson Mountains (e.g. Mount Moses and Mount Maish) will give information about Lucchitta Glacier. If the opportunity arises and there is sufficient outcrop, I would also like to visit some of the islands in Pine Island Bay (e.g. Brownson and Backer Islands). Dates from these would tell us about ice sheet thinning further out towards the continental shelf.

9. THE EFFECTS OF KRILL LARVAE AND COPEPODS ON THE DIVERSITY AND FUNCTION OF THE ANTARCTIC MICROBIAL FOOD WEB

S. Wickham (Uni Salzburg), N. Kamennaya (University Jerusalem),
E. Neubacher, U. Steinmair, T. Walter (University Salzburg)

Objectives

The microbial food web plays a central role in most aquatic systems, and in the Antarctic, this is particularly true during in the austral fall and winter, when primary production is minimal and the food web is net heterotrophic. The central question of the project is to what degree the microbial food web in the Antarctic is connected to the classic food web, and what is the role of biodiversity in modulating this connection? It is well established that predation can alter the diversity of prey communities and this can reduce the impact of predators on total prey biomass: less predation-vulnerable species increase as the competitively dominant prey species are grazed down. Recent work has proposed that this interaction between predation and biodiversity of the prey is dependant on the productivity of the system, with predation having less impact on prey biodiversity as productivity declines. It is often difficult to show strong connections between the microbial and classic food webs, with changing biomass in upper trophic levels having little or no effect on the heterotrophic and autotrophic flagellates or bacteria of the microbial food web. Previous work of the project leader showed that in late fall, removing almost all ciliate biomass through predation by the furcilia larvae of krill had no measurable effect on the trophic levels beneath ciliates. A possible explanation for this is that there were changes in abundance of individual species, but not in the community as a whole. The project will address these questions during the cruise as primary productivity is declining.

Work at sea

Surface water samples will be amended with a range of abundances of either krill furcilia larvae, calanoid, or cyclopid copepods. This will allow the grazing rates and the effect of grazers on prey biodiversity to be measured over a broad range of predation pressures. Biodiversity will be measured with both morphological and molecular methods. Anton Post will examine the molecular diversity of the picoautotrophs, Ulrike Steinmayr the molecular diversity of the protists, Elke Neubacher the morphological diversity and grazing rates of the heterotrophic flagellates, and Torbin Walter the grazing rates of the copepods and furcilia. Stephen Wickham, the project leader, will coordinate the experiments and examine the morphological diversity of the ciliates. The same experimental design will be repeated during the cruise as primary productivity declines. In this way, the interaction of predation and productivity on biodiversity within the microbial food web can be examined. In addition, water profile samples will be taken in order to determine the in-situ diversity of the autotrophs, protists and metazoan zooplankton.

The experiments will be run on board and require deck space with a seawater supply for three 500 L incubators (e.g. C deck or the observation deck). It is planned to run 15 experiments, each with a 24 – 48 h duration, spaced regularly throughout the cruise. The day previous to the start of an experiment, we will need a single haul with the Bongo nets, from 300 m water depth and vertical tow rate of 0.3 m sec^{-1} (i.e. ca. 40 min. for a complete tow). The following day water for the experiments will be obtained with a single CTD cast, taking water from 30 m depth. This will require ca. 30 min.

In addition to the experiments, we will take samples to measure *in-situ* diversity. At S. Schiel's (AWI) request, 12 Multinet hauls will be taken to sample copepods. When possible, hauls will be taken from 1000 m water depth, raising and lowering the net at 0.5 m sec^{-1}. As a result, a single haul will require ca. 70 min. Concurrent with the Multinet hauls, CTD casts will be taken to sample protist and picoautotroph diversity, sampling the same depth range as the Multinet. This will require ca. 30 min per cast. On five occasions, it is hoped to take parallel hauls to fix samples for morphological and molecular work (in formol and alcohol, respectively). It would be optimal, if the Multinet and CTD profiles can be taken along an offshore-onshore transect, either from Peter I Island or the Marie Byrd Seamounts to Pine Island Bay.
Should the opportunity arise to visit land ponds or ice melt-water ponds in connection with ongoing work by other groups, these "targets of opportunity" will also be sampled for their biodiversity.

10. MARINE MAMMAL AUTOMATED PERIMETER SURVEILLANCE (MAPS)

M. Ritter (AWI)

Background
Ship based detection of marine mammals has a broad range of applications. Population ecologists with focus on whale distributions and migratory patterns are interested in effective methods for conducting a census of marine mammals. Users of hydroacoustic instruments are interested to most effectively implement reliable mitigation methods if adverse reactions of marine mammals to the ship's presence may be apprehended.

Objectives
Near the surface, whales might be recognized by their warm blow, which stands out against the cold Antarctic environment. This project, which is part of the mitigation strategy for hydroacoustic surveys, focuses on infrared imagery to develop a pattern recognition algorithm aimed at automatically and reliably detect whale blows under varying environmental conditions.

Work at sea
Two infrared cameras with different field of views (7 and 12 degree) and a visual camera are mounted in the crow's nest with image acquisition software continuously monitoring the regions ship's perimeter for infrared signatures of whale spouts, even at night and poor visibility. A pattern recognition algorithm developed at University of Leipzig shall be tested and improved upon during the cruise. The number of automated detections will be compared with concurrent visual (human) whale sightings to evaluate the efficiency of the MAPS System.

