Bundesanstalt für Geowissenschaften und Rohstoffe

MENTE ET MALLEO

M.S. SONNE cruise SO-36 February–May 1985

ANTARTICA AUSTRALIA

BGR & BMR Geoscientific Studies

BUNDESANSTALT FÜR GEOWISSENSCHAFTEN UND ROHSTOFFE

HANNOVER

Abschlußbericht

über die

SONNE-Fahrt SO-36

Teil 2:

GEOPHYSIKALISCHE, GEOLOGISCHE UND GEOCHEMISCHE UNTERSUCHUNGEN VOR WEST TASMANIA UND AUF DEM SÜD TASMAN RÜCKEN

13. März 1985 - 12. Mai 1985

Report

GEOPHYSICAL, GEOLOGICAL AND GEOCHEMICAL STUDIES OFF WEST TASMANIA AND ON THE SOUTH TASMAN RISE

13th March 1985 - 12th May 1985

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SUMMARY

The 2nd and 3rd Leg of SONNE cruise SO-36 were designed to investigate the structure, geological development and hydrocarbon potential of two frontier areas, the western and southwestern continental margin of Tasmania and the South Tasman Rise.

On the 2nd Leg (12.03.-12.04.1985) multichannel seismic reflection measurements were carried out in parallel with magnetic, gravimetric, sea-beam and 3.5 kHz subbottom profiler measurements on 19 lines with a total length of 3820 km. In addition, 2140 km were surveyed with magnetics, gravity meter, sea-beam and 3.5 kHz subbottom profiler in transit from and to Sydney, respectively.

On the 3rd Leg, which started in Sydney on 12th April, 1985 and ended in Suva/Fiji one month later, 63 stations were sampled by dredging and coring with the aim, a) to provide lithologic and biostratigraphic information about the seismic sequences mapped during Leg 2, and b) to obtain geochemical evidence of hydrocarbon generation from the character of gases absorbed onto the surficial sediment.

Samples came from 33 stations off Western Tasmania, 23 stations on the South Tasman Rise, and from 7 stations in the region of the Lord Howe Rise and the Dampier Ridge.

In transit to the sampling sites, 11 single channel seismic lines with a total length of 470 km were surveyed, and in addition, 4230 km were surveyed with magnetics, gravity meter, sea-beam, and subbottom profiler.

The SONNE cruise SO-36 was financed by the Federal Ministry of Research and Technology (BMFT). The cruise was carried out as a co-operative project by the Federal Institute for Geosciences and Natural Resources (BGR), and the Bureau of Mineral Resources (BMR).

26 BGR employees and 5 BMR officers attended the Legs 2 and 3 of SONNE cruise SO-36.

Seven regional seismic unconformities were recognized in the area off Western Tasmania and on the South Tasman Rise:

- A Miocene unconformity, which is often at the sea bed.
- An Oligocene unconformity, which is characterized by erosional truncation. On the South Tasman Rise this distinct unconformity often is at the top of bevelled basement blocks.
- An Eocene unconformity, which is interpreted to represent an increase of the spreading rate of the South Indian Rift at anomaly 19 time (43 m.y.B.P.). The unconformity forms the lower boundary of a sedimentary sequence which is characterized by a high frequency reflection pattern.
- A Paleocene unconformity, which has a conspicuous low frequency pattern. This unconformity forms the upper boundary of a Cretaceous sedimentary wedge existing beneath the western shelf of Tasmania. It appears, that here this unconformity represents Early Paleocene/Late Cretaceous conglomerates.
- A Middle Cretaceous unconformity, which was unequivocally recognizable only beneath the shelf of Western Tasmania.
- An interpreted rift-onset unconformity.

The continental margin of Western Tasmania shows characteristic features of divergent margins, namely tilted horsts with intervening halfgrabens, 20 - 40 km wide, and probably filled by Lower Cretaceous sediments. Sedimentary piercement structures are wide-spread beneath the continental margin of Western Tasmania. It is assumed that these structures are wrench -fault related structures, which presumably developed in Eocene time.

The southern Tasmanian continental margin is an extremely starved margin, characterized by step-like downfaulted and tilted continental basement blocks which are nearly sediment-free. We believe that the separation of Tasmania from the South Tasman Rise commenced in the Oligocene by extension and movements along strike-slip faults, resulting in South Tasman Rise being left behind in its present position relative to Tasmania during the process of separation between Australia and Antarctica.

The South Tasman Rise covers an area of approximately 130 000 km^2 as bounded by the 3000 m bathymetic contour. It consists of numerous and characteristically bevelled continental basement blocks, separated by asymmetrically v-shaped and propagating basins. It is partially flanked by rift basins. A steep NNW-trending escarpment constitutes the western boundary of the South Tasman Rise from where metamorphic rocks, pegmatites and granodiorites were dredged.

High metamorphic rocks were recovered from four sites indicating that continental basement underlie both, the western Tasmanian slope and the South Tasman Rise. Mica schists and garnet-mica schists are the dominant methamorphic rock type. Samples of volcanic rocks were dredged at two sites. Basalt was encountered from a structure on seismic line SO-36-44 at the western margin of the Tasmanian slope, and a basaltic rock was recovered from a piercing structure on top of the eastern part of the South Tasman Rise.

A number of samples dredged at different sites are thought to be older than Tertiary.
The collected Paleogene sediments are characterized by a substantial terrigenous component; but samples from the Tasmanian slope and the South Tasman Rise exhibit significant differences. Bryozoan limestone of Late Paleocene to Early/?Middle Eocene age were dredged at the upper southwest Tasmanian slope, whereas organic carbon-rich, "peaty", micaceous silts and fine sands of Eocene age were encoutered from the deeper parts of the Tasmanian slope. On the South Tasman Rise the Eocene is most probably represented by olive mudstone or grey/green mudstones, frequently zeolitic, which usually contain glauconitic sand.
Neogene deposits are characterized by relatively homogenous pelagic sediments. Shallow water carbonates were deposited on the Tasmanian shelf.

Thermogenic hydrocarbons, locally in substantial concentration were found in the surface sediments, specially at the western Tasmanian slope. Basins on the southwestern margin of Tasmania and on the South Tasman Rise are also geochemically interesting due to relatively high hydrocarbon yields.
In several instances, the concentration of the gases could be related to sub-

surface structures identified by the seismic survey. In particular, the presence of faults in the rift basins seem to create preferential migration which could accentuates the hydrocarbon yields.

1. INTRODUCTION AND SCIENTIFIC OBJECTIVES OF THE 2nd AND 3rd LEG OF R/V SONNE CRUISE SO-36

It was proposed that geoscientific investigations be carried out by the Federal Institute for Geosciences and Natural Resources (BGR) in co-operation with the Bureau of Mineral Resources, Geology & Geophysics (BMR) off Western Tasmania and on the South Tasman Rise on the 2nd and 3rd Leg of R/V SONNE cruise SO-36 in the frame of the Agreement between the Government of Australia and the Government of the Federal Republic of Germany on Scientific and Technical Co-operation.
On the basis of modern multichannel seismic data which have been collected by the BGR in the Ross Sea (HINZ & BLOCK, 1983) and by the IFP off Wilkes Land and the Terrie Adelie coast (WANNESON et al., 1985), we considered that the following principal problems exist on the Antarctic continental margin south of the Southeast Indian Rift that can be addressed by geoscientific studies on the conjugate continental margins of Australia, principally in the South Otway Basin, off Western Tasmania and on the South Tasman Rise, where only few modern seismic data exist. The principal problems are:
- The timing of the Gondwana fragmentation events that lead to the separation of Australia and Antarctica. This age may be around 55 m.y. (anomaly 22), 90 m.y. (anomaly 34) or possibly even older.
- The tectonics and the magmatic-volcanic processes that are associated with the separation of Australia and Antarctica.
- The nature, age and origin of regional seismic unconformities.
- Structure, geological development and hydrocarbon potential of rift basins.

The scientific objectives of the proposed survey consisting of geophysical reconnaissance measurements, geological sampling of pre-Quaternary rocks and isotope-geochemical studies off Western Tasmania and on the South Tasman Rise were:

1. To study basin development and seismic stratigraphy of the continental margin of Western Tasmania by extending geophysical lines from the shelf to oceanic

basement, making ties to the wells Clam no. 1 and Cape Sorell no. 1;

2. To examine basin tectonics on a sheared margin;

3. To regionally survey assumed rift basins on the South Tasman Rise and determine their relationship to basins of the conjugate Antarctic continental margin;

4. To assess the hydrocarbon potential of selected rift basins using geochemical reconnaissance surveys.

The cruise plan is complementary to both, the BMR's proposed survey of the Otway Basin and the BGR's aeromagnetic survey, which was carried out during the 4th German Antarctic North Victoria Land Expedition (GANOVEX-IV) on North Victoria Land and the western Ross Sea (Figure 1) in 1985.

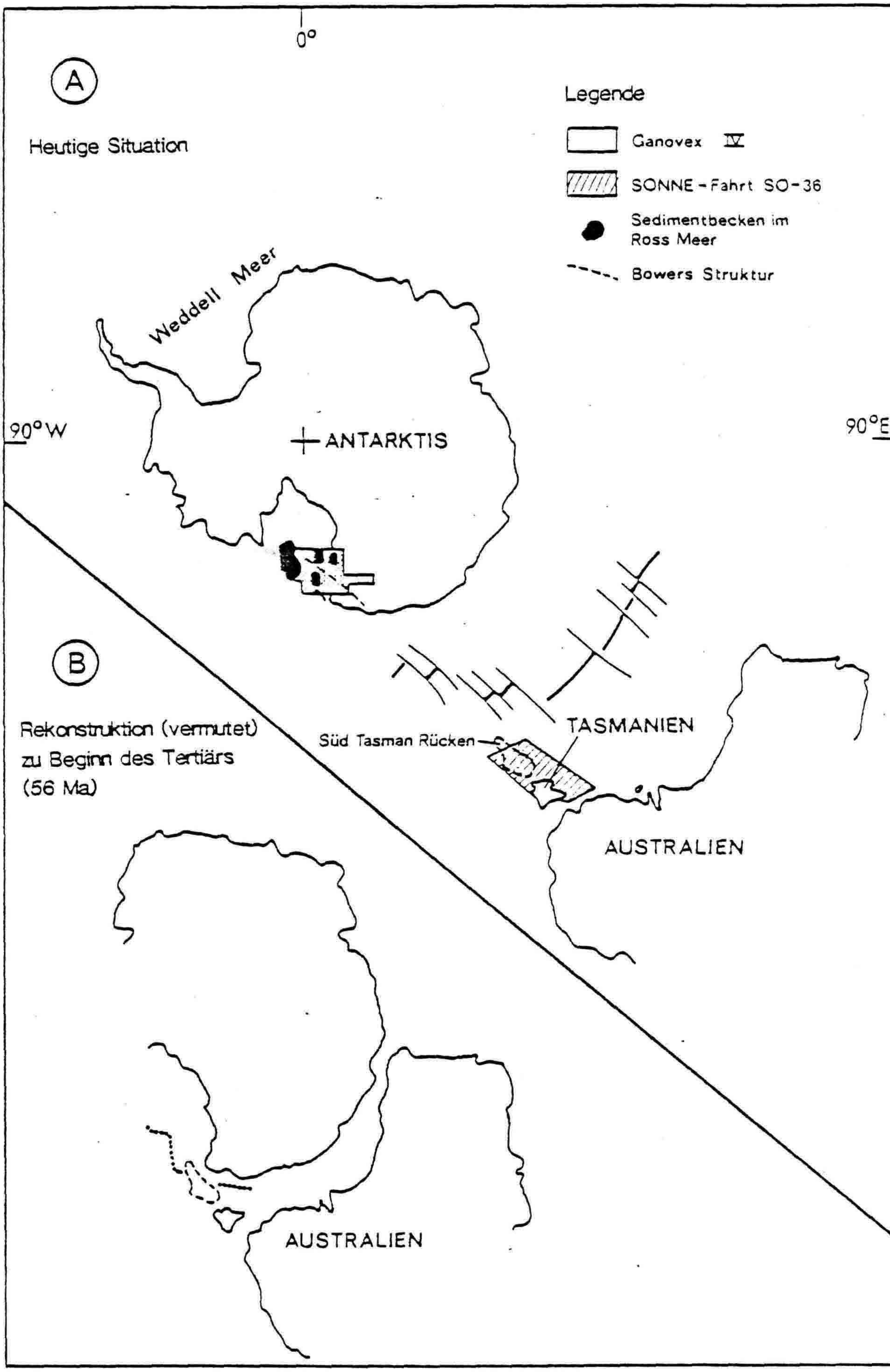

Figure 1: Location of the areas of investigation of SONNE cruise SO-36 (Western Tasmania and South Tasman Rise) and of GANOVEX-IV (Victoria Land/Antarctica)

2. FAHRTVERLAUF/SEQUENCE OF OPERATION

2.1 FAHRTVERLAUF DES 2. FAHRTABSCHNITTS DER SONNE-FAHRT SO-36 SEQUENCE OF OPERATION ON LEG 2 OF SONNE-CRUISE SO-36

12.03.-15.03.1985 F.S. SONNE läuft nach einer 30-tägigen geophysikalischen Vermessung am 12.03.1985 in Sydney ein und macht um 09:30 an Wharft 9 in der Woolloomooloo Bay fest.

Am 13. und 14.03.85 besichtigen diverse Gruppen das Schiff darunter die Herren Dr. Bolewski und A. Lück vom Deutschen Generalkonsulat, Dr. David A. Falvey, Chief Marine Geoscience & Petroleum Geology im Bureau of Mineral Resources, Professor Packham, University Sydney, Herr C. Chappell vom Department of Transport, das das neue australische Explorationsschiff R/V RIG SEISMIC bereedert. Kapitän und Fahrtleiter werden am 14.03.1985 von Reportern der Europa Welle und dem Heinrich Bauer Verlag interviewt. Die Kessler-Zwillinge besuchen das Schiff.
Nach gravimetrischen Anschlußmessungen verläßt F.S. SONNE am 15.03.1985 um 10:36 die Woolloomooloo Bay von Sydney und läuft aus zum westlichen Kontinentalrand von Tasmania. An Bord befinden sich 25 Mann Besatzung, 17 deutsche Wissenschaftler und Techniker und 2 australische Gastwissenschaftler. Auf der Anfahrt wird ab 12:30 das parallel zur australischen Ostküste verlaufende Profil SO-36-41 mit Magnetik, Gravimetrie, Sea Beam, 3,5 kHz Subbottom Profiler und Echolot vermessen.

16.03.-22.03.1985 Am 16.03.1985 gegen 08:00 passieren wir Cape Howe und drehen danach ab in die Bass Straße; vermessen Profil SO-36-42 und laufen südlich an den Kohlenwasserstoffe-produzierenden offshore Feldern des Gippsland Beckens vorbei. Ein Bootsmanöver und ein wissenschaft-

liches Einsatzplanungsgespräch finden statt. Wegen Untiefen wird um 15:36 die Magnetometersonde eingeholt. Am 17.03.1985 erreichen wir den nördlichen Teil des eigentlichen Arbeitsgebietes, nämlich den Nordwestschelf von Tasmania.
Auf der Position der Bohrung Clam-1, die in einem Subbecken des Otway Beckens (Fig. 41) niedergebracht worden ist, und die unter kretazischen Sedimenten devonische Rotsedimente und darunter Sedimente des unteren Paläozoikums sowie präkambrische Metamorphite erbohrte, wird mit dem Ausbringen des seismischen Streamers begonnen. Da die neuen und bis in 50 m Wassertiefe zuverlässig anzeigenden Drucktiefengeber nicht rechtzeitig vom Hersteller nach Sydney angeliefert werden konnten, dampfen wir aus Sicherheitsgründen für den Streamer von der Position der Bohrung Clam-1 zum äußeren Schelf und setzen das Ausbringen des Streamers bei Erreichen der 120m-Wassertiefenlinie fort. Die Wassertemperatur beträgt 16° C, die Salinität ist uns nicht ausreichend genug bekannt, um das Absenkungsverhalten des Streamers abzuschätzen.
Nach Auswechseln verschiedener Streamersektionen und Einsetzen zusätzlicher Gewichtslängen (Fig. 2 zeigt die Streameranordnung) sind am 17.03.1985 um 15:45 der insgesamt 3.003 m lange seismische Streamer und das aus zehn Airguns bestehende 19,5 m lange seismische Erregerarray ausgebracht. Die kombinierte geophysikalische Vermessung mit Digitalseismik, Magnetik, Gravimetrie, Sea Beam, 3,5 kHz Subbottom Profiler und Echolot beginnt um 15:55 (05:55 GMT) mit Profil SO-36-44.

			57m	30kg 7m	50kg 10m	58m	58m	50kg 10m	30kg 7m	2m	I 2m	1		2		3	
	yoyo	GNRG 16	GNRG 14	GLG 09	GLG 12	GNRG 15	GNRG 13	GLG 11	GLG 10	Adapter	GM 16	GS 28	GN 51	GS 39	GN 52	GS 01	GN 11

4		II	5		6		7		8		9		III	10		11	
GS 12	GN 07	GM 03	GS 15	GN 22	GS 10	GN 44	GS 46	GN 24	GS 08	GN 28	GS 42	GN 37	GM 05	GS 44	GN 01	GS 04	GN 09

12		13		14		IV	15		16		17		18		19		V
GS 06	GN 58	GS 17	GN 43	GS 14	GN 27	GM 13	GS 40	GN 46	GS 05	GN 19	GS 27	GN 60	GS 48	GN 36	GS 16	GN 42	GM 08

20		21		22		23		VI	24		54m	2kg 260 m					
GS 22	GN 08	GS 36	GN 16	GS 38	GN 04	GS 20	GN 13	GM 14	GS 47	GN 32	GNRG 07						

BGR - STREAMER   Fahrt-Nr.: S036   Schiff: SONNE 1985/6

GS = Aktiv
GN = Neutral
GM = Mano
GLG = Gewicht
GNRG = Stretch

Ausgesetzt am 17.3.85 12⁰⁰-15¹⁵

Eingeholt am ______________

Defekte

Austausch

Figure 2: Streamer configuration

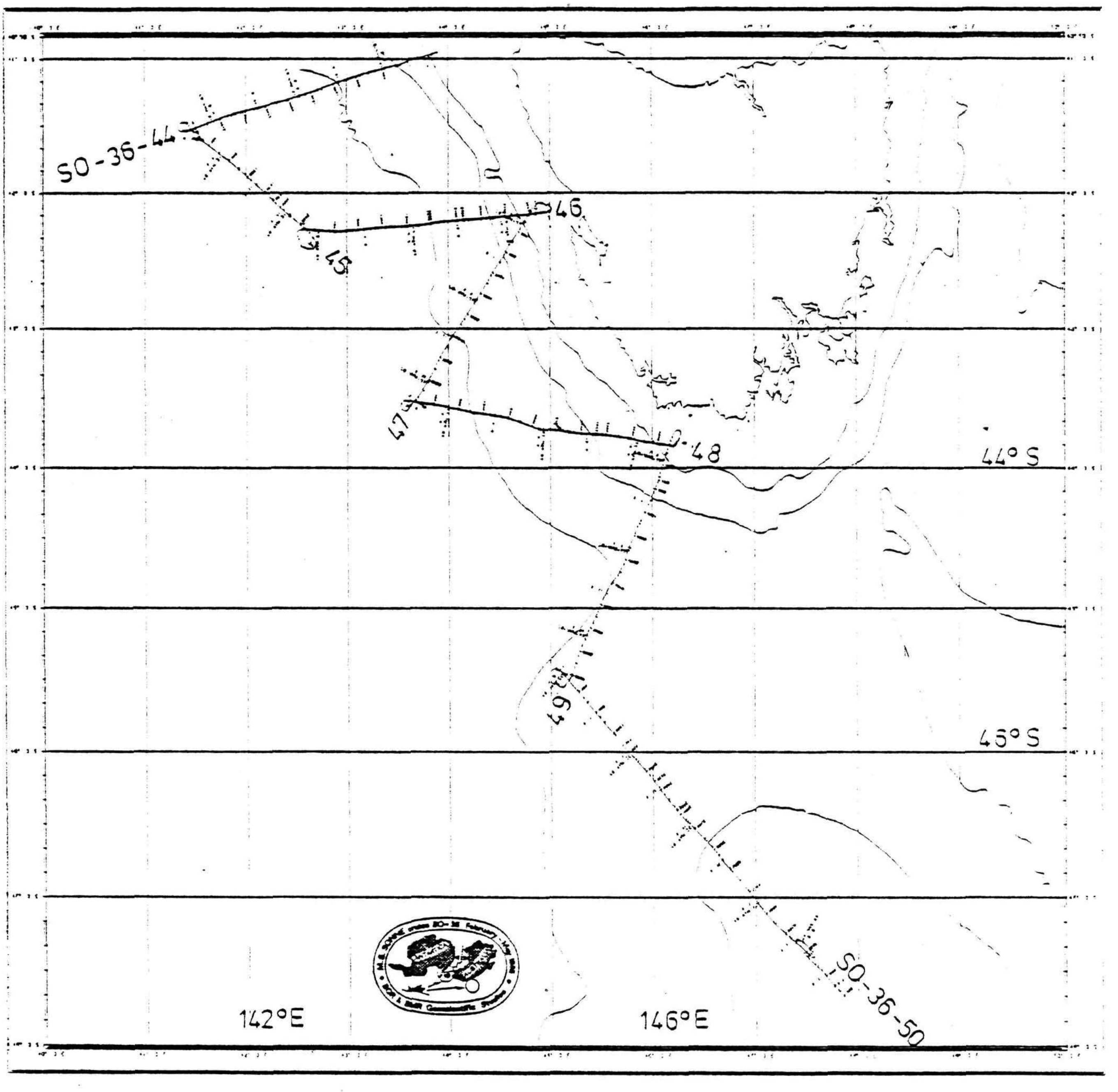

Figure 3: Location of multichannel seismic lines off Western Tasmania

Aufgrund eines relativ stabilen Hochdruckzentrums über Tasmania* haben wir für dieses Seegebiet ungewöhnlich ruhige Wind- und Seeverhältnisse. Ohne nennenswerte Ausfälle werden bis zum 22.03.1985 um 05:06 die Profile SO-36-44, SO-36-45, SO-36-46, SO-36-47 und SO-36-48 mit einer Gesamtlänge von 920 km vermessen (Fig. 3 und Fig. 28-33). Profil SO-36-48 endet auf dem Schelf von Süd Tasmania mit seiner imposanten, vorwiegend aus präkambrischen Metamorphiten, bestehenden Küste.

Mit dem Profil SO-36-46 sind lithostratigraphische Einhängungsmöglichkeiten an die Bohrungen DSDP Site 282 und die Explorationsbohrung Cape Sorell-1 für die Reflexionsseismik geschaffen worden. Die 1982 im Auftrage der Amoco Australia Petroleum Company niedergebrachte Bohrung ist die südlichste Explorationsbohrung in australischen Gewässern. Die nächstliegende Explorationsbohrung ist Clam-1, die etwa 156km nördlich liegt. Bohrung Cape Sorell-1 steht auf dem Schelf in 94 m Wassertiefe, etwa 12 sm westlich von Cape Sorell, dem Zugang zum Macquarie Harbour, dem einzigen Hafen an der Westküste Tasmanias. Mit der Bohrung sollte das Kohlenwasserstoffpotential des sog. Cape Sorell Beckens, einem etwa NNW-streichenden Bekken von etwa 50 km Länge und 25 km Breite erkundet werden.

Nach Schleifenfahrt wird am 22.03.1985 um 08:17 mit der Vermessung des Profiles SO-36-49 begonnen, das vom Südschelf Tasmanias nach Südwesten zum nördlichsten Ausläufer des Süd Tasman Rückens verläuft (Fig. 3).

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*Zu Tasmania: Insel Tasmania ist etwa 120 sm durch die Bass Straße von Australien getrennt. Tasmania hat eine Fläche von etwa 67.900 km² = etwa 1/3 der Bundesrepublik Deutschland. Die Bevölkerungszahl ist etwa 500.000.

23.03.-25.03.1985 Neben dem Meßbetrieb wurden die magnetischen, gravimetrischen und bathymetrischen Daten offline verarbeitet. Profilpläne mit den nach dem Programm SATFIX online berechneten Satellitenfixen und Schußpunktpositonen wurden täglich erstellt. Die seismischen Monitorregistrierungen mit 8 sec und 10 sec Sweep sind ausgewertet und in Form von interpretierten Laufzeitprofilen zusammen mit der Freiluftschwere dargestellt worden (Fig. 28-42). Mit Hilfe der digital erfaßten und kartenmäßig entlang der vermessenen Profile ausgedruckten Tiefenwerte ist unter Berücksichtigung der Sea Beam Registrierungen und Verwendung der in den GEBCO-Plotting Sheets dokumentierten Wassertiefen laufend an der Erstellung einer neuen verbesserten bathymetrischen Karte gearbeitet worden.

Die Registrierungen des 3,5 kHz Subbottom Profilers sind kontinuierlich speziell im Hinblick auf die Auswahl geeigneter Beprobungslokationen für den 3. Fahrtabschnitt ausgewertet worden.

Das Profil SO-36-49 wird am 23.03.1985 beendet. Nach einer Schleifenfahrt beginnt die Vermessung des Profils SO-36-50, das wegen Ausfälle mehrerer Airguns am 25.03.1985, dem Geburtstag des Kapitäns, für vier Stunden unterbrochen werden muß.

Das 380 km lange Profil SO-36-50/50 A quert die breitere nördliche Hälfte des Süd Tasman Rückens in NW-SE Richtung (Fig. 4). Mit dem anschließenden Profil SO-36-51, das nach Südwesten bis 49° 14'S' verläuft - die südlichste südliche Breite, die F.S. SONNE bisher je erreicht hat - werden die DSDP Sites 280 und 281 überlaufen.

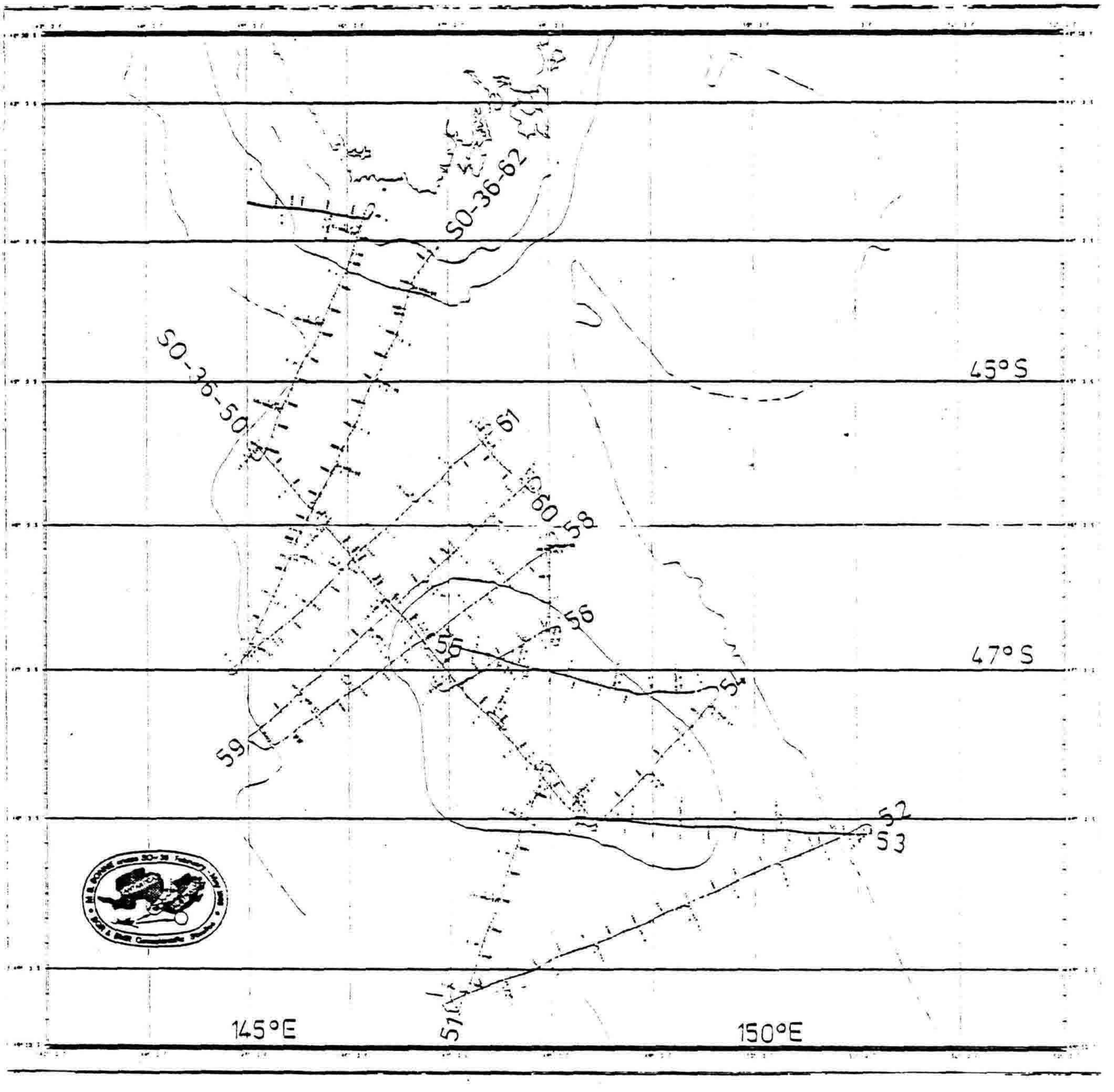

Figure 4: Location of multichannel seismic lines on the South Rise

Von dem zwischen 45° S und 51° S gelegenen Süd Tasman Plateau, das bezogen auf die 3.000 m Wassertiefenlinie eine Fläche von etwa 130.000 km² einnimmt, gibt es bisher kein digitalseismisches Profil. Trotz der beiden DSDP-Bohrungen Site 280 und Site 281, die 1973 von GLOMAR CHALLENGER an der SW-Flanke niedergebracht worden sind, war der geologische Aufbau und die geologische Entwicklung dieses riesigen NNW-streichenden submarinen Rückens bisher unbekannt.

26.03.-31.03.1985 Bis zum 29.03.1985 werden die Profile SO-36-52 bis SO-36-54 bei zunehmend rauher werdender See vermessen. Jetzt bekommen wir einen Eindruck davon, warum diese Breiten von den alten Seefahrern die "Roary Forties" genannt wurden. Bei Windstärken von 6 bis 8 Beaufort und in Böen mit guten 9 (Fig. 6) baut sich eine steile Dünung auf. Wegen der rauhen See ist die Lage des Streamers unbefriedigend und der Noise-Pegel zu hoch. Das Profil wird am 29.03.1985 um 18:36 abgebrochen. Wegen auflaufender Brecher auf das Achterdeck kann das Airgun Array nicht an Deck gehievt werden. F.S. SONNE dampft langsam gegen an und wettert ab.
Der seimische Meßbetrieb wird am 30.03.1985 um 08:45 wieder aufgenommen. Die steile von Westen anlaufende Dünung zwingt am 30.03. und 31.03.1985 zur Änderung der Profilkurse. Figur 5 zeigt eine für das Arbeitsgebiet typische Wettersituation. Zwischen den aufeinanderfolgenden und ostwärts ziehenden antarktischen Tiefdrucksystemen schalten sich äquatorwärts Hochdruckgebiet ein, was zu veränderlichen Windverhältnissen und langandauernder rauher Dünung führt. Die Winde kommen überwiegend aus einer Richtung zwischen Nord und Südwest.

01.04.-07.04.1985 Vom 01.04. bis 05.04.1985 werden bei durchweg rauher Dünung drei NE-SW verlaufende Profile über den Nordteil des Süd Tasman Rückens vermessen, nämlich die Profile SO-36-58, SO-36-59 und SO-36-61 (Fig. 4). Nach den Monitorregistrierungen zu urteilen, sind die digitalseismischen Meßdaten insge-

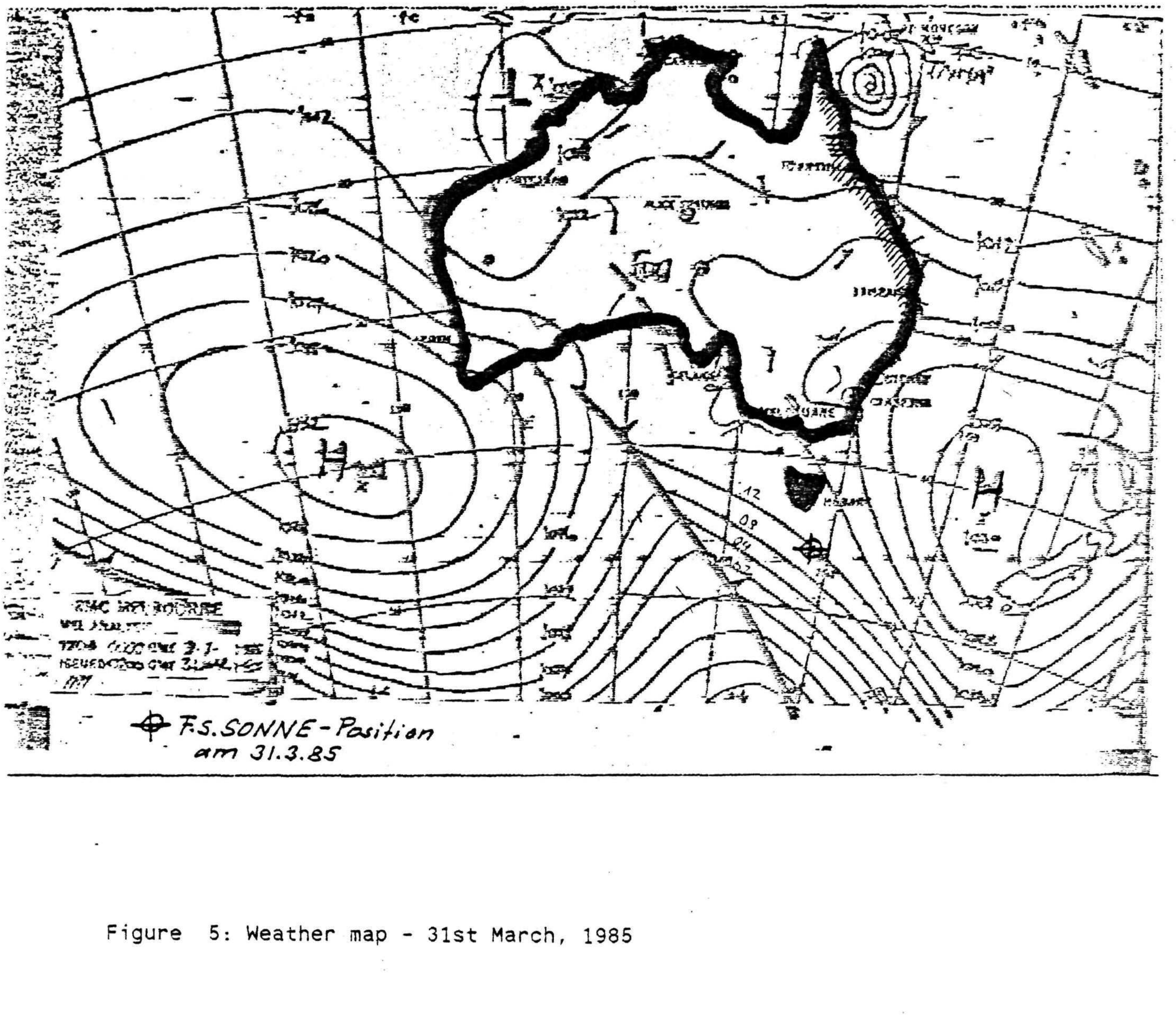

Figure 5: Weather map - 31st March, 1985

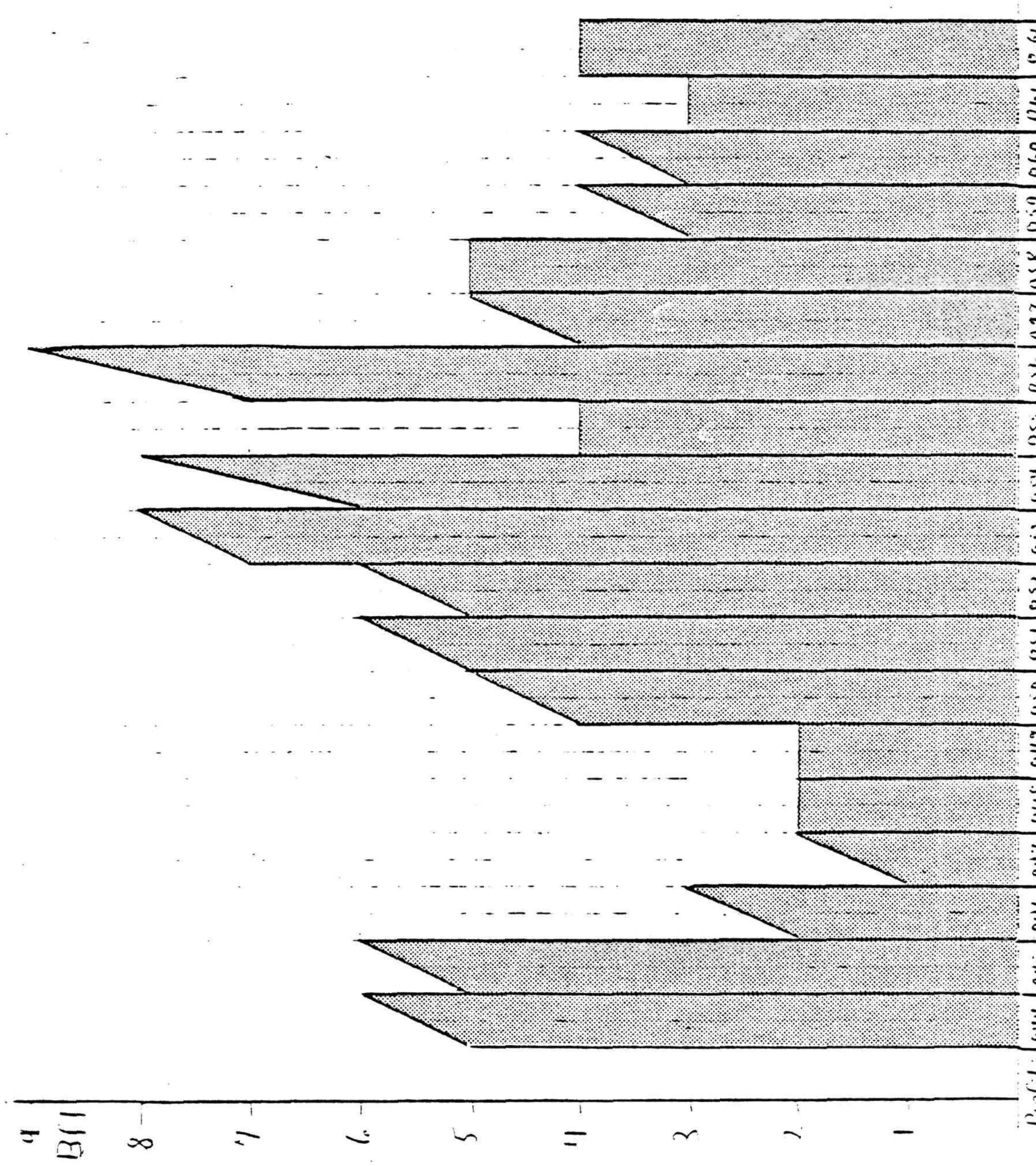

Figure 6: Wind statistics - Leg 2 of SONNE cruise SO-36

samt von guter Qualität. Durch die neue Aufhängung für die elektrischen Triggerleitungen und die Hochdruckluftschläuche sind die Ausfälle am Airgun Array erheblich vermindert worden.
Seit der schweren See in der letzten Märzwoche ist die Tailboje am Ende des 3.000 m langen Streamers weder mit Fernglas noch im Radar zu erkennen. Unsere Vermutung, daß sie durch Brecher Leck geschlagen und untergeschnitten ist, wird beim Einholen des Streamers am Ende der seismischen Meßkampagne bestätigt.
Am 02.04.1985 beobachten wir gegen 02:30 Nordlicht. Am 03.04.1985 mußte die digitalseismische Vermessung des Profils SO-36-59 auf einer Strecke von etwa 15 km wegen eines Defekts am Airgun Array ausgesetzt werden.
Das letzte digitalseismische Profil des 2. Fahrtabschnitts der SONNE-Fahrt SO-36 beginnt am 05.04.1985 um 16:12. Das 344 km lange Profil SO-36-62 verläuft parallel zu Profil SO-36-49 vom Süd Tasman Rücken zum Südschelf von Tasmania und wird dort am Ostersonntag beendet. Nach Anbordnahme des Airgun Arrays und des seismischen Streamers dampft F.S. SONNE zunächst entlang der landschaftlich schönen Steilküste der Insel Bruny.

08.04.-10.04.1985 Nach Passieren von Cape Pillar/Tasman Peninsula drehen wir nach Norden und dampfen nach Sydney. Auf dieser Fahrt wird das Profil SO-36-63 mit Magnetik, Gravimetrie, 3,5 kHz Subbottom Profiler und Sea Beam vermessen. Das digitalseismische Instrumentarium wird abgerüstet und für den Versand zurück nach Deutschland verpackt. Die geophysikalischen Untersuchungen des 2. Fahrtabschnittes der SONNE-Fahrt SO-36 werden am 10.04.1985 um 04:50 beendet. Um 05:59 kommt der Lotse an Bord, um 07:06 macht F.S. SONNE fest im Darling Harbour in Sydney.

Auf dem 2. Fahrtabschnitt der SONNE-Fahrt SO-36 sind insgesamt vermessen worden:

19 Profile mit einer Gesamtlänge von 3.820 km mit digitaler Reflexionsseismik, Magnetik, Gravimetrie, Echolot, Sea Beam und 3,5 kHz Subbottom Profiler; zusätzlich

4 Profile mit einer Gesamtlänge von 2.147 km mit Magnetik, Gravimetrie, Echolot, Sea Beam, 3,5 kHz Subbottom Profiler.

2.2 FAHRTVERLAUF DES 3. FAHRTABSCHNITTS DER SONNE FAHRT SO-36 SEQUENCE OF OPERATION ON LEG 3 OF SONNE CRUISE SO-36

12.04.-15.04.1985 Durch die leider unvorhersehbaren Reaktionen der australischen Hafenarbeitergewerkschaft sind wir völlig im Ungewissen darüber, ob die bereits Ende März von See aus an die Agentur abgesetzten und zeitlich und sachlich spezifizierten Aufträge bezüglich der anstehenden umfangreichen Demob- und Mobarbeiten in Sydney eingehalten werden. Erst am Vormittag des 12.04.1985 geht das umfangreiche See- und Luftfrachtgut der BGR von Bord. Die etwa 10 to schwere Streamerwinde wird erst um 14:00 mit Hilfe eines extra von der Agentur gecharterten Autokrans von Bord gehievt. Die Hafenkräne standen nicht zur Verfügung, da gerade die Stauerleute des Hafenbereichs streikten, in dem die Kräne stehen.

Um 15:00 wirft F.S. SONNE alle Leinen los und läuft mit 27 Mann Besatzung, 19 deutschen Technikern und Wissenschaftlern und 3 australischen Gastwissenschaftlern an Bord aus Sydney aus zum 3. Fahrtabschnitt. Um 15:11 wird die berühmte Harbour Bridge passiert; um 15:48 beginnt die auf 28 Tage ausgelegte Seereise. Um 17:10 wird die Magnetometersonde zu Wasser gebracht und auf der Anfahrt werden die Profile SO-36-64 und 65 magnetisch, gravimetrisch und mit Sea Beam vermessen.

Am 14.04.1985 passieren wir die Albatros Insel auf Backbordseite und die Insel Black Pyramide auf Steuerbordseite. Danach wird das Profil SO-36-66.1 analogseismisch vermessen, das die Bohrung Clam-1 mit dem digitalseimischen Profil SO-36-44 verbindet. Nach den Kolbenlotstationen SO-36-001 und 002 (Figur 7) wird am 15.04.1985 von 19:03 bis 22:34 das Profil SO-36-66.3 mit Analogseismik abgelaufen, mit dem die Streichrichtung einer diapirartigen und mit einer positiven Freiluftschwereanomalie assoziierten Struktur erkundet werden soll.

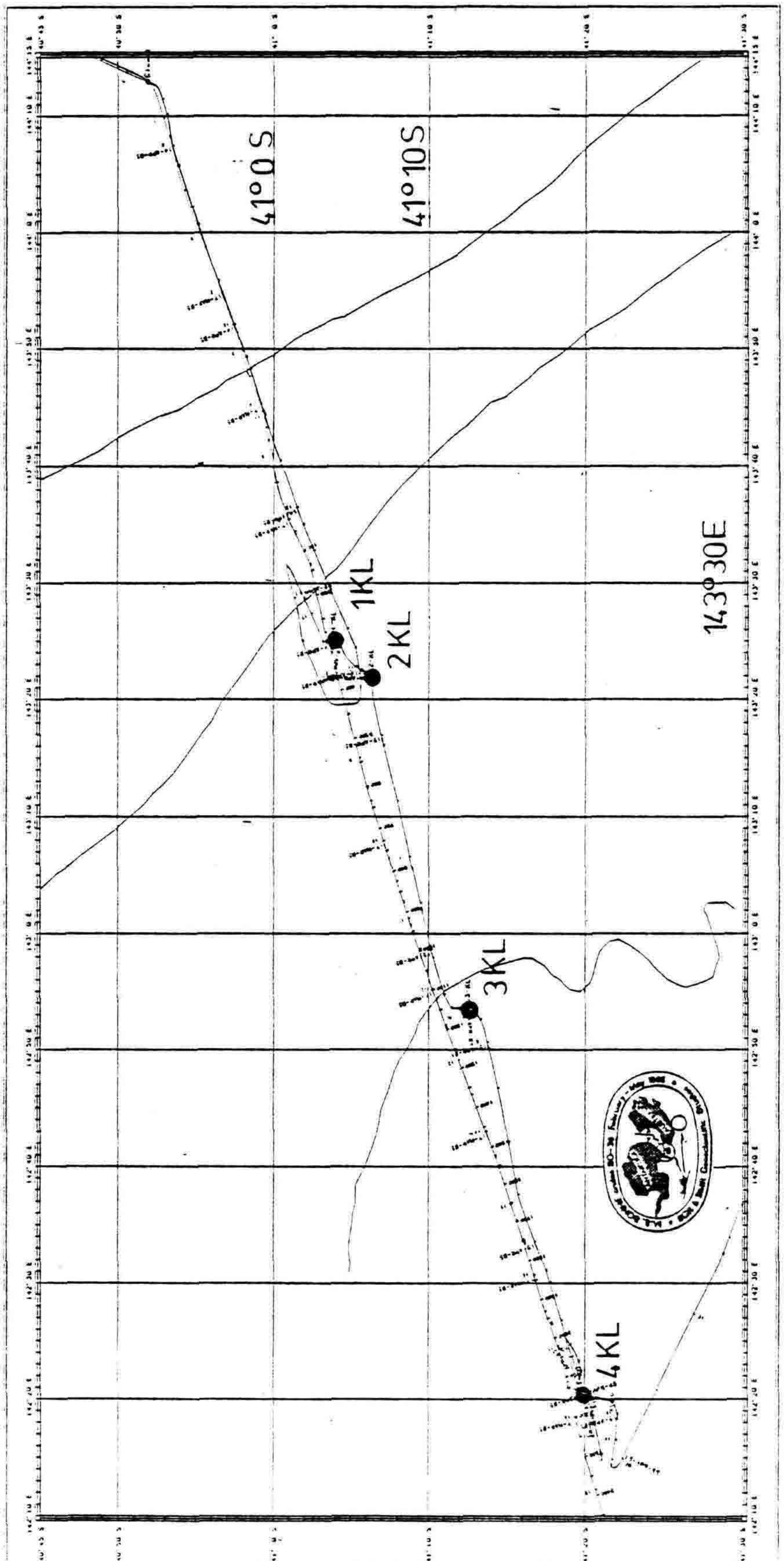

Figure 7: Location of geological stations off northwestern Tasmania

16.04.-18.04.1985 Bei der nachfolgenden Beprobung (Station SO-36-04) dredgen wir verwitterte Basalte und einen Sandstein. Bedingt durch ein über Tasmania liegendes Tiefdruckgebiet kommt Wind auf in Böen bis zu 10 Beaufort. Die See ist sehr rauh. Wir laufen nach Süden und ziehen in der Zeit vom 16.04./17:53 bis 18.04./04:20 am Kontinentalrand vor Cape Sorrel 16 Schwerelote (Stationen SO-36-05 bis SO-36-20, Fig. 8) für geochemische Untersuchungen. Wegen Schlechtwetter muß am 18.04.1985 für mehrere Stunden abgewettert werden.

19.04.-24.04.1985 Am 19.04.1985 werden die Stationen SO-36-21 bis SO-36-27 mit dem Schwerelot erfolgreich beprobt. Danach werden am 20. und 21.04.1985 am südlichen Kontinentalrand von Tasmania zur Klärung der geologischen Natur der seismischen Unkonformität "Braun" und des Grundgebirges die Stationen SO-36-28 bis SO-36-36 (Figur 9) mit Kettendredge und Kolbenlot gefahren.

Nach einer analogseismischen Vermessung (Profile SO-36-69 und 70) wird am 20.04.1985 die westliche Steilstufe des Süd Tasman Plateaus beprobt. Die von 44,5° S bis 48° S verlaufende Steilstufe des Süd Tasman Plateaus wird am 24.04.1985 nochmals erfolgreich bedredged (Stationen SO-36-43 und 44), nachdem vorher zur Klärung der geologischen Natur der planierten Grundgebirgsblöcke die Kolbenlotstationen SO-36-38 bis SO-36-42 gefahren worden sind (Figur 10).

25.04.-29.04.1985 Beprobungen für die Geochemie in einem Riftbecken, das den zentralen Grundgebirgskern des Süd Tasman Plateaus westlich flankiert, werden am 24.04. und 25.04.1985 durchgeführt (Stationen SO-36-45 - SO-36-51, Figur 11). Dabei wird auch wieder die Geothermiksonde

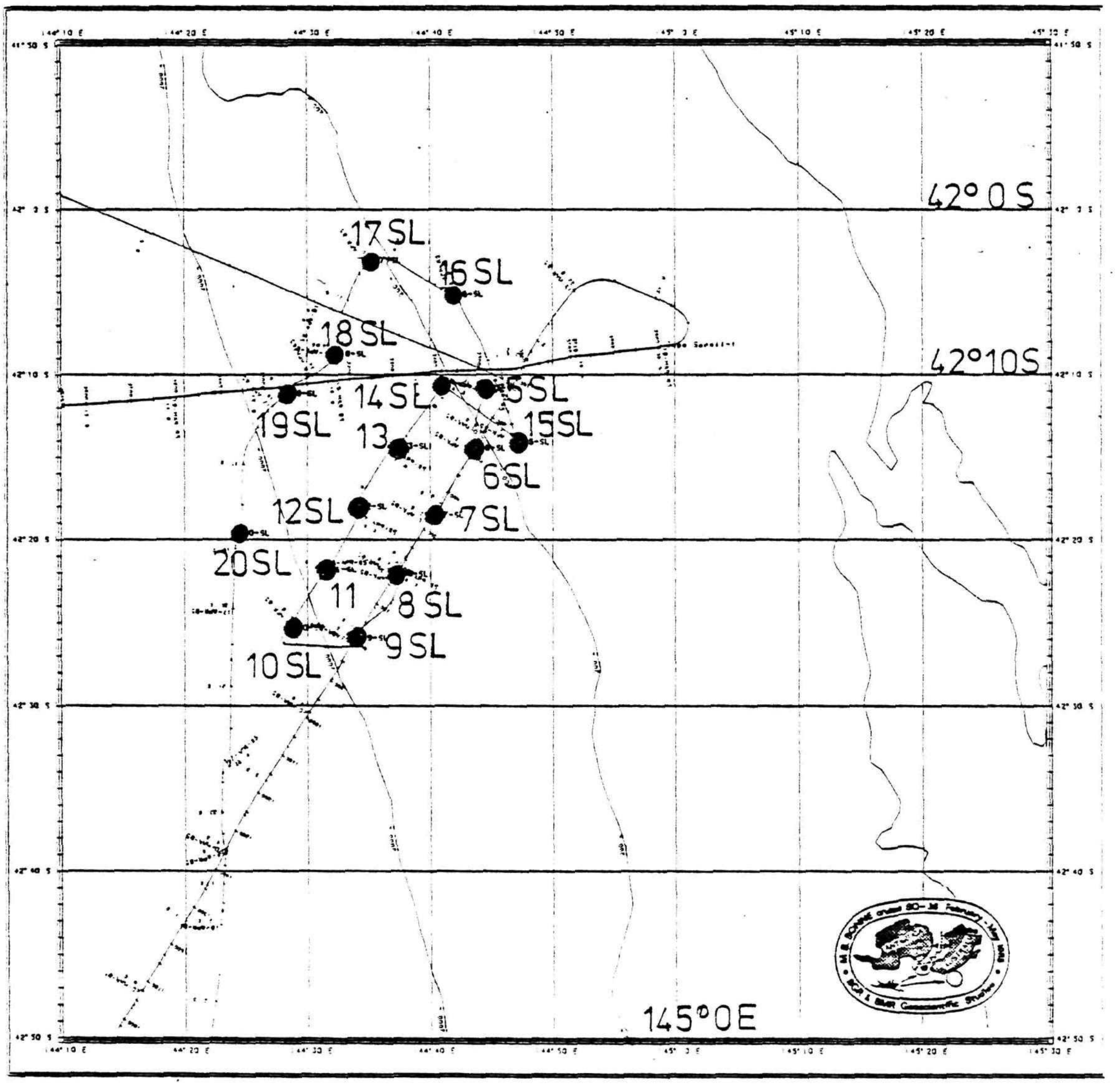

Figure 8: Location of geological stations off Cape Sorell/Western Tasmania

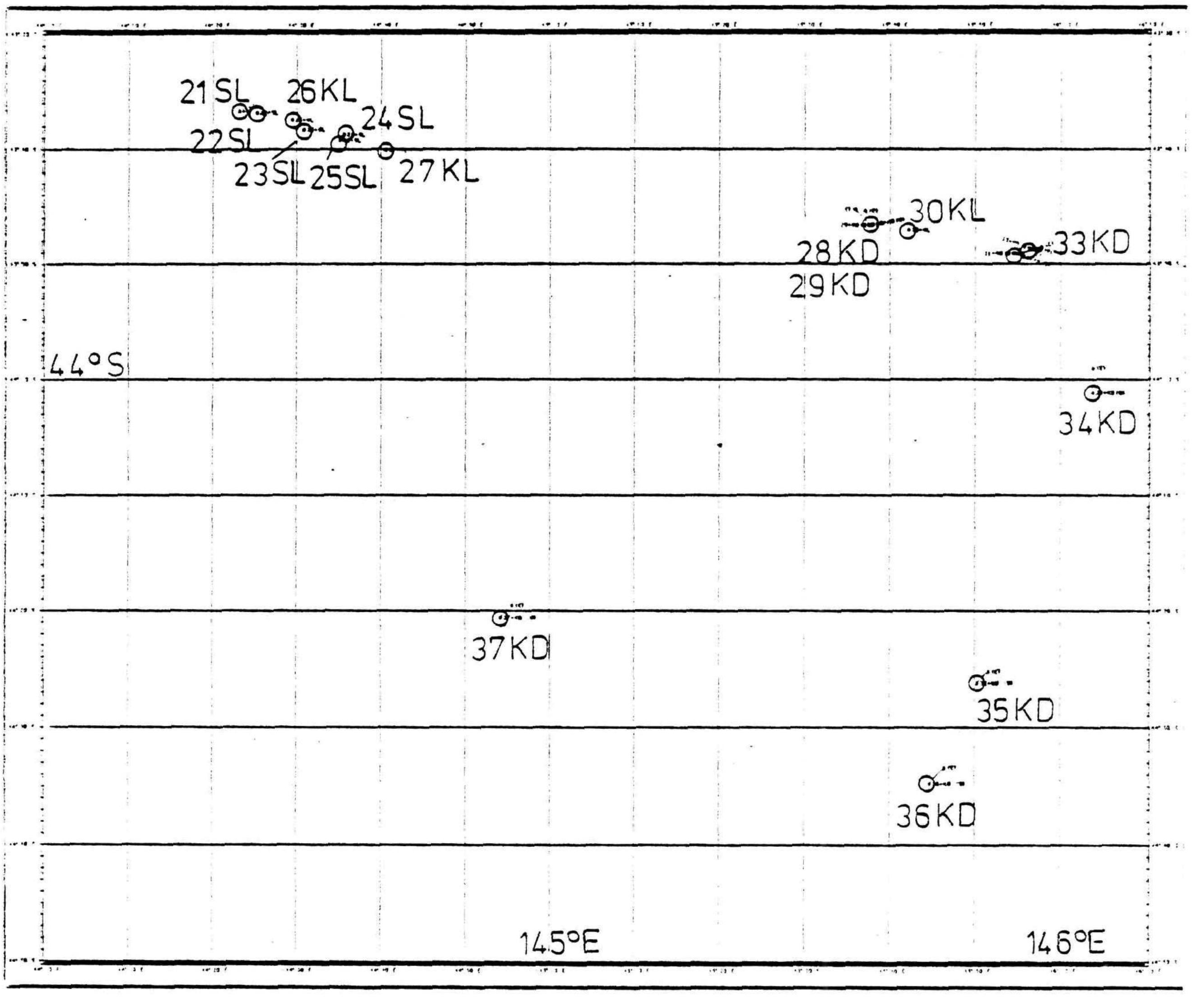

Figure 9: Location of geological stations off southern Tasmania

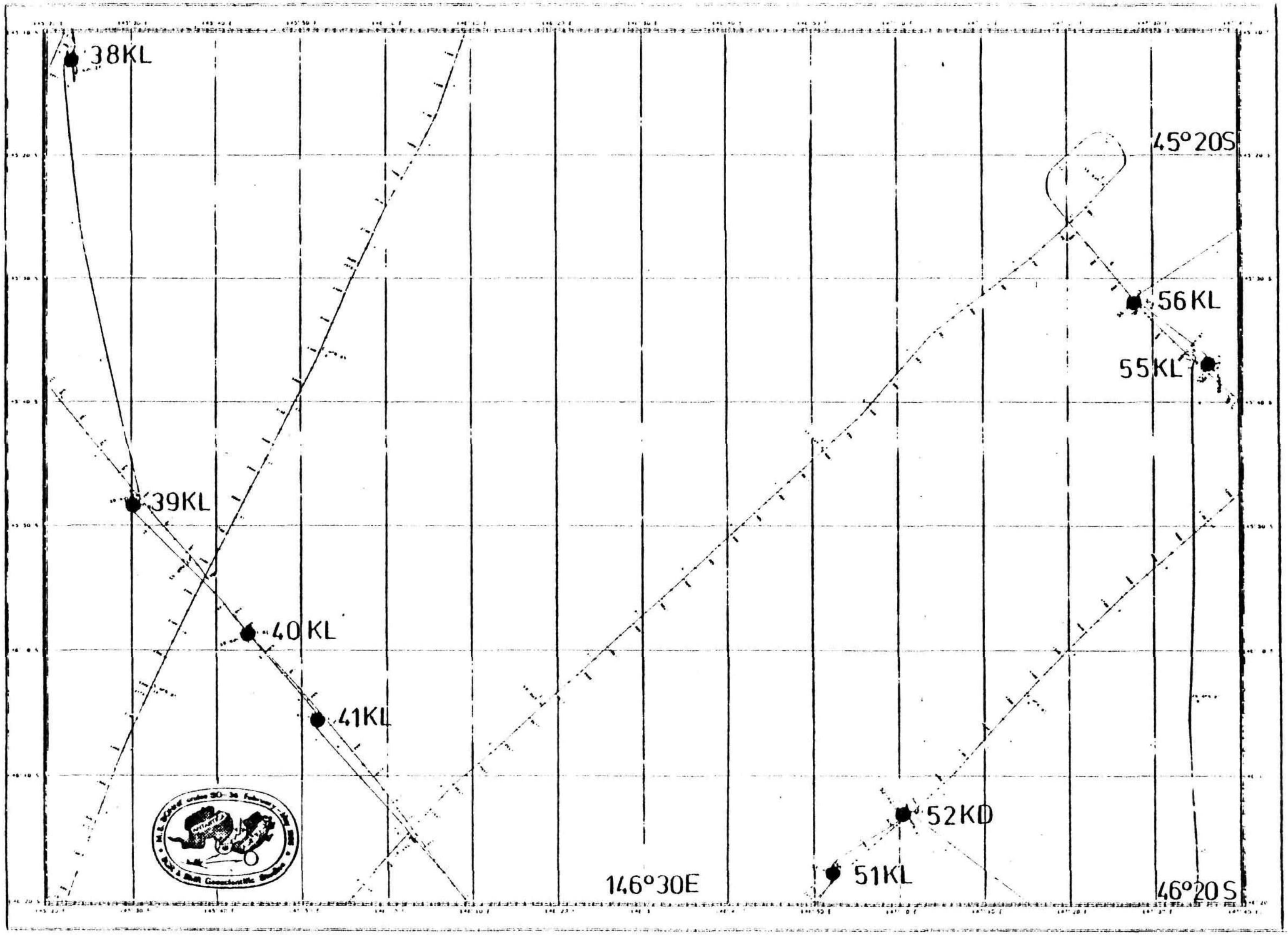

Figure 10: Location of geological stations on the South Tasman Rise north of latitude 46° 20' S

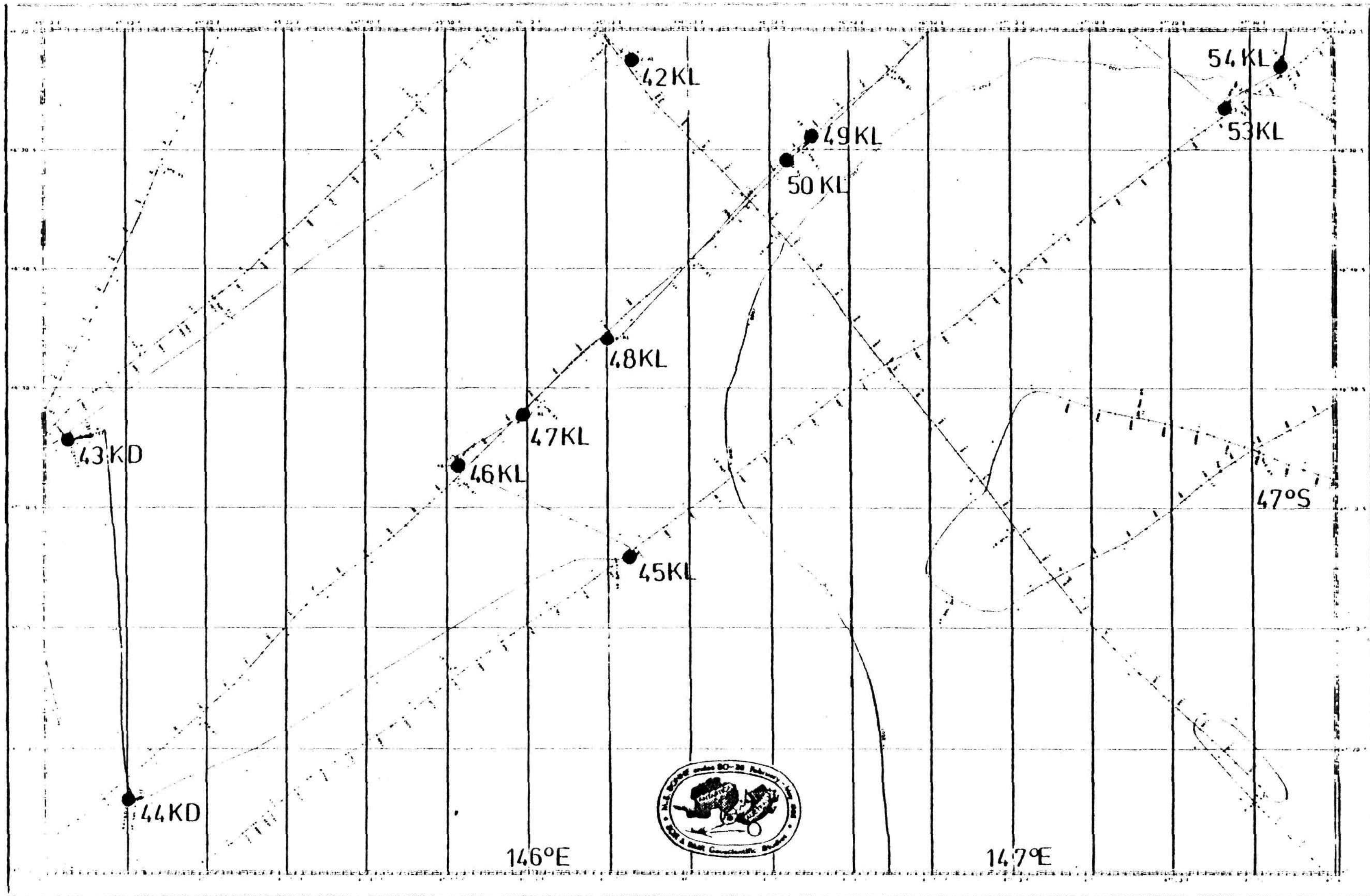

Figure 11: Locations of geological stations on the South Tasman Rise south of latitude 46° 20' S

eingesetzt. Nach einer Dredgestation (Station SO-36-52), mit der nachgewiesen wird, daß das Süd Tasman Plateau im Tertiär von Basalten intrudiert worden ist und drei danach gefahrenen Kolbenlotstationen und einem Einsatz der Geothermiksonde werden die geologischen Arbeiten auf dem Süd Tasman Plateau am 26.04.1985 um 23:00 beendet. F.S. SONNE läuft ab zum Lord Howe Rücken und vermißt dabei mit Magnetik, Gravimetrie, Sea Beam und 3,5 kHz Subbottom Profiler die Profile SO-36-77 und 78. Am 29.04.1985 überfahren wir den Gascoyne Seamount.

30.04.-08.05.1985 Zur Lokalisierung einer geeigneten Dredgeposition werden am 30.04.1985 und 01.05.1985 bei grober See auf dem Dampier Rücken die Profile SO-36-80 und 81 analogseismisch vermessen. Auf der ausgewählten Position werden mit der Dredge (Station SO-36-57) granitische Gesteine gewonnen (Figur 12). Damit ist erstmalig nachgewiesen, daß der etwa 800 km lange und N-S verlaufende Dampier Rücken ein Mikrokontinent ist. Wegen Schlechtwetters muß die geplante Beprobung an der Westflanke des Lord Howe Rückens aufgegeben werden. Die Profile SO-36-82/83 und 84 werden am 02. und 03. Mai 1984 mit Magnetik abgelaufen. Dann folgt ein geochemisches Untersuchungsprogramm mit vier Schwerelotstationen (Stationen SO-36-58 bis SO-36-61) in einem auf dem 1. Fahrtabschnitt geophysikalisch erkundeten Sedimentbecken (Figur 13). Wegen ungenügender adsorbierter Gasgehalte in den oberflächennahen Sedimenten werden die Beprobungen am 03.05.1985 eingestellt. F.S. SONNE läuft ab zur Vening Meinesz Fracture Zone. Die Vening Meinesz Fracture Zone ist eine etwa 1.700 m tiefe und NW-streichende bathymetrische Depression an der Ostflanke des Lord Howe Rückens. Nach einer analogseismischen Vermessung (Profile SO-36-86 und 87) werden am 04.05.1985 eine Beprobung mit Kolbenlot und eine Beprobung mit der Ketten-

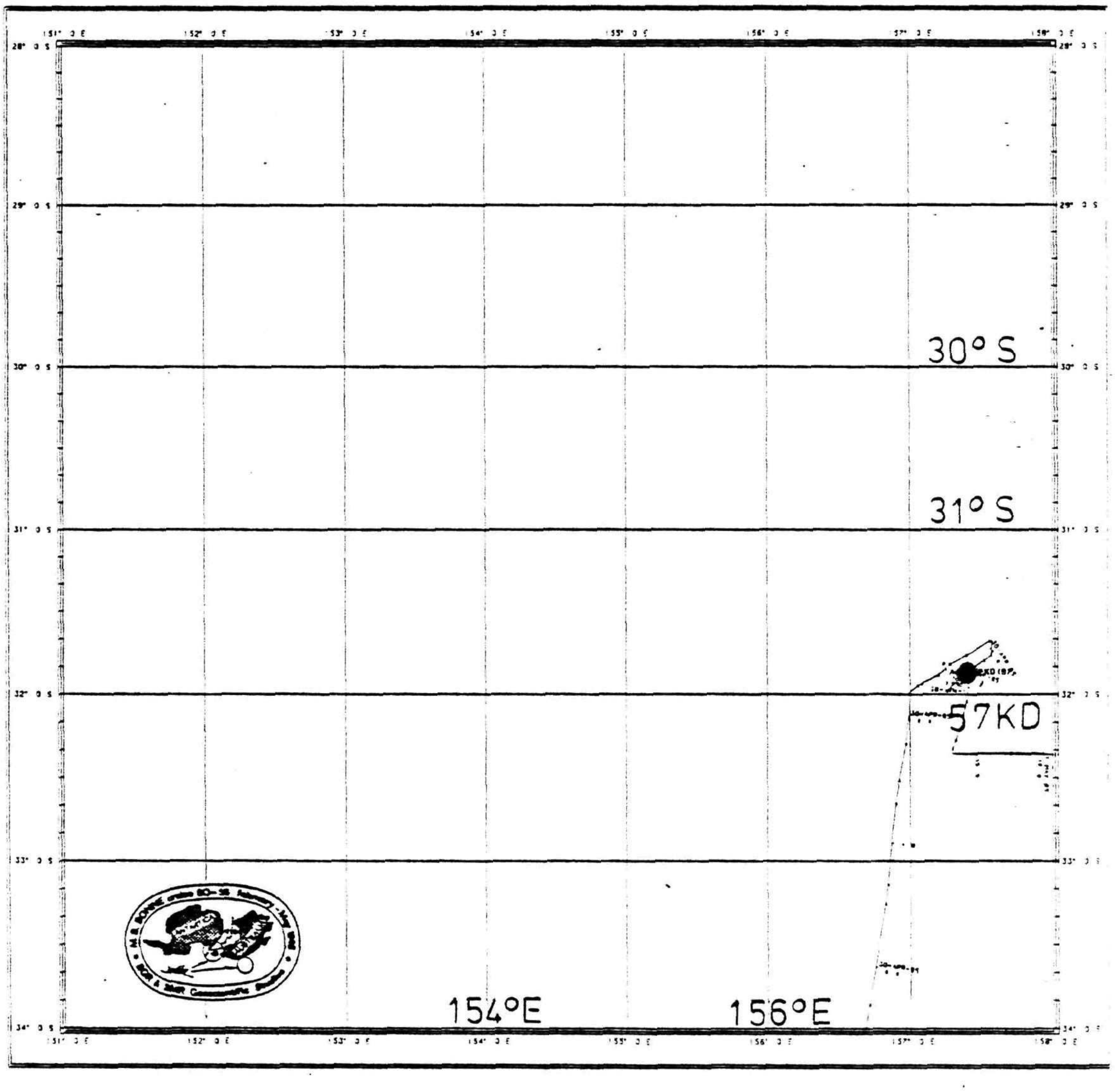

Figure 12: Location of station SO-36-57 on the Dampier Ridge

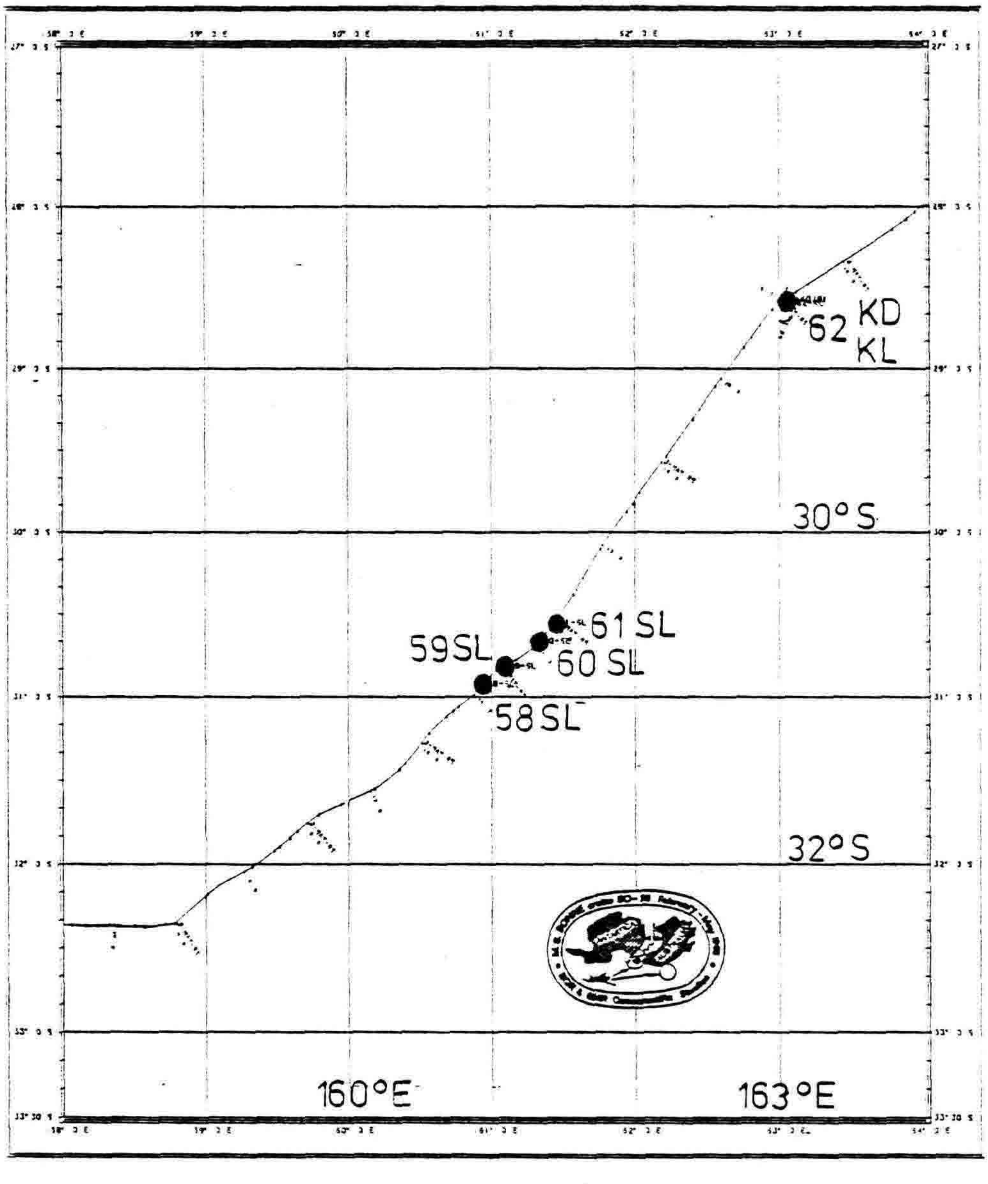

Figure 13: Geological stations on the Lord Howe Rise

sackdredge an der Vening Meinesz Fracture Zone durchgeführt. Dabei werden vererzte Sedimente gewonnen. Die Ergebnisse der geologischen und geochemischen Arbeiten auf dem Dampier Rücken und auf dem Lord Howe Rücken werden im Bericht über den 1. Fahrtabschnitt der SONNE-Fahrt SO-36 diskutiert.
Auf der Anfahrt nach Suva/Fiji wird am 05.05.1985 im 3.600 m tiefen Norfolk Trog erneut die Geothermiksonde getestet, und am 07.05.1985 wird eine Sternfahrt durchgeführt, um das Gravimeter KSS 31, Nr. 22, zu testen.

09.05.-12.05.1985 Die Seereise endet am 09.05.1985 um 08:42. Um 09:00 kommt der Lotse an Bord, und um 09:42 macht F.S. SONNE fest an der Walu Bay Wharft von Suva/Fiji. Nach Gravimeteranschlußmessungen werden die beiden BGR-Container von Bord gehievt. Die Beladung des Leihcontainers und Demob der Luftfracht kann am Sonnabend, 10.05.1985, abgewickelt werden.
Auf Einladung von Direktor D. Kleinert von der Hanns Seidel Stiftung besuchen Berichterstatter und einige Mitarbeiter das Fiji National Video Centre in Suva. Der Aufbau des Fiji National Video Centre wird von der Hanns Seidel Stiftung gefördert. Junge Mitarbeiter dieser Institution hatten unter Anleitung von Herrn Kleinert bei der Aufrüstung der SONNE Anfang Februar 1985 einen beeindruckenden Kurzfilm über das Forschungsschiff F.S. SONNE gedreht.

Auf dem 3. Fahrtabschnitt der SONNE-Fahrt SO-36 sind vor West Tasmania und auf dem Süd Tasman Rücken auf 56 Stationen geologische und geochemische Untersuchungen durchgeführt worden. Es wurden 23 Kolbenlotstationen, 20 Schwerelotstationen und 13 Kettensackstationen gefahren.

Auf dem Dampier Rücken und dem Lord Howe Rücken sind zusätzlich auf 7 Stationen geologische und geochemische Studien vorgenommen worden.

Auf den Anfahrten zu den Stationen sind geophysikalische Messungen durchgeführt worden: Es wurden 11 Profile mit einer Gesamtlänge von 470 km analogseismisch vermessen. Zusätzlich sind auf 16 Profilen mit einer Gesamtlänge von 4.230 km Messungen mit Magnetik, Gravimetrie, Sea Beam und 3,5 kHz Subbottom Profiler vorgenommen worden.

3. PARTICIPANTS AND PARTICIPATING INSTITUTIONS

3.1 PARTICIPANTS AND PARTICIPATING INSTITUTIONS ON LEG 2:

Scientific crew:

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BURZEIA, Heiko	2. Ingenieur
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KONRATH, Rolf	Elektriker
HAENSEL, Helmuth	Elektroniker
HEYGEN, Ronald	Elektroniker
SCHULTDREES, Wilhelm	Maschinen-Assistent
UNTERBERGER, Anton	Maschinen-Assistent
IRION, Arthur	Maschinen-Assistent
ROSEMEYER, Rainer	Maschinen-Assistent
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von MINDEN, Heiko	2. Offizier
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von WIEDING, Dieter	2. Ingenieur
BURZEIA, Heiko	2. Ingenieur
ARNDT, Heinz-Dieter	Elektriker
HAENSEL, Helmut	Elektroniker
HEYGEN, Ronald	Elektroniker
RUELKE, Uwe	Storekeeper
UNTERBERGER, Anton	Maschinen-Assistent
IRION, Arthur	Maschinen-Assistent
ROSEMEYER, Rainer	Maschinen-Assistent
ZAROTT, Wolfgang	Maschinen-Assistent
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GRUENDINGER, Emil	Bootsmann
LUDE, Günter	Matrose
PESCHKES, Peter	Matrose
SEIDEL, Horst	Matrose
PITZOFF, Rudolf	Matrose
JAHNS, Winfried	Matrose
HOEDL, Werner	Matrose

4. SCIENTIFIC INSTRUMENTS

4.1 SCIENTIFIC INSTRUMENTS USED ON LEG 2:

Seismik:

1 digitalseismisches Datenerfassungssystem, Typ DFS V der Fa. Texas Instruments, 24 Kanäle, SEG B-Format 1600 bpi, Sample-Rate 4 msec
1 EDO Western Monitorschreiber, 10 sec sweep
2 EPC Monitorschreiber, 4 sec und 8 sec sweep
1 24-spuriger Streamer, Typ AMG 37-43 der Fa. Geomecanique mit 2400 m Gesamtaufnahmelänge. Die Streameranordnung zeigt Figur 2
1 hydraulisch angetriebene Streamerwinde
1 seismisches Erregersystem von 19,5 m Länge und bestehend aus 10 pneumatischen Schallquellen mit einem Gesamtspeichervolumen von 25,6 lt. Arbeitsdruck: 140 bar
1 Airgun Synchronizer VZAD mit Speicheroszilloskop zur vollautomatischen Synchronisation und Überwachung der seismischen Schallquellen
1 24-spuriger Camera Oszilloskop Typ SDW-300
1 Sonobojenempfänger, Typ Teleseis STR 70-2F
1 6-Kanalschreiber Siemens Oszillomink

Gravimetrie, Magnetik und Positionierung:

1 Seegravimeter Typ KSS 31 Nr. 22 des Bodenseewerk Geosystem GmbH
1 Seegravimeter Typ Gss 3 (Askania), Nr. 53
1 kreiselgestützte Horizontalplattform der Fa. Anschütz
1 Landgravimeter, Typ La Coste-Romberg, Modell G, Nr. 480
1 Protonenmagnetometer G 801/3 der Fa. Geometrics und elektrisch angetriebene Winde

2 Monitorschreiber für gravimetrische und magnetische Messungen
1 Minicomputer vom Typ PDP 11/34 (Fa. Digital Equipment, mit 256 k Byte Hauptspeicher, Floating Point Processor, drei Plattenlaufwerken RK 05, zwei Doppel-Floppylaufwerken, einem Magnetbandlaufwerk, zwei Trommelplottern, vier Terminals, zwei Bildschirmgeräten und einem Lineprinter
1 Datenerfassungsanlage für die digitalen Meßwerte der Gravimeter, des Magnetometers, der Echolote, von Fahrt und Kurs der Positionsdaten (Rohdaten und prozessierte Daten) der Echtzeit und der Schußpunktnummern

Schiffseigene Geräte:

6 gekoppelte Hochleistungskompressoren, Typ 4 FK 115 K der Fa. Junkers, Betriebsdruck 140 bar
1 integriertes Navigationssystem der Fa. Magnavox
2 Echolote der Fa. ELAC, 12 kHz und 20 kHz
1 SEA BEAM Bathymetric Survey System der Fa. General Instrument Corp.
1 O.R.E. (Ocean Research Equipment) Modell 140, 10 kW Subbottom profiling system
1 OMEGA Receiver mit 1 Kanal Satelliten Empfänger Typ MX 1105 Magnavox

4.2 SCIENTIFIC INSTRUMENTS USED ON LEG 3:

Geology:

1 Piston corer, 1000 kg weight, 5-10 metres length, 90 mm diameter
1 Gravity cover, 1000 kg weight, 5 metres length, 90 mm diameter
2 Chain-bag dredges, 1300 x 800 mm opening with 2 attached pipe dredges (500 mm long, 90 mm wide)
1 Saw for core liner splitting
1 Microscope
1 Binoculare microscope

Geochemistry:

1 BGR Vacuum/acid degassing apparatus
1 Packard 430 FID analytical gas chromatograph
1 G.E. Hydrogen Generator
1 J.M.U. Engineering Compressed Air Source
1 Sartorius 1203 MP Integrating Balance
1 Edwards Vacuum Pump
1 Ingold Eh und pH Electrodes with Metrawatt electronics
1 HP 85 Portable Computer
1 Apple IIc Personal Computer
1 Sediment Core Temperature Probe

For gravity, magnetics, sea beam, subbottom profiling, echo sounding and positioning see chapter 4.1

5. RESULTS AND OPERATIONAL REPORTS

5.1 REGIONAL GEOLOGY by J.B. Willcox and K. Hinz

The South Tasman Plateau lies between the Southeast Indian Ocean and the Tasman Basin spreading regimes (Figure 14). Its continental association has been demonstrated by the drilling results at DSDP Site 281 on the southern crest of the Plateau, which penetrated a basement of Paleozoic mica-schists overlain by a basal angular agglomerate and which in turn is overlain by Late Eocene detrital sediments (KENNETT, HOUTZ et al., 1973).