11. MONITORING OF WHALES

M. Blume, M. Schmiing, J. Strahl (AWI)

Objectives

Ship based monitoring of whales is a widely applied method to study whale populations. This method allows the detection of animals which reach the surface in order to breath. Their blow is standing out against the cold Antarctic air, therefore animals can be recognized. Thus it is possible to draw conclusions about the migration, behaviour, size and status of these populations. Due to discriminatory attributes like the appearance of the blow, the dorsal fin, animal size and diving behaviour the different whale species can be identified.

Work at sea

Visual surveys will be conducted along the tracks of RV POLARSTERN. They will complement the research of the AWI Ocean Acoustics group. Marine mammal observers (MMO) will observe a 180° area ahead. Handheld binoculars (25x) and "Big Eyes" will be used to detect animals and, as far as possible, identify these to species level. Each sighting will be recorded including parameters like group size, heading and behaviour of the whale(s), sighting/weather conditions, swell, date, time and position. Depending on weather conditions, the three MMOs will try to ensure at least eight hours of surveying each day. The visual sightings will be compared with automated detections by infrared and visual cameras. In compliance with mitigation measurements during hydroacoustic surveys on board of RV POLARSTERN, the MMOs will conduct visual monitoring following international standards (e.g. JNCC, Australia, Canada).

12. OCEANOGRAPHY OF THE AMUNDSEN SEA CONTINENTAL SHELF

F. Nitsche (LDEO), R. Guerrero (INIDEP)

Objectives

In the Amundsen Sea, the floor of the continental shelf is largely blanketed by 'warm' Circumpolar Deep Water that gains access across and around shoals on the outer shelf. This inflow appears to be strongest in the eastern sector, fills deep troughs and extends under the local ice shelves. As this water can be more than 3 degrees above the in-situ melting point of ice, it rapidly erodes the ice shelves, which are reported to be thinning in this area along with their incoming ice streams. From NB Palmer cruises in 1994 and 2000 we obtained snapshots of the late summer ocean properties on the shelf and of the shelf bathymetry that controls the deep circulation. But as yet we can only estimate dimensions and conditions within the ice shelf cavities, and guess how the ocean density field varies over an annual cycle. In an initial attempt to address these issues, Jacobs, Jenkins, Nitsche, and Huber have obtained support from NSF and NERC for new field work in the Amundsen sector with several related objectives.

Time series measurements are needed in order to assess potential seasonal changes in the CDW inflow, and its evolution on the shelf. However, shipboard access can be difficult because of the remote location, often extensive fast ice, and numerous icebergs that can move and/or destroy moored instruments. RV POLARSTERN expedition ANT XXIII/4 presents an opportunity to access the region and deploy several simple recording

instruments at appropriate sites along its cruise track, for recovery during an NB Palmer cruise scheduled in early 2007. As prior measurements have indicated that local thermohaline properties are well correlated and important inflows are associated with the troughs, it is feasible to focus primarily on temperature variability near the sea floor. Coincidentally, we will be providing all previous single- and multibeam bathymetric data for the region, mostly obtained from US ships and compiled at Lamont. This may allow RV POLARSTERN to fill in some of the remaining gaps, and lead toward improved maps of the Amundsen shelf, and a better understanding of its interactions with the ice and ocean.

Observations are also needed beneath the Amundsen ice shelves, and in early 2007 a British Autosub will be deployed from the NB Palmer with the intention of making several traverses beneath them. An important objective of that work will be mapping of dimensions and ocean properties in the cavities under Pine Island, Thwaites and Crosson Ice Shelves, as these features are fed by the deepest, fastest moving ice streams and are rooted in the warmest CDW. Alternative sites include the Dotson and Getz ice shelf caverns, and in all cases a primary interest is ocean links through glacially cut troughs toward the ice stream grounding lines. In addition, moorings deployed by RV POLARSTERN the previous year will be recovered, and possibly reset along with additional arrays and repeat CTD/rosette casts. Multibeam work will continue to fill existing gaps in coverage throughout the shelf region.
On the larger scale and longer term, the goals of this work include a better understanding of ocean controls on ice sheet evolution, and the impacts of that evolution on the ocean. These topics include the substantial freshening measured downstream of the Amundsen Sea over recent decades and the potential for accelerated sea level rise. We are additionally interested in obtaining background information to assist projects undertaken during the IPY, developing representative ocean data sets that can be assimilated into high-resolution numerical models, and fostering international collaboration on related scientific and logistic issues.

Work at sea
We plan to deploy six small mooring arrays of two types that will consist of one or two recording instruments each. All moorings will have a CTD sensor that will stay closely to the bottom. Four moorings will have an additional temperature and pressure sensor installed ~100 m above the near-bottom instrument.

As we are focussing on the bottom boundary layer in this component of the project, and its source is north of the continental shelf, the preferred locations for the moorings are on the eastern sides of potential conduits near the shelf break and ice shelf fronts. Final mooring locations will be chosen during the cruise based on a prioritized list of potential sites, and in dependence of the actual ship track, conditions encountered, available ship time, and other factors. If time and conditions permit, CTD casts might be performed at the mooring sites.