The South Tasman Plateau also called South Tasman Rise lies in water depths of 800 to 3000 m and covers an area of about 130 000 km^2 related to the 3000 metres water depth contour.
In most reconstructions it is implied that the South Tasman Plateau has occupied a similar position on the Australian Plate throughout the rifting and spreading history of the Southeast Indian Ocean (WEISSEL & HAYES, 1974; DEIGHTEN et al., 1976). However ROBERTSON et al. (1978) conjecture that the Plateau once lay adjacent to the Otway Basin and north of Iselin Bank, a situation more in keeping with the results of SONNE cruise SO-36 (Figure 15). Furthermore, in an interpretation of BMR line 11/026 over the northern extremity of the Plateau WILLCOX (1981) shows a central Paleozoic block flanked by rift basins, which appear to be related to the Otway Basin rather than the Tasman Sea Basin (Figure 16).
It would appear that the geology which is most relevant to the South Tasman Plateau area is from the Otway Basin and its southeast extension offshore Tasmania.

5.1.1 EXISTING DATA

The only modern seismic data in the western Tasmania/South Tasman Plateau region consists of two BMR lines across the margin in the area of King Island (Bass Strait Survey) and a survey for AMOCO on the shelf near Macquarie Harbour. These data are tied to the Clam - 1 and Cape Sorell - 1 exploration wells. The latter now lies within relinquished acreage (Once T-12-P).

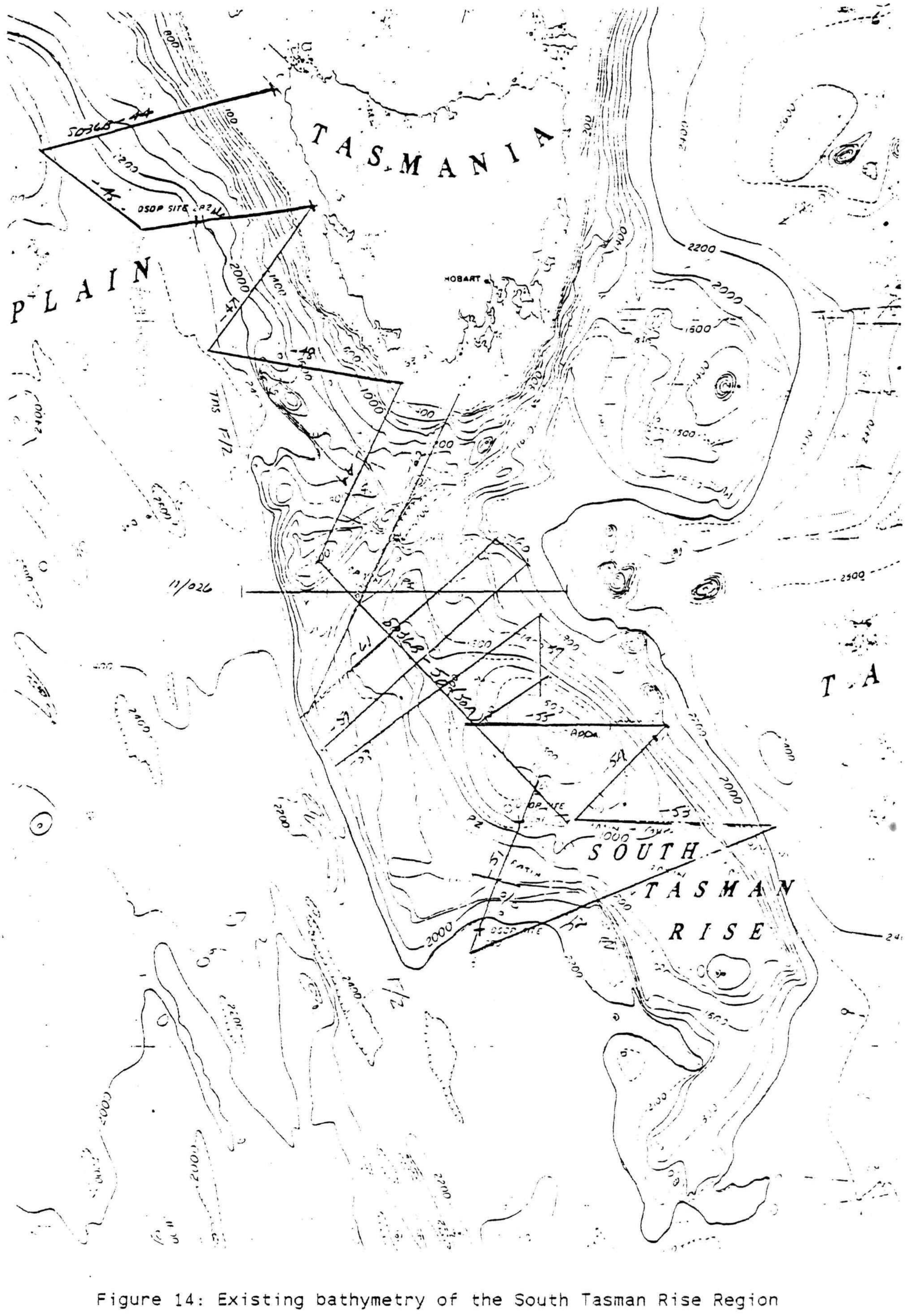


Figure 14: Existing bathymetry of the South Tasman Rise Region
(HAYES, CONOLLY and MAMMERICKX, 1974)

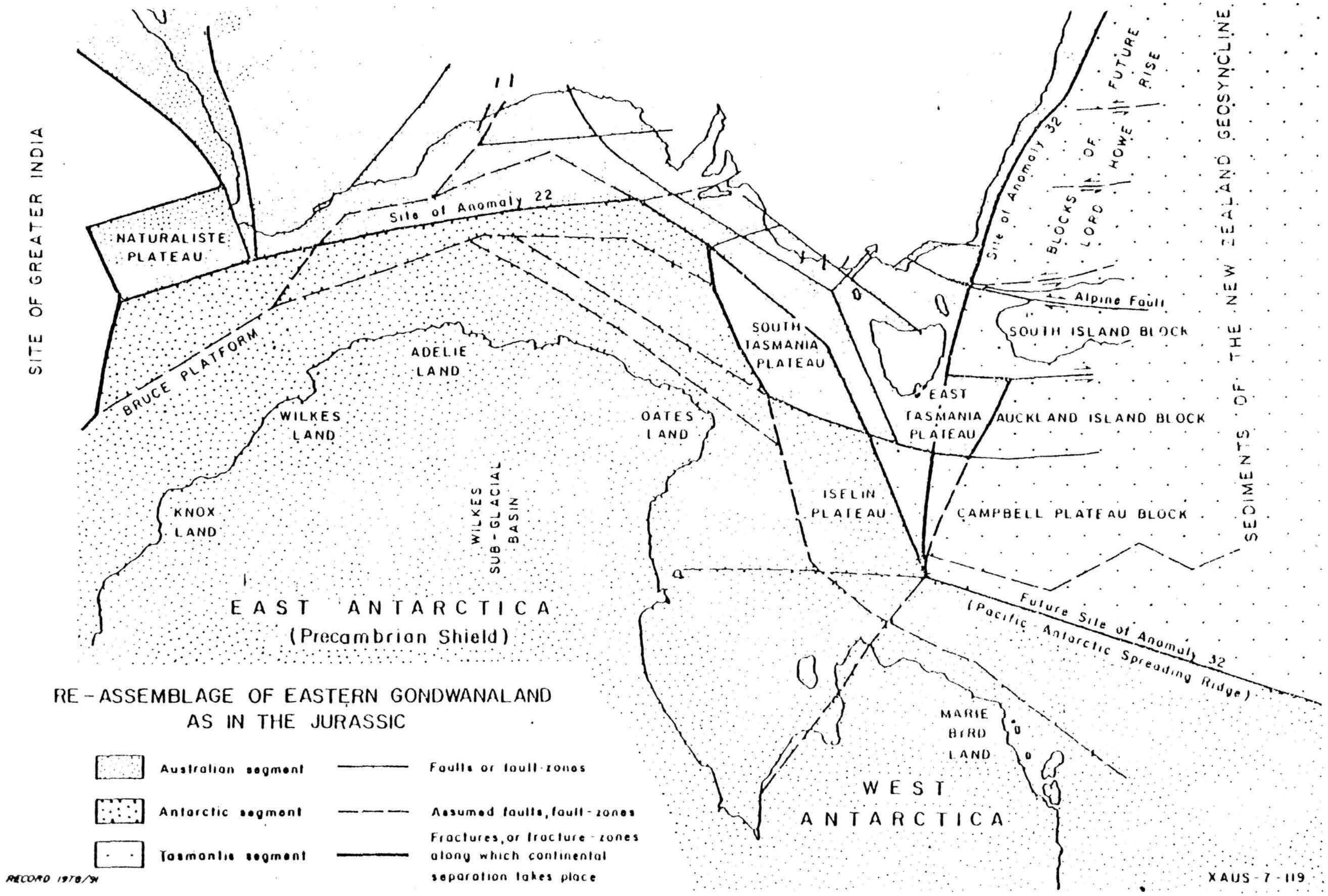


Figure 15: Re-assemblage of Eastern Gondwanaland as in the Jurassic (ROBERTSON et al., 1978)

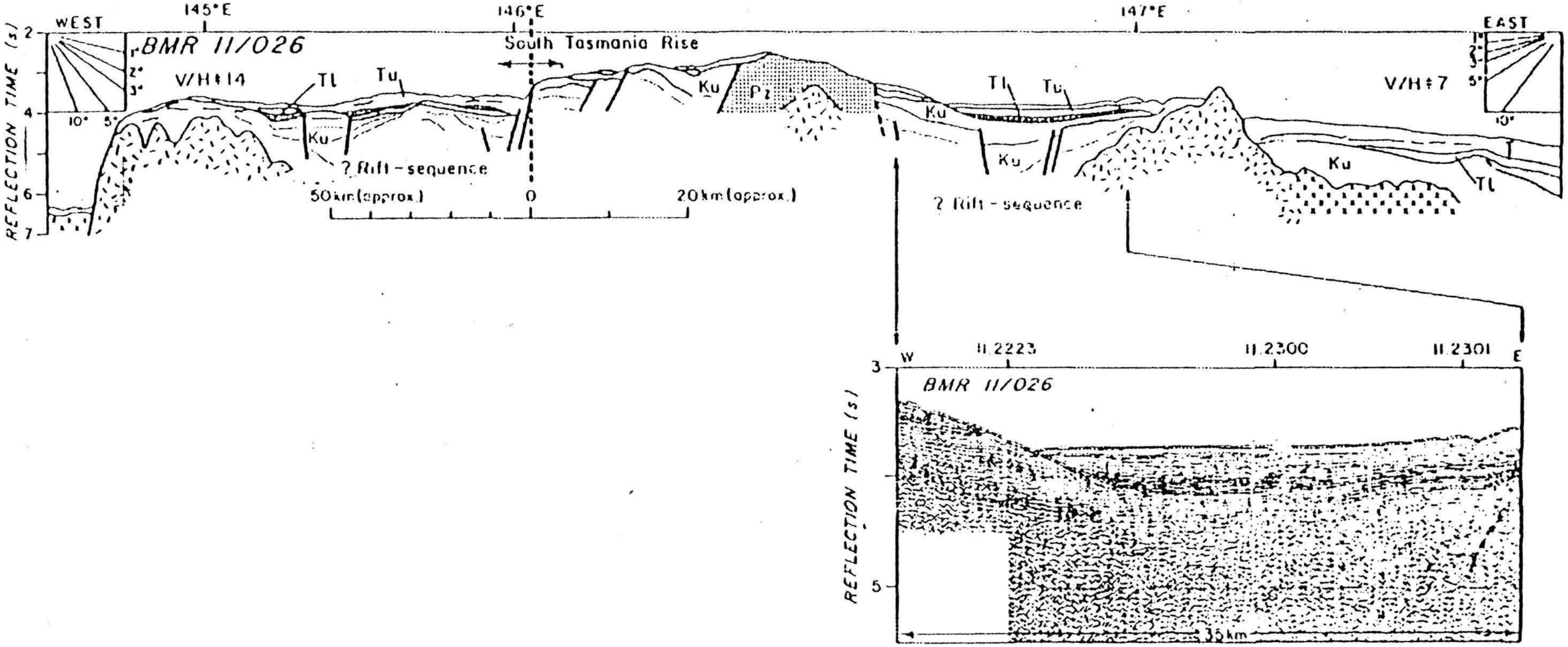


Figure 16: An interpretation of BMR Line 11/026 over the South Tasman Rise (WILLCOX, 1980)

Some fair quality data is also available for western Tasmania from reconnaissance lines collected during the Shell 'Petrel' survey (early 1970's). This data needs to be reprocessed if it is to make any significant contribution.

Poor quality lines from the BMR Continental Margin Survey cover western Tasmania and the northern tip of the South Tasmania Plateau. Much of this data if of little use but a few lines hint at a relatively thick sedimentary section and rift-basin development around Macquarie Harbour and in the flanks of the Plateau.

5.1.2 TECTONIC FRAMEWORK AND EVOLUTION OF THE OTWAY BASIN

The Otway Basin is one of a series of extensional basins (including the Bremer, Eyre, Great Australian Bight, Duntroon, Bass, and Gippsland Basins) which developed in Late Jurassic and Early Cretaceous times, as a precursor to formation of the southern margin of the Australian continent. These basins range in character from predominantly 'rift' related in the Great Australian Bight area, to mixed 'rift' and 'wrench' in the Otway Basin, to predominantly 'wrench' related (i.e. transform margin) along the western seabord of Tasmania. However, the relatively abrupt termination of most of these basins and accompanying offsets of the continental shelf is attributed to further areas of major transform or transfer fault development (e.g. between Eyre and Ceduna Terraces, around Kangaroo Island, etc.).
The commonly accepted breakup age for the Tasman Sea is Anomaly 32 time (Santonian), with possible Anomaly 33 spreading forming the Lord Howe and Middleton Basins (WEISSEL & HAYES, 1977). The situation on the southern margin appears more complex: although breakup was originally dated at Anomaly 22 time (Early Eocene), Cande & Mutter (1982) have used a revised identification of magnetic anomalies to conclude that the margin commenced formation at about 95 m.y. B.P. They postulate a period of slow spreading spanning 90 to 43 m.y. This conclusion is more in accord with Willcox (1978), and unpublished studies by Symonds and Willcox, which have concluded that

1) Cretaceous sediments (and not Eocene sediments) lie directly on oceanic basement,

2) marine conditions became established in the Bight and Otway Basins in the Late Cretaceous, suggesting Late Cretaceous breakup (although the eustatic highstand would have made a significant contribution),
3) that the band of deeper seated oceanic crust lying north of the Diamantina Zone, but probably also extending eastward to the Tasmania region, is the product of an older phase of spreading.

Reconstructions, such as that in Figure 15, show that Otway Basin is close to the eastern flank of the South Tasmania Plateau, which is poorly surveyed but appears to be underlain by rift basins.

Recently, several papers have been presented which invoke the development of passive margins and rift basins by the processes of lithospheric extension [for example, BALLY (1987), GIBBS (1984), ETHERIDGE et al.,(1984)]. This concept involves stretching of the ductile lithosphere, accompanied by faulting and rotation of fault-blocks in its brittle upper part, along both planar and/or listric fault planes. Of necessity, the surface between the brittle and ductile parts of the lithosphere is a decollement, which is in places evident on modern deep penetration seismic data. This style of interpretation has been given for the Bass and Gippsland Basins (ETHERIDGE et al., 1984) and could probably be extended into the Otway Basin region.

<u>Basin Subdivision and Stratigraphy</u> (ELLENOR, 1976; MC PHEE, 1976)

The Otway Basin was initiated in Late Jurassic (?)-Early Cretaceous as a major east trending trough, formed by numerous synsedimentary faults subparallel to the basin's axis. This graben-like structure apparently continued eastward to the Gippsland Basin in eastern Victoria. By end Early Cretaceous, block faulting superimposed upon this essentially single depositional trough a series of north-east trending highs (Dartmoor Ridge, Warrnambool High, Otway Ranges High). During the Late Cretaceous-Tertiary, these highs effectively divided the area into four sub-basins which from west to east are: the Gambier Embayment, the Tyrendarra Embayment, the Port Campbell Embayment, and the Torquay Embayment (Figure 17). Seismic and gravity data suggest that the Otway Ranges High continues off-shore and during Late Cretaceous-Paleocene time divided the Otway Basin into two different sedimentary provinces. The Dartmoor and Warrnambool highs appear to be essentially on-shore features.

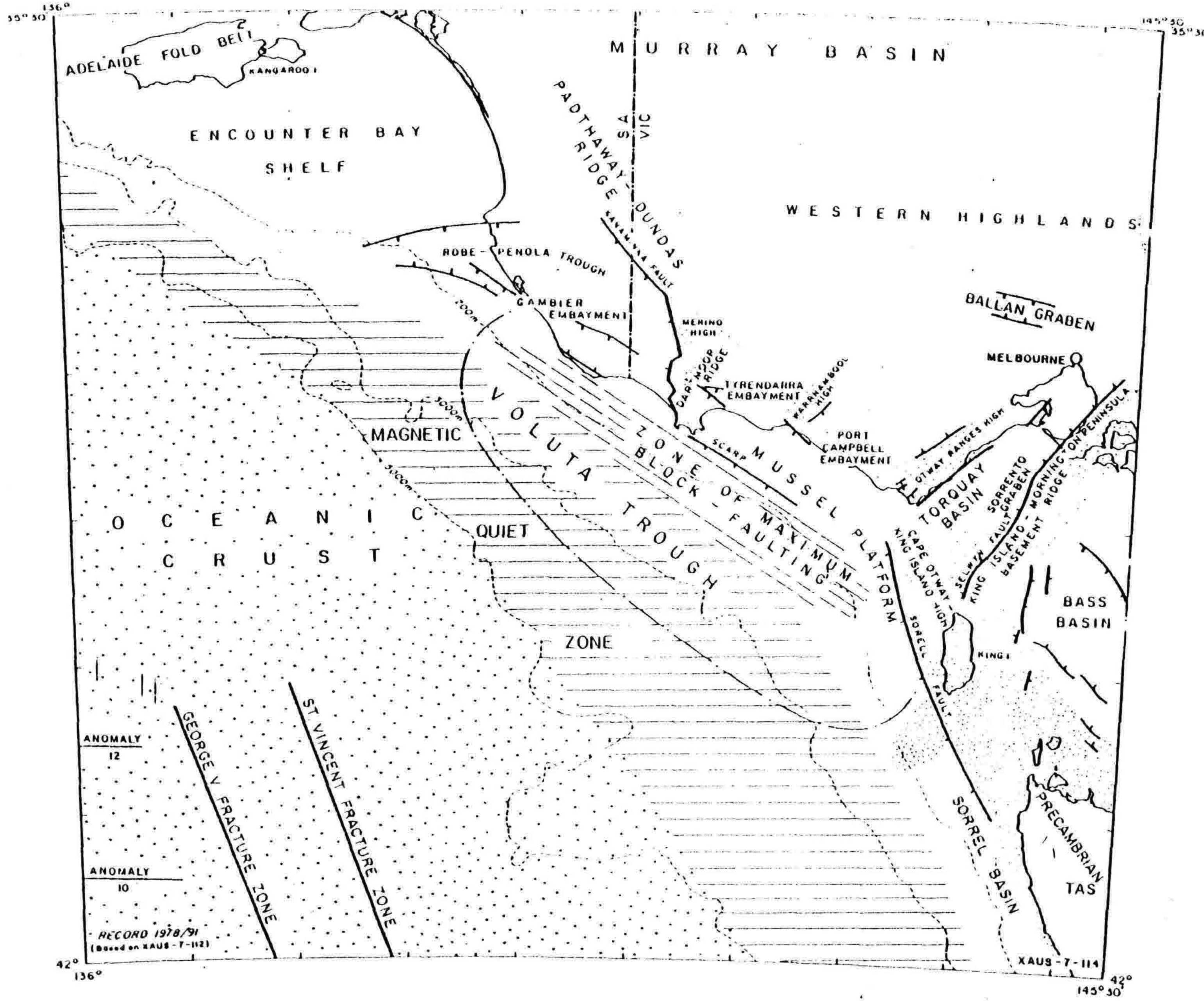


Figure 17: Major structural elements of the Otway Basin region

West of Cape Otway, two major normal fault provinces are recognized. Between the Cape Otway-King Island Basement High and Portland on the Dartmoor Ridge, basement and the Lower Cretaceous are complexly faulted while late Upper Cretaceous and Tertiary levels are generally unaffected. West of the Dartmoor Ridge however, a regional Late Cretaceous hingeline is recognized south of which numerous west-northwest trending faults progressively downthrow both Upper Cretaceous and Tertiary levels southward. Faulting appears to be syn-sedimentary, producing an Upper Cretaceous section greater than 3000 m thick west of Portland.

Following the Early Cretaceous block faulting episode the Torquay Embayment developed as a small trough almost completely enclosed by structurally high areas (Figure 17). During the Late Cretaceous and Early Tertiary this area was relatively stable but Late Tertiary folding produced NW-trending anti-clinal features along a mid-embayment high trend making the area structurally more similar to the Gippsland Basin than to the rest of the Otway Basin.

The sedimentary fill of the Otway Basin (Figure 18) consists of Upper Jurassic (?)-Lower Cretaceous continental lithic sandstones and intercalated shales (Otway Group), Upper Cretaceous-Paleocene transgressive-regressive sands/shales (Sherbrook and Wangerrip Groups) west of the Otway Ranges (but continental Upper Cretaceous-Paleocene siliciclastic lithologies (Eastern View Formation) in the Torquay Embayment), Upper Eocene marine sands/marls (Nirranda Group) and Oligocene-Miocene limestones/marls (Heytesbury Group). Palaeontological and palynological data indicate that these major units are bounded by regional unconformities, each of which can generally be equated with mappable seismic events (see Figure 19).

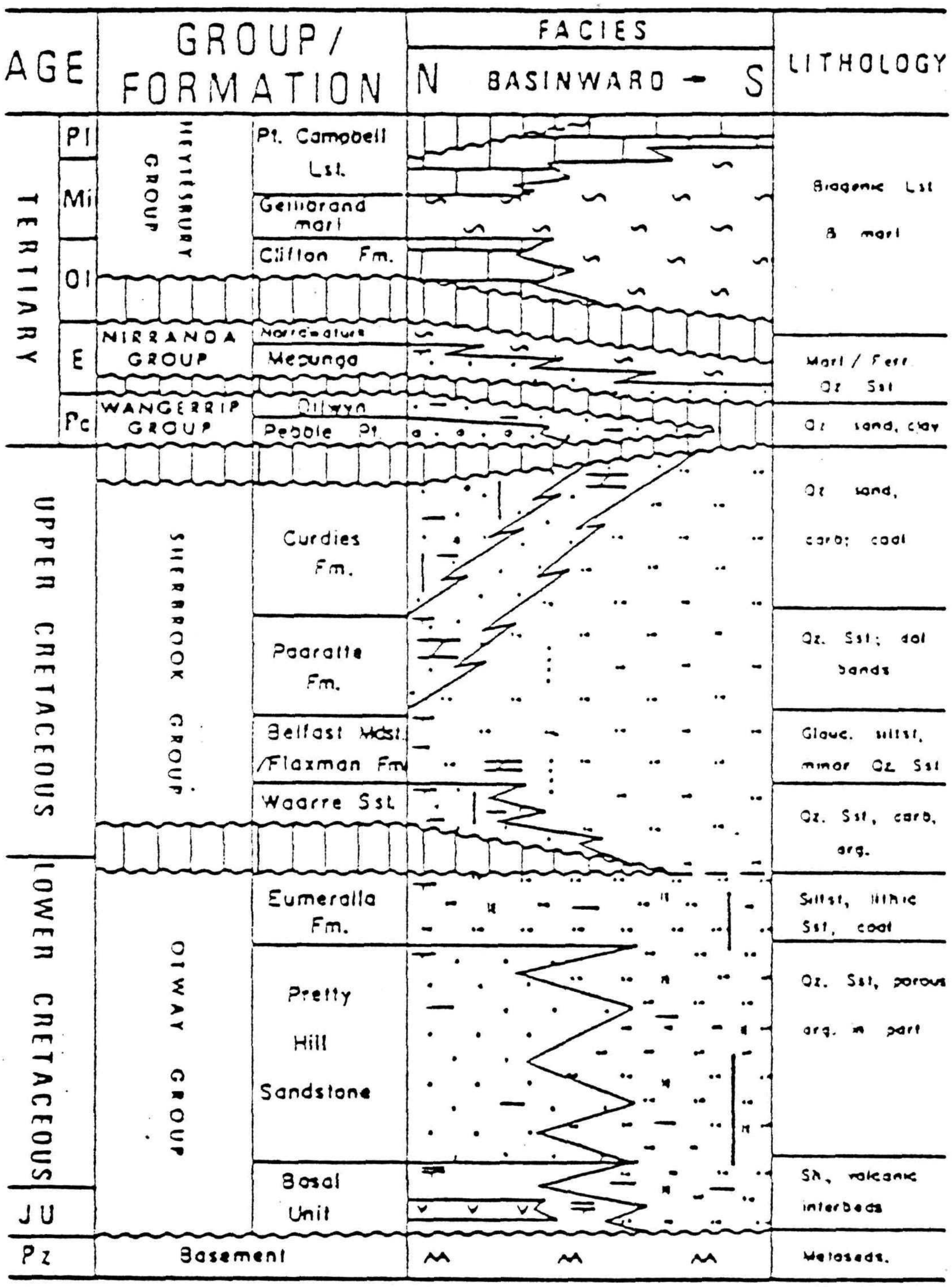
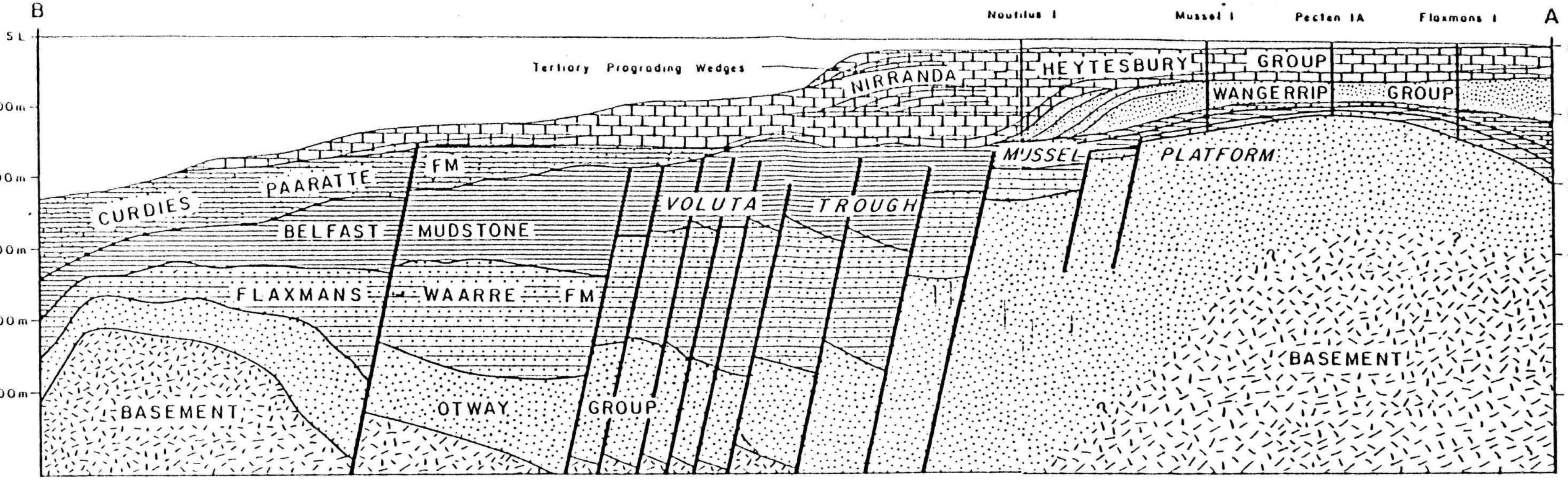


Figure 18: Otway Basin stratigraphy (ELLENOR, 1976)



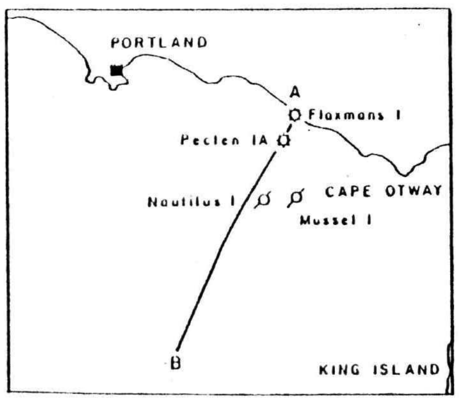
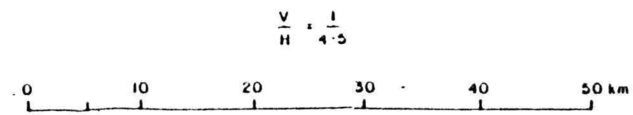


Figure 19: NE-SW cross section through the Otway Basin

(based on DENHAM & BROWN, 1976)



Upper Jurassic (?) - Lower Cretaceous - OTWAY Group:
The known maximum thickness of the Otway Group is over 3.500 m, penetrated in Crayfish-1 without encountering basement. Seismic data indicate that the group may exceed 4.500 m in thickness in more basinal areas.
Sedimentation began with black fissile shales which are interpreted as paludal deposits and have some source potential. Contemporaneous lava flows were also associated with the deposition. This unit is overlain by quartzose sandstones (Pretty Hill Sandstone) which form the main Lower Cretaceous objective. The depositional regime is predominantly fluvial, though there are indications of marginal marine environments in some wells. The overlying unit (Eumeralla Formation) consists of very thickly bedded fluvial sandstones and finer-grained deposits, with diagenetic alteration of the acid volcanic content. Consequently reservoir chracteristics are largely destroyed.

Upper Cretaceous - Paleocene - EASTERN VIEW FORMATION
Otway Group sedimentation was terminated by a period of differential uplift and erosion, producing the several sub-basins previously mentioned.
East of the Otway Ranges during the Late Cretaceous - Paleocene, a thick fluvio-deltaic sequence was deposited unconformably on the Otway Group. The sands have excellent reservoir chracteristics. The interbedded argillaceous sediments are considered caprock in the area while associated brown coals could be regarded as a potential hydrocarbon source, analogous with the Gippsland Basin where Latrobe Group coals are believed to have generated oil and gas. In Shell's dry hole Nerita-1 the Eastern View Formation was 790 m thick, but seismic data indicate that it may be over 3.000 m thick in the embayment's depocentre southeast of the well.

- SHERBROOK GROUP
West of the Otway Ranges two transgressive-regressive sedimentary cycles were deposited during the Late Cretaceous and Paleocene. The non-marine Waare Sandstone forms the basal unit. It has good reservoir properties and forms the principle Upper Cretaceous objective. This formation is overlain by increasingly marine dark grey shales, glauconitic siltstone and minor sandstone (Flaxmann Formation and Belfast Mudstone Member), forming the regional seals for the basal sands. The upper Sherbrook Group regressive phase consists of marine to paralic glauconitic quartz sandstones and siltstones (Paaratte Formation) passing upward into fluviatile quartz sands, coal and minor siltstones (Curdies Formation). Sands within the upper Sherbrook Group all have good porosities and permeabilities.

- WANGERRIP GROUP
The Paleocene transgressive-regressive cycle consists of marine conglomeratic basal sands (Pebble Point Fm.) and overlying continental, clayey sands, lignitic silts and minor coal beds (Dilwyn Fm.).

EOCENE -
Upper Eocene sediments rest unconformably on Wangerripp Group lithologies over most parts of the basin. In the Torquay Embayment, the Upper Eocene consists of fluviatile quartz sands (Boonah Sandstone) and overlying continental-marine sand, clay and dolomite (Demon's Bluff Fm.). In the western sedimentary province, the thin, discontinous Upper Eocene Nirranda Group consists of two units, the Mapunga Sandstone and Narrawaturk Marl (biogenic marls-packstones).

Oligocene - Miocene - HEYTESBURY GROUP
During the Oligocene - Miocene transgression a biogenic marl-grainstone sequence was deposited. Generally the sequence is 150 m to 600 m thick. The sequence pinches out northward, but progrades seaward and in Nautilus-1 near the continental shelf exceeds 1.500 m in thickness.

Pliocene - RECENT

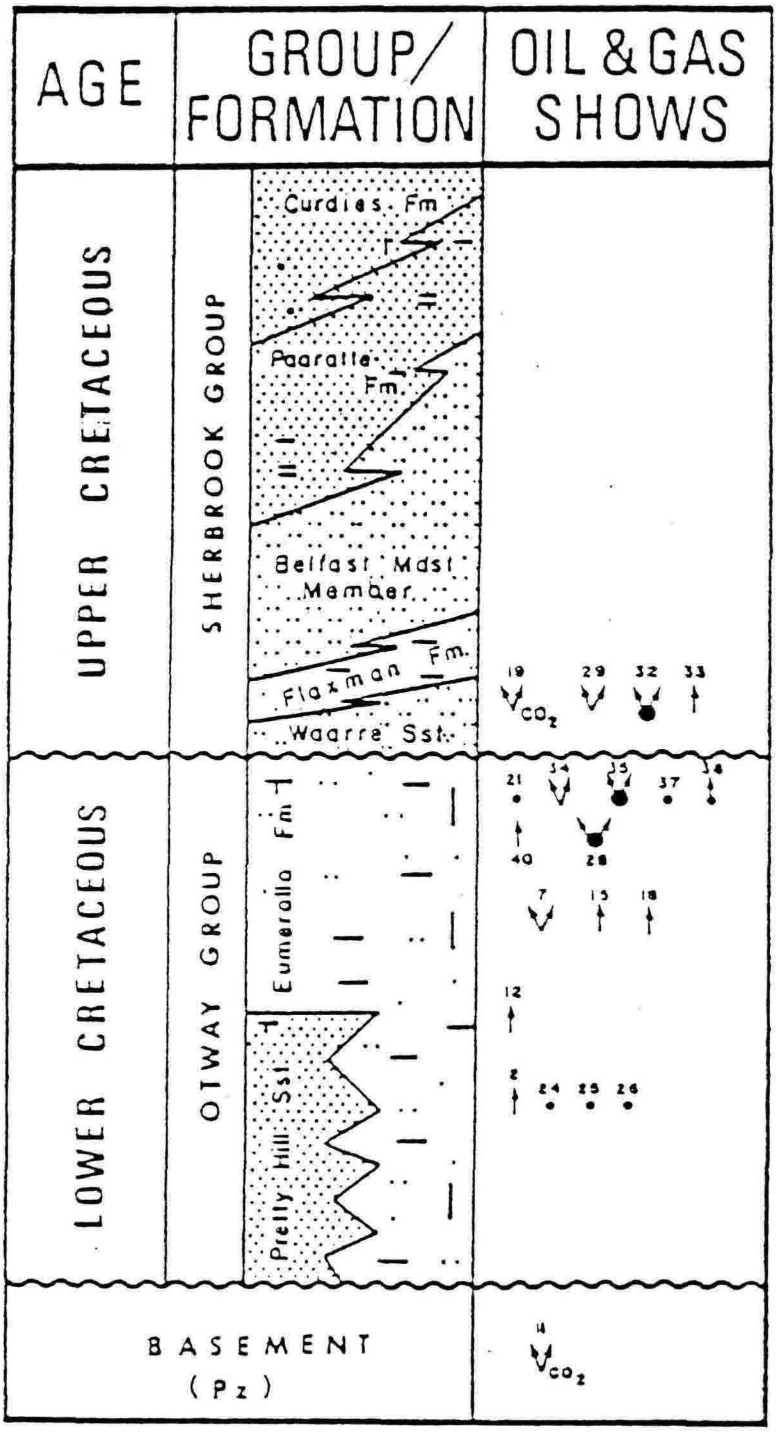
From the Pliocene to Recent, the Otway Basin area has undergone uplift with accompanying gentle folding and faulting. Vulcanism was widespread with the result and basaltic flow,tuff and scoria deposits covering much of the onshore Otway Basin and marking the landward limits of Mesozoic and Tertiary sediments.

5.1.3 PETROLEUM OCCURENCES AND EXPLORATION

No commercial quantities of hydrocarbons have yet been discovered in the Otway Basin offshore, although 18 of the 45 wells drilled in the basin have recorded shows. The area referred to as the Port Campbell Embayment has proved most favourable to date, with Port Campbell No. 1 flowing gas at 4.2 MMcfd from what appears to be a restricted reservoir. Several onshore finds near Paaratte are to supply gas to Warrnambool.

The main objectives are the lower Sherbrook group sandstone (Waarre Sandstone) and porous Otway Group sandstones (Pretty Hill Sandstone). The marine Belfast Mudstone and chloritized Eumeralla Formation provide regional seals for Upper and Lower Cretaceous reservoirs (Figure 20). Porous upper Sherbrook Group and Tertiary reservoirs are generally water flushed.

Most of the Otway Basin is still under lease except for the area bordering Tasmania (Sorell Basin) which is now entirely relinquished.



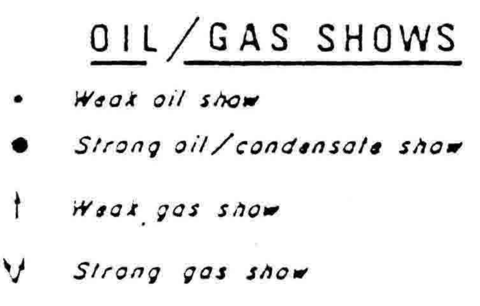


Figure 20: Oil/Gas Shows (ELLENOR, 1976)

5.1.4 WELL DATA

5.1.4.1 PETROLEUM EXPLORATION WELLS

CLAM-1 (Esso Australia)

Location: King Island sub-basin of Otway Basin, a sedimentary trough between King Island and Northwest Tasmania

Latitude: 40° 51' 52" S

Longitude: 144° 12' 55" E

Age/Formation	Lithology	Depth below sea level	Thickness (metres)
Seabed		102 m	
Miocene	Lstn.	102 - 293 m	191
Oligocene	Marl	293 - 387 m	94
Eocene	Glaucon.sstn.	387 - 513 m	126
Paleocene			
Wangerrip Group	Mudstn.,siltstn., sstn.	513 - 820 m	307
Late Cretaceous*			
Basal conglomerate	Conglom.	820 - 925 m	105
Curdies/Paaratte Formation	sstn.	925 -1223 m	298
Belfast (Turonian)	Mudstn.	1223 -1250 m	27
Waare	Siltstn.,sstn.	1250 -1272 m	22
Devonian	Red beds	1272 -1463 m	191
Carbonif.?-Early Paleozoic	Siltstn.	1463 -1510 m	47
Pre-Cambrian	Phyllite	1510 -1622 TD	

*The uppermost Late Cretaceous age of the conglomerate is similar to that from the Prawn-1 well, but is unlikely to underly a large regional unconformity between Late Cretaceous and Early Tertiary, such as that recognized in the central and western Otway Basin. Esso suggests that unconformity is time transgressive.

CAPE SORELL - 1 (Amoco Australia)

Location: Cape Sorell sub-basin, 19 km off Cape Sorell, Western Tasmania

Latitude: 42° 08' 10" S

Longitude:145° 01' 46" E

Release of data relating to this well is beeing sought by BMR.

Age	Lithology	Depth below sea level	Thickness (metres)
Miocene/Oligocene ?	Seabed	approx. 94 m	
	Lstn.	94 - 335 m	approx. 241
Early Eocene	sstn, inter-bedded with mudstone and siltstone	approx. 335 - 1448 m	approx.1113
Middle/Late Paleocene	sstn	approx. 1448 -(?)2134 m	approx. 686
Middle Paleocene	sstn	approx. 2134 - 2850 m	approx. 716
Early Paleocene/ Late Cretaceous	Conglomerate and congl.sandstone underlain by approx. 250m of interbedded shales, siltstones and sstn	approx. 2850 - 3528 T.D.	

5.1.4.2 DSDP Sites

Site 280, located south of South Tasman Rise
Position: 48° 57.44' S; 147° 14.08' E
Water depth: 4.176 m
Maximum penetration: 524 m
Age of oldest sediment cored: Early to Middle Eocene

Site 281, located on the southwestern flank of the South Tasman Rise
Position: 47° 59.84' S; 147° 45.85' E
Water depth: 1.591 m
Maximum penetration: 169 m
Age of oldest sediment cored: Late Eocene

Site 282, located within the magnetic quiet zone west of Tasmania
Position: 42° 14.76' S; 143° 29.18' E
Water depth: 4.202 m
Maximum penetration: 310.5 m
Age of oldest sediment cored: Late Eocene

Note: The results of Sites 280, 281, 282 are published:
KENNETT J.P., HOUTZ R.E. et al., 1974: Initial REPORTS of the DEEP SEA DRILLING PROJECT, Volume 29, Washington (U.S. Government Printing Office)

5.2 SEISMIC

5.2.1 DATA ACQUISITION

by K. Hinz & A. Popovici

On the 2nd Leg of R/V SONNE cruise SO-36 multichannel reflection seismic measurements were carried out on 19 lines with a total length of 3820 km on the continental margin of West Tasmania and on the South Tasman Plateau. In addition, 11 lines with a total length of 470 km were surveyed with an analogue single channel system on Leg 3.

Receiving and digital recording of the seismic signals were done in conventional form with BGR's digital seismic system. A 24-trace streamer, type Geomecanique AMG 37-43, was used for receiving the seismic signals. The 24 active sections, each of 50 m length, were located between neutral sections each equally of 50 m length. Along the streamer 6 depth transducers were installed. The total length of the streamer, including 1 yoyo, 5 stretch sections, 4 weight sections and 1 run out section with tail buoy, was 3000 metres.
The digital recording of the seismic data was done by a DFS-V, Texas Instruments. The data were recorded on magnetic tape in SEG-B format, 1600 bpi. The recording length was 12 sec per shot; sampling rate was 4 msec.
For on-board interpretation of the seismic results the seismic data of the first trace behind the stern were taken from the analogue output of the DFS-V and were plotted using 3 EPC graphic recorders with 4 sec, 8 sec and 10 sec sweep. The 8 sec and 10 sec records were continously interpreted on board so that suitable problem-oriented locations could be selected before the geological programme of Leg 3, having regard to the results of the 3,5 kHz subbottom profiler and sea beam. The results of the preliminary seismic interpretation of each profile have been presented as simplified line drawings (see chapter 5.2.4).
A tuned air gun array, consisting of 10 airguns with a total capacity of 25.6 litres, was used as the seismic energy source. The air pressure was 130 - 140 bar. Six coupled Junkers compressors, type 4 FK 115 K, produced the high-pressure air. Shooting interval was 50 metres, i.e. 19 sec at a

survey speed of approximately 5 knots. An air gun synchronizer, type Prakla-Seismos VZAD, controlled instantiously and accurately the shot release and the functioning of each air gun.
The integrated Magnavox-satellite navigation system of R/V SONNE fired the shots and triggered the DFS-8.

5.2.2 SEISMIC STRATIGRAPHY

by K. Hinz and J.B.Willcox

From the revised identification of the magnetic anomalies south of Australia and along the conjugate margin of Antarctica (CANDE & MUTTER, 1982) it follows that Australia and Antarctica separated very slowly, i.e. with a spreading halfrate of 0.45 cm/y. between 90 and 43 m.y. B.P.

Although the accurate position of southern Australia relative to Antarctica is still not known, one can assume that only a relatively narrow i.e. less than 500 km wide ocean basin existed between the Great Australian Bight area and Wilkes Land/Antarctica at anomaly 19 time i.e. 43 m.y.B.P. Taking further into consideration that the final separation of Tasmania and especially of the South Tasman Plateau from Antarctica probably occured later than the separation of the Great Australian Bight from Wilkes Land, it becomes clear that any attempt to identify the unconformities and seismic sequences for the South Tasman Plateau and western Tasmania has to consider all known events on the Antarctic plate:

Antarctic area: In the Antarctic areas of the Ross Sea and the Dumont d' Urville Sea HINZ (Figure 21) recognized eight regional seismic unconformities/ markers in seismic records, collected by BGR in 1980 (HINZ & BLOCK, 1983) and by IFP (WANNESON et al., in press) in 1982.
The tentative identification of these unconformities, labelled U8 to U 1, together with a compilation of the Mesozoic and Cenozoic plate tectonic, tectonic and volcanic/magmatic events, and paleoenvironmental and paleooceanographic changes in the southern oceans and on Antarctica are shown in Figure 21.

Unconformity U 8: This unconformity is interpreted as the break-up unconformity, and is difficult to define in the seismic records from the Ross Sea. The expected older "onset of rifting" (Late Jurassic) unconformity is thought to be represented by the top of basement in the Ross Sea.

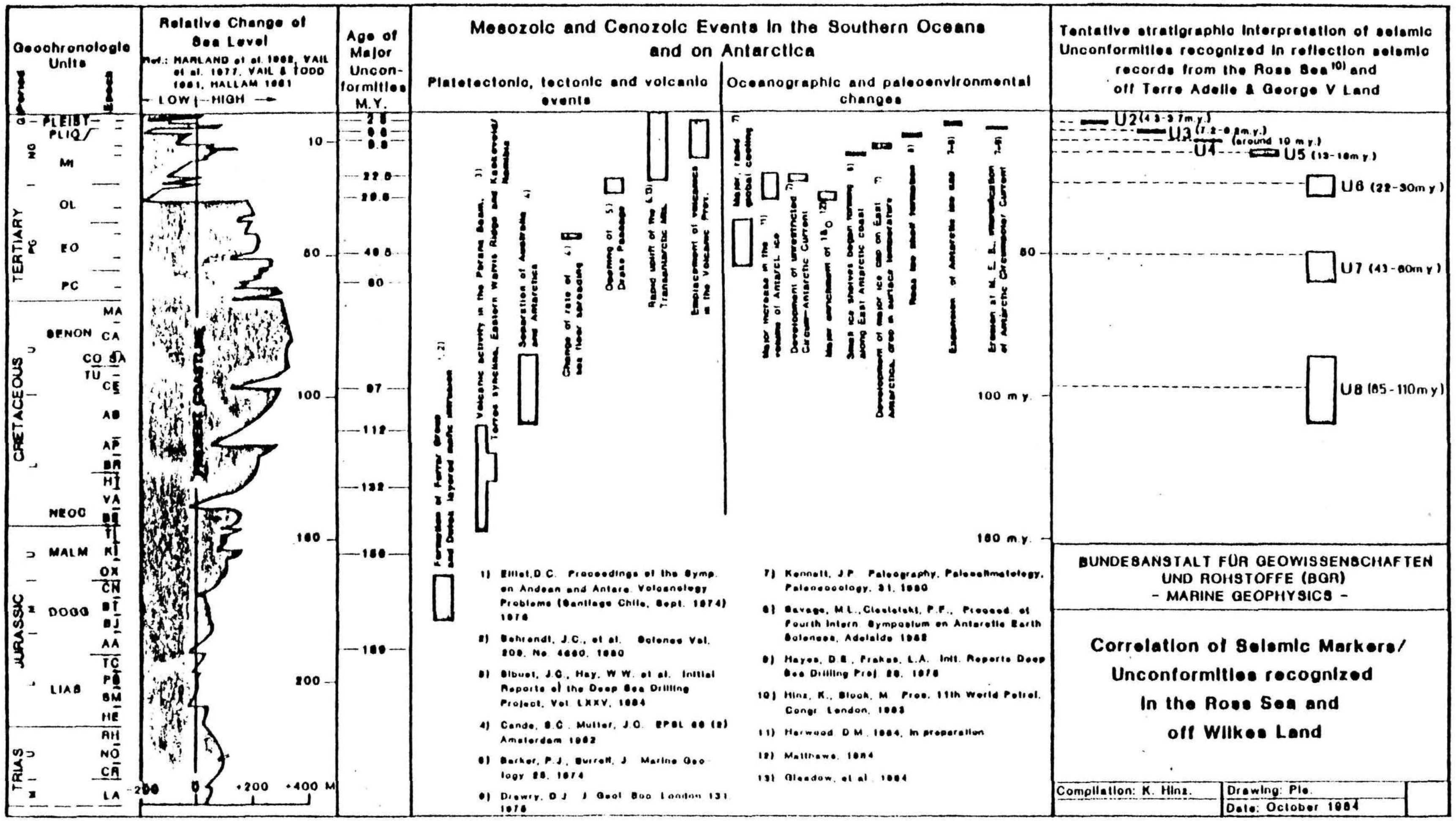


Figure 21: Correlation of seismic markers/unconformities recognized in the Ross Sea and off Wilkes Land

Unconformity U 7: This unconformity is clearly recognizable off Terre Adelie and is interpreted to represent a change of the spreading rate of the South Indian Rift from 0.45 cm/y. (half spreading rate) to much faster at anomaly 19 time, approximately 43 m.y.B.P. (CANDE and MUTTER, 1982). Locally here is another unconformity recognizable beneath unconformity U 7 in the records off Terre Adelie, which might be unconformity U 8.

Unconformity U 6: Unconformity U 6 has a Late Oligocene age according to the results of DSDP Site 270, located in the Southern Ross Sea (HAYES & FRAKES, 1975). In the Late Oligocene an unrestricted Circum - Antarctic current developed (KENNETT, 1980) as a result of the opening of the Drake Passage (BARKER and BURRELL, 1974), and a major increase in the volume of Antartic ice occurred (HARWOOD, 1984). HINZ & BLOCK (1983) correlated the pronounced regional unconformity U 6 with this important paleooceanographic/paleoenvironmental events and assumed an age between 22 and 30 m.y. for U 6.

Unconformity U 5: Although there is a great degree of uncertainty regarding the ages of the locally numerous younger unconformities, due to poor biostratigraphic data from the DSDP Sites 269 - 273 drilled off Wilkes Land and in the Ross Sea, it is very probable that the regional unconformity U 5 is of Early Miocene age. In the eastern Ross Sea unconformity U 5 forms the base of a well developed series of fluvio-marine delta lobes. HINZ and BLOCK (1983) believe that the sediments comprising this prograding wedge in the eastern Ross Sea were largely derived by glacial erosion. They probably were deposited by melting of debris-charged icebergs and/or the floating extension of the grounded Ross Ice Shelf, and were mainly transported by Antarctic coastal currents and/or dense Antarctic bottom waters across the eastern Ross Sea shelf and slope, forming the observed series of prograding delta lobes. An age between 13 m.y. and 16 m.y. is assumed for unconformity U 5 which constitutes the base of the prograding wedge, because small ice shelves began forming at this time (SAVAGE and CIESIELSKI, 1982).

Unconformity U 4: At the Middle to Late Miocene boundary a decrease in the carbonate content from predominately carbonate to a corbonate-siliceous regime was observed in holes drilled during DSDP Leg 85. This shift is attributed to a worldwide cooling. Unconformity U 4 has been tentatively correlated with this event, and an age of around 10 m.y.B.P. has been assumed.

Unconformities U 3 and U 2: A major erosional phase has been recognized between 7.2 and 6.2 m.y.B.P. at the Maurice Ewing Bank which is attributed to an intensification of the Antarctic Circumpolar Current, and a remarkable expansion and build-up of the Antarctic ice cap occurred between 4.3 and 3.7 m.y.B.P. (KENNETT, 1980; SAVAGE & CIESIELSKI, 1982). Unconformities U 3 and U 2 have been tentatively attributed to these events.

Otway Basin:
BMR line 22/23, running across the continental slope of the Otway Basin, has been chosen as a typical line because it has been extensively processed and it best shows the character of the main unconformities (Figures 22 and 23). At least seven main unconformities, labelled U 7 to U 1, can be identified, together with at least three lesser unconformities within the prograded sequences [labelled (a), (b), (c)].

The basis for the identification of the unconformities on line BMR 22/23 - Otway Basin is given in the following:

Basement:
1) Low frequency stratified pattern on some records - Paleozoic & Precambrian;
2) Diffractions within stratified section - Rift-fill and younger volcanics;
3) Envelope of diffractions in deep water - oceanic crust.

Unconformity U 7: Top of main fault blocks; rift-onset characteristics - possible Jurassic/Early Cretaceous.

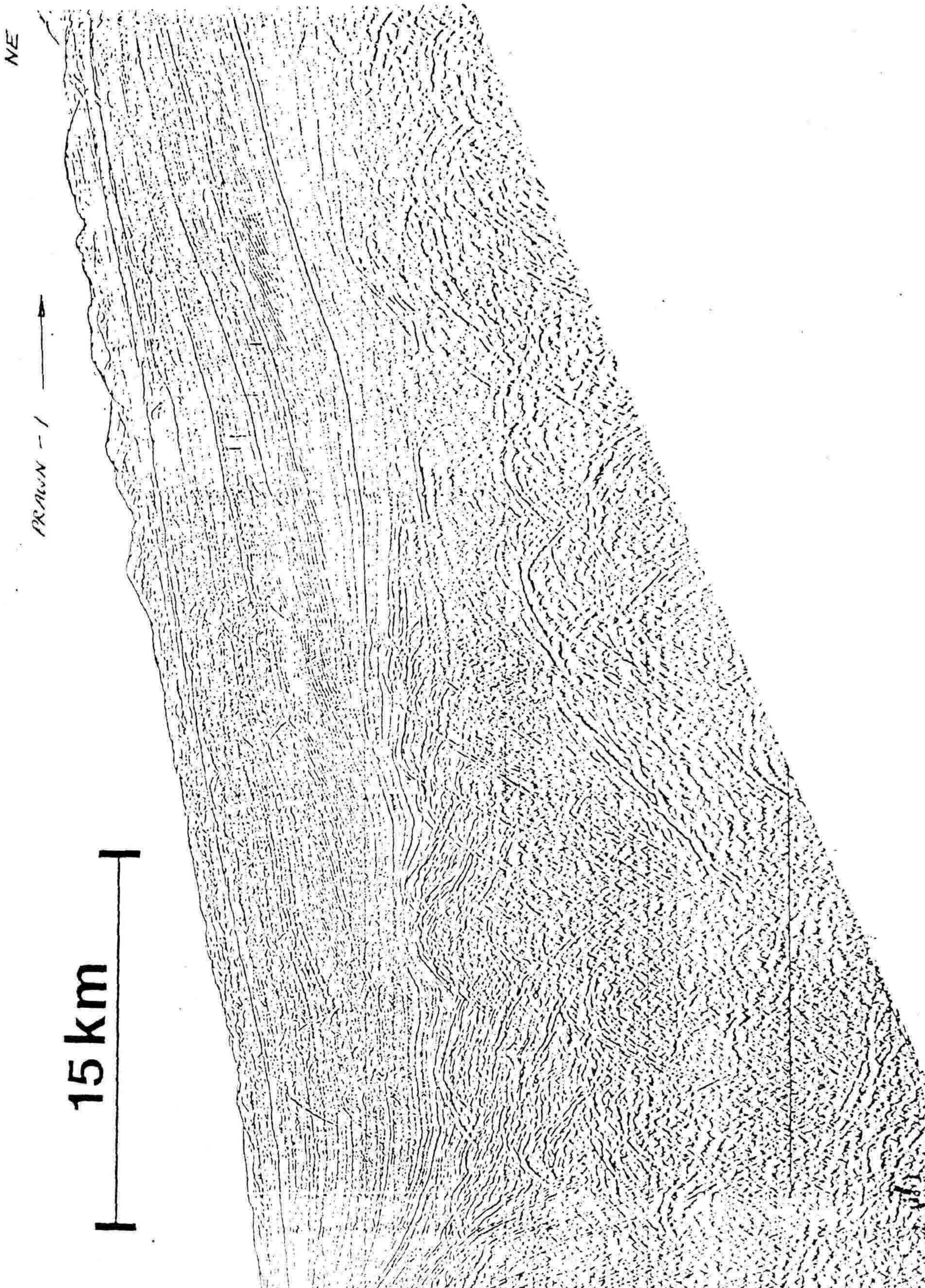


Figure 22: BMR Line 22/23 Otway Basin Continental Slope

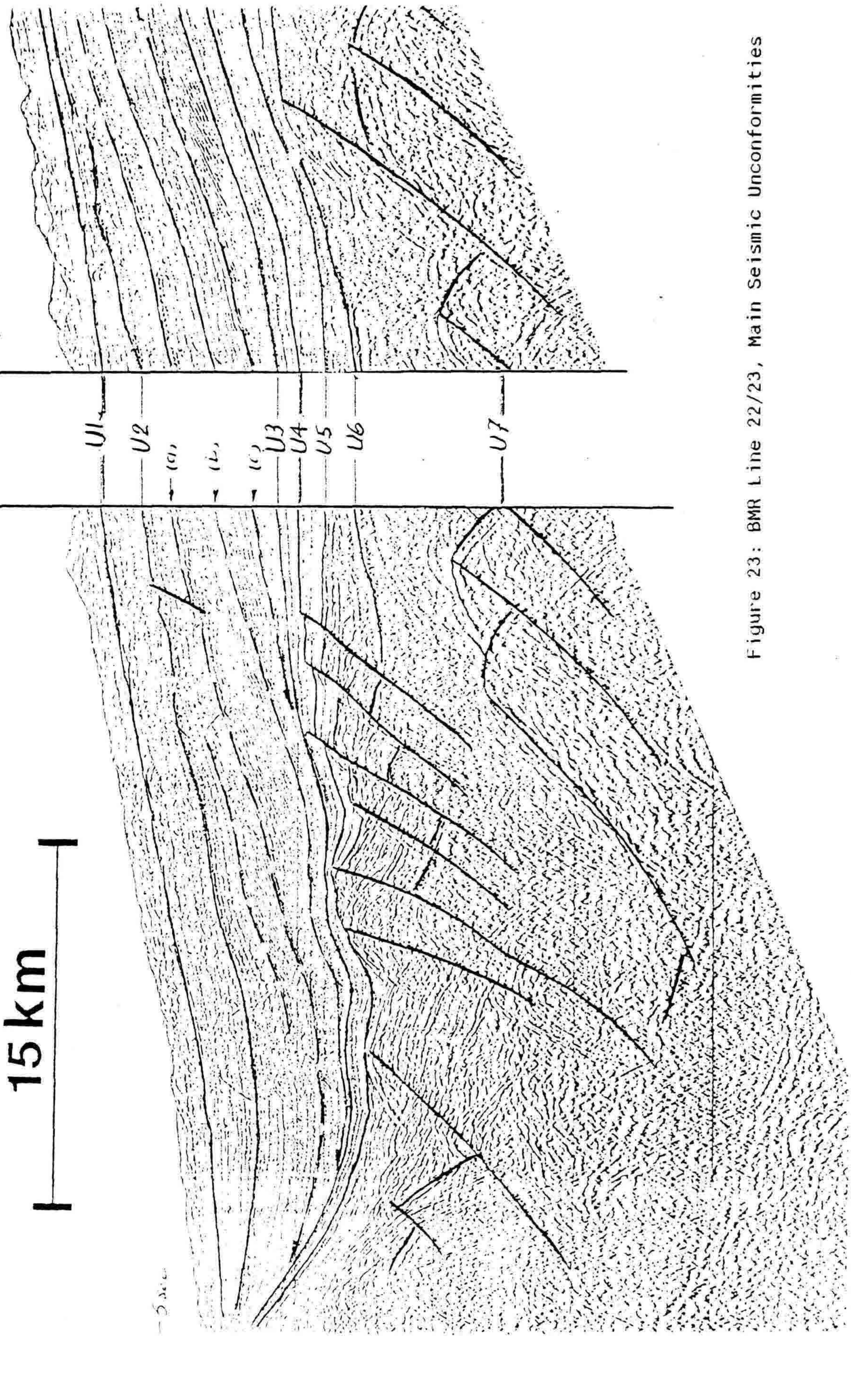
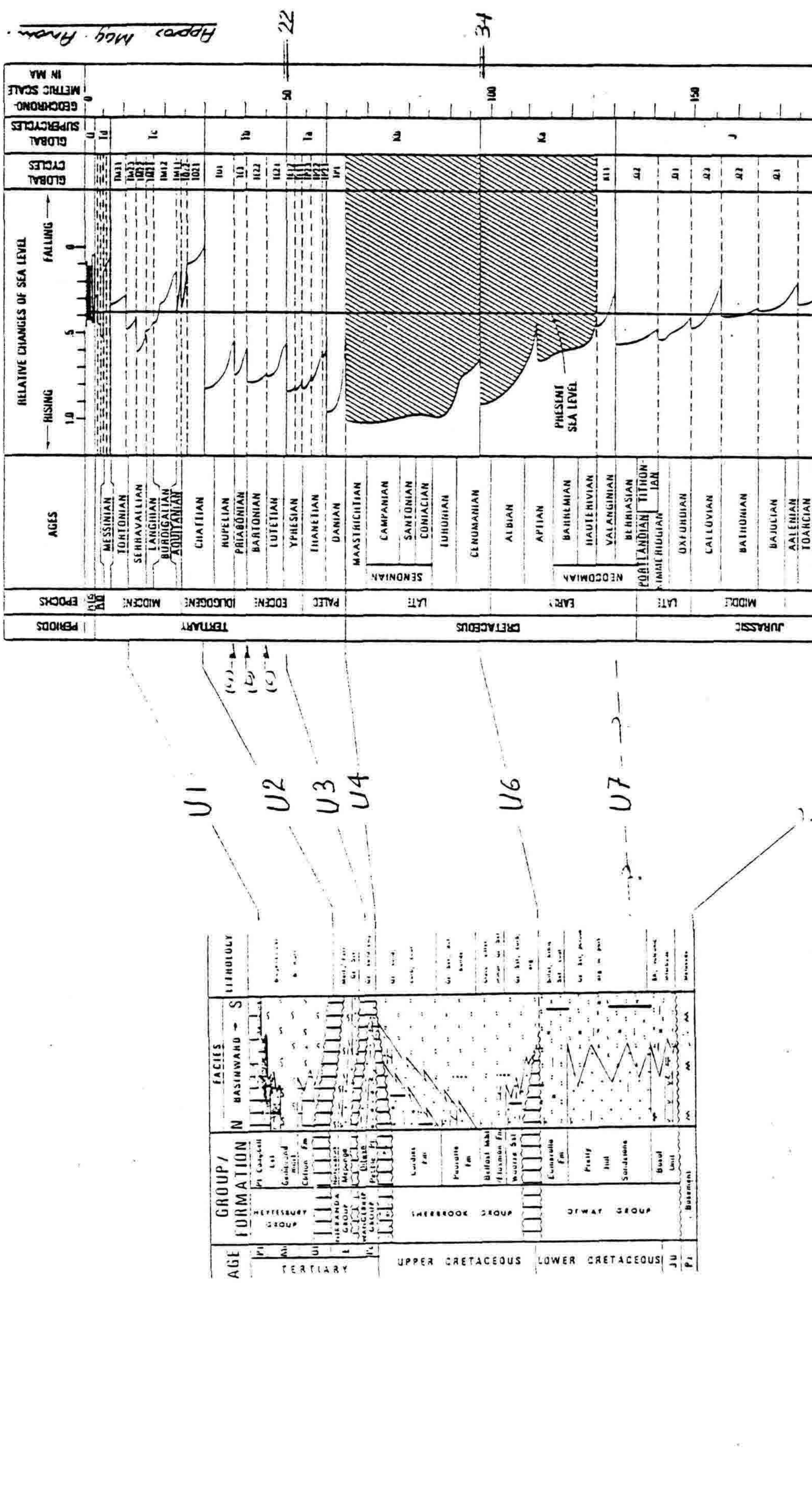


Figure 23: BMR Line 22/23, Main Seismic Unconformities



Jurassic-Cretaceous time scale after Van Hinte 1976 a, b

Global cycles of relative change of sea level during Jurassic-Tertiary time. Cretaceous cycles (hatchured area) have not been released for publication.

Figure 24: Tentative correlation of Otway Basin unconformities with global sea level changes and magnetic events

Unconformity U 6: Possible break-up unconformity or low-stand of sea level followed by transgression - Middle Cretaceous, approximately Cenomanian.

Unconformity U 4: (?) Break-up and transgression - Latest Cretaceous or Paleocene.

Unconformity U 3: A prominent and extensive unconformity associated with (?) low-stand - (Figure 24). It appears that this unconformity relates to a speed-up of seafloor spreading, approximately at magnetic anomaly 19 time.

Unconformities (a), (b), (c): Progradational cycles of probable Eocene - Oligocene age, separated by still-stand and low-stand events.

Unconformities U 2: Erosional truncation - Oligocene.

Unconformity U 1: Associated with at least two phases of channelling as in the Gippsland Basin - Miocene.

The age identifications proposed here for the unconformities of the Otway Basin are not consistent with those presented by DENHAM & BROWN (1976): Figure 19. They have considered that unconformity U 1 is a base of Tertiary unconformity, that the entire Tertiary is relatively thin or absent on the continental slope, and that the prominent prograding sequences are within the Upper Cretaceous.

Regional seismic unconformities on the South Tasman Rise and off western Tasmania:

After having looked over the seismic records the seismic shipboard party came to the conclusion that the following regional seismic unconformities exist on the South Tasman Plateau and on the continental margin of western Tasmania (Figure 25 and 26). Correct identification of the younger, i.e. Miocene and Oligocene, boundaries is supported by the DSDP results at Sites 280, 281 and

282. A character correlation of some sequences can also be made to Esso's exploration wells Clam-1 in the King Island Sub-basin, and Prawn-1 in the Otway Basin proper.

"Orange" Unconformity: This unconformity is rarely identified because it is very often at the seabed. The Antarctic unconformities U 5 and/or U 4 and U 1 of the Otway Basin are thought to be equivalent unconformities to the "Orange" marker.

"Yellow" Unconformity: Characterized by erosional truncation. On the South Tasman Rise the "Yellow" unconformity often is at the top of the characteristically bevelled basement blocks. According to the results of DSDP Site 281 (KENNETT, HOUTZ et al., 1974) the intensity of the developing Antarctic circumpolar current increased around the Eocene - Oligocene boundary and in the Oligocene, producing a late Eocene - early Oligocene disconformity and an Oligocene disconformity spanning most of the Oligocene at Site 281. The characteric bevelling of the basement blocks (Figure 38-40) probably is the result of abrasion by ice, although abrasion by the Antarctic circumpolar current in the Oligocene might also be a plausible explanation.

"Green" Unconformity: This prominent unconformity is interpreted to represent a distinct increase of the spreading rate of the South Indian Rift at anomaly 19 time, i.e. in the Middle Eocene. The "Green" Unconformity often forms the lower boundary of a sedimentary sequence which is characterized by a high frequency reflection pattern (Figure 23 and 26), and often shows the same (a), (b), (c) progradational sequences as seen in the Otway Basin.

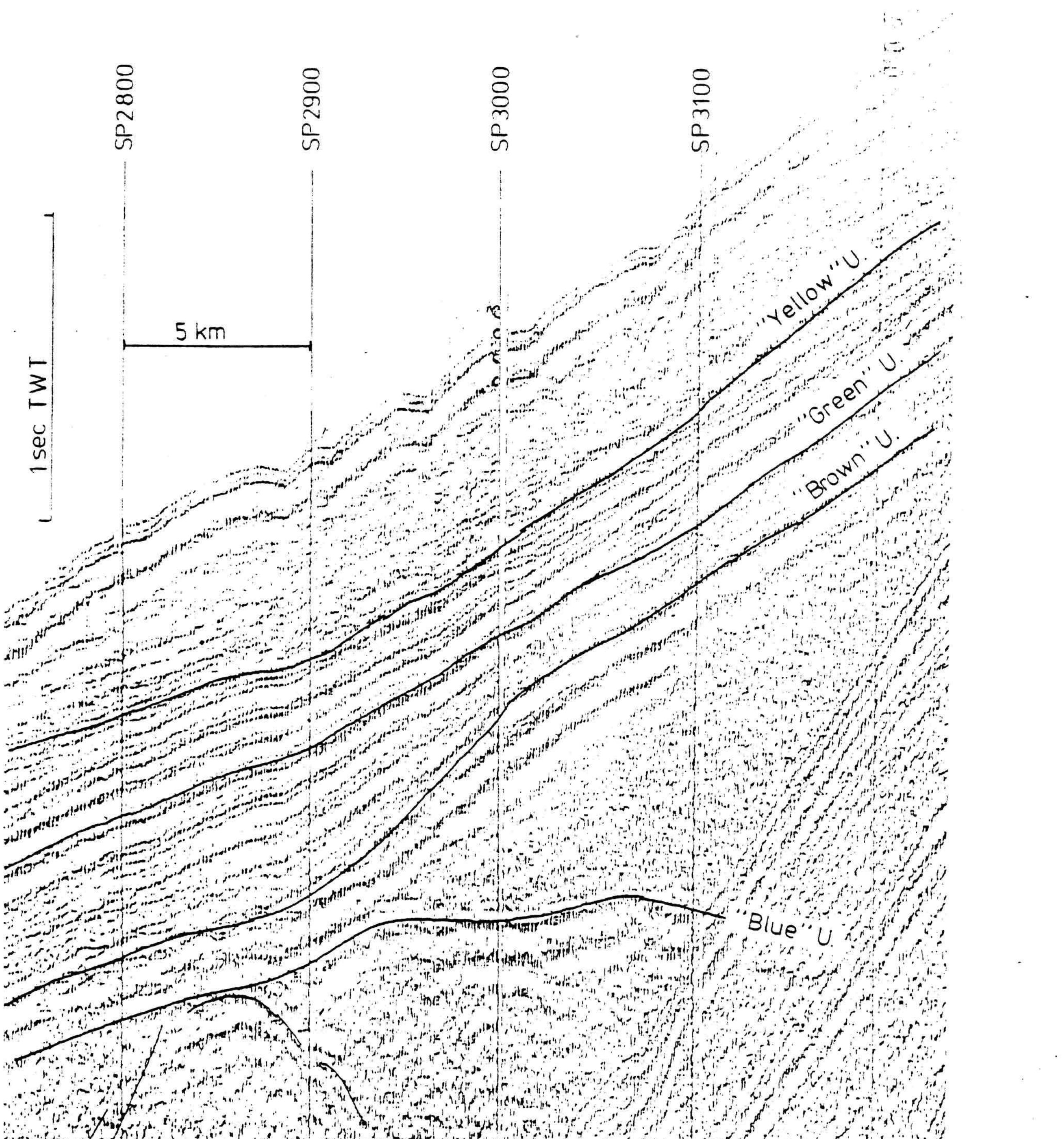


Figure 25: SONNE Line SO-36-46, West Tasmania

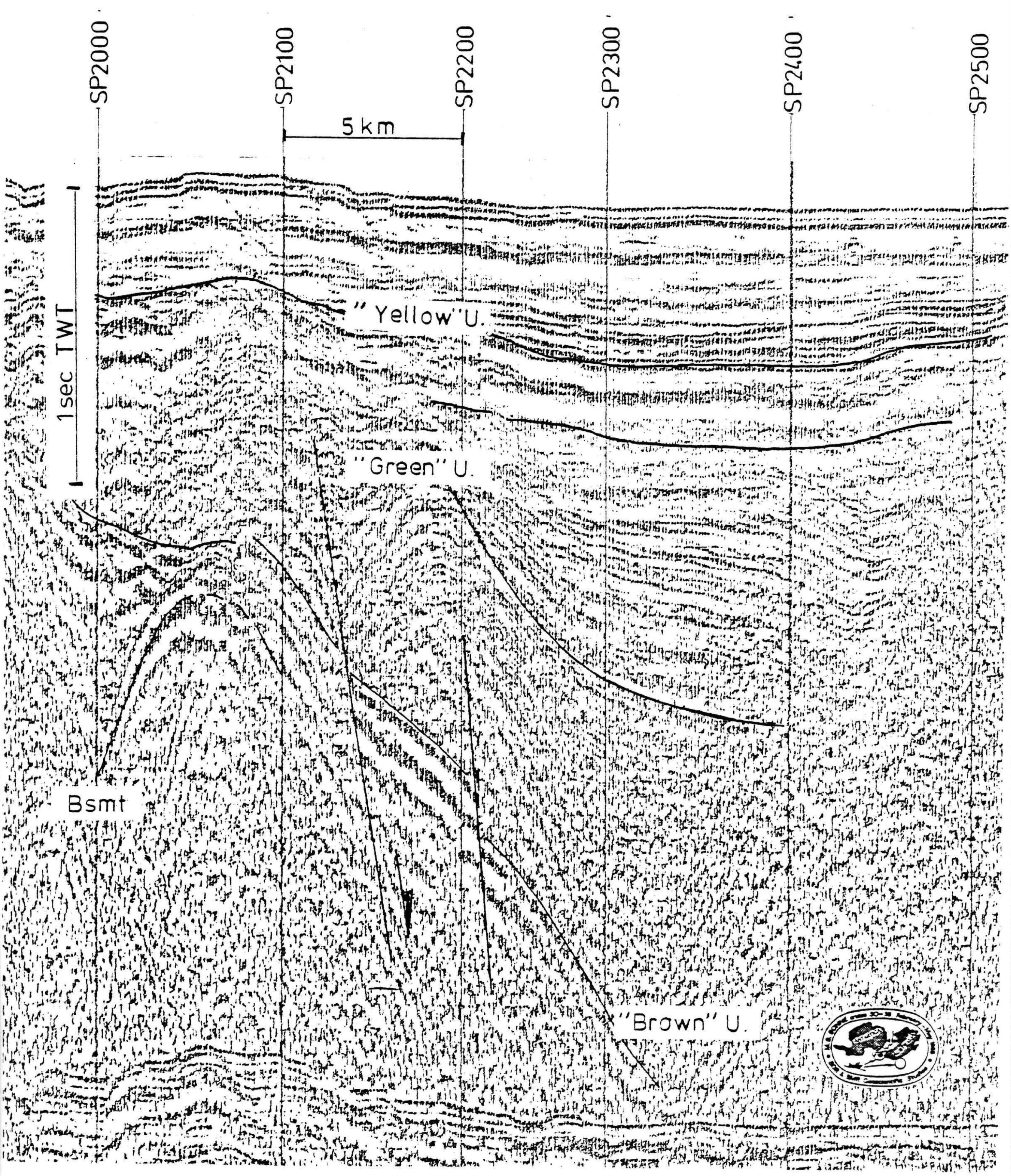


Figure 26: SONNE Line SO-36-50, South Tasman Rise

"Brown" Unconformity: This unconformity/marker has a conspicuous low-frequency reflection pattern consisting of some sub-parallel oscillation maxima and minima (see Figure 25). At stations SO-36-32, SO-36-33 and SO-36-34, where the "brown" unconformity/marker is at the seabed, limestones of Late Paleocene - Early Eocene age have been dredged by R.V. SONNE. We therefore assume a Paleocene age for the "brown" unconformity.

"Blue" Unconformity: In the monitor records this unconformity was unequivocally recognizable only beneath the shelf of western Tasmania, i.e. on lines SO-36-44, SO-36-46 and SO-36-47. It appears that the "blue" unconformity, interpreted as the middle Cretaceous break-up unconformity, does not exist on the South Tasman Rise.

"Violet" Unconformity: Top of main fault blocks; rift-onset characteristics. Rift onset occurred on the continental margin of western Tasmania possibly in the Late Jurassic/Early Cretaceous. The South Tasman Rise is characterized by a prograding rift phase which presumably started later and continued locally into the Paleogene, as will be discussed later.

5.2.3 SEISMIC STRATIGRAPHY OF LINE SO-36-44 CORRELATED TO DRILLED STRATIGRAPHY OF WELL CLAM-1

by G. Wissmann

Two wells are located on the western continental shelf of Tasmania (see also chapter 5.1.4.1):
The Clam-1 and the Cape Sorell-1.
For the shipboard interpretation some information on the stratigraphy and lithology of both wells were available. However, only the well velocity survey of the Cape Sorell-1 well was provided, so that its results must be utilized to find reflection times for the major seismic sequences encountered in the Clam-1 well.
The one-way travel time versus depth list of the Cape Sorell-1 velocity survey was plotted graphically to check for apparent changes of slope which could represent obvious sequence boundaries or unconformities. The resulting curve was very smooth and potential unconformities deduced from major changes in the actual drilled section (see Figure 27 A) did not show up in the travel time graph.

As a next step the interval velocities between the 24 different shot levels were calculated with the formula

$$v_i = \frac{\Delta s}{\Delta t}$$

and plotted in the middle of the respective depth interval (see Figure 27 B). While the interval velocity increases from 2.0 to 4.5 km/s, this increase is no longer smooth, but interrupted by abrupt breaks and by zones of irregular velocity variations.

These discordancies in the calculated interval velocity were interpreted as geological unconformities and correlated to the few lithological informations of Cape Sorell-1 well. Thus it is suggested here that the Late Cretaceous unconformity occurs either at the base of the conglomerates at 10,250 feet depth or below the total depth drilled.

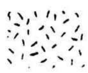
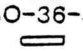
A decrease in velocity of 0.5 km/s at 7000 feet is thought to represent a Middle Paleocene unconformity.

The rift onset unconformity by defination must be older than the Late Cretaceous sediments and younger than the underlying Devonian-Carboniferous red beds drilled at Clam-1. The position of the Clam-1 well on an uptilted edge of a Precambrian basement block (Line SO-36-661) probably explains the absence of conglomerates of Late Cretaceous age in Clam-1 in contrast to the Cape Sorell well. These Cretaceous conglomerates probably exist in the basin seaward of the Clam-1 site. The establishment of marine conditions after the break-up unconformity is probably coincident with the occurrence of mudstone with noticably increased sonic velocities (here set as 3.5 km/s) in the Paleocene section of the Clam-1 well. The break-up unconformitiy could then be related to the conglomerate at the base of the Tertiary, or as suggested in the well report, possibly within the Upper Cretaceous. HINZ and WILLCOX (this report) prefer a Middle Cretaceous breakup age for the Southern Australian margin.
These interpreted unconformities in the Clam-1 well were taken as markers to divide the drilled section. Between these markers interval velocities were assigned in such a range as they were calculated for sediments of equivalent age in the Cape Sorell well. For the Devonian-Carboniferous section there was no equivalent and a velocity of 4.5 km/s was assumed.

The assigned interval velocities were then used to calculate reflection times for the different formation levels known from the geological stratigraphy report of the Clam-well. Unfortunately this report does not state the depth of any unconformity drilled.

The reflection times for some formation boundaries coincide well with unconformities or marker reflectors interpreted on single channel line SO-36-661, which starts at the Clam-1 site and connects downslope with the multichannel line SO-36-44. The fact that the Precambrian basement is shown on the reflection seismic record at the calculated depth of about 1 sec TWT supports the assumed interval velocity structure of the Clam-1 well (Figure 28).