13. BETEILIGTE INSTITUTE / PARTICIPATING INSTITUTES

	Adresse Address
AWI	Stiftung Alfred-Wegener-Institut für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft Postfach 12 01 61 27515 Bremerhaven
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HeliTransair	HeliTransair GmbH Am Flugplatz 63329 Egelsbach
INIDEP Argentina	Instituto Nacional de Investigacion y Desarrollo Pesquero (INIDEP) Pasco Victoria Ocampo 1 7600 Mar del Plata Argentina
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14. FAHRTTEILNEHMER / PARTICIPANTS

Fahrtleiter: Karsten Gohl
Punta Arenas - Punta Arenas

Name	Vorname/ First Name	Institut/ Institute	Beruf / Profession
Blume	Marlen	AWI	Biologist
Bohlmann	Harald	Isitec	Technician
Buldt	Klaus	DWD	Technician
Daniel	Kristin	FSU Jena	Student, geology
Dietrich	Reinhard	TU Dresden	Geodesist
Eagles	Graeme	AWI	Geophysicist
Fahl	André	AWI	Student, geophysics
Feigl	Thomas	Uni Graz/AWI	Student, geodesy
Feldt	Oliver	HeliTransair	Technician
Forwick	Matthias	Uni Tromsø	Geologist
Gebauer	Manfred	DWD	Meteorologist
Gohl	Karsten	AWI	Geophysicist
Grobys	Jan	AWI	Geophysicist
Guerrero	Raul	INIDEP Argentina	Oceanographer
Hass	Christian	AWI Sylt	Geologist
Hauff	Silke	IfM-Geomar	Technician
Hauff	Sven Folkmar	IfM-Geomar	Geologist
Heckmann	Hans-Hilmar	HeliTransair	Pilot
Heise	Katja	AWI	Biologist
Hillenbrand	Claus-Dieter	BAS	Geologist
Johnson	Joanne	BAS	Geologist
Just	Janna	AWI	Student, geophysics
Kamennaya	Nina	Uni Jerusalem	Student, biology
Kober	Martin	FSU Jena	Student, geology
Krüger	Stefan	Uni Leipzig/AWI	Geologist
Kuhn	Gerhard	AWI	Geologist
Leinweber	Volker	AWI	Student, geophysics
Lemenkova	Polina	Uni Moskau	Cartographer
Lensch	Norbert	AWI	Technician
Mayr	Christina	AWI	Student, geophysics
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Nitsche	Frank	Lamont-Doherty	Geophysicist
O'Donovan	Terence	BAS	Technician
Parsiegla	Nicole	AWI	Geophysicist
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Rackebrandt	Nick	AWI	Student
Richter	Andreas	TU Dresden	Engineer
Ritter	Marc	AWI	Engineer
Schlüter	Philip	AWI	Geophysicist

Name	Vorname/ First Name	Institut/ Institute	Beruf / Profession
Schmiing	Mara	AWI	Student, biology
Steinmair	Ulrike	Uni Salzburg	Student, biology
Strahl	Julia	AWI	Student, biology
Suckro	Sonja	AWI	Student, geophysics
Thiede	Jörn	AWI	Geologist
Uenzelmann-Neben	Gabriele	AWI	Geophysicist
Veit	Andreas	FSU Jena	Geologist
Walter	Torben	Uni Salzburg	Student, biology
Werner	Reinhard	Tethys/Geomar	Geologist
Wickham	Stephen	Uni Salzburg	Biologist
Wiencke	Christian	AWI	Biologist
Winter	Stefan	HeliTransair	Pilot
Zeidler	Martin	HeliTransair	Mechanic
Zimmermann	Katja	AWI	Student, geophysics
Gauger	Steffen	Fielax	Engineer

15. SCHIFFSBESATZUNG / SHIP'S CREW

Besatzungsliste Reise ANT XXIII/4
Name of Ship : POLARSTERN
Nationality : GERMAN
Punta Arenas - Punta Arenas

No.	Name	Rank
1	Pahl, Uwe	Master
2	Grundmann, Uwe	1.Offc.
3	Ziemann, Olaf	Ch.Eng.
4	Hering, Igor	2. Offc.
5	Wunderlich, Thomas	2.Offc.
6	Bratz, Herbert	3.Offc.
7	Türke, Helmut	Doctor
8	Koch, Georg	R.Offc.
9	Simon, Wolfgang	1.Eng.
10	Schnürch, Helmut	3.Eng.
11	Wanke, Steffen	3.Eng.
12	Haefke, Bernd	ElecEng.
13	Feiertag, Thomas	ELO
14	Fröb, Martin	ELO
15	Muhle, Helmut	ELO
16	Riess, Felix	ELO
17	Clasen, Burkhard	Boatsw.
18	Neisner, Winfried	Carpenter
19	Burzan, Gerd-Ekkeh.	A.B.
20	Hartwig-Lab.,Andreas	A.B.
21	Kreis, Reinhard	A.B.
22	Lamm, Gerd	A.B.
23	Moser, Siegfried	A.B.
24	Pousada Martinez, S.	A.B.
25	Schröder, Norbert	A.B.
26	Schultz, Ottomar	A.B.
27	Beth, Detlef	Storek.
28	Dinse, Horst	Mot-man
29	Fritz, Günter	Mot-man
30	Hoppe, Kurt	Mot-man
31	Krösche, Eckard	Mot-man
32	Watzel, Bernhard	MotMan
33	Fischer, Matthias	Cook
34	Martens, Michael	Cooksmate
35	Tupy, Mario	Cooksmate
36	Dinse, Petra	1.Stwdess
37	Tillmann, Barbara	Stwdss/Kr
38	Deuß, Stefanie	2.Stwdess
39	Hu, Guo Yong	2.Steward
40	Möller, Wolfgang	2.Steward
41	Schmidt, Maria	2.Stwdess
42	Sun, Yong Sheng	2.Steward
43	Yu, Chung Leung	Laundrym.
44	Felsenstein, Thomas	Apprent.