Legend for Figures 28 - 42

O	=	"orange" unconformity, Miocene
Y	=	"yellow" unconformity, Oligocene
G	=	"green" unconformity, Eocene
B	=	"brown" unconformity, Paleocene
BL	=	"blue" unconformity, Cretaceous
	=	Continental basement block
	=	Volcanics
SO-36- 	=	Geological sampling by coring
KD SO-36- 	=	Geological sampling by dredging

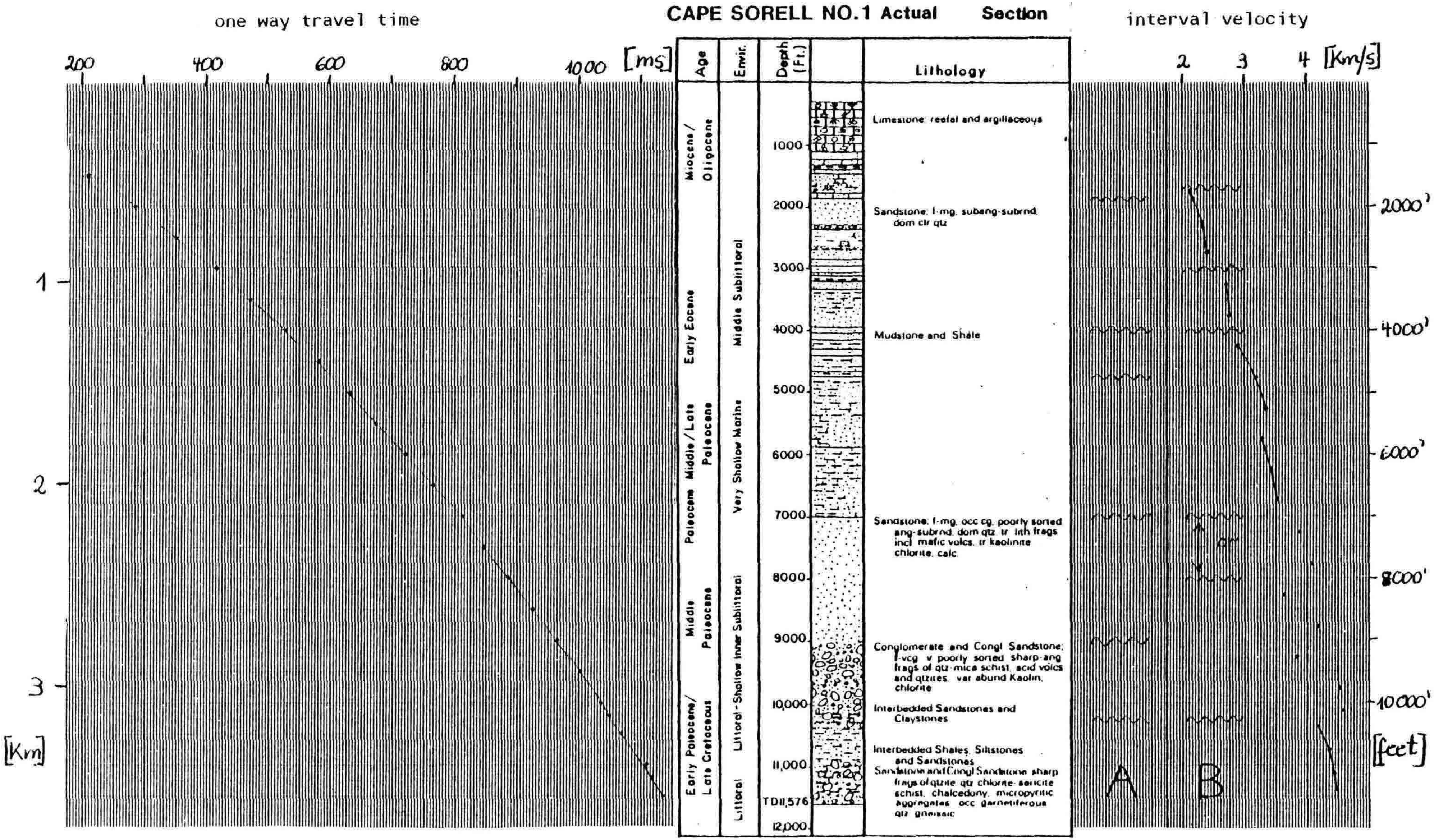


Figure 27: CAPE SORELL NO. 1 well velocity survey with depth of probable unconformities deduced from
A) encountered lithology B) calculated interval velocities

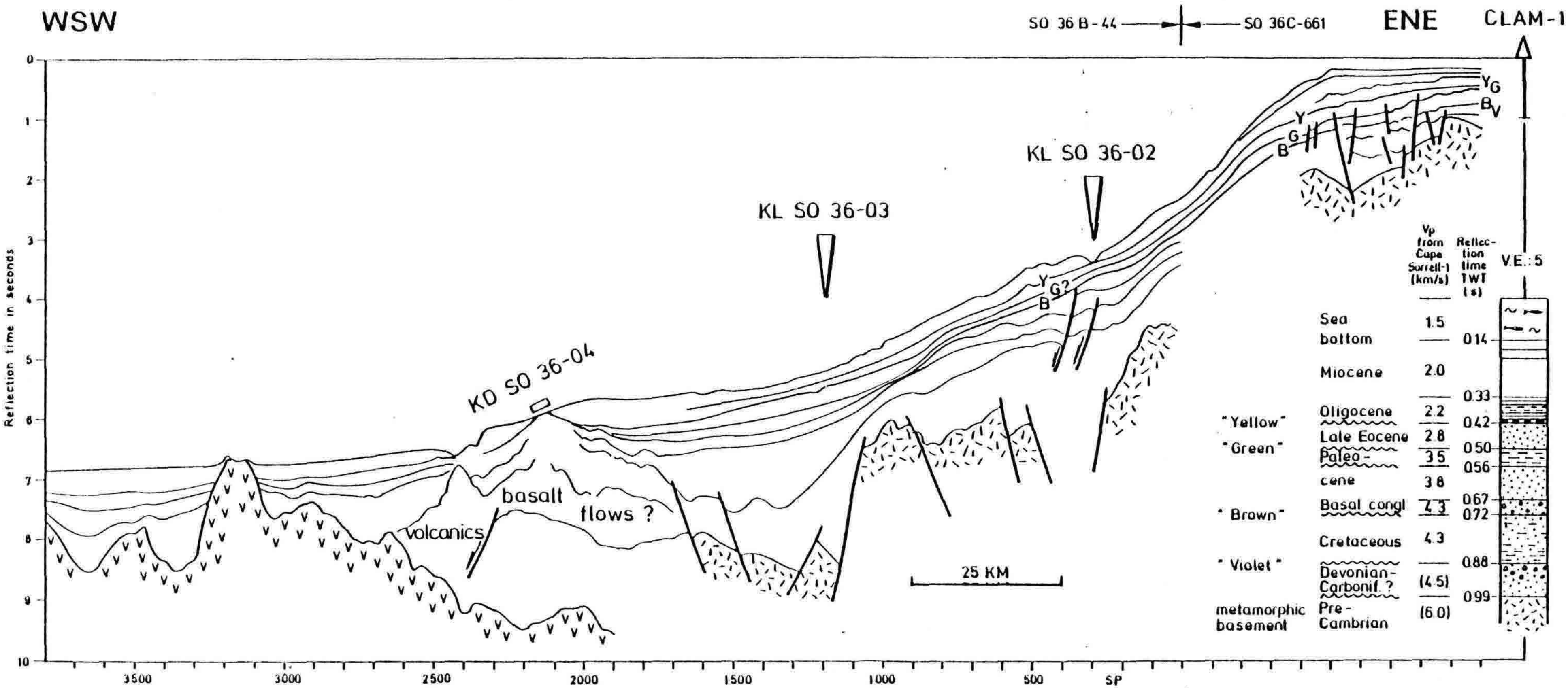


Figure 28: Correlation of 9 stratigraphic levels in the Clam-1 well to SO 36-profiles 661 and 44

Although a detailed stratigraphy can only be attempted when additional velocity information to identify the recognized seismic sequences becomes available during processing from NMO analysis, the presented correlation of the Clam-1 well stratigraphy to the multichannel line SO-36-44 already allows some points to be made:

1) The Paleozoic sediments probably do not extend seaward further than the Precambrian basement block drilled in the Clam well, as both the tie line SO-36-661 and the NW-trending BMR line 40/21 show a planated wedge of Devonian-Carboniferous redbeds and siltstones to lap onto the western basement block. In the rift basins seaward of the basement block extension and downfaulting is thought to be of Cretaceous age and younger. No tilted, previously planated surfaces are recognized above the interpreted basement in the rift basins on line SO-36-44.

2) This interpretation of missing Paleozoic sediments under the Tasmanian continental slope leaves the rift basins filled with more than 2 s TWT (approximately 4.3 km, from the assigned velocity) of potentially hydrocarbon generating Cretaceous sediments.

3) The canyon at SP 300 on line SO-36-44 cuts down to a reflector which could be traced to a possible Oligocene unconformity in the Clam well, which separates mudstone from underlying Eocene sandstone. Station SO-36-2 indeed sampled Late Oligocene/Early Miocene sediments from this canyon. This indicates that the unconformity was not penetrated by the core, but that the established seismic stratigraphy is correct at least to the level of this reflector. At station SO-36-4 crystalline volcanics and sandstone were dredged.

5.2.4 INTERPRETATION AND DISCUSSION OF SELECTED SEISMIC LINES COLLECTED OFF WESTERN AND SOUTHERN TASMANIA

by K. Hinz, H.U. Schlüter and H. Schröder

5.2.4.1 LINE SO-36-46 (Figures 29 and 3):

This line runs from the Cape Sorell No. 1 Well, located in Amoco's T-12-P permit area, offshore West Tasmania in 95 metres water depth across the outer shelf and slope to DSDP Site 282 and further to the west into the magnetic quiet zone off Tasmania. Although Cape Sorell No. 1 Well (Figure 30) terminated in Early Paleocene/Late Cretaceous sandstones and did not encounter the anticipated Lower Cretaceous sediments, the monitor record clearly shows tilted basement blocks with intervening halfgrabens. The halfgrabens, 20 km - 40 km wide, are very probably filled with Lower Cretaceous sediments. Beneath the shelf and upper slope an approximately 2 sec (TWT) thick and seaward rapidly thinning sedimentary wedge of presumably Upper Cretaceous age overlies the "blue" unconformity. The latter is interpreted as the break-up unconformity. The "brown" unconformity forms the upper boundary of the Cretaceous sedimentary wedge and represents Early Paleocene/Late Cretaceous littoral to shallow sublittoral conglomerates and conglomeratic sandstone encountered in Cape Sorell No. 1.
The layer between the Oligocene "yellow" unconformity and the "brown" unconformity consists of Middle to Late Paleocene shallow marine sandstone with mudstone interbeds and overlying Early Eocene sublittoral sandstones with interbeds of mudstone and shales. At Site 282 a 240 metres thick Late Eocene to Middle Oligocene sequence consisting mainly of nannofossil detrital to silty clay was encountered beneath the "yellow" unconformity which coincides with the drilled Middle Oligocene to Early Miocene hiatus.
Refraction seismic velocities of 2.8 to 3.2 km/s were derived from the camera records for the sediments at the seabed of the shelf. These relatively high velocity values indicate that Miocene limestone, as drilled at well Cape Sorell No. 1, probably subcrops at the seabed on the shelf.
It appears that the extrusive pillow basalts drilled at Site 282, and coinciding with both a positive magnetic anomaly and a positive free air gravity anomaly, represent post-rift volcanism, because the basalts apparently pierce Eocene sediments, i.e. pre-"green" unconformity sediments.

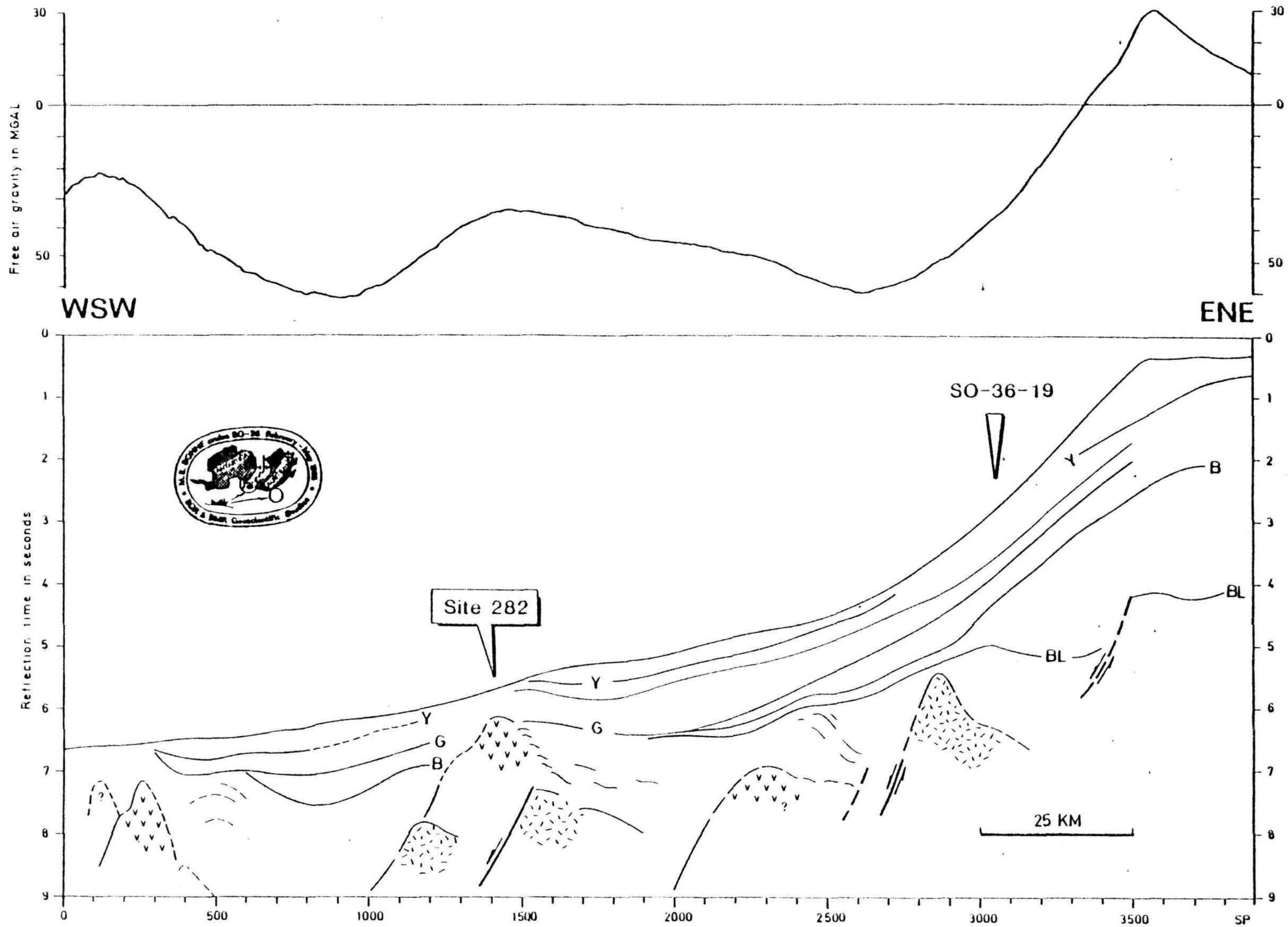


Fig. 29: Interpretation of Line SO-36 B-46

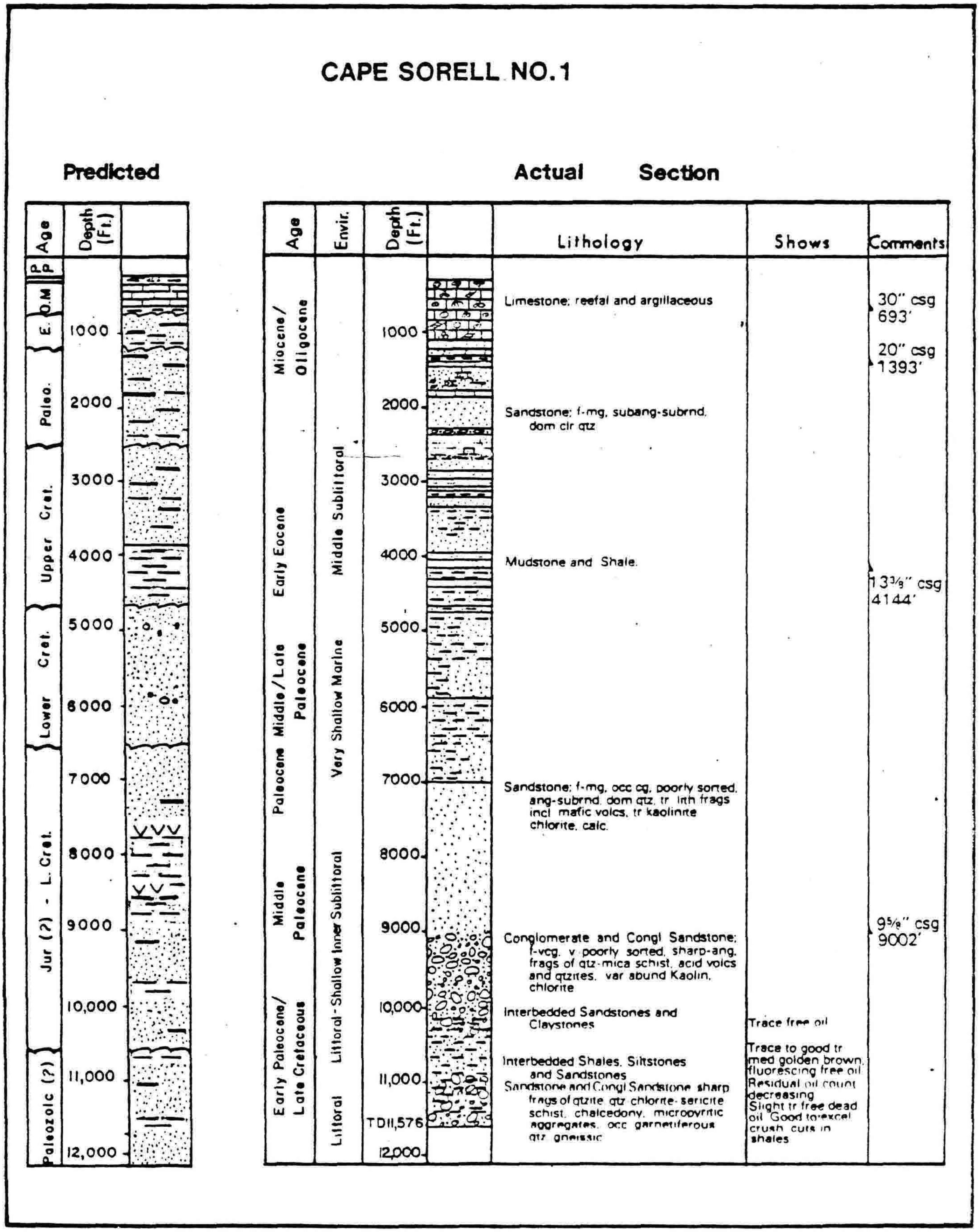


Figure 30: Drilled section of well Cape Sorell No. 1 (ANONYMOUS, 1982)

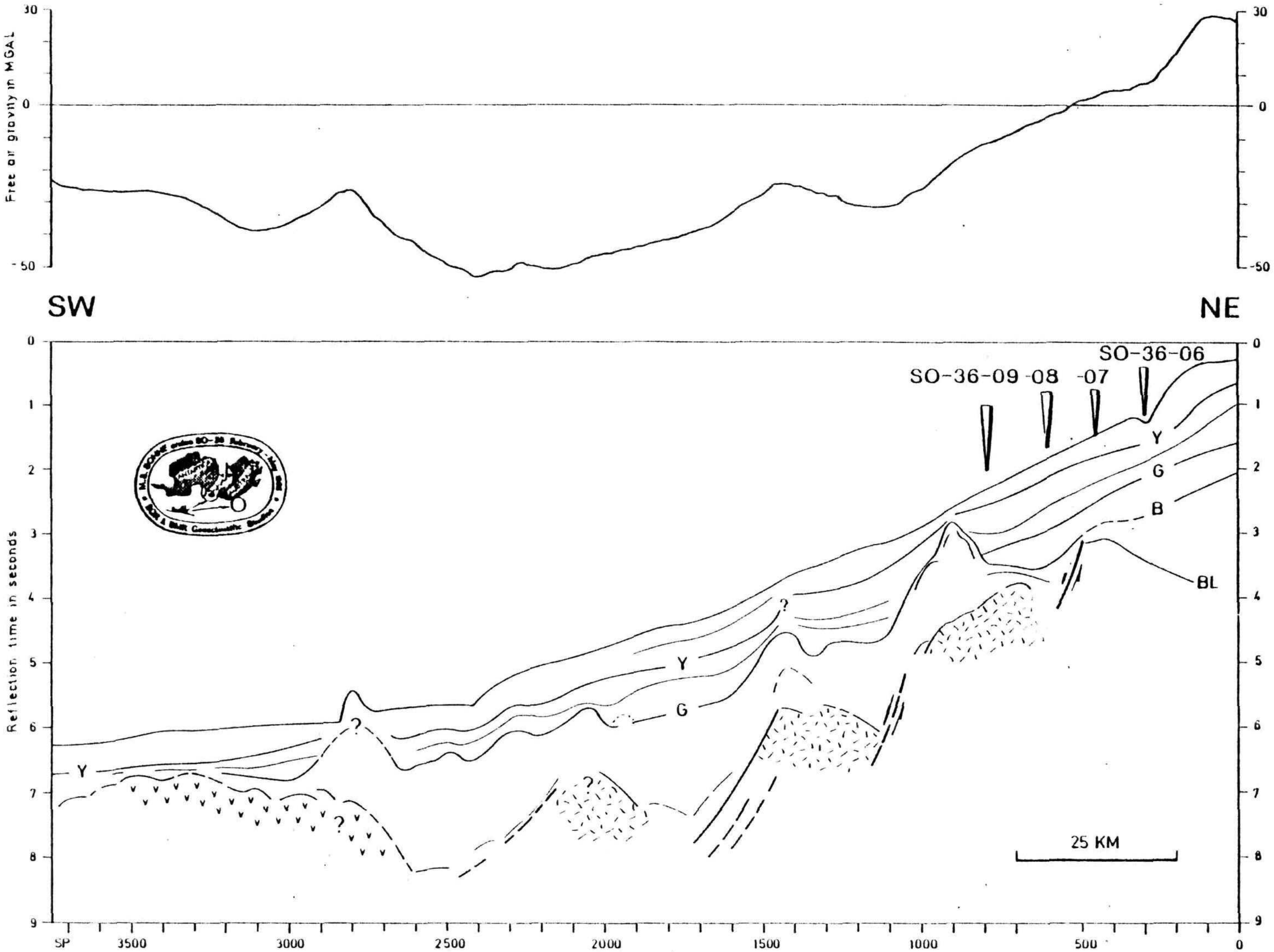


Fig. 31: Interpretation of Line SO-36 B-47

Line SO-36-46 shows characteristic divergent margin features, namely tilted fault blocks with intervening halfgrabens. The latter probably originated mainly in Early Cretaceous time. Since the Upper Cretaceous, i.e. post-"brown" unconformity, subsidence has been the main tectonic process affecting the continental margin on line SO-36-46.

5.2.4.2 LINE SO-36-47 (Figure 31):
The structural style of this line running from the Cape Sorell Sub-basin, 30 miles long and 15 miles wide (ANONYMOUS, 1982), to the southwest across the continental slope and rise is similar to that of the previous and neighbouring line SO-36-46. It differs from the latter by containing sedimentary piercement structures (SP 800-1100, 1350-1550, 1950-2150, 2700-2900). Although the true nature of these structures which presumably developed in Eocene time is not known, it is assumed that they are wrench-fault related structures. Note that the freeair gravity profile reflects nicely the topography of the basement as on the previous line SO-36-46.

5.2.4.3 Line SO-36-48 (Figure 32):
This line traverses the continental margin of southwestern Tasmania in a west-east direction. The line ends south of Cape South West on the outer shelf.

The dominant structural elements on this line are narrow, fault-bounded and acute angled continental basement blocks with steep flanks (up to 25°), and narrow intervening sedimentary halfgrabens.
Mica schists were dredged (Station SO-36-28/29) from the outcropping peak of the basement block at S.P. 3350.
Correct identification of the interpreted "brown" and "green" unconformities is supported by the results of dredging and coring during Leg 3: On the upper slope the "brown" unconformity is at seabed (SP 3800). Here, Late Paleocene/Middle Eocene limestones and calcarenite were dredged.
A sequence interpreted as Eocene/Early Oligocene and characterized by a high-frequency subparallel reflection pattern toplaps against the sea floor between S.P. 1200 - 2000. At stations SO-36-22 and SO-36-30 peaty sand of prosumed Late Eocene/Early Oligocene age was encountered by piston coring. It is not clear on this line whether the unconformity labelled "yellow" in Figure 48 represents a boundary of one of the Eocene-Oligocene progradational cycles known

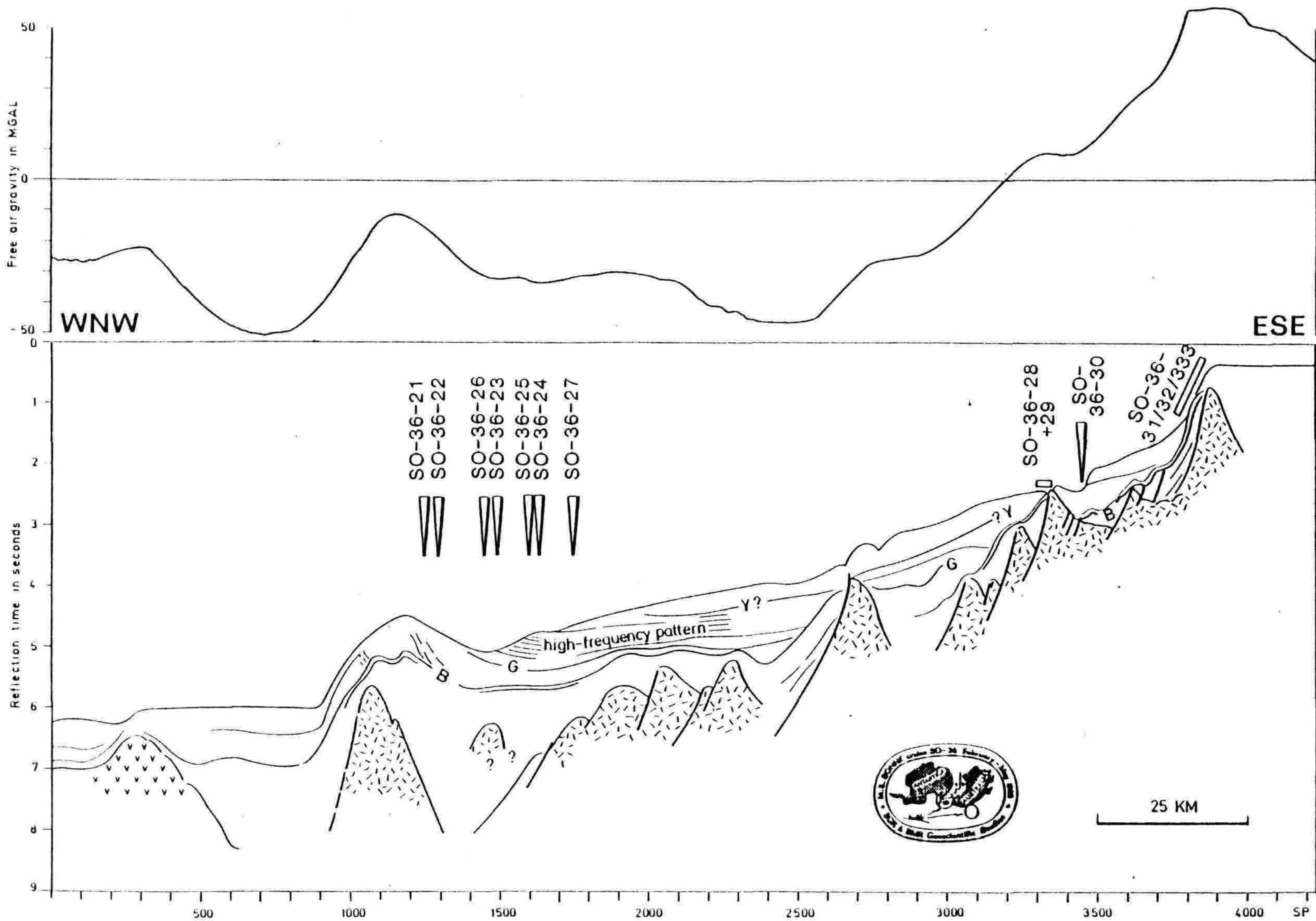


Fig. 32: Interpretation of Line SO-36 B-48

from the Otway Basin (see chapter 5.2.2) or the Oligocene unconformity, but the latter is preferred.
The overall impression is that the small-scale block-tectonics are the result of both crustal extension and strike-slip motion. This transtensional process occurred presumably in the Early Paleocene/Late Cretaceous, i.e. immediately before the "brown" unconformity was formed, and was followed by strong subsidence. The peaty sand is believed to be a reworked deposit laid down in deep water (see geological report).
On the shelf, the near-surface refraction seismic velocities of 3.2 to 5 km/s derived from the camera records indicate that the rocks are already lithified.

5.2.4.4 Line SO-36-49 (Figure 33):
This line starts south of South West Cape on the outer shelf of southern Tasmania, and runs in a SSW-direction across the complex and approximately 3000 metres deep bathymetric depression which separates the South Tasman Rise from the Tasmanian continental margin, to the northern tip of the rise.

The southern Tasmanian continental margin is an extremely starved margin. The step-like downfaulted and tilted continental basement blocks are nearly sediment-free. Quarzitic sandstone and metamorphic rocks were dredged at stations SO-36-35 and SO-36-36 respectively.
The transition from the South Tasman Rise to the deep depression occurs at a distinct fault (SP 2250-2300) on line SO-36-49. Within the depression depositional sequences up to approximately 2000 metres thick overly bevelled basement blocks (SP 2500 - 3100 in Figure 33). We believe that these characteristically bevelled basement blocks are subsided proportions of the South Tasman Rise, and that rapid subsidence occurred after the distinct bevelling event which affected the South Tasman Rise, probably in the Oligocene as will be discussed later.

If this interpretation is correct, it follows that the separation of Tasmania from the South Tasman Rise commenced in the Oligocene by extension and movements along strike-slip faults resulting in South Tasman Rise being left behind in its present position relative to Tasmania during the process of separation between Australia and Antarctica.

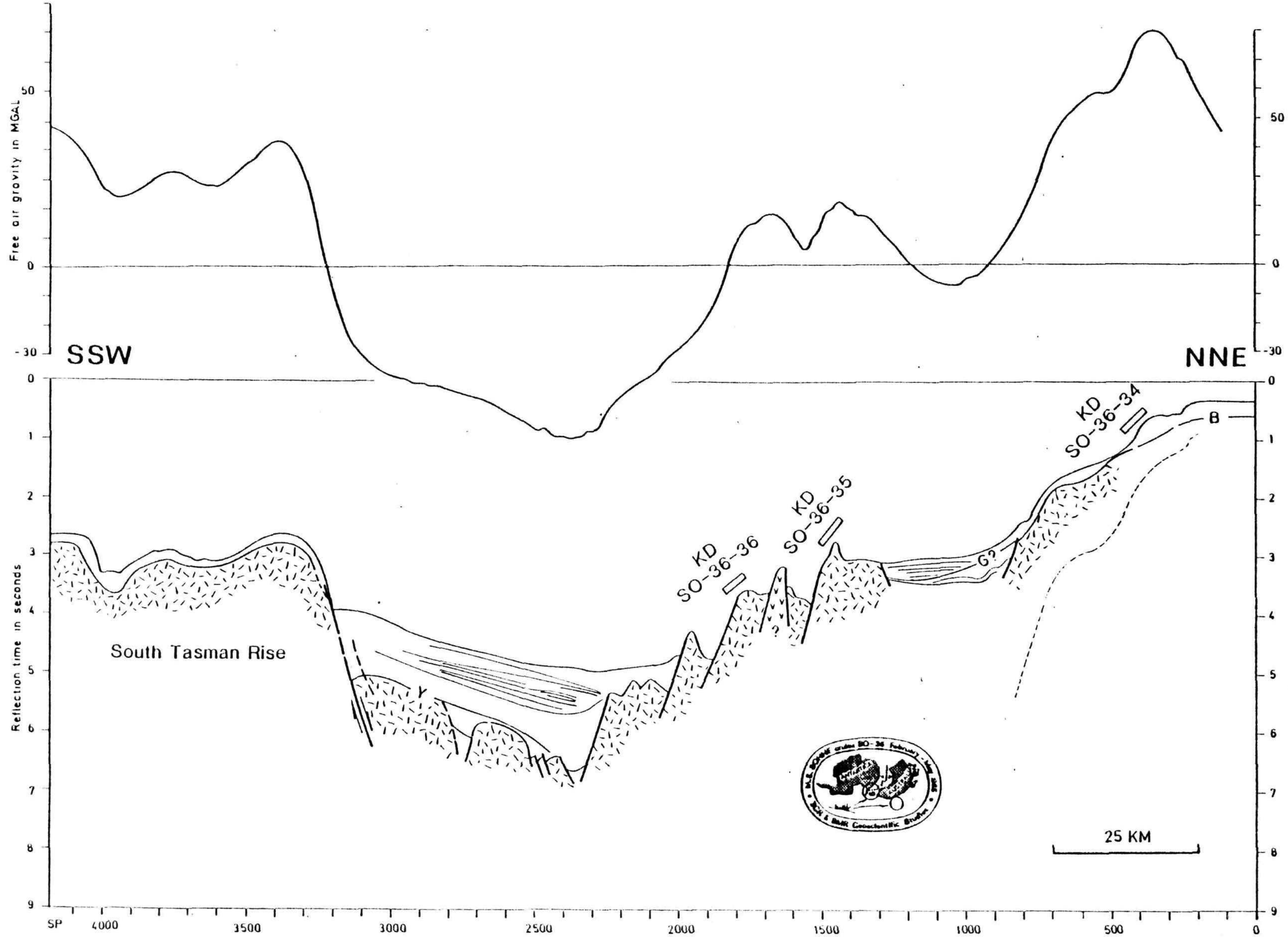


Fig. 33: Interpretation of Line SO-36-49

5.2.5 INTERPRETATION AND DISCUSSION OF SELECTED SEISMIC LINES COLLECTED ON THE SOUTH TASMAN RISE

by K. Hinz and H. Schröder

During Leg 2 of SONNE cruise SO-36 fourteen multichannel seismic lines with a total length of 2,480 km were surveyed on the South Tasman Rise (Figure 4).

The geophysically poorly surveyed NNW-trending South Tasman Rise lies between 45° S and 51° S in water depths of about 800 to 3000 metres. It covers an area of approximately 130 000 km² related to the 3000 m bathymetric contour. Its margins parallel two Southern Ocean transforms to the west, i.e. Balleny and Tasman Fracture Zones and the Tasman Sea spreading ridges to the east.

During DSDP Leg 29 (KENNETT, HOUTZ et al., 1974) Sites 280 and 281 were drilled on the abyssal plain south of the South Tasman Rise and near its culmination, respectively.
Although rough seas and heavy swell hampered the seismic measurements, and often forced changes of the direction of the planned seismic lines in order to avoid unacceptable streamer noise, we were able to extend our seismic reconnaissance survey to about 49° 15' South.

5.2.5.1 LINE SO-36-52 (Figure 34, for location see Figure 4):
This line is our southernmost line and crosses the South Tasman Rise in a SW-NE direction. The line starts in the Southwest in a deep-water area which is underlain by oceanic crust. The oceanic basement has relatively rough relief with clear indications of successively superimposed lava flows. According to the results of DSDP Site 280, where a basaltic intrusion was drilled, the age of the oceanic crust is Middle Eocene or perhaps younger (KENNETT, HOUTZ et al., 1974). The basement high between S.P. 1700 - 2200 might also be a basaltic intrusion because it is associated with a positive magnetic anomaly.
The southwestern flank of the South Tasman Rise has relatively irregular relief, and is underlain by a series of tilted basement blocks. Immediately northeast of the flank is a basin about 45 km wide. In the centre of this rift basin are sediment-piercing structures similar to those structures ob-

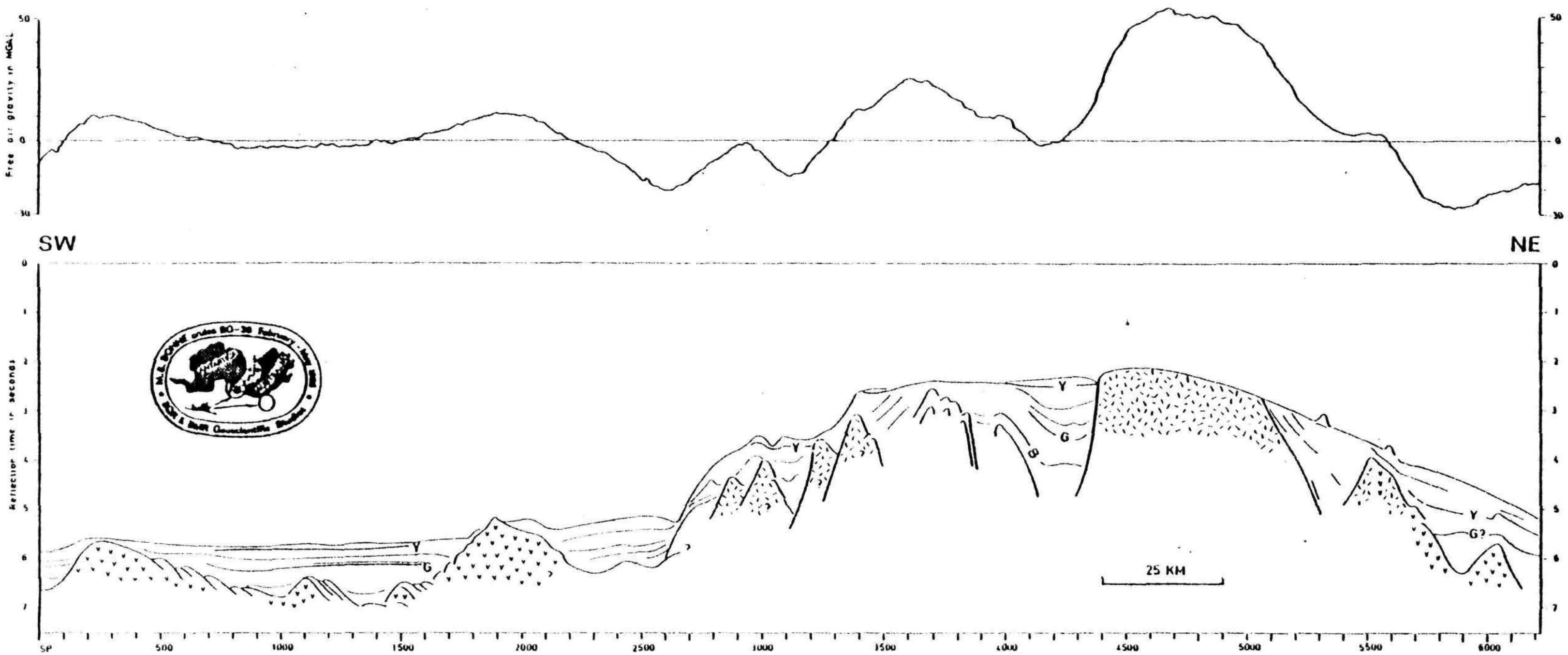


Fig. 34: Interpretation of Line SO-36-52

served off western Tasmania on line SO-36-47 (compare chapter 5.2.4.2), suggesting that the basin was affected by both strike-slip faulting and extensional tectonics. It is assumed that rifting started in the Late Cretaceous, i.e. before the formation of the "brown" unconformity (compare chapter 5.2.2). It appears that most of the basin infill consists of Eocene sediments, which are abundant on the South Tasman Rise (see geological report).

The updomed Eocene sediments toplap against the "yellow" unconformity, interpreted to represent an important erosional event in the Oligocene, which apparently also affected the adjacent, 35 km wide, basement block to the northeast, and the basin beyond the basement block. Neogene sediments are apparently thin or absent on the South Tasman Rise on this line.

5.2.5.2 <u>LINE SO-36-53</u> (Figure 35, for location see Figure 4):
Line SO-36-53 traverses the eastern half of the South Tasman Rise at latitude 48° S.

Between two characteristically bevelled basement blocks which lie at different depths lies a basin, about 50 km wide (S.P. 1300 - 2300) and characterized by irregular seafloor topography. This irregular seafloor topography presumably is the result of young, i.e. post-Oligocene basaltic dyke injections/intrusions. It is noteworthy that the interpreted basaltic intrusions lie in the southern prolongation of a chain of NNW-trending seamounts, located beween 45 ° - 47° S/148° - 150° E at the western margin of the Tasman Basin. The ocean-continent boundary is thought to lie between S.P. 500 - 700.

5.2.5.3 <u>LINE SO-36-54</u> (Figure 36, for location see Figure 4):
This NE-trending line exhibits the same structural elements as the previous line, namely a dyke-injected basin and a bevelled basement block. It appears that the dyke injection zone continues to the north into a NNW-trending zone of seamounts. The distinctive asymmetrically v-shaped narrow troughs within the basement block (S.P. 500 - 650, 700 - 800) indicate that crustal fragmentation occurred still in the early Oligocene, i.e. before the "yellow" unconformity was formed.

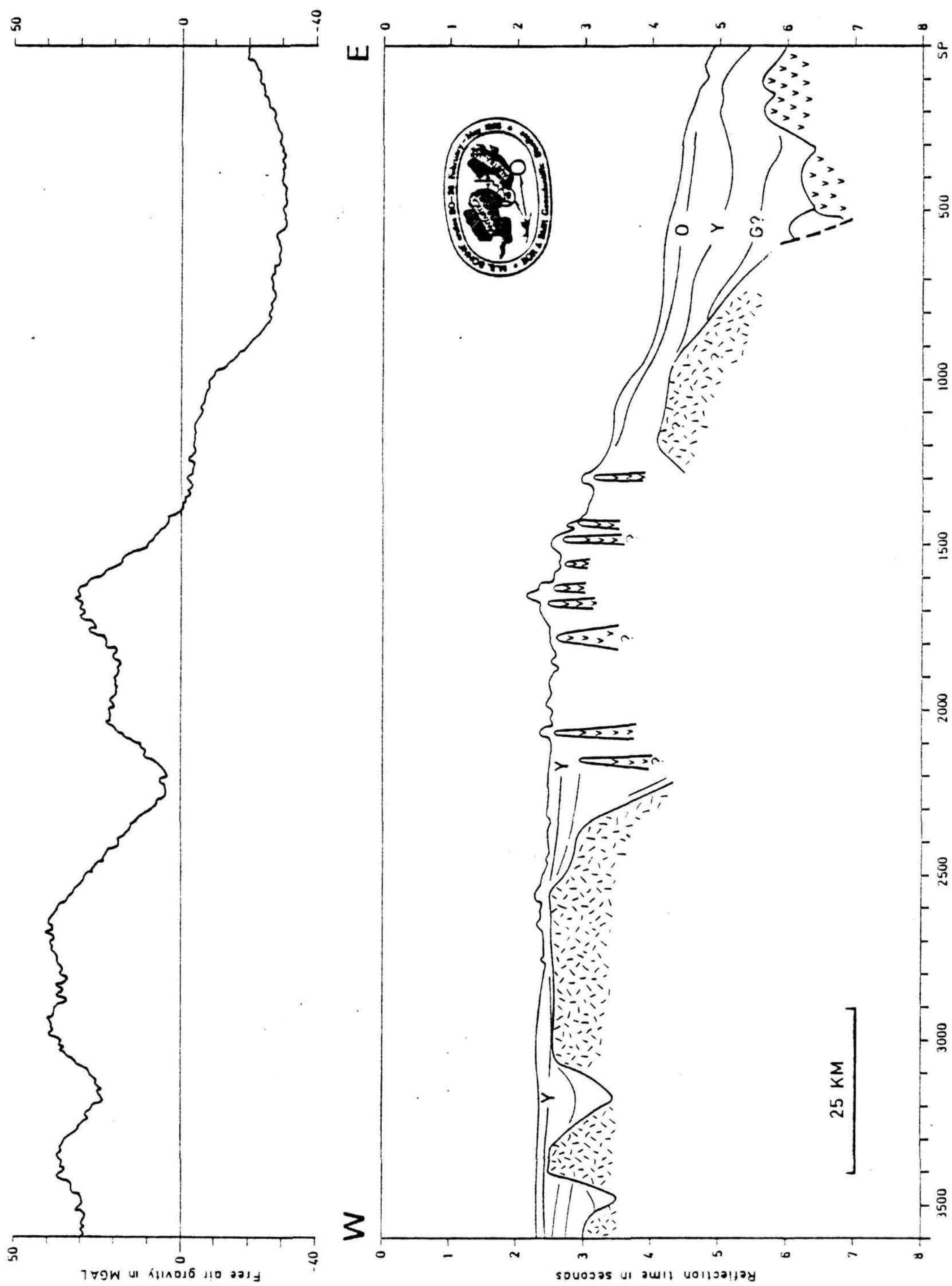


Fig. 35: Interpretation of Line SO-36-53

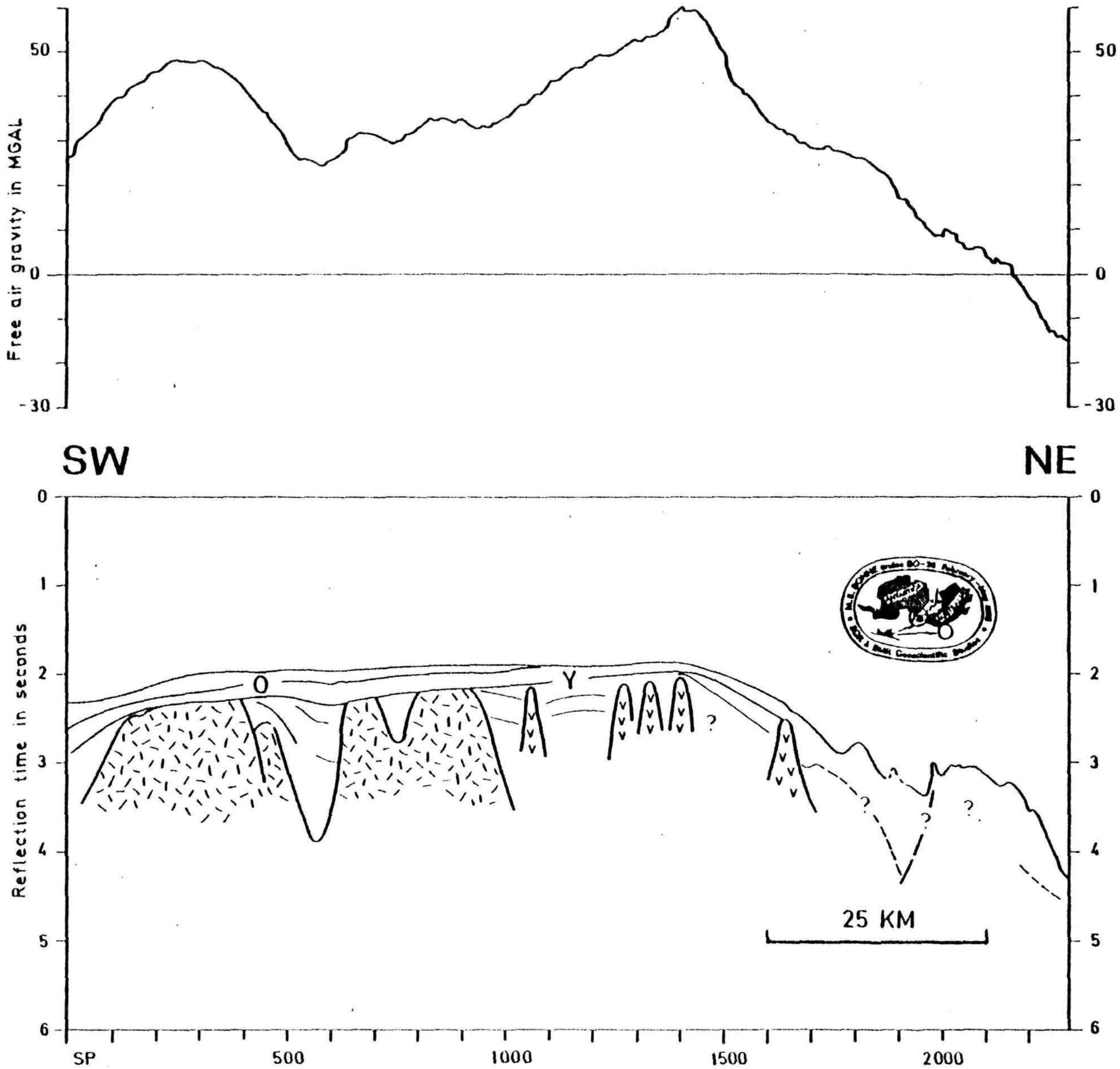


Fig. 36: Interpretation of Line SO-36-54

5.2.5.4 LINES SO-36-56 and SO-36-57 (Figure 37, for location see Figure 4):
On these lines the South Tasman Rise consists of a central continental basement block flanked by two basins. The basement block is flattened by current abrasion and/or glacial erosion in the Oligocene. Refraction seismic velocities of 5.9 - 6.4 were derived from the camera records for the basement. The continental basement block is pierced by two post-Oligocene, i.e. post "yellow" unconformity intrusions. The intrusion at S.P. 1300 - 1500 is not associated with a positive magnetic anomaly. Propagating pre-Oligocene rifting of the continental basement is indicated by narrow v-shaped trough (S.P. 450 - 550).

5.2.5.5 LINE SO-36-58 (Figure 38, for location see Figure 4):
On this NE-trending line the South Tasman Rise consists of four outstanding planated basement blocks and three intervening basins flanked on the western side by a rift basin. Without processing and migration it is difficult to define the geological nature of the distinctive diffraction pattern at S.P. 4000 - 4800. The planated basement block located between S.P. 2400 and 3500 is associated with a positive magnetic anomaly and has some coherent intracrustal reflections.

5.2.5.6 LINE SO-36-59 (Figure 39, for location see Figure 4):
Line SO-36-59 lies 10 to 25 nautical miles north of the previous line SO-36-58 and traverses the northern part of the South Tasman Rise. A steep escarpment constitutes the western border of the Tasman Rise from which metamorphites, pegmatites and granodiorites were dredged at Site SO-36-44. The escarpment extends from 48° South to 44.5° South and represents a major strike-slip fault.
Immediately to the east is a complex structural zone.

The two central and bevelled continental basement blocks, which are separated by a 15 km wide v-shaped basin, are flanked by rift basins. The eastern and presumably strongly deformed rift basin has a quiet magnetic signature.

Basalts and volcanic breccia were dredged from the piercing structure on the eastern basement block (S.P. 3850 - 3900) at station SO-36-52.

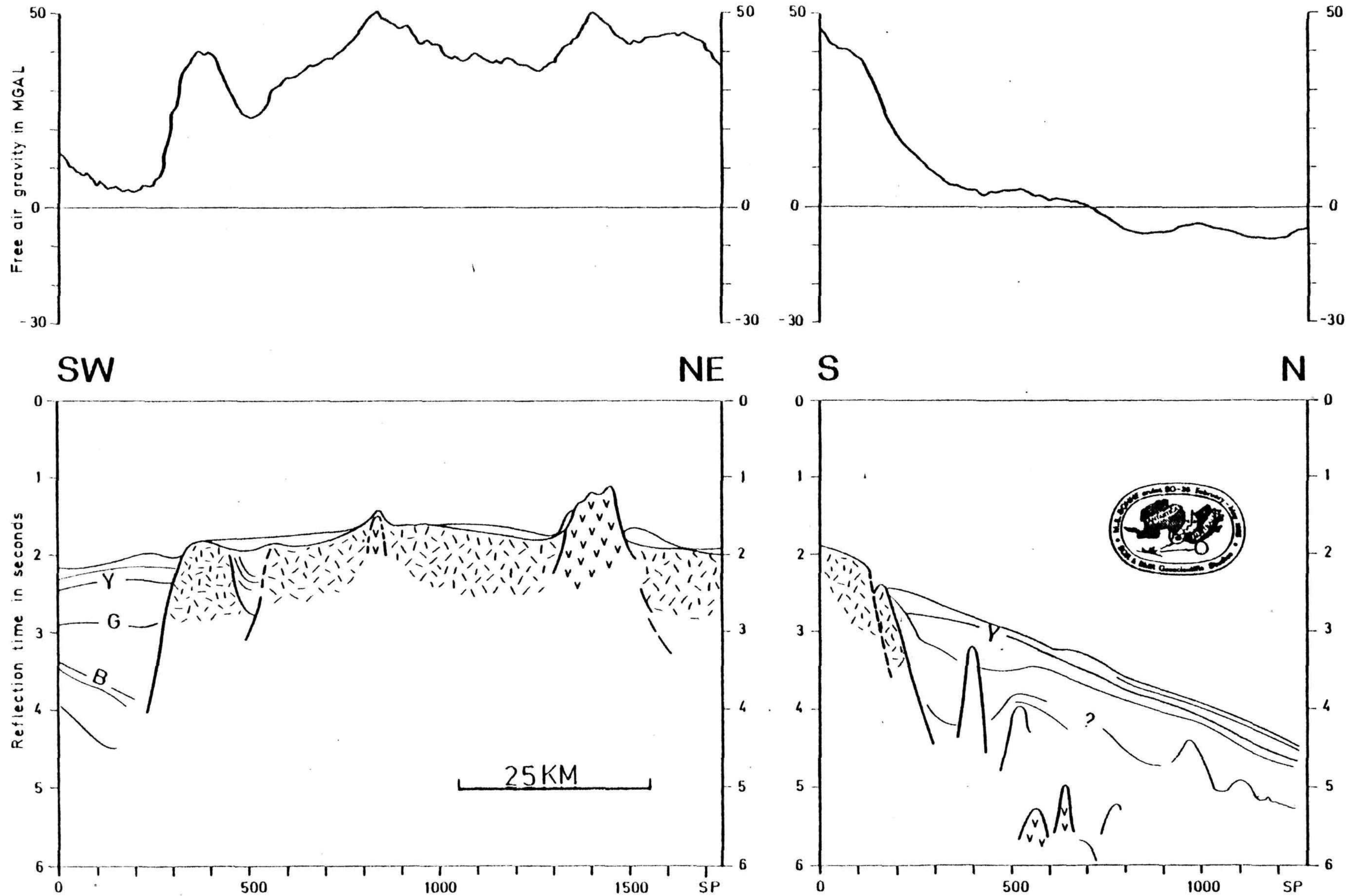


Fig. 37: Interpretation of Lines SO-36-56 (left) and SO-36-57 (right)

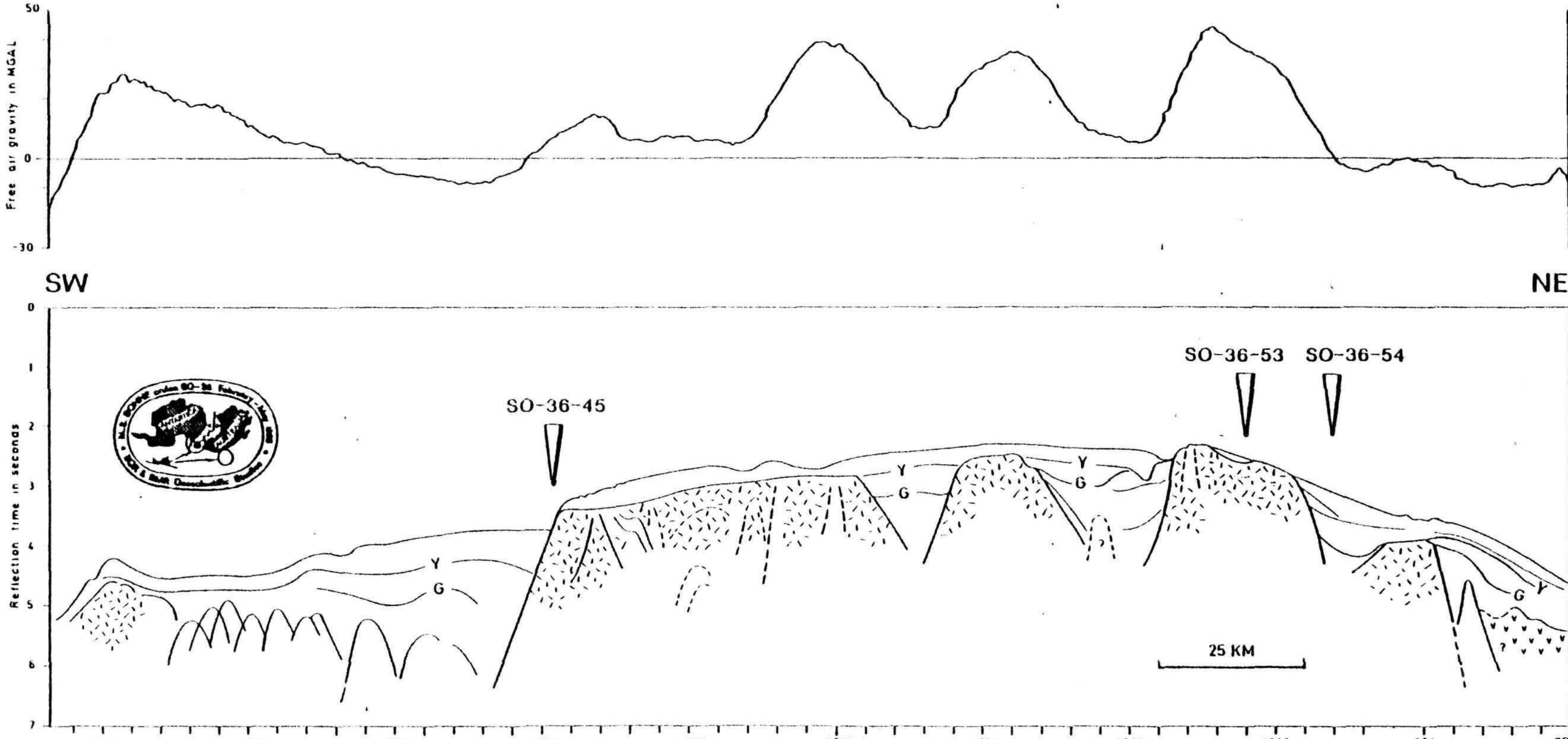


Fig. 38. Interpretation of Line SO-36-58

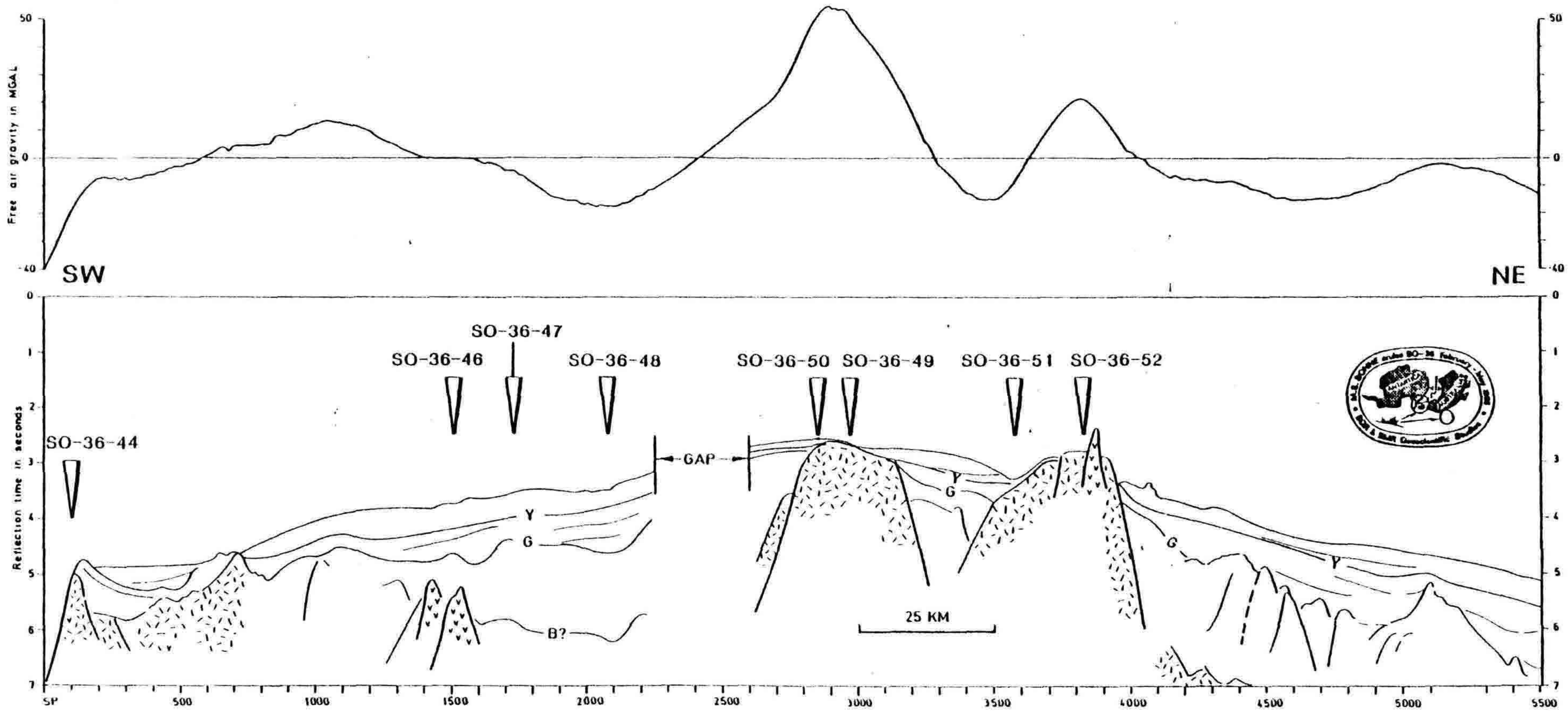


Fig. 39: Interpretation of Line SO-36-59

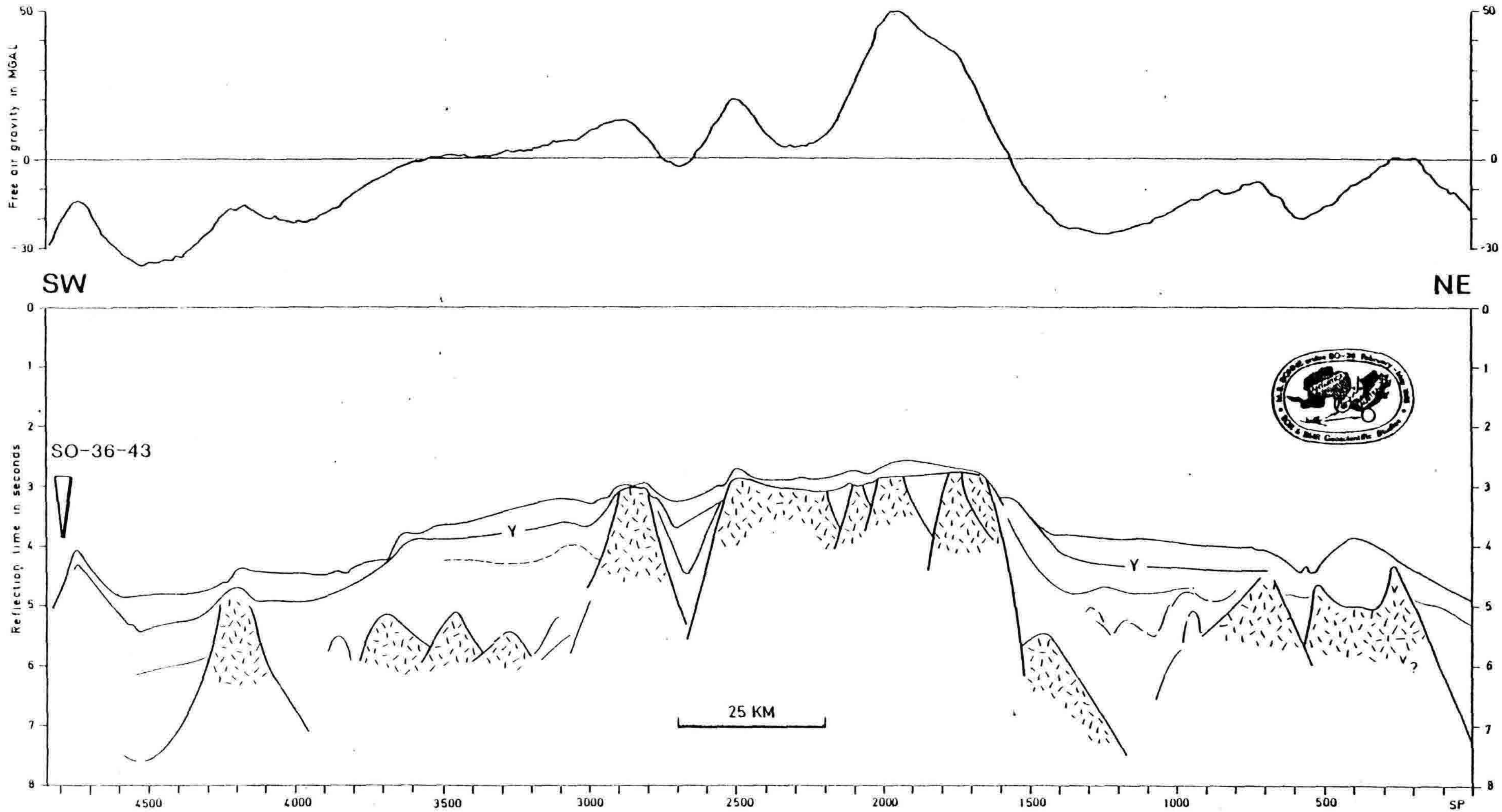


Fig. 40: Interpretation of Line SO-36-61

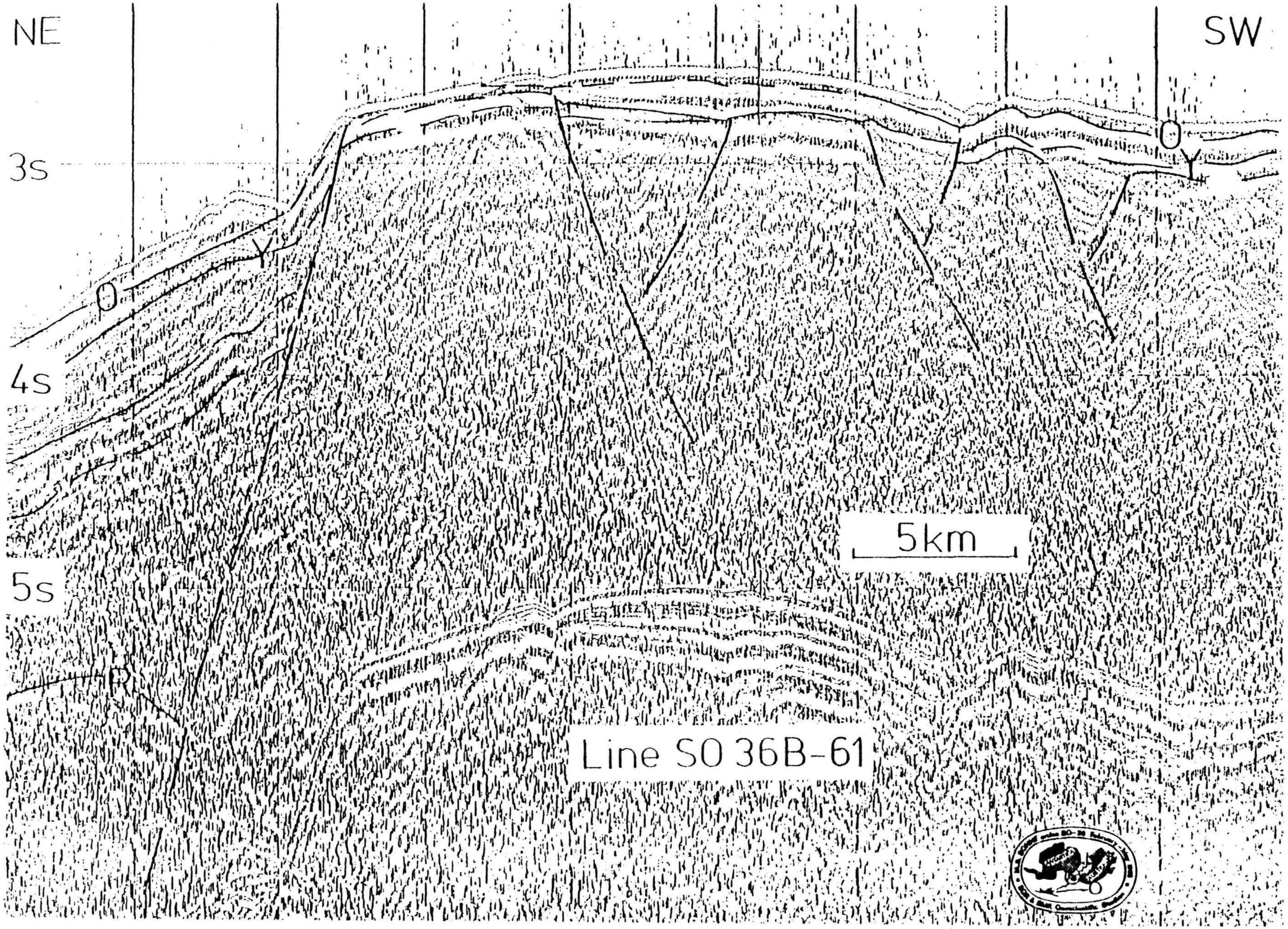


Figure 41: Seismic record of line SO-36-61. The central continental basement block is intensively fragmented as indicated by v-shaped troughs

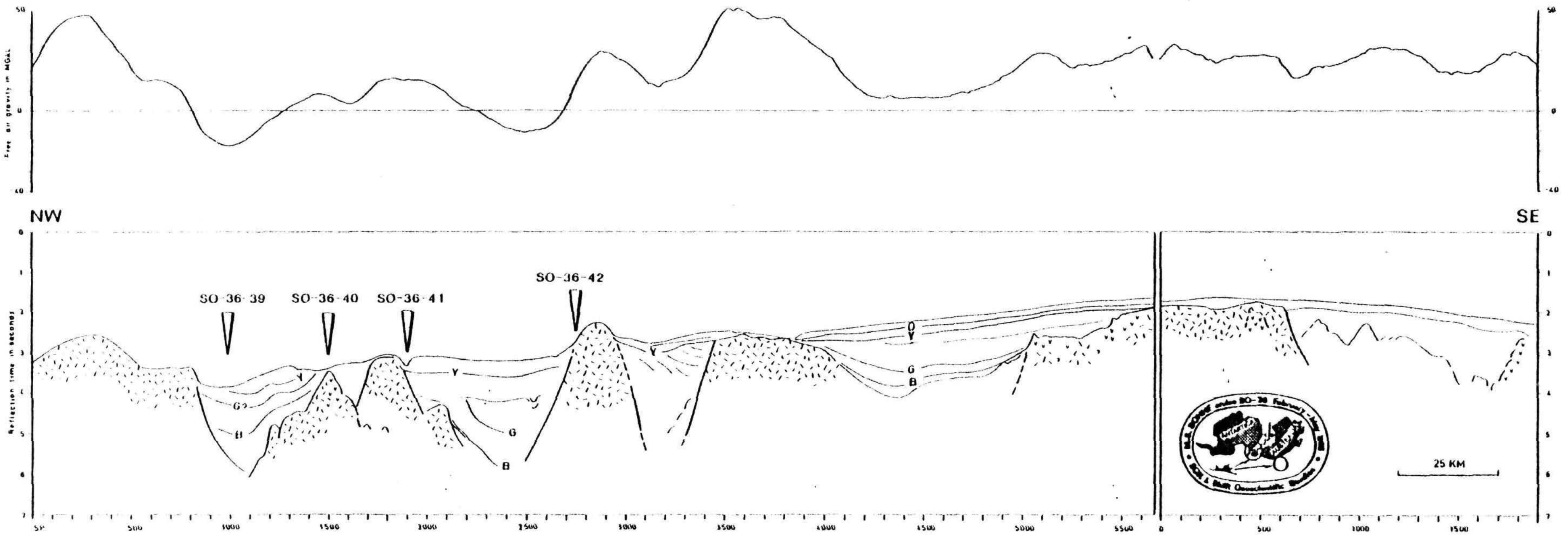


Fig. 42: Interpretation of Lines SO-36-50 and -50 A

5.2.5.7 <u>LINE SO-36-61</u> (Figure 40, for location see Figure 4):

Line SO-36-61 is the northernmost line which traverses the northern part of the South Tasman Rise. The central continental basement block is intensively fragmented as indicated by the v-shaped troughs (Figure 41) which probably are the result of propagating transtension.

HINZ, K., & BLOCK, M., 1983: Results of geophysical investigations in the Weddell Sea and in the Ross Sea, Antarctica. Proceed. 11th World Petroleum Congr., London 1983, 2, 79-91.

KENNETT, J.P., HOUTZ R.E. et al., 1974: Initial Reports of the Deep Sea Drilling Project, Volume 29. Washington (U.S. Government Printing Office), 1197 p.

MCPHEE, I., 1976 - Fuels: Black coal, brown coal, oil and gas. In Geology of Victoria, GSA Special Publication No. 5, Douglas, J.G., & Fergusson, J.A. (Editors), Melbourne.

ROBERTSON, C.S., CRONK, D.K., MAYNE, S.T., & TOWNSEND, D.G., 1978: A Review at Petroleum Exploration and Prospects in the Otway Basin Region. Bureau Mineral Resources Australia, Record 1978/91, 100 p.

WEISSEL, T.K., & HAYES, D.E., 1974: The Australian - Antarctic Discordance: New Results and Implications. Journal Geophys. Research, 79 (17), 2579 - 2587.

WEISSEL, J.K., & HAYES, D.E., 1977: Evolution of the Tasman Sea reappraised. Earth and Planetary Science Letters, 36, 77-84.

WILLCOX, T.B., 1981: Petroleum Prospectivety at Australian Marginal Plateaus. AAPG Studies in Geology, 12, 245 - 272.

WILLCOX, J.B., 1978: The Great Australian Bight: a regional interpretation of gravity, magnetic, and seismic data from the Continental Margin Survey. Bureau Mineral Resources Report, 201, 65 p.

VAIL, P.R., MITCHUM, R.M., & THOMPSON III, S., 1977: Global Cycles at Relative Changes of Sea Level. AAPG Memoir, 26, 83 - 98.

HINZ, K., & BLOCK, M., 1983: Results of geophysical investigations in the Weddell Sea and in the Ross Sea, Antarctica. Proceed. 11th World Petroleum Congr., London 1983, 2, 79-91.

KENNETT, J.P., HOUTZ R.E. et al., 1974: Initial Reports of the Deep Sea Drilling Project, Volume 29. Washington (U.S. Government Printing Office), 1197 p.

MCPHEE, I., 1976 - Fuels: Black coal, brown coal, oil and gas. In Geology of Victoria, GSA Special Publication No. 5, Douglas, J.G., & Fergusson, J.A. (Editors), Melbourne.

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VAIL, P.R., MITCHUM, R.M., & THOMPSON III, S., 1977: Global Cycles at Relative Changes of Sea Level. AAPG Memoir, 26, 83 - 98.

5.2.6 THE GEOLOGICAL STRUCTURE OF THE SOUTH TASMAN RISE
by K. Hinz

The NW-SE trending South Tasman Rise lies between 45° S and 51° S in water depths of approximately 800 - 3000 metres. According to the results of both sampling of SONNE cruise SO-36 and drilling at DSDP Site 281 the South Tasman Rise is a microcontinental feature.
Although we recognize that, given the existing coarse grid of multichannel seismic lines and the difficulties in interpretation discussed before, the true geological nature of various structures in the area of the South Tasman Rise is still obscure, our best preliminary guess on the fault pattern is shown in Figure 43.
The dominant structural elements of the South Tasman Rise are dinstinctively planated continental basement blocks split by a series of predominantly northwest-southeast and north-south trending troughs. The majority of these troughs, specially those recognized north of latitude 47° S, have a characteristic v-shape configuration both in the two-dimensional cross section (Figure 41) and in the square dimension. Depth, width and sedimentary infill of the individual troughs decrease from north to south indicating propagating fragmentation of the South Tasman Rise by transtensional tectonics e.g. a combination of extension and strike-slip motion. Transtension affected the South Tasman Rise presumedly from the Early Eocene through the Oligocene e.g. before the "yellow" unconformity was formed.
The characteristic bevelling of the basement blocks probably is the result of abrasion by ice, although abrasion by the Antarctic circumpolar current in the Oligocene might also be a plausible explanation.

A steep escarpment constitutes the western boundary of the South Tasman Rise between latitudes 44.5° S and 48° S from which metamorphites, pegmatites and granodiorites were dredged. The escarpment represents a major left-lateral strike-slip fault. A northwest trending rift basin, labelled "A" in Figure 43, probably terminates against this fault. The rift basin labelled "A" in Figure 43 is approximately 50 km wide and presumedly originated in the Late Cretaceous. Most of the basin infill consists of Eocene sediments (see also Figures 34 and 38).

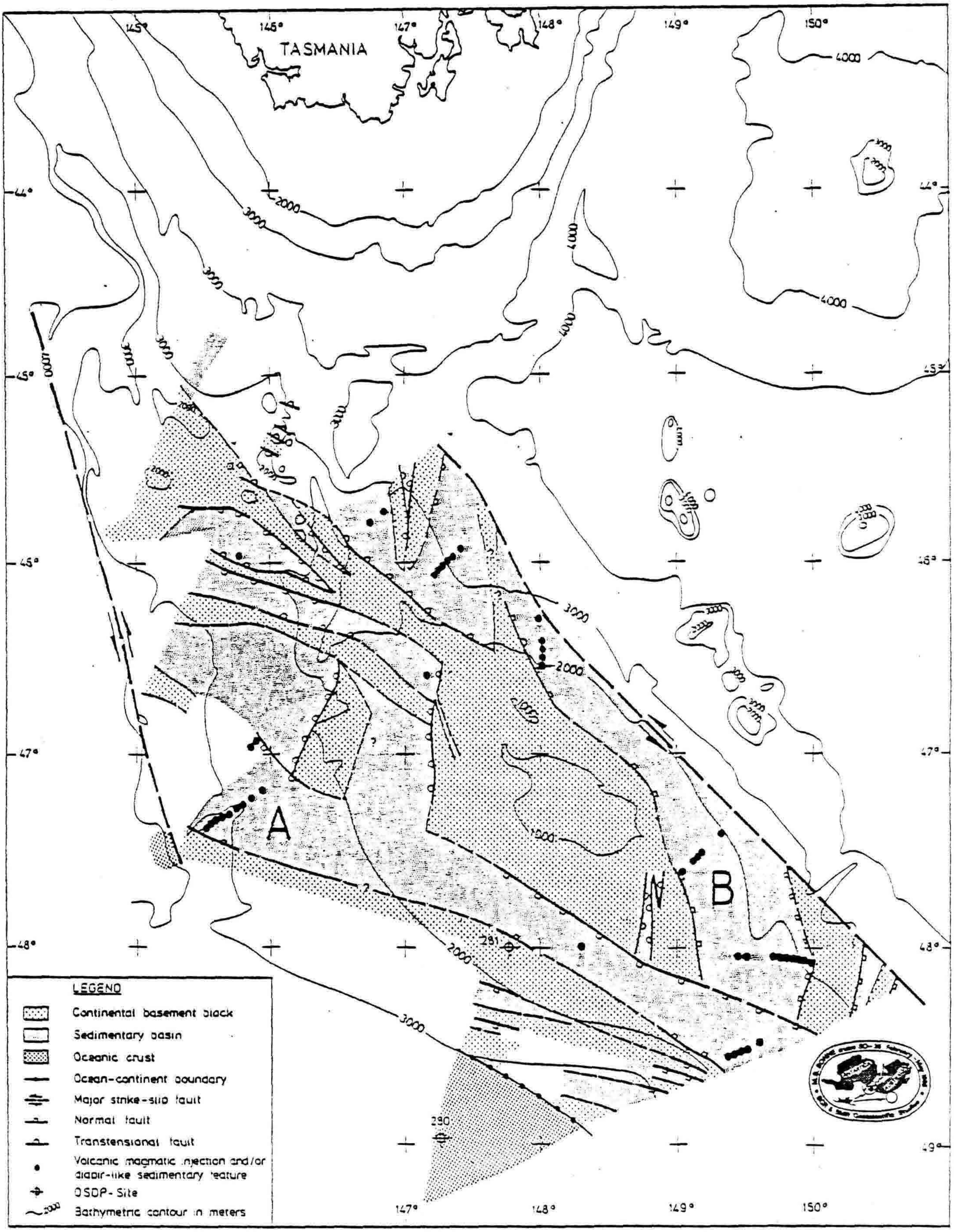


Figure 43: Structural map of the South Tasman Rise

Another NW-trending major strike-slip fault forms the eastern boundary of the South Tasman Rise. It apparently cuts off a NW-trending rift basin, labelled "B" in Figure 43, which is characterized in its southern part by an irregular seafloor topography. This irregular seafloor topography presumedly is the result of post-Oligocene basaltic dyke injections. It is noteworthy that the interpreted basaltic intrusions lie in the southern prolongation of a chain of seamounts located at the western margin of the Tasman Basin.

The transition between the South Tasman Rise and Southern Tasmania is characterized by a more than 3000 metres deep bathymetric depression subdivided by many small circular highs, interpreted as volcanic features (compare chapter 5.2.7). The NW-trending narrow ridge between the 3000 metres contours at 44° S/145° S is probably a continental basement block which has been sheared off and rotated during the separation of Tasmania from the South Tasman Rise. This separation presumedly commenced in the Oligocene resulting in South Tasman Rise being left behind in its present position relative to Tasmania.

The Iselin Bank/Antarctica exhibits similar structural features as the South Tasman Rise, namely planated basement blocks and intervening sedimentary troughs, suggesting that the South Tasman Rise once lay adjacent to Iselin Bank and to the southwestern Tasmanian margin.

5.2.7 BATHYMETRY AROUND TASMANIA (Figure 44):
by G. Wissmann

A bathymetric chart of the ocean around Tasmania and the South Tasman Rise was constructed and continuously updated with the uncorrected bathymetric information of the SO-36 profiles.