ANT XXIII/5

13 April 2006 - 12 June 2006
Punta Arenas - Cape Town

Chief Scientist:
Wilfried Jokat

ANT XXIII/5

1. ÜBERBLICK UND FAHRTVERLAUF

W. Jokat (AWI)

Die Expedition ANT XXIII/5 ist der erste systematische Versuch umfangreiche geophysikalische und petrologische Experimente im Südatlantik durchzuführen, um neue Erkenntnisse über den mesozoischen/känozoischen *Hotspot* Vulkanismus zu erhalten. Bisher existieren nur wenige Gesteinsproben von geologischen Strukturen wie Shona Ridge, Meteor Rise, Agulhas Ridge, Cape Rise sowie den Discovery Seamounts, um sowohl deren zeitliche Entwicklung als auch ihre geochemischen Ähnlichkeiten, falls welche existieren, zu verstehen. Um diese Lücken zu schließen, ist ein umfangreiches petrologisches Beprobungsprogramm (Dredge) entlang dieser Strukturen geplant.
Geophysikalische Informationen in dieser Region sind ebenfalls kaum vorhanden. Dies gilt insbesondere für krustenseismische und seismische Mehrkanaldaten. Tiefenseismische OBS-Profile über den Shona-Rücken, die Discovery Seamounts und den südlichen Walfisch-Rücken sollen erste Informationen über die Krustendicke und –struktur liefern. In Ergänzung zu den seismischen Daten werden Potentialfelddaten entlang der gesamten Fahrtroute erfasst. Magnetische Daten werden zusätzlich mit Hilfe eines Helikopters gemessen, u.a wenn das Schiff auf Station ist.
Diese beiden geowissenschaftlich orientierten Programme werden durch ein biologisches Beprobungsprogramm ergänzt. Die biologischen Stationsarbeiten werden überwiegend auf dem Transit von Punta Arenas in das erste Messgebiet durchgeführt. Ziel des Vorhabens ist, neue Informationen zur Biodiversität und Ökologie von Tiefsee-Copepoden in polaren Regionen zu erhalten. Die beiden Copepoden Familien *Euchaetidae* und *Aetideidae* sind zwei wichtige Komponenten des Zooplanktons weltweit und in den polaren Meeren. Während der Expedition werden die Tiefsee-Copepoden mit Hilfe eines Multinetzes (Hydro-Bios MultiNet, 200 µm Maschengröße) gefangen. Es sind zwischen 10 und 15 Stationen geplant.
Hinsichtlich der generellen Fahrtplanung ist zu berücksichtigen, dass der Shona Ridge-Meteor Rise Komplex in einer Region südlich von 50°S liegt, in der während des Expeditionszeitraumes mit hoher Wahrscheinlichkeit sehr schlechtes Wetter herrschen wird. Da das Schiff zwischen den unterschiedlichen Dredgepositionen erhebliche Transitwege zurückzulegen hat, ist ein schneller Transfer zwischen den Stationen ein wichtiger Punkt für den Zeitplan der gesamten Expedition. Daher ist im schlechtesten Fall mit einer Streichung des Dredgeprogrammes südlich von 50°S zu rechnen, falls die Wetterbedingungen auf Dauer schlecht sind. Die entsprechende Schiffszeit wird dann verwendet, um den Walfischrücken so weit wie möglich nach Norden petrologisch und geophysikalisch zu untersuchen. Dieser Alternativplan ist in Abbildung 1 (dünne weiße Linie) eingezeichnet.

OVERVIEW AND ITINERARY

The cruise ANT XXIII/5 is the first systematic petrological/geophysical attempt to conduct extensive experiments in order to better understand the Mesozoic/Cenozoic "hotspot" volcanism in the South Atlantic. So far only few, randomly distributed samples exist from the Shona Ridge-Meteor Rise-Agulhas Ridge-Cape Rise lineament and the Discovery Seamounts to better constrain their temporal evolution, but also their compositional relationships, if any exist. For this objective an extensive dredging programme along and across these features are planned.
There are hardly any geophysical information on these areas available, in particular for deep seismic and multichannel seismic data. Geophysical profiles using OBS instruments are planned for the Old Shona Ridge, the Discovery Seamounts and the southern Walvis Ridge. Potential field data will be acquired along the entire ship track. Helicopter borne magnetic data will also be collected during the dredging operations.
These two geoscientific programmes will be supplemented by a biological sampling experiment, which will be mainly conducted during the transit from Punta Arenas into the research area. It will contribute to the biodiversity and ecology of deep-sea copepods in polar seas. The two copepod families *Euchaetidae* and *Aetideidae* are important components of zooplankton communities throughout the World Ocean, especially in deep oceanic waters and Polar Regions. During the cruise, deep-sea copepods will be sampled by multiple opening/closing net hauls (Hydro-Bios MultiNet, 200 µm mesh size) at approximately 10 to 15 stations.

For the general cruise planning it is important to note that the Shona Ridge-Meteor Rise is located in the very south where bad weather conditions are normal. Since the ship has to sail significant distances between the dredge locations, a fast transit between such positions is critical for the success of the programme. Thus, in the worst case if constantly bad weather conditions south of 50°S are predominating, it might be necessary that this part of the programme will have to be cancelled. The saved time will be used to sample the Walvis Ridge as far north as possible. This alternative plan is included in figure 1.