Other information included four GEBCO charts and a preliminary bathymetric draft by D. JONGSMA based on these four charts, which also included the tracks of the Australian seismic surveys around Tasmania. These charts were the GEBCO ocean sounding plotting sheets 442 and 472 west of and 443 plus 473 east of Tasmania. They are presenting ocean depths along ships tracks in metres, corrected for the velocity of sound in sea water using Matthews tables.

As it became apparent that the GEBCO values were not sufficiently considered by JONGSMA, a redraft of his map became neccessary. From this new map several bathymetric provinces can be outlined which probably coincide with 8 different structural tectonic units.

1) The flat, low gradient western abyssal plain lies west of the 4 km contour of the Tasmanian and South Tasmanian continental rise and definitely belongs to the oceanic domain. A NW-SE trending trough near 42° S reaches 5000 m water depth.

2) Coast-parallel and high gradient contours shallower than 4 km are associated with the continental margin of Tasmania and may be expected to overlie continental crust. On the eastern margin of Tasmania the gradients are steeper than in the west, however, between 45.0° S and 42.5° S the 4 km contour encircles the East Tasman Rise and obscures the eastern end of the Tasmanian margin. Identations of the 4 km contour striking NE-SW like the coast line suggest that the East Tasman Rise came into existence after the Tasmanian margin had already been well established.

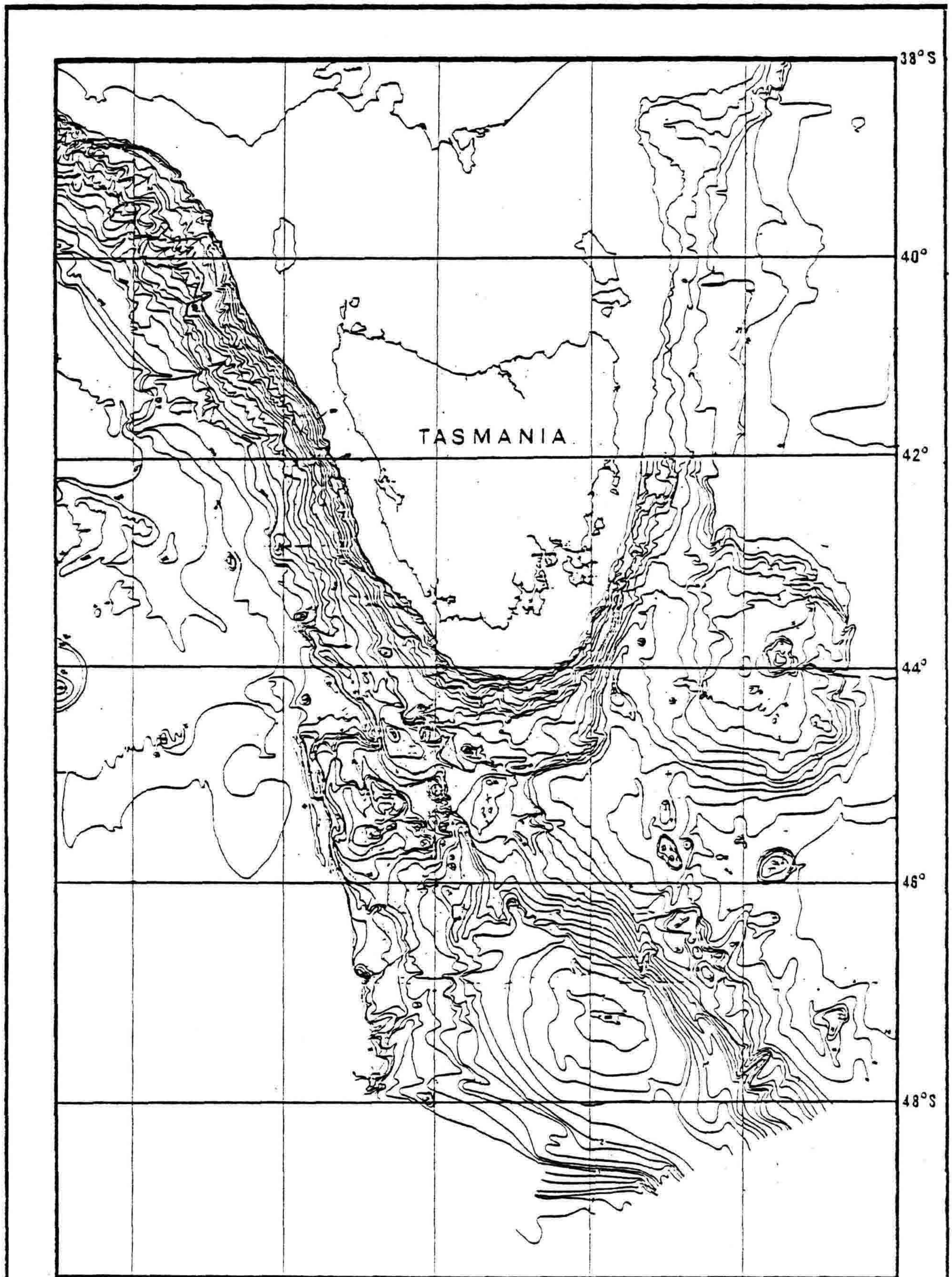


Figure 44: Bathymetry around Tasmania

3) The East Tasman Rise has a circular form with a radius of about 110 km. It rises up to 800 m waterdepth, an E-W offset of the 4 and 3 km contours at its eastern slope near 44° S suggests a (transform?) fracture zone.

4) The South Tasman Rise has a more ellipsoidal form trending NW-SE and also rises to 800 m. The area shallower than the 2 km contour seems to constitute the proper rise defined by rather smooth bathymetric contours.

5) The western margin of the South Tasman Rise between the 2 and the 4 km contour is more structured by E-W trending ridges and canyons and probably defines a different tectonic regime. The 4 km contour at the edge of the abyssal plain at this side constitutes a N-trending straight lineament with locally extreme gradients from the 3 to the 4 km contour between 44.5° S and and 48.0° S.

The lineament suggests a tectonic feature like a transcurrent or wrench fault. A sense of motion along the fault is not readily deduced. An eastward pointing triangle described by the 4 and 3 km contours at 44.5° S in the transition zone to the Tasmanian continental margin could be interpreted as having opened by splitting Tasmanian crust like a sphenochasm. Then the motion on the fault would be right-lateral, which, however, is opposite to the sense of the left-lateral Balleny Fracture Zone offsetting the oceanic South East Indian Ridge spreading center further south.

On the oceanic abyssal plain the fracture zone is outlined by a very narrow trough reaching 4.8 km waterdepth between 44.5° S and 46.0° S.

6) The eastern margin of the South Tasman Rise between the 2 and 4 km isobath is structured by some curious NE-pointing ridges at 48° S and 47° S and numerous ellipsoidal or oblong highs rising to 2 km waterdepth. The shape of the features suggests volcanic ridges and seamounts.

7) The same volcanic activity created seamounts rising to 2 km waterdepth over the eastern oceanic abysall plain which is outlined by the 4 km isobath between the East Tasmanian and the South Tasmanian Rise. The eastern

abysall plain forms a westward pointing equi-lateral triangle with the base along the South Tasman Rise.

8) The most distinctly structured bathymetric province is the transition zone between southern Tasmania and the South Tasman Rise which lies between the 2 km isobath of both features. Many small circular highs rising to 2 km waterdepth point to volcanic activity and seamounts. More elliptical and oblong highs like the 2 km isobath north-pointing spur at the north-western edge of the South Tasman Rise and the northwest trending ridge between the 3 km isobaths at 44° S, 145° E could constitute blocks of continental crust which have been sheared off and rotated during a relative motion between Tasmania and the South Tasman Rise.

5.3. REPORT OF THE GEOLOGICAL WORKING GROUP (SO36-C)

Kudrass, H.R., Exon, N.E., Wiedicke, M., Belford, D.J., Feary, D.A.

During the SONNE cruise SO36-C the geological group had two main objectives:

- to collect pre-Quaternary rocks to determine the lithology and age of seismic sequences;
  and
- to collect cores of unconsolidated sediment for the geochemical study of contained hydrocarbon gases (see report of the geochemical group, chapter 5.4, this report).

Position, water depth, and core length are given in Table 1. Table 2 contains brief descriptions of rock and unconsolidated sediment samples. Simplified logs of six typical cores are shown in Figures 47 - 52. The relationships of the samples to each other and to nearby DSDP holes and the Esso Clam No. 1 well are shown in Fig. 53.

SAMPLING METHODS AND ONBOARD ANALYSES

Holocene and Pleistocene sediments were recovered by gravity and piston coring using a 1,000 kg weight and 5 - 10 m long core barrels with 90 mm diameter liners. In addition to unconsolidated sediment, some piston cores also contained consolidated sediments and layers of manganese nodules. At some stations fragments of basement were recovered by piston coring, but usually at the cost of heavily dented core cutters.

A piston corer was used for most soft sediment sampling, exept for a short period of heavy weather when a gravity corer was used for safety reasons. Core liners were immediately opened onboard, and the cores described and sampled. Smear slide examination and washing of sandy samples helped to define lithology and genesis. One of us (Denis Belford) analysed planktonic and benthonic foraminiferal assemblages to infer biostratigraphic ages. In addition, the location of sample station on seismic profiles were used to obtain the overall stratigraphic sequence of samples (compare chapters 5.2.2, 5.2.4, 5.2.5). This showed, for example, that the undated "peaty" sand recovered in cores 22 and 30 lies stratigraphically between a late Oligocene - Early Miocene marl and a Middle Eocene lithified shelf limestone.

Outcrops of basement and highly consolidated sediments were sampled by dredging. We used a new heavy chain-bag dredge (opening 1.3 x 0,7 m with a total weight of 370 kg) recently designed by BGR. This dredge has exchangeable teeth made from extra hardened steel and a solid halter with movement restricted to 20 degrees either side of the horizontal position. If the dredge becomes entangled at the sea bottom, the restricted mobility of the halter will increase the breaking force of the ships's pull. The dredge lost on the upper continental slope of southern Tasmania became entangled in a submarine outcrop of karst limestone, which cut the wire cable approximately 80 m above the dredge.

Two small pipe dredges (50 cm long, 9 cm diameter), one with a coarse sieve at the end and the other one closed, were attached to the dredge chain bag to collect fine to gravelly particles. These small dredges proved very successful in areas where submarine weathering has resulted in the outcropping rocks becoming disintegrated to small pieces able to pass through the chain bag and its nylon net. Dredge recovery rates were highly variable, ranging from just one fragment to approximately one tonne of rock.

During a number of dredge hauls the depth of submergence of the dredge was recorded by a newly depth meter (Preussag), which produces a printout of pressure and temperature data at selected time intervals (set to 30 secs). This instrument was enclosed in a shockabsorbing housing fabricated onboard, and was fixed by shackles to the inside of the lower part of the chain bag. Pressure data were transformed to water depth by using a mean water density of 1.027 calculated from standard salinity and temperature profiles from the southern Pacific Ocean. The instrument was first used to monitor the lowering of the dredge in relation to ships's speed and the length of suspending cable. The results indicated that the depth of the dredge is almost equal to the cable length when the ship is stationary (Figure 45), but was 200 - 300 m shallower than cable length when the ship's speed is 1 - 1.5 knots. Dredge lowering was halted at 1500, 3000, and 3200 m cable length, on each occasion for 10 minutes. During these stops the dredge moved upwards between 75 and 30 m, without reaching equilibrium. This observation suggests that the dredge should be lowered to the sea bed without any halt, to avoid uncontrolled upward and especially sideward movements.

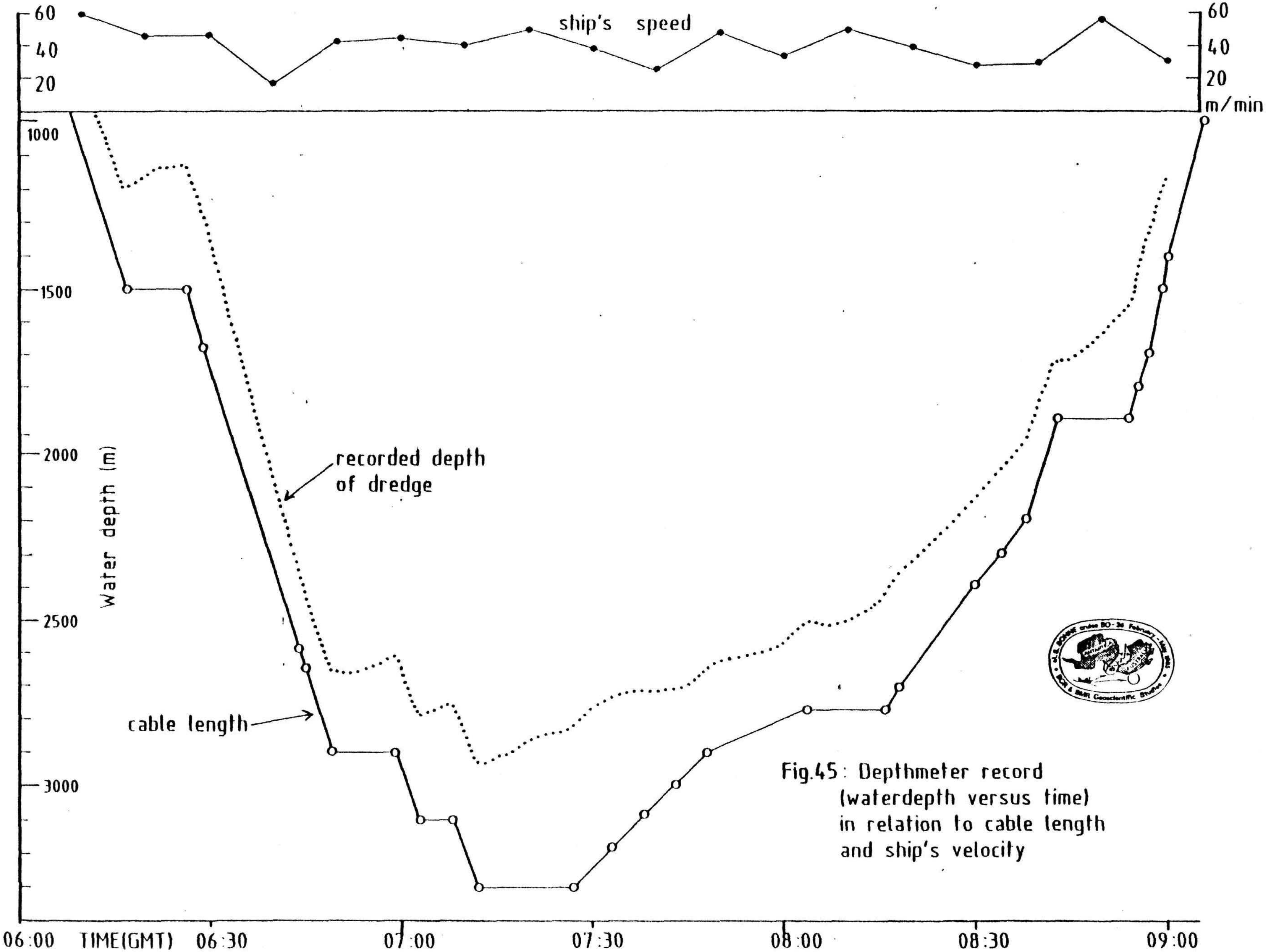


Fig.45: Depthmeter record (waterdepth versus time) in relation to cable length and ship's velocity

The second major function of the depth meter is to record the water depths at which the dredge collects rocks, as reflected by increased cable tension. On occasions when both a clear "pull" was recorded and the depth meter was attached to the dredge (i.e. when there was little risk of losing the dredge), it was possible to determine sample depth with great accuracy.

METAMORPHIC ROCKS

High grade metamorphic rocks were recovered from four sites (28KD, 29KD, 36KD, and 44KD), and indicate that a continental basement underlies both the western Tasmanian slope and the South Tasman Rise. Mica schists and garnet-mica schist are the predominant metamorphic rock type in each of these dredge hauls. In addition, dredge 28KD contained some lower grade phyllite and 44KD included granodiorite and pegmatite fragments. The metamorphic rocks recovered from sites on west-facing slopes at water depths between 3200 and 4000 m in both areas are thought to represent the westernmost outer continental margin.

VOLCANIC ROCKS

Samples of volcanic rocks were dredged at two localities. Fresh, dense, ophitic basalt was recovered from a water depth of 4200 m at the western margin of the Tasmanian slope (4KD), and a further basaltic rock was recovered in dredge 52KD from a conical feature on top of the eastern part of the South Tasman Rise. This sample consists of vesicular lapilli and reddish, palagonitised, vitric tuff, and is covered by a 4 - 5 cm thick manganese crust which excludes a Quaternary age of extrusion. By comparison with the adjacent DSDP holes (Figure 53), it is possible that both volcanic samples are of Eocene age.

PRE-TERTIARY SEDIMENTS

A number of sediment samples dredged at different sites are thought, because of their greater consolidation, to be older then Tertiary. A fine-grained sandstone (37KD), a fine-grained greywacke (49KL), and a quartzite (53KL) are presumed to be basement rocks, and a medium- to coarse-grained sandstone from dredge 4KD is likely to be rift basin fill.

PALEOGENE SEDIMENTS

Paleogene sediments are characterized by a substantial terrigenous component, and by a considerable variation in sediment type. Unlike the overlying Neogene sediments, samples from the Tasmanian slope and the South Tasman Rise exhibit significant differences.

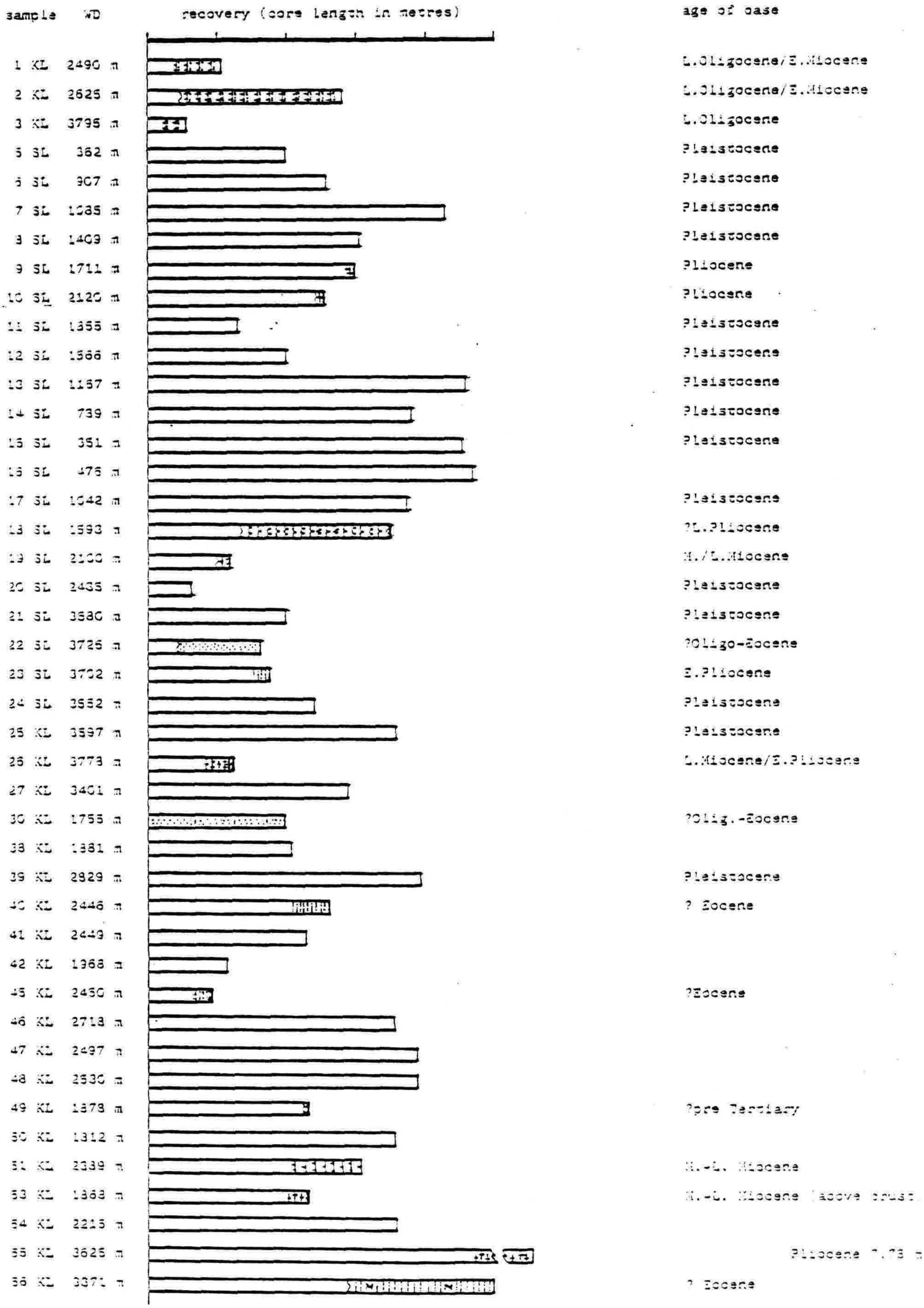
Moderately consolidated, highly porous, bryozoan limestones (31KD, 32KD, 33KD) from the upper southwest Tasmanian slope have a tentative age of Late Oligocene. Reworked Eocene foraminiferal species are present in the samples, which were deposited in an outer shelf to upper slope environment. A well cemented micritic, bryozoan limestone from the same area (32KD) may have a Middle Eocene age; it was deposited in a deep water environment. "Peaty", micaceous, silty sand (Figures 49) from the deeper parts of the Tasmanian slope (22SL, 30KL) contain small planktonic forams, radiolaria, gastropods, and bivalves. Although the planktonic forams indicate a middle to Late Miocene age, the distinct possibility that they represent later contamination has led to the conclusion that the "peaty" sands may well be contemporaneous with Eocene euxinic claystones noted in circum-Antarctic DSDP holes (ANDREWS, 1977).

Comparable sediments were not found on the South Tasman Rise. In this region, the Eocene is most probably represented by olive or grey/green mudstones (40KL, 43KD, 44KD, 45KL, 56KL), frequently zeolitic, which contain poorly preserved radiolaria and arenaceous forams (Figure 52). These mudstones usually contain glauconitic sand and are highly bioturbated, although there are also horizons which are partly silicified or are finely bedded. Upper parts of the Eocene are probably represented by white nanno/foram chalk (56KL, 45 KL).

Unconformities above Paleogene sediments are sometimes marked by manganese nodules or crusts which have formed during long periods of non-deposition.

NEOGENE SEDIMENTS

In contrast to the underlying Paleogene, Neogene horizons are characterized by relatively homogenous pelagic sediments which differ from overlying Quaternary sediments only by greater compaction and by the onset of lithification. Stiff nanno/foram and foram/nanno ooze, and their more consolidated chalky equivalents, were recovered at many sites (Table 2).