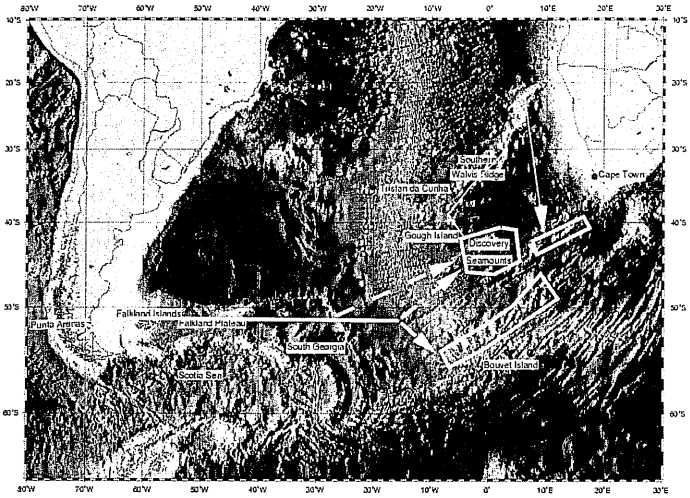

Abb. 1: Geplante Fahrtroute (dicke Linie) und Alternativplanung (dünne Linie). Es ist geplant, die Arbeiten im südlichsten Gebiet zu beginnen und dann nach Norden zu den Discovery Seamounts zu fahren.
Figure 1: Planned cruise track and the alternative programme are indicated. The bold white line marks the original plan. It is planned to start the work in the southernmost research area and move then north towards the Discovery Seamounts. The thin white line shows the possible alternative plan. The stippled files show alternative routes to the Discovery Seamount research area.

2. DREDGE SAMPLING KEY SOUTH ATLANTIC HOTSPOT TRAILS: SHONA RIDGE-METEOR RISE-AGULHAS RIDGE AND DISCOVERY SEAMOUNTS

D. Berger, B. Ehlers, A. Ferk, W. Jokat, N. Lensch, H. Martens, J. Schinkel,
M. Voß (AWI), C. Class, J. Hanley (LDEO), J. O'Connor (University Amsterdam),
D. Long, A. Nakashole, P. le Roux, C. Tinguely (University Cape Town),
A. Schwenk (KUM Kiel), C. Hagen (University Kiel)

Objectives and Work Program

Key questions are:

- Are South Atlantic bathymetric anomalies initiated/maintained by deep plumes or shallow sources in the mantle or a combination of both?
- In case of the former - how well do South Atlantic hotspot trails fit the predictions of the fixed Mantle Plume hypothesis?
- Does the Meteor Rise represent detached continental material?
- Can the distinct DUPAL and LOMU signature in the South Atlantic be related to shallow detached continental material?

The petrological objective is a systematic dredge sampling of the effectively un-sampled Discovery Seamounts and the aseismic Shona Ridge-Meteor Rise-Agulhas Ridge-Cape Rise lineament. Age and compositional data for dredge samples will reveal the long-term temporal, spatial and geochemical development of these major bathymetric anomalies, and their possible origin through excess volcanism above deep upwelling mantle plumes, purportedly Discovery and Shona, respectively.

The South Atlantic is a key area for addressing two important scientific questions: the existence and possible fixity of mantle plumes, and the origin of extreme geochemical mantle components postulated to occur in the sub-lithospheric oceanic mantle. With regard to the first, the reliable measurement of migration rates of volcanism along seamount chains and aseismic ridges is the key to establish the existence of mantle plumes in the area, their possible role in continental rifting, and their constraints on plate reconstructions. Our project is encouraged by recent evidence that the migration rates of volcanism along the St. Helena and Walvis hotspot trails are not well constrained (O'Connor et al., 1998). With regard to the second, the sub-South Atlantic mantle is world wide unique in hosting a number of compositionally extreme end-member mantle components (EM-I, DUPAL and LOMU), whose presence is evident from limited sample suites available from oceanic basalts from the aseismic Tristan-Gough-Walvis Ridge and the Mid-Atlantic Ridge (MAR).
We propose addressing these questions by dredge-sampling two major, previously effectively unsampled volcanic trails known as the Discovery Seamount Chain and the

Shona Ridge-Meteor Rise-Agulhas Ridge aseismic bathymetric anomaly, followed by post-cruise acquisition of high precision 40Ar/39Ar ages, geochemical data, and seafloor magnetic ages.

Testing the mantle plume hypothesis

For more than 30 years, "hotspots," i.e., melting anomalies that create age-progressive, linear seamount chains or ridges in the direction of plate motion, have been attributed to mantle plumes. However, the concept of mantle plumes has been increasingly criticized based on its misuse as an explanation for almost any volcanic feature, even without evidence for age-progression and other simple tests. At this point the mantle plume hypothesis remains the best concept to describe the volcanic features of the 'big' hotspot trails such as Hawaii and Tristan da Cunha. However, volcanic features lacking initial flood basalt volcanism require testing on an individual basis. On the basis of unusual geochemical signatures along the southern MAR and plate reconstruction models, Hartnady and le Roex (1985) proposed the existence of the Shona plume, and developed a model of complex plume-ridge-fracture zone dynamics as cause of the unusual zig-zag plume track including the Meteor Rise, Agulhas Ridge and Cape Rise seamounts. However, the only samples recovered from this potential plume track (ODP Leg 117 Site 703 on the Meteor Rise) have been shown to have compositions different from the Shona 'plume' in having a continental affinity, suggesting that the Meteor Rise might represent a rifted continental fragment (Mueller et al., 1992), perhaps more similar to the Agulhas Plateau (Allen and Tucholke, 1981; Ben-Avraham et al., 1995). In a likewise fashion, there is only one dredge sample from the Discovery Tablemount (Kempe and Schilling, 1974), yet a number of major conceptual models (e.g. Duncan et al., 1978; Crough et al., 1980; Duncan, 1981; Hart, 1984; le Roex, 1986; Douglass et al., 1999; Douglass and Schilling, 2000; le Roux et al., 2002a) are based on these features representing a long-lived major mantle plume. A mantle plume origin of the Shona and Discovery bathymetric anomalies will be tested through a combination of high precision 40Ar/39Ar ages, geochemical data, and seafloor magnetic ages.

Mantle geochemical components

A number of geochemical studies have shown that the South Atlantic hosts some of the more extreme mantle end-member components (EM-I – Walvis Ridge; DUPAL – Tristan/Gough and Discovery hotspots; LOMU – southern MAR). The origin of these geochemical components is poorly constrained and proposals range from constructional heterogeneities established at the time of Earth formation (Hart, 1984), recycled ancient pelagic sediment (Weaver, 1990), and delaminated sub-continental lithosphere (Hawkesworth et al., 1986; Milner and le Roex, 1996; Douglass et al., 1999). To resolve these alternatives, detailed sample suites are required from along the relevant seamount chains/aseismic ridges to evaluate the degree of temporal and spatial heterogeneity of these anomalies to determine whether they are comparatively shallow level, passive, features located today within the convecting oceanic mantle, or deep-seated (lower mantle?) anomalies brought to the surface by upwelling plumes. With the exception of EM-I, these anomalies are unique to the Gondwana ocean basin systems, and the South Atlantic provides an ideal location for their study.

Work at sea

- Comprehensive along and cross chain dredge-sampling of the Shona and Discovery hotspot lineaments
- Initial description and selection of rocks recovered at dredge stations
- Sample preparation for the following post-cruise analytical work:
  - Detailed petrological description of selected rock samples
  - Major element analyses (XRF) of selected samples
  - Geochemical analyses (ICP-MS) of selected samples
  - High precision 40Ar/39Ar mineral ages
  - Isotope analyses (Sr, Nd, Pb, Hf etc)

Expected results

The acquisition of a comprehensive suite of samples for geochemical analysis from along the lengths of the Shona Ridge-Meteor Rise-Agulhas Ridge and Discovery bathymetric anomalies will allow the following to be determined/evaluated:

- the extent of age progressive volcanism along the Shona Ridge-Meteor Rise-Agulhas Ridge-Cape Rise Seamount lineament and the Discovery Seamount Chain;
- the hypothesis that the Shona mantle plume is a long-lived feature, or whether the purported 'zig-zag' bathymetric anomaly attributed to the Shona plume in fact represents a combination of different, and partly non-plume, features;
- how well the Shona, Discovery hotspot trails fit the predictions of the Mantle Plume Paradigm;
- if the Shona and Discovery bathymetric anomalies are shown to be plume related, provide possible constraints on plume fixidity and improve plate reconstruction models through use of the sub-parallel, age-progressive, Shona, Dicsovery and Tristan plume tracks;
- the role that detached continental blocks might have in the formation of small oceanic plateaux such as the Meteor Rise;
- alternative models for the origin of South Atlantic geochemical components (EM-I, HIMU, DUPAL, FOZO) – e.g., shallow level, passive features located in the convecting mantle, or deep-seated (lower mantle?) anomalies brought to the surface by the upwelling plumes.

Through a combination of the above to contribute to a better understanding of the respective roles of localized (shallow?) lithospheric control on South Atlantic hotspot volcanism versus long-lived (deep) plume origins, and how the latter might develop and interact with the overlying lithosphere.

3. GEOPHYSICAL INVESTIGATIONS ACROSS POTENTIAL HOTSPOT TRAILS IN THE SOUTH ATLANTIC

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Objectives

Since the middle Mesozoic the South Atlantic has faced several pulses of marine magmatism during his geological history. The most prominent feature is the Walvis Ridge/Rio Grande Rise, which is believed to be a consequence of a long-living thermal anomaly (hotspot?) in the earth's mantle. Another hotspot trail might have been created along the old and young Shona ridges. The youngest expression of submarine volcanism besides the mid-ocean ridge are the Discovery seamounts, which are located between the Shona and Walvis ridges. Along and across the seamounts extensive geophysical investigations are planned to unravel key parameters like crustal thickness for this features.

While one of the petrological objectives is to understand if and how these volcanic events were connected, the geophysical work will concentrate to retrieve basic parameters on crustal thickness and evolution. Furthermore, seismological, magnetic and gravimetric measurements are planned.

In detail we would like to contribute to the following problems/questions:

- What is the budget of volcanic material of the Discovery seamounts? For this, we would like to investigate the crustal structure and mantle composition beneath the seamounts.
- Did the seamount erupt at the axis of the mid-ocean ridge or off-axis? This will be investigated with a detailed magnetic helicopter survey to map the magnetic signature of the Discovery seamounts.
- The southern Walvis Ridge has a complete different topographic signature than its northern part, which is much narrower. If the mantle anomaly is more diffuse in that area, we might also find oceanic crust, which is thicker than standard. This will be investigated by a deep seismic sounding experiment. Further lines along the Walvis Ridge towards the north will be conducted, if we cannot reach one of our primary targets (Young Shona ridge).
- Similar experiments are planned for the Old Shona ridge on the way to Cape Town.

Work at Sea

To achieve the most complete geophysical data set, we will conduct the following experiments:

- Deep seismic sounding profiles across prominent ridge segments/seamounts.
- Multichannel seismic data acquisition across the Discovery Seamounts, the old Shona Seamounts and the southern Walvis Ridge.

- Continuous acquisition of gravity data with a KSS31 gravimeter
- Magnetic surveys with a helicopter borne system (Helimag)
- If necessary and required we will also conduct a limited amount of multichannel seismic profiles to characterize the roughness of the oceanic basement and to determine the sediment thickness for an enhanced modelling of the deep seismic data. Such data might also be used for any IODP pre-site survey.

The data will be quality controlled on the vessel and processed as far as time allows.

Expected results
We expect that the geophysical results will provide insights in the amount of magmatic material in the crust and upper mantle, which is related to the magmatism along the ridges and the seamounts. It will allow us to calculate some volume budget. The magnetic data will provide information on the eruption style (axis vs off-axis eruption) of the features, if seafloor spreading anomalies can be detected.

In general the resulting petrological data (age, compositional) determined from the dredge samples in combination with the geophysical data set will reveal the long-term temporal, spatial and geochemical development of Discovery, Shona and Walvis hotspot magmatism on the African plate.

4. BIODIVERSITY AND ECOLOGY OF DEEP-SEA COPEPODS

H. Auel, S. Laakmann, M. Stumpp (University Bremen)

Background & Objectives
The DFG funded project "Biodiversity and ecology of deep-sea copepods in polar seas – speciation processes and ecological niches in the homogeneous environment of the pelagic realm" focuses on the biodiversity and feeding ecology of dominant deep-sea copepods in the Southern Ocean.

The two copepod families *Euchaetidae* and *Aetideidae* are important components of zooplankton communities throughout the World Ocean, especially in deep oceanic waters and Polar Regions. Most of these species inhabit meso- and bathypelagic depths, while some are epi- or benthopelagic. *Euchaetidae* significantly contribute to the zooplankton biomass in both Polar Regions, while *Aetideidae* are characteristic inhabitants of the Antarctic and Arctic deep-sea. The genus *Paraeuchaeta* is carnivorous and includes major predators on other mesozooplankton. Aetideid copepods are generally referred to as omnivorous. Species of both families can be responsible for one to two thirds of the total energy flow through the carnivorous trophic level, and may consume nearly half of the vertical carbon flux. Thus, these meso- and bathypelagic copepods substantially affect pelago-benthic coupling processes and, hence, may have a significant impact on carbon and energy fluxes in polar systems.

A characteristic, but still enigmatic feature of *Euchaetidae* and *Aetideidae* is the co-occurrence of several many closely related species in pelagic deep-sea habitats of the Antarctic and Arctic. For instance, 14 species of the genus *Paraeuchaeta* coexist in waters around the South Georgia archipelago in the Southern Ocean. Since the pelagic deep-sea is an almost homogeneous environment without physical barriers, the sympatric co-occurrences of such closely related species raises the questions how the biodiversity of these deep-sea species evolved and what mechanisms effectively minimize inter-specific competition, which would otherwise lead to the extinction of less fit competitors.

Most deep-sea ecosystems depend on primary production in the thin euphotic surface layer of the ocean and on the sedimentation of organic matter to deeper strata. Therefore, resource limitation presumably represents an important factor in the evolution of meso- and bathypelagic species. Our project focuses on differences in vertical distribution, life-cycle strategies, diet spectra and feeding behaviour of different co-occurring deep-sea copepods in order to characterise their distinct ecological niches in the deep-sea pelagic realm. Thus, our project contributes to an improved understanding of deep-sea biodiversity and evolutionary patterns in general and in particular of the reasons and mechanisms sustaining a relatively rich meso- and bathypelagic fauna with a comparatively high biodiversity in polar seas despite the limited food supply and in the absence of physical barriers. With these objectives, our project actively contributes to international marine biodiversity initiatives, such as Census of Marine Zooplankton (CMarZ) and Census of Marine Life (CoML).

Concentrating on important families of deep-sea copepods and applying state-of-the-art molecular genetic and biochemical methods, the project will address the following questions:

1) How do closely related species (or even congeners) find individual niches in the almost homogeneous environment of the deep-sea pelagial?

2) Are there any differences in the vertical distribution of sympatric species?

3) How do feeding behaviour and diet composition differ between co-occurring species in order to minimise or avoid inter-specific competition?

4) When, how and why did the radiation of aetideid and euchaetid copepods occur leading to the high biodiversity of these groups of deep-sea inhabitants?

5) What are the speciation mechanisms in the almost homogeneous environment of the deep-sea pelagial?

6) What are the reasons and mechanisms sustaining a relatively rich meso- and bathypelagic fauna with a comparatively high biodiversity in polar seas despite the limited food supply and in the absence of physical barriers?

Work at sea

During the cruise, deep-sea copepods will be sampled by multiple opening/closing net hauls (Hydro-Bios MultiNet, 200 µm mesh size) at approximately 10 to 15 stations on a transect across the Atlantic sector of the Southern Ocean. Stratified samples will be used to establish the vertical and regional distribution of copepod species in relation to hydrographic regimes. In order to allow the comparison of vertical distributions at different stations, standard depths intervals will be sampled. A typical depth profile will include the following series of sampling

intervals: 2000-1500-1000-500-200-100-50-0 m. Since only five discrete depth strata can be sampled in one haul of the MultiNet, two successive hauls (one to 2000 m depth and another one to 200 m) will be conducted at each station in order to combine deep sampling with a higher vertical resolution of the upper water layers.

Deep-sea copepods of the families *Euchaetidae* and *Aetideidae* (and other dominant species) will be sorted immediately after the catch and either used for experiments on board or deep-frozen at -80°C for molecular genetic and biochemical analyses (diet composition via fatty acid trophic biomarkers and stable isotopes) at the home laboratory.

Since food availability, feeding behaviour and diet composition are crucial factors determining the ecological niches of deep-sea animals, feeding experiments will by carried out onboard to identify differences in diet spectra between co-occurring species. During qualitative feeding experiments with copepods of both families, different food items, including phytoplankton, detritus, nauplii and copepodite stages of different sizes will be offered to establish dietary preferences. The feeding reaction to the different prey items and the production of faecal pellets will be recorded. In addition, ingestion rates will be determined during quantitative feeding experiments at ambient conditions (darkness and in situ temperature) with carnivorous species. Predators and prey samples will be deep-frozen and body dry mass will be determined in the home laboratory. In addition, respiration rates will be measured directly in order to estimate the energy requirements of deep-sea zooplankton.

Depending on the cruise track of ANT XXIII/5, we are also interested in collecting zooplankton samples off South-West Africa. For several years we have been co-operating closely with scientists from South Africa and Namibia, studying retention mechanisms of zoo- and ichthyo-plankton species in the upwelling system of the Benguela Current, as well as physiological and behavioural adaptations of zooplankton to the pronounced oxygen minimum layer (<1 ml O_2 l-1 in c. 50 to 400 m depth) in offshore waters along the Namibian continental shelf. Individuals collected during the cruise can be either used for respiration measurements and hypoxia tolerance experiments onboard or brought to shore for our South African partners in Cape Town.

Expected results

The expected outcome of the cruise includes detailed data on the vertical distribution and zonation of deep-sea copepods across the Atlantic sector of the Southern Ocean, information on species-specific differences in feeding behaviour and diet composition of co-occurring euchaetid and aetideid copepods, an estimate of the energy requirement of the deep-sea zooplankton community and their impact on pelago-benthic coupling processes. In addition, we intend to collect many deep-frozen samples of the different species for molecular genetic and lipid-biochemical analyses at the home laboratory in order to elucidate the timescale and reasons for the radiation of meso- and bathypelagic copepods and evolutionary processes in the deep-sea.

5. BETEILIGTE INSTITUTE / PARTICIPATING INSTITUTES

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University Cape Town	Department of Geological Sciences University of Cape Town Rondebosch 7701 South Africa

6. FAHRTTEILNEHMER / PARTICIPANTS

Fahrtleiter:
Punta Arenas - Cape Town

Name	Vorname/ First Name	Institut/ Institute	Beruf / Profession
Auel	Holger	Uni Bremen	Biologist
Berger	Daniela	AWI	Geophysicist
Büchner	Jürgen	HeliTransair	Pilot
Class	Cornelia	Lamont Doherty	Geologist
Ehlers	Birte-Marie	AWI	Geophysicist
Ferk	Annika	AWI	Student, Geophysics.
Hagen	Claudia	Uni Kiel	Student, Geophysics
Hanley	Jean	Lamont Doherty	Technician
Hering-Zieringer	Reinhard	DWD	Meteorologist
Johnson	Mark	HeliTransair	Inspector
Jokat	Wilfried	AWI	Geophysicist
Krocker	Ralf	AWI	Engineer
Laakmann	Silke	Uni Bremen	Biologist
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Veen	Jan	HeliTransair	Pilot
Voß	Max	AWI	Geophysicist
Zeidler	Martin	HeliTransair	Mechanic
NN			
NN			

7. SCHIFFSBESATZUNG / SHIP'S CREW

Besatzungsliste Reise ANT XXIII/5
Name of Ship: POLARSTERN
Nationality : GERMAN
Punta Arenas Cape Town

No.	Name	Rank
1	Schwarze, Stefan	Master
2	Spielke, Steffen	1.Offc.
3	Farysch, Bernd	Ch.Eng.
4	Fallei, Holger	2. Offc.
5	Peine, Lutz	2.Offc.
6	Niehusen, Frank	3.Offc.
7	NN	Doctor
8	Hecht, Andreas	R.Offc.
9	Minzlaff, Hans-Ulrich	1.Eng.
10	Westphal, Henning	3.Eng.
11	NN	3.Eng.
12	Scholz, Manfred	ElecEng.
13	Nasis, Ilias	ELO
14	Verhoeven, Roger	ELO
15	Dimmler, Werner	ELO
16	Himmel, Frank	ELO
17	Loidl, Reiner	Boatsw.
18	Reise, Lutz	Carpenter
19	Vehlow, Ringo	A.B.
20	Lamm, Gerd	A.B.
21	Winkler, Michael	A.B.
22	Guse, Hartmut	A.B.
23	Hagemann, Manfred	A.B.
24	Schmit, Uwe	A.B.
25	Bäcker, Andreas	A.B.
26	Wende, Uwe	A.B.
27	Preußner, Jörg	Storek.
28	Ipsen, Michael	Mot-man
29	Voy, Bernd	Mot-man
30	Elsner, Klaus	Mot-man
31	Hartmann, Ernst-Uwe	Mot-man
32	Grafe, Jens	MotMan
33	Müller-Homburg, Ralf-Dieter	Cook
34	Silinski, Frank	Cooksmate
35	Völske, Thomas	Cooksmate
36	Jürgens, Monika	1.Stwdess
37	Wöckener, Martina	Stwdss/Kr
38	Czyborra, Bärbel	2.Stwdess
39	Silinski, Carmen	2.Steward
40	Gaude, Hans-Jürgen	2.Steward
41	Möller, Wolfgang	2.Stwdess
42	Huang, Wu-Mei	2.Steward
43	Yu, Kwok Yuen	Laundrym.
44	Felsenstein, Thomas	Apprent.
45	Kusch, Thomas	Mot-man