Tertiary Lithologies (see figures 47,49,51,52), Quaternary shown blank

Figure 46: Core recovery

CORE SO36-24SL
Water depth 3555m

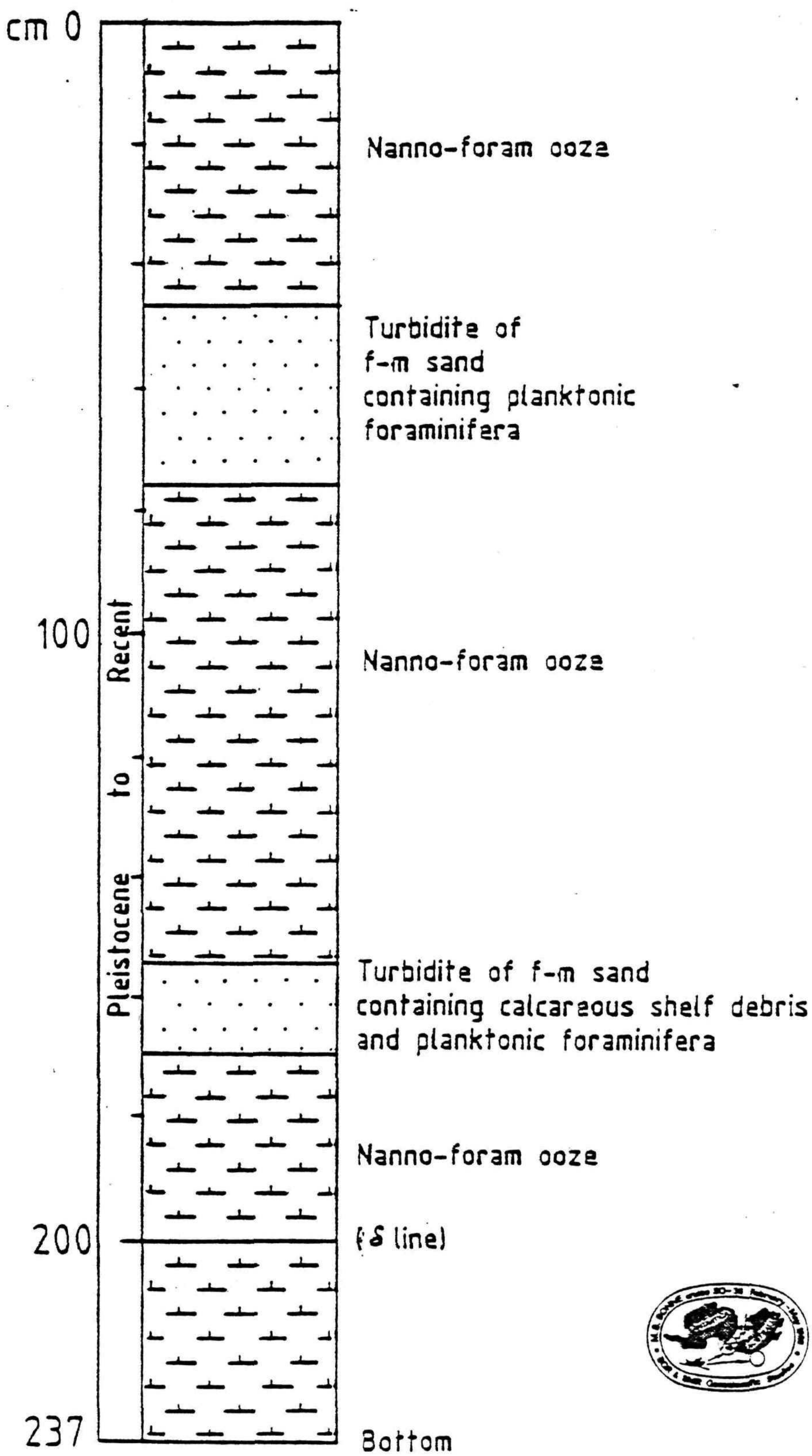


Figure 47: Log of core SO-36-24 SL

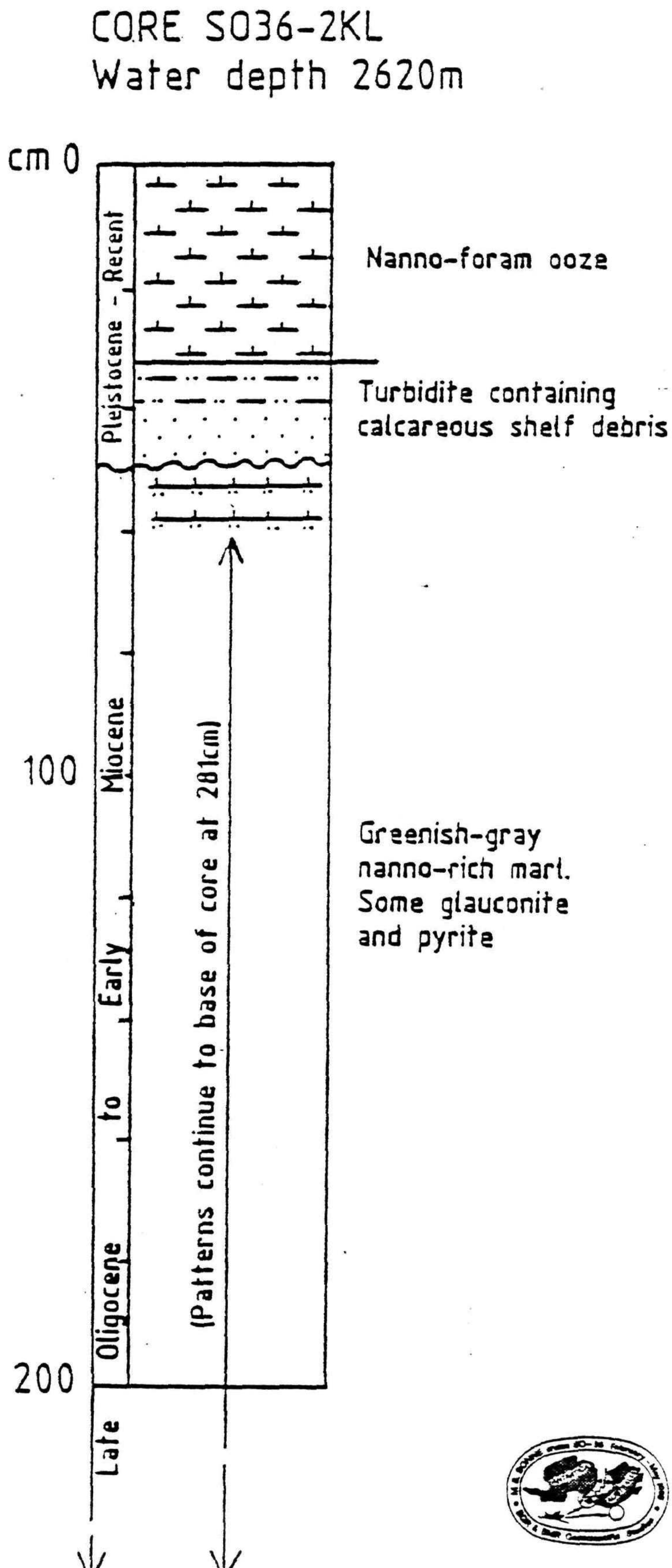


Figure 48: Log of core SO-36-2 KL

CORE SO36-22SL
Water depth 3710m

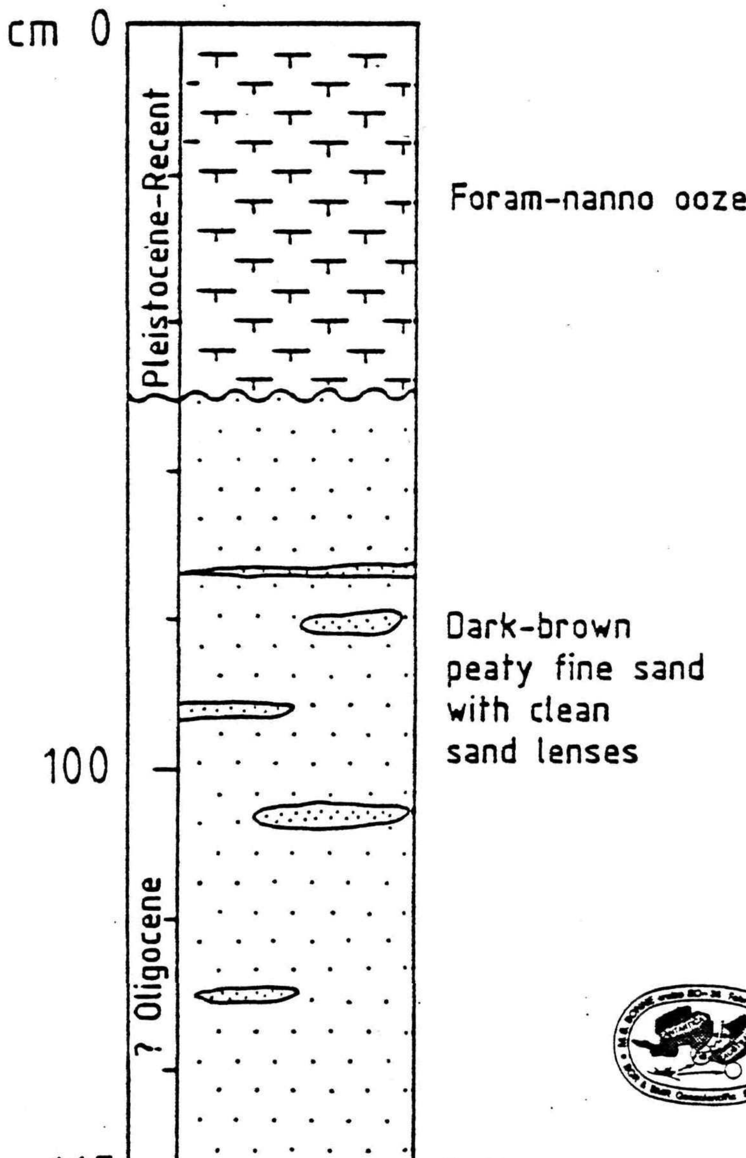


Figure 49: Log of core SO-36-22 SL

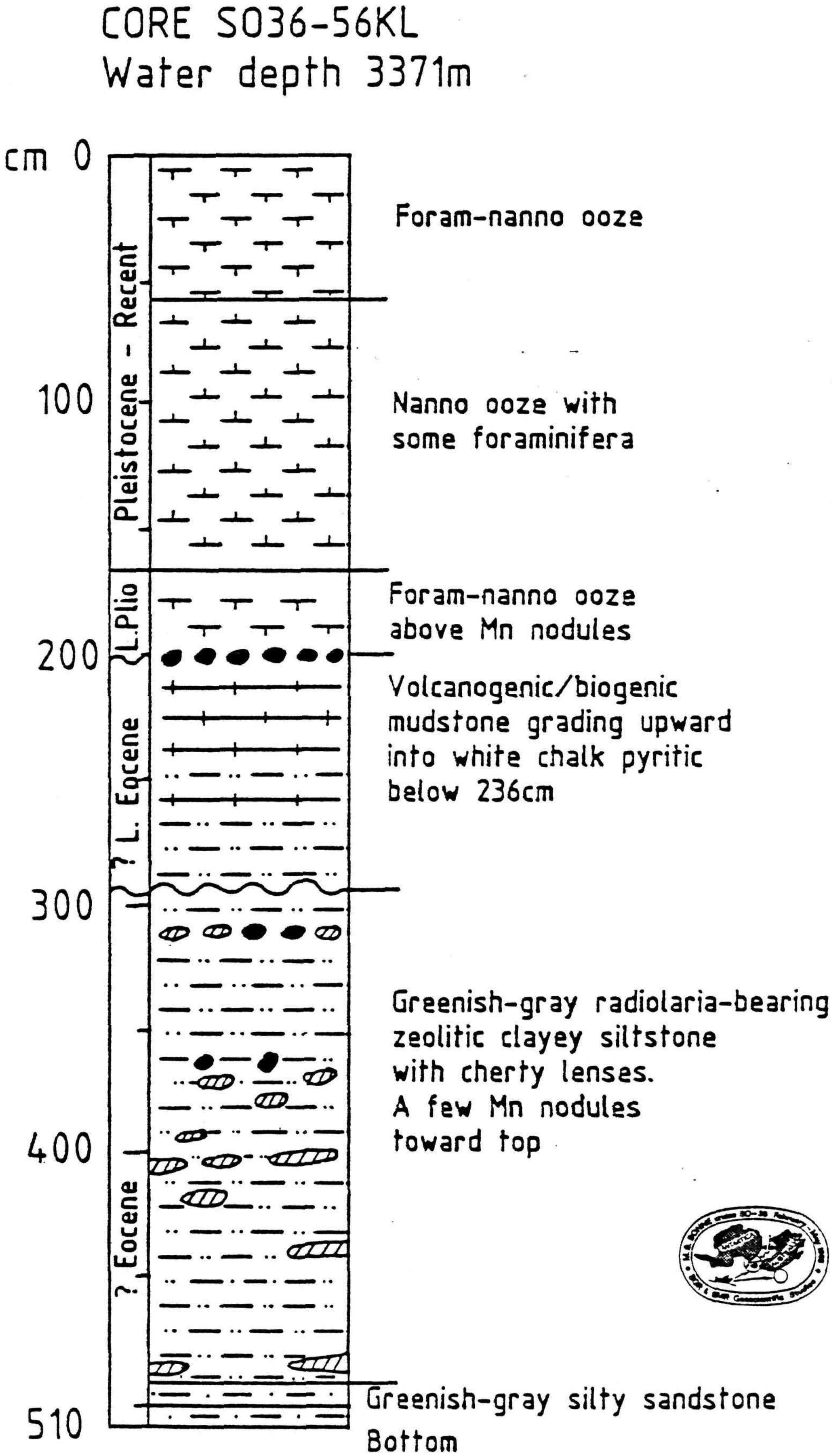


Figure 50: Log of core SO-36-56 KL

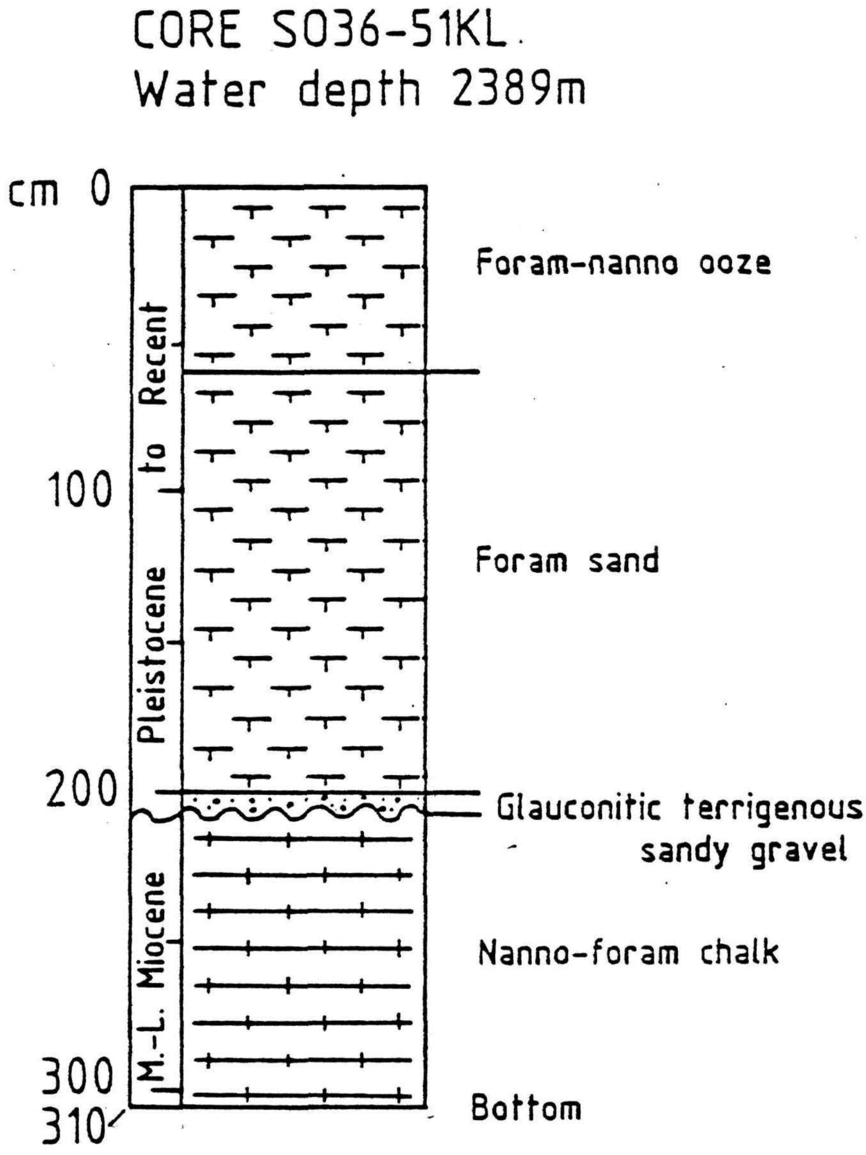


Figure 51: Log of core SO-36-51 KL

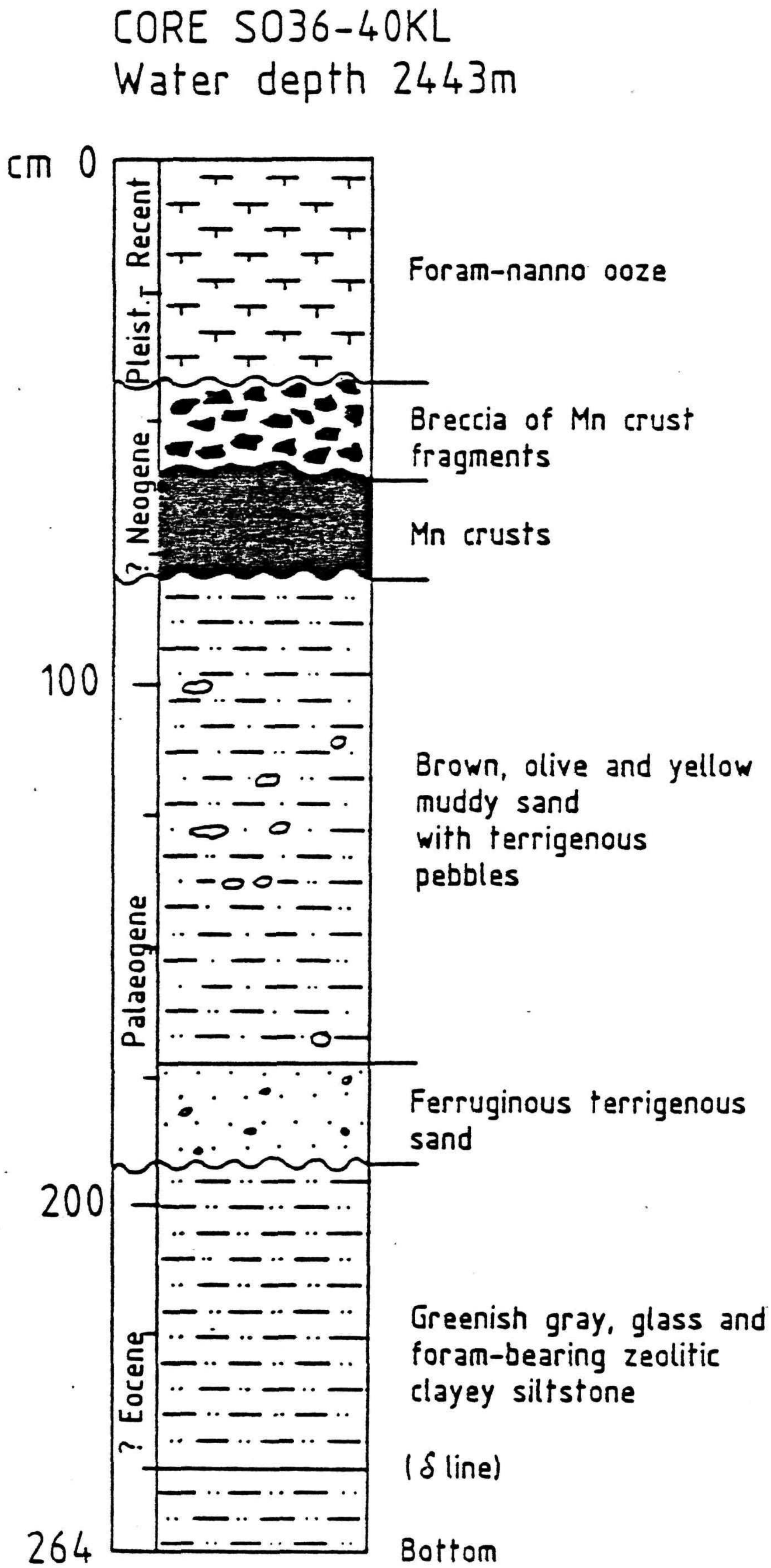


Figure 52: Log of core SO-36-40 KL

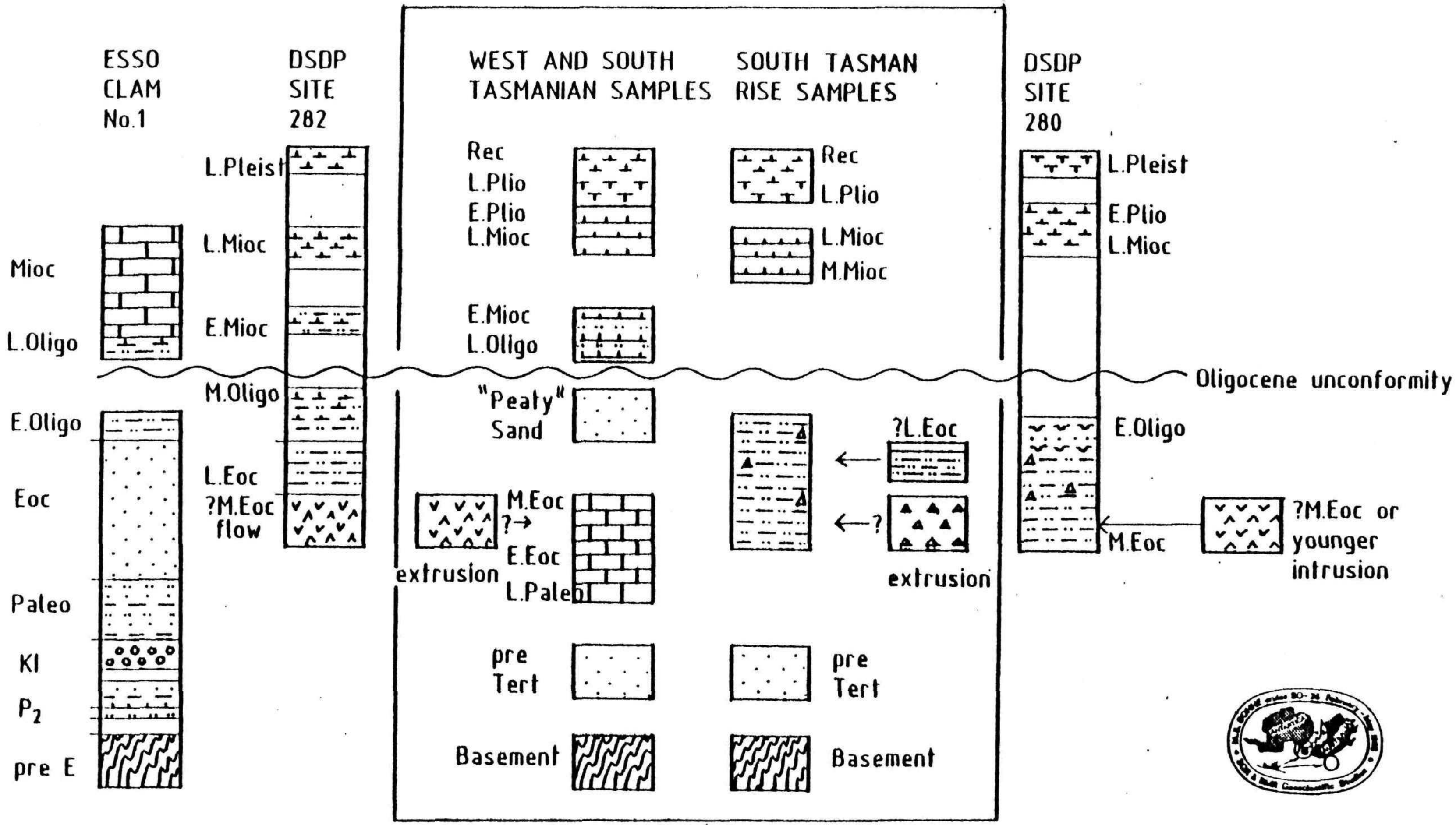


Fig.53: RELATIONSHIP OF SO36 SAMPLES TO NEARBY DSDP HOLES & ESSO CLAM NO.1

As was the case in the Paleogene, shelf material in the form of bryozoan-rich sand interbedded with pelagic chalk attests to the action of sediment gravity flows. Nanno-rich marls, which may extend down to the Late Oligocene, also reflect the influence of a nearby continental hinterland.

Although the transition from late Pliocene to early Pleistocene appears to be present in some cores (Figure 47), in many cases the top of the Neogene is eroded, sometimes down to the Middle Miocene. However this situation is certainly not typical for the whole area, as we usually chose coring sites where seismic records indicated high erosion rates.

PLEISTOCENE AND HOLOCENE SEDIMENTS

Pleistocene and Holocene foram/nanno ooze and foraminiferal sand were deposited throughout most of the area investigated. Only in submarine canyons, on the steep slopes of submarine mountains, and on the upper continental slope of southwest Tasmania is the Pleistocene - Holocene cover reduced or completely missing. A typical core is shown in Figure 47.

The proportion of planktonic forams varies widely relative to the silt-sized coccolith fraction, but this variation does not appear to correlate with Pleistocene glacial and interglacial periods. Terrigenous clay and silt are an important component of sediment on the Tasmanian slope, whereas winnowed foram sands lacking a terrigenous component were present on the South Tasman Rise. Pleistocene cores on the Tasmanian slope usually contain pyrite, and in some cases also include graded turbidites with shelf-derived bryozoan fronds, molluscs, and benthic forams. The Holocene core sections are usually less than 0,5 m thick, and have a higher concentration of planktonic forams and are light brown/grey coloured in contrast to the underlying olive grey Pleistocene sediments.

Ice-rafted material is very rare throughout the area. Only in two Pleistocene cores (51KL and 53KL) on the eastern side of the South Tasman Rise are there layers containing a highly diverse, sand-sized assemblage of garnet-mica schist, amphibolite, and quartzite which may represent input from icebergs.

CONCLUSIONS AND RELATIONSHIP OF SO36 SAMPLES TO DSDP HOLES

Neogene and Pleistocene carbonate sediments were deposited throughout the area investigated. While shallow water carbonate accumulated on the Tasmanian shelf (Esso Clam No. 1), more oceanic conditions are represented by the foram- and nannofossil-rich sediments recorded in DSDP holes 280, 281, and 282, and also in samples collected during this cruise. In most areas the oldest pelagic carbonates are of Late Oligocene age, representing the establishment of a new sedimentary regime following the final separation of Tasmania and the South Tasman Rise from Antarctica and the initiation of the circum-Antarctic current (KENNETT et al., 1975). These marked changes in the deep-sea sedimentation pattern are reflected by a regional unconformity, found throughout the southern ocean, which records the period of erosion affecting Earlier Oligocene and older sediments (compare also chapter 5.2.2). Manganese nodules and crusts developed on the sea floor during this period (DSDP hole 280; SO36 cores 40KL, see Figure 52, and 45KL).

A variety of predominantly terrigenous Paleogene sediments were found beneath the Oligocene unconformity. The youngest Paleogene sediments recovered, according to the seismic stratigraphy (chapter 5.2.2) are dark brown, organic carbon-rich, "peaty", micaceous silts and fine sands confined to the Tasmanian region (SO36 cores 22SL and 30KL). These sediments appear lithologically comparable either with the dark brown, organic-bearing, nannofossil silty clay or clayey silt of Late Oligocene age in DSDP hole 282, or with the mid-Eocene siltstone with an organic carbon content up to 2,2 % in DSDP hole 280. The sparse faunas in the DSDP and SO36 samples indicates a restricted marine environment, interpreted as euxinic by Andrews (1977). However the usually high degree of bioturbation in both the DSDP and SO36 samples argues against euxinic conditions. The sparse microfauna suggests low marine productivity, and indicates that there was little marine contributation to the high organic carbon content in the sediment. The organic material is therefore assumed to be of detrital origin, probably eroded from peaty coastal lowlands.

The "peaty" sand is inferred to be part of an otherwise reasonably uniform mid-Eocene to mid-Oligocene sedimentary unit occurring in DSDP holes, and reaching a maximum thickness of 480 m in DSDP hole 280. This unit consists of light olive to greenish-grey terrigenous siltstone which also contains glauconite, pyrite, and cherty layers. Microfossils (arenaceous forams, radiolaria, and sponge spicules) are poorly preserved except in the coccolith-rich Oligocene section of DSDP hole 280 and the diatom-rich Oligocene sections of DSDP hole 282. We recovered several samples of an identical facies from the South Tasman Rise, and therefore infer that these are of Eocene to Oligocene age (Figure 53). These sediments were presumably deposited in the marine basins formed during the late stages of rifting of Tasmanian crustal blocks, and are most probably part of the thinly layered seismic facies.

DSDP holes 280 and 282 bottomed in Middle Eocene basalt. Zeolites in the ?Eocene olive siltstone may have been derived from this volcanic activity. Ophitic basalt was recovered in dredge SO36-4KD from the magnetic quiet zone off west Tasmania, approximately 120 km NNW of DSDP hole 282. This basalt has a fresh appearance, and may be suitable for K/Ar dating. Additional basaltic rocks were recovered from a conical feature on the eastern part of the South Tasman Rise.

Middle Eocene and Late Paleocene shallow water bryozoan limestones from the southwest corner of the Tasmanian shelf indicate that, in contrast to other parts of the area studied, this part of the Tasmanian crustal block had not subsided deeply during the Eocene.

The high grade metamorphic rocks (paragneiss, garnet-mica schist) and the plutonic rocks (granodiorite, pegmatite) recovered from four dredge sites further contribute to our knowledge of the nature of the continental basement of the western Tasmanian slope and the South Tasman Rise.

REFERENCES

ANDREWS, P.B., 1977: Depositional facies and the early phase of ocean basin evolution in the circum-Antarctic region. Mar. Geol., 25: 1-13

KENNETT, J.P.; HOUTZ, R.E.; ANDREWS, P.B.; EDWARDS, A.R.; GOSTIN, V.A.; HAJOS, M.; HAMPTON, M.A.; JENKINS, D.G.; MARGOLIS, S.V.; OVENSHINE, A.T.; PERCH-NIELSEN, K., 1975: Cenozoic paleoceanography in the southwest Pacific Ocean, Antarctic glaciation, and the development of the circum-Antarctic current. pp. 1155-1169 In KENNETT, J.P., HOUTZ, R.E., et al., Initial Reports of the Deep Sea Drilling Project, Volume 29. Washington (U.S. Government Printing Office).

TABLE 1

SO-36C

List of geological and geochemical stations with co-ordinates and water depths. Corer stations additionally contain the core recovery; dredge stations give the times of the sampling interval of each dredge haul. KL = piston corer; SL = gravity corer; KD = dredge; GT = heat flow;

Offshore West Tasmania and South Tasman Rise

station number		date	time	latitude	longitude	depth	core	recove
SO-36-01		14.04.85	18.43	41 3.789'S	143 25.120'E	2499 m	KL,	1.05
SO-36-02		14.04.85	22.15	41 6.246'S	143 21.872'E	2625 m	KL,	2.80
SO-36-03		15.04.85	04.13	41 12.505'S	142 53.599'E	3795 m	KL,	0.55
SO-36-04	from	15.04.85	15.52	41 20.200'S	142 20.055'E	4216 m	KD	
	to	15.04.85	16.06	41 20.550'S	142 20.135'E	4084 m		
SO-36-05		16.04.85	07.53	42 10.798'S	144 44.552'E	362 m	SL,	2.00
SO-36-06		16.04.85	09.27	42 14.449'S	144 43.648'E	907 m	SL,	2.60
SO-36-07		16.04.85	11.23	42 18.520'S	144 40.243'E	1085 m	SL,	4.30
SO-36-08		16.04.85	13.19	42 22.065'S	144 37.289'E	1409 m	SL,GT,	3.05
SO-36-09		16.04.85	17.43	42 25.909'S	144 34.004'E	1711 m	SL,	3.00
SO-36-10		16.04.85	20.22	42 25.319'S	144 28.754'E	2120 m	SL,	2.60
SO-36-11		16.04.85	22.41	42 21.814'S	144 31.452'E	1855 m	SL,	1.30
SO-36-12		17.04.85	00.46	42 17.991'S	144 33.945'E	1566 m	SL,	2.00
SO-36-13		17.04.85	02.50	42 14.320'S	144 37.357'E	1167 m	SL,	4.60
SO-36-14		17.04.85	04.24	42 10.562'S	144 40.942'E	789 m	SL,	3.80
SO-36-15		17.04.85	06.00	42 14.068'S	144 47.204'E	351 m	SL,	4.50
SO-36-16		17.04.85	07.53	42 5.111'S	144 41.815'E	476 m	SL,	4.70
SO-36-17		17.04.85	09.41	42 3.094'S	144 35.116'E	1042 m	SL,	3.75
SO-36-18		17.04.85	12.25	42 8.741'S	144 32.272'E	1593 m	SL,	3.50
SO-36-19		17.04.85	15.11	42 11.156'S	144 28.290'E	2100 m	SL,	1.20
SO-36-20		17.04.85	18.20	42 19.630'S	144 24.374'E	2435 m	SL,	0.60
SO-36-21		18,04.85	11.37	43 36.751'S	144 22.985'E	3574 m	SL,	2.00
SO-36-22		18.04.85	14.12	43 36.866'S	144 25.124'E	3726 m	SL,	1.65
SO-36-23		18.04.85	17.05	43 38.345'S	144 30.699'E	3702 m	SL,	1.80
SO-36-24		18.04.85	19.40	43 38.761'S	144 35.474'E	3552 m	SL,	2.40
SO-36-25		18.04.85	23.24	43 39.277'S	144 34.992'E	3597 m	KL,	3.60
SO-36-26		19.04.85	04.15	43 37.495'S	144 29.336'E	3778 m	KL,	1.25
SO-36-27		19.04.85	09.18	43 40.137'S	144 40.433'E	3401 m	KL,	2.90
SO-36-28	from	19.04.85	16.18	43 46.621'S	145 37.853'E	1860 m	KD	
	to	19.04.85	16.30	43 46.345'S	145 37.540'E	1830 m		
SO-36-29	from	19.04.85	19.11	43 46.693'S	145 37.656'E	1864 m	KD	
	to	19.04.85	19.32	43 46.320'S	145 37.130'E	1800 m		
SO-36-30		19.04.85	23.21	43 47.094'S	145 42.016'E	1755 m	KL,	2.00
SO-36-31	from	20.04.85	03.06	43 49.060'S	145 56.275'E	530 m	KD	
	to	20.04.85	03.08	43 49.050'S	145 56.375'E	500 m		
SO-36-32	from	20.04.85	08.28	43 49.100'S	145 55.760'E	680 m	KD	
	to	20.04.85	08.33	43 49.035'S	145 55.870'E	650 m		
SO-36-33	from	20.04.85	10.16	43 48.690'S	145 56.505'E	510 m	KD	
	to	20.04.85	10.22	43 48.700'S	145 56.670'E	460 m		
SO-36-34	from	20.04.85	15.46	43 59.395'S	146 3.825'E	735 m	KD	
	to	20.04.85	15.52	43 59.300'S	146 3.850'E	710 m		
SO-36-35	from	20.04.85	21.16	44 26.234'S	145 50.238'E	2495 m	KD	
	to	20.04.85	22.32	44 25.223'S	145 51.561'E	2009 m		
SO-36-36	from	21.04.85	02.08	44 34.970'S	145 44.610'E	3250 m	KD	
	to	21.04.85	02.16	44 34.815'S	145 44.635'E	3230 m		
SO-36-37	from	21.04.85	21.28	44 20.755'S	144 54.000'E	4050 m	KD	
	to	21.04.85	21.39	44 20.620'S	144 54.195'E	3890 m		

Continuation of Table 1

station number		date	time	latitude	longitude	depth	core	recover
SO-36-38		22.04.85	13.33	45 12.286'S	145 22.870'E	1886 m	KL,	2.10
SO-36-39		22.04.85	19.19	45 48.208'S	145 30.142'E	2829 m	KL,	2.90
SO-36-40		22.04.85	23.25	45 58.556'S	145 43.672'E	2446 m	KL,	2.65
SO-36-41		23.04.85	02.36	46 5.431'S	145 51.786'E	2449 m	KL,	2.30
SO-36-42		23.04.85	07.07	46 22.338'S	146 13.308'E	1968 m	KL,	1.15
SO-36-43	from	23.04.85	15.36	46 54.253'S	145 2.837'E	3520 m	KD	
	to	23.04.85	17.13	46 53.861'S	145 5.618'E	3086 m		
SO-36-44	from	23.04.85	23.44	47 24.128'S	145 10.059'E	3968 m	KD	
	to	24.04.85	23.55	47 24.186'S	145 10.575'E	3670 m		
SO-36-45		24.04.85	07.13	47 4.005'S	146 12.867'E	2484 m	KL	0.90
SO-36-46		24.04.85	11.47	46 56.488'S	145 51.322'E	2718 m	KL,GT,	3.60
SO-36-47		24.04.85	16.51	46 52.161'S	145 59.571'E	2497 m	KL,	3.90
SO-36-48		24.04.85	20.00	46 45.763'S	146 10.161'E	2540 m	KL,	3.90
SO-36-49		25.04.85	01.33	46 28.766'S	146 35.375'E	1878 m	KL,	2.30
SO-36-50		25.04.85	03.58	46 30.843'S	146 32.227'E	1812 m	KL,	3.60
SO-36-51		25.04.85	09.04	46 17.661'S	146 52.059'E	2398 m	KL,	3.10
SO-36-52	from	25.04.85	11.55	46 12.765'S	147 0.365'E	1810 m	KD	
	to	25.04.85	12.03	46 12.675'S	147 0.610'E	1600 m		
SO-36-53		25.04.85	17.42	46 26.355'S	147 27.078'E	1868 m	KL,	2.35
SO-36-54		25.04.85	21.12	46 22.836'S	147 33.792'E	2215 m	KL,	3.60
SO-36-55		26.04.85	04.49	45 36.890'S	147 36.514'E	3625 m	KL,GT,	7.78
SO-36-56		26.04.85	11.49	45 31.904'S	147 27.794'E	3371 m	KL,	4.98
Dampier and Lord-Howe-Rise								
SO-36-57	from	1.05.85	04.03	31 51.810'S	157 22.690'E	2530 m	KD	
	to	1.05.85	04.10	31 56.670'S	157 22.780'E	2370 m		
SO-36-58		2.05.85	21.47	30 55.300'S	160 56.396'E	1422 m	SL	2.68
SO-36-59		3.05.85	00.56	30 48.774'S	161 5.244'E	1435 m	SL	1.60
SO-36-60		3.05.85	04.56	30 39.803'S	161 19.656'E	1455 m	SL	3.00
SO-36-61		3.05.85	07.47	30 33.017'S	161 26.294'E	1343 m	SL	3.26
SO-36-62		4.05.85	08.11	28 35.815'S	163 5.422'E	1557 m	KL	1.05
SO-36-63	from	4.05.85	10.53	28 34.420'S	163 0.230'E	1740 m	KD	
	to	4.05.85	11.02	28 34.300'S	163 0.425'E	1682 m		
SO-36-64		5.05.85	10.40	26 13.159'S	166 1.021'E	3616 m	GT	

TABLE 2: SONNE CRUISE SO-36 - SAMPLE DESCRIPTIONS

NOTE: In our descriptions we have tried to be consistent with the classification used in DSDP Leg 29. Most Pliocene and younger sediments are essentially mixtures of planktonic foraminifera, nannofossils, and terrigenous mud. Unconsolidated sediments, with increasing foram content, are nanno ooze, nanno/foram ooze, foram/nanno ooze, foram ooze, and foram sand. Consolidated nanno-rich sediments are chalks. In grain size terms planktonic forams are fine to medium sand, and nannofossils are muds; thus a foram/nanno ooze is a muddy sand. Terrigenous mud is present, often in appreciable quantities, off western and southern Tasmania, but is essentially absent on the South Tasman Rise.

WEST AND SOUTH TASMANIAN SLOPE

No.	TYPE	WD(m)	
1	KL	2490	0.94m greenish/grey nanno-rich sandy marl with some forams (L. Olig- E. Mioc.) o'lain by 0.1m light grey nanno/foram ooze (Holoc.).
2	KL	2620	2.3m greenish/grey nanno-rich marl (L. Olig. - E. Mioc.) o'lain by 0.2m calcareous silt-sand turbidite, o'lain by 0.35m light grey nanno/foram ooze (Pleist.- Holoc.).
3	KL	3776	0.45m greenish/grey nanno-rich marl (L. Olig.-E. Mioc.) o'lain by 0.1m pale brown nanno ooze (prob. Holoc.).
4	KD	4216 -4087	Mn-coated finely crystalline volcanics (largely basalt); Mn-coated yellow/brown med-crs sandstone; ooze.
5	SL	350	1.52m olive-grey sandy mud with forams, shelf carbonate debris, and nannofossils (Pleist.), o'lain by 0.48m pale olive foram sand (Holoc.).
6	SL	907	2.45m olive grey nanno/foram ooze (H2S odour) (Pleist.) o'lain by 0.15m foram/nanno ooze (Holoc.).
7	SL	1078	4.16m light olive grey nanno/foram ooze (H2S odour) (Pleist.), o'lain by 0.14m foram/nanno ooze (Holoc.).
8	SL	1400	3.0m light olive grey nanno ooze with some foram-rich layers (Pleist.), o'lain by 0.05m pale brown foram/nanno ooze (Holoc.).
9	SL	1710	Trace white, stiff, nanno/foram ooze (Plioc.), o'lain by 2.94m variably sandy light olive grey nanno/foram ooze (Pleist.), o'lain by 0.06m light grey/brown foram/nanno ooze (Holoc.).
10	SL	2111	0.1m white, stiff, nanno/foram ooze (Plioc.), o'lain by 2.41m olive-grey nanno/foram ooze (Pleist.), o'lain by 0.06m pale yellow foram/nanno ooze (Holoc.).
11	SL	1851	1.22m light olive grey nanno/foram ooze (Pleist.), o'lain by 0.06m light grey foram/nanno ooze (Holoc.).

12	SL	1562	1.89m light olive grey nanno/foram ooze (with pyrite) (Pleist.), o'lain by 0.11m light grey foram/nanno ooze (Holoc.).
13	SL	1170	4.46m (light) olive grey nanno/foram ooze (Pleist.), o'lain by 0.14m pale brown foram sand (Holoc.).
14	SL	780	3.67m light olive grey nanno ooze (H2S odour; contains 48cm horizon of coarse shelly sand) (Pleist.), o'lain by 0.13m light grey mollusc-bearing foram/nanno ooze (Holoc.).
15	SL	340	4.19m grey-light olive grey calcareous mud containing abundant coarse bryozoan fronds (slight H2S) (Pleist.), o'lain by 0.33m foram sand (Holoc.).
16	SL	475	3.96m grey-light olive grey, highly variable, calcareous mud/sand with bryozoan fronds towards the top (Pleist.), o'lain by 0.04m pale olive foram/nanno ooze (Holoc.).
17	SL	1035	3.65m light grey to olive grey nanno/foram ooze (with burrows) (Pleist.), o'lain by 0.1m light grey foram sand (Holoc.).
18	SL	1589	2.15m white-light grey, bioturbated, soft foram-rich chalk (?L. Plioc.), o'lain by 1.19m bioturbated nanno/foram ooze (Pleist.), and by 0.16m of nanno/foram ooze (Holoc.).
19	SL	2110	0.23m white foram-bearing chalk (M-L. Mioc.), o'lain by 0.94m light olive grey nanno/foram ooze (?Pleist.), o'lain by 0.05m light grey foram sand (Holoc.).
20	SL	2430	0.33m bryozoan sand, o'lain by 0.22m light olive grey nanno/foram ooze (?Pleist); 0.06m pale brown nanno/foram ooze.
21	SL	3580	1.73m light grey nanno/foram ooze with thin dark grey-stained layers (Pleist.), o'lain by 0.07m white foram sand (Holoc.).
22	SL	3710	1.15m very dark grey-black, fine-grained 'peaty' sand with irregular patches containing abundant mica and rock fragments (?Oligo-Mioc.), o'lain by 0.5m beige/orangey grey foram/nanno ooze.
23	SL	3709	0.3m dark grey/green, consolidated foram-bearing mud (?E. Plioc.), o'lain by 0.83m light grey-light olive grey nanno/foram ooze (?Pleist.), o'lain by 0.57m light grey/green nanno/foram ooze (Holoc.).
24	SL	3555	2.27m light grey nanno/foram ooze containing dark grey-stained patches and grey, graded, sandy turbidites containing forams, molluscs, and bryozoans (Pleist.), o'lain by 0.1m light grey/green nanno/foram ooze (Holoc.).
25	KL	3590	3.5m light grey nanno/foram ooze containing yellow/green, graded, fossiliferous (foram/bryozoa/mollusc/echinoid) turbidites; basal layer is very disturbed (apparently original), (Pleist.), o'lain by 0.1m light grey/green nanno/foram ooze (Holoc.).

26	KL	3780	0.88m interbedded white chalk and light grey nanno/foram ooze, containing rare pebbles (sandstone/quartz/carbonate), and bryozoan-rich sandy turbidites (L. Mioc.-E. Plioc.), o'lain by 0.37m light olive grey nanno/foram ooze (Pleist.-Holoc.).
27	KL	3396	2.9m light grey nanno/foram ooze containing light olive grey, graded, fossiliferous (foram/bryozoa) sandy turbidites (Pleist.-Holoc.).
28	KD	1860 -1830	Few small fragments of mica schist and phyllite; pale brown ooze.
29	KD	1860 -1800	Small fragments of garnet-mica schist containing minor vein quartz, white thin-bedded calcarenite, rounded pebbles of quartz, chert, ?basalt, schist; ooze.
30	KL	1757	2.0m brown 'peaty', micaceous silty sand with a small faunal (small planktonic foram/mollusc/radiolaria) assemblage), o'lain by trace foram sand. (Planktonic forams indicate a M.-L. Mioc. age).
31	KD	530 -500	Greyish-brown sandy moderately consolidated fossiliferous (nanno/bryozoa/mollusc) mudstone (L. Oligocene); yellow/brown, well cemented, porous bioclastic limestone; med-crs fossiliferous sand.
32	KD	680 -650	Moderately consolidated (L. Oligocene) and lithified (M. Eoc.) bryozoan limestones (variably micritic/porous/ferruginous), phosphatic calcarenite/conglomerate; rounded pebbles of volcanics, granitoids, metasediments; one phosphatised whale otolith.
33	KD	510 -460	Moderately consolidated bryozoan limestone (L. Oligocene partially phosphatised, lithified, med. calcarenite.
34	KD	735 -710	Fragment of brown, lithified, ferruginous, micritic, bryozoan limestone containing gastr/bivalve/coral.
35	KD	2560 -2000	Single pebble of quartzose sandstone; Mn crust fragments and Mn/phosphatic conglomerates [poor recovery].
36	KD	3250 -3230	Greenish-grey, strongly weathered, mica schist/gneiss with quartz veins; phosphatised Mn-crust breccia; fragments of Mn/Fe crusts up to 15cm thick; grey foram ooze.
37	KD	4050 -3900	Fragments of green/grey micaceous, fine-grained, well-sorted quartzose sandstone; foram ooze.

SOUTH TASMAN RISE

38	KL	1881	Mn crust at base, o'lain by 1.7m of light grey/green medium foram sand containing large shell fragments (?L. Plioc./Pleist.), o'lain by 0.2m slightly mottled, light grey/green foram sand.
39	KL	2820	2.14m white-pale greenish yellow muddy foram/nanno ooze (Pleist.), o'lain by 0.8m light grey/green muddy foram/nanno ooze (Holoc.).

40	KL	2443	2.24m age indeterminate; made up of 0.72m uniform olive, glass-bearing, zeolitic mudstone, 0.81m variably coloured (dark yellowish brown/light olive brown/pale yellow) muddy sand containing rock fragments and pebbles (?paleosol), 0.41m Mn-crust fragments with interstitial phosphatic clay; o'lain by 0.4m pale grey foram/nanno ooze (Holoc.).
41	KL	2450	2.24m light olive grey foram/nanno ooze (Pleist.), o'lain by 0.06m light olive grey foram sand (Holoc.).
42	KL	1960	1.15m pale grey medium-grained foram/nanno ooze with nannos decreasing upward (?all Holoc.).
43	KD	3540 -3090	Fragments of greenish-grey, finely laminated, glass-bearing feldspathic siltstone; grey foram sand.
44	KD	3990 -3670	Diverse assemblage: dark grey schist/gneiss containing garnet; granodiorite and pegmatite; pale greenish grey glass-bearing siltstone containing agglutinated forams and radiolaria; fine-grained (?tectonic) breccia/conglomerate; Mn nodules.
45	KL	2440	0.85m pre-Holoc., consisting of 0.05m Mn crust, o'lain by 0.11m light olive brown, steeply-laminated siltstone, unconformably o'lain by 0.6m inhomogeneous olive/red/brown siltstone containing Mn nodules, micritic limestone fragments, sharks teeth, and variable amounts of clay, o'lain by 0.09m Mn nodules with interstitial light brown clay; o'lain by 0.04m pale grey foram sand containing small Mn nodules (Holoc.).
46	KL	2713	3.56m grey-pale grey nanno/foram ooze containing dark grey-stained ellipses (Pleist.-Holoc.).
47	KL	2490	3.88m white-light olive grey, muddy foram/nanno ooze with minor dark-stained layers (Pleist.-Holoc.).
48	KL	2530	2.75m interbedded grey-grey/green foram/nanno ooze and pale grey foram/nanno ooze (?Pleist.), o'lain by 1.15m pale olive grey foram/nanno ooze (?Holoc.).
49	KL	1872	Layer of Mn-encrusted grey/green, indurated, fine-grained quartzose greywacke pebbles, o'lain by 0.58m white foram sand, o'lain by 0.53m chalk (presum. all pre-Pleist.); o'lain by 1.19m light brownish grey foram sand (Holoc.).
50	KL	1805	3.6m light grey foram sand with dark grey-stained layers (Pleist.-Holoc.).
51	KL	2389	1.0m white chalk containing abundant forams (M-L. Mioc.), unconformably o'lain by 2.1m pale green-white foram sand with 10cm basal layer of light grey/green sandy gravel composed of angular-subangular clasts of quartz, quartzite, garnet-mica schist, ?amphibolite, and abundant glauconite (?Pleist.-Holoc.).
52	KD	1810 -1600	Blocks of glassy (partially palagonitised) basaltic breccia in a white/yellow (?zeolitic/phosphatic) matrix, with 3cm thick Mn crust.

53	KL	1865	Layer of Mn crust fragments and a single quartzite pebble at base, o'lain by 0.4m of white muddy foram/nanno ooze (M-L. Mioc.), o'lain by 1.95m white, clean foram sand containing thin sand/gravel layers of terrigenous material (c.f. 51) (?Pleist.-Holoc.).
54	KL	2211	3.58m light grey muddy foram/nanno ooze (?Pleist-Holoc.).
55	KL	3615	7.78m light greenish grey, varied nanno/foram-foram/nanno ooze with minor dark grey-stained layers and a single 3cm long pyrite tube (L. Plioc.-Holoc.).
56	KL	3371	2.1m greenish-grey, radiolaria-bearing, zeolitic mudstone with cherty lenses and volcanic debris and a few Mn nodules (?Eoc.), o'lain by 1.0m brown volcanogenic/biogenic mudstone grading up into white chalk (?Eoc.), o'lain by thin layer of Mn nodules, o'lain by 0.29m very pale brown foram/nanno ooze (L. Plioc.), o'lain by 1.65m very pale brown nanno ooze passing up into foram/nanno ooze (Pleist.-Holoc.).

5.4 SHIPBOARD REPORT OF GEOCHEMICAL SURFACE EXPLORATION OFF WESTERN TASMANIA AND ON THE SOUTH TASMAN RISE

by M.J. Whiticar, U. Berner, J. Poggenburg and H. Tostmann

5.4.1 INTRODUCTION AND OBJECTIVES

The primary objectives of the third leg of the R.V. SONNE cruise SO-36 to West Tasmania and South Tasman Rise were to provide geological ground evidence for the preceding geophysical seismic leg (SO-36-2), and in close conjunction with both the geophysical and geological activities, to assess the hydrocarbon potential of selected areas using geochemical reconnaissance surveys. This integrated approach had also been successfully applied previously during the R.V. SONNE cruise SO-27 to West Palawan, Philippines in 1983. The three offshore study areas during the SO-36-III cruise are named:

1) West Tasmania
2) Shear Zone
3) South Tasman Rise

Geochemical evidence of hydrocarbon generation can often be obtained from the character of gases sorbed onto the surface sediments. Using a combination of parameters such as 1) gas yield, 2) molecular composition, and 3) stable carbon isotope ratios (13/12C), gases of genetically different types can often be distinguished, such as:

1) Biogenic hydrocarbons
2) Thermogenic hydrocarbons
   a) Early mature
   b) Mature/associated
   c) Overmature

In addition to the recognition of the presence of thermogenic hydrocarbons originating in the subsurface, often the type and maturity of organic source unit (s) which generated these hydrocarbons can be ascertained from the geochemical data obtained. Detection of higher amounts of thermogenic hydrocarbons in the surface sediments points to the existance of either active source units or possible leaking structures (seeps or micro-seeps). This information is of vital importance to the development of petroleum exploration strategies, particularly in frontier regions such as West Tasmania and the South Tasman Rise.

5.4.2 PREVIOUS GEOCHEMICAL INVESTIGATIONS

Both offshore west Tasmania and the South Tasman Rise are frontier regions. The geophysical and geological frameworks are described in chapters 5.2.1 - 5.2.7 and 5.3 of this report.

SOUTH TASMAN RISE

Details of the carbon geochemistry for DSDP Leg 29 are reported by ERDMAN, SCHORNO and SCALAN, 1975 and are not repeated here. In DSDP site 280, the Pleistocene (unit 1) through mid-late Eocene (unit 5C to 320 m) sediments are coloured light brown and the organic contents in this sub-unit are higher (0,6 to 2,2 %). The sediments consist predominantly of semilithified silty claystones, with thin deformed clay beds, and were more rapidly deposited (4 cm/1000 years) in a deep ocean environment of restricted circulation. Based on this information, the Middle Eocene sediments represented potential source rocks for petroleum generation, although maturity is currently unknown. Basalt intrusions at the base of the well indicate higher heat regime, although the intruded sediments showed no signs of baking.

DSDP Site 281 consists of foraminiferal-nannofossil oozes grading downward into silts and clay silts, and ending in brecciated, then non-brecciated quartz-mica schists. No source beds are identified.

WEST TASMANIA

DSDP Site 282 shows a greater source rock potential than DSDP Site 280 or 281 to the south. The Pleistocene (unit 1) through mid Oligocene (unit 4) consisted of nannofossil oozes and silty clays. Brown staining was recorded in the organic-rich detrital silts and clays in unit 5 of the mid Oligocene (105 - 114 m depth). The best source potential is displayed by the organic carbon-bearing silty-clays of the late Eocene (unit 7). Organic staining was observed to be pervasive. HUNT, 1974* reported that these sediments contain about 590 ppb butane (C4) to heptane (C7) higher hydrocarbons (by weight), which is a strong indication of petroleum generation. As is the case for DSDP Site 280, the hole bottomed out in basalts, however in contrast to Site 280 they are extrusive pillow basalts. There are no signs of baking of the overlying sediment, suggesting that deposition took place after the basalts had cooled. Higher heat flow in this region could accelerate maturation of organic matter in support of the early generation of hydrocarbons.

In the proximity of the West Tasmanian study region, two exploratory wildcat wells have been drilled (see chapter 5.1.4.1, this report)

ESSO/HEMATITE <u>CLAM 1</u>

In the first wildcat well, Clam 1, which penetrated Lower Paleozoic siltstone and bottomed in Pre-Cambrian metamorphic phyllite, no significant hydrocarbon shows were encountered.

AMOCO <u>CAPE SORELL No. 1</u>

Further south, off Cape Sorell, Tasmania, AMOCO drilled the second wildcat well, Cape Sorell No. 1, in exploration block T-12-P. Traces of oil with medium pale yellow fluorescence were reported in the Early Paleocene/Late Cretaceous claystones from 10,090 to 11,130 ft. (3075 to 3392 m). Within this interval, a slight trace of free oil with golden yellow fluorescence was observed from 10,130 to 10,290 ft. (3088 to 3136 m). Good traces of residual oil were reported within intense transparent yellow fluorescence from 11,130 to 11,286 ft. (3392 to 3440 m), particularly in the argillaceous lithologies. Although no significant oil zones were penetrated, there is good evidence of petroleum source rock activity in this well.

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*Complete reporting of the hydrocarbon studies is by J.M. HUNT, DSDP vol 31, Appendix II.

Gas shows (Methane) from the mud logger were reported in the Miocene/Oligocene reefal, argillaceous, fossiliferous limestone between 1035 and 1985 ft. (315 to 605 m). Blender gas analysis from 10,515 to 11,325 ft. (3205 to 3452 m) revealed methane through butane hydrocarbons (C1 to C4). The quantities were considered insignificant, but no information on amounts or relative composition were given.
The average geothermal gradient in Cape Sorell No. 1 was calculated to be 16.0 F/1000 ft. (2.92° C/100 m).
Thus additional geochemical information from the investigation area is currently limited.

5.4.3 SAMPLING AND METHODS

The geochemical sampling around Tasmania is divided into 3 regions (Figure 54, Table 3). Two major structural/basinal types identified during the seismic operations in the Tasmanian area were selected for the application of surface geochemistry:

1) Rifted basins of subsided West Tasmanian continental block

2) propagating rift basins on the South Tasman Rise with locally basaltic intrusions

3) The third area, the Shear Zone, is a series of stratigraphic targets at the south Tasman continental margin which has been subjected to faulting and shearing.

The first region, West Tasmania is located in the proximity of the two exploration wells CLAM 1 and CAPE SORELL 1, which are on the continental shelf of West Tasmania. The first four samples, SO-36-1 to SO-36-4, are situated on seismic line SO-36-44, off CLAM 1, north of the main West Tasman study area (seismic lines SO-36-46, 47) but are structurally equivalent to the latter and thus incorporated in the first study area. These four samples provide information on the lateral extension of hydrocarbons. The DSDP Site 282 is further offshore and west of the main geochemical study area (Figure 54).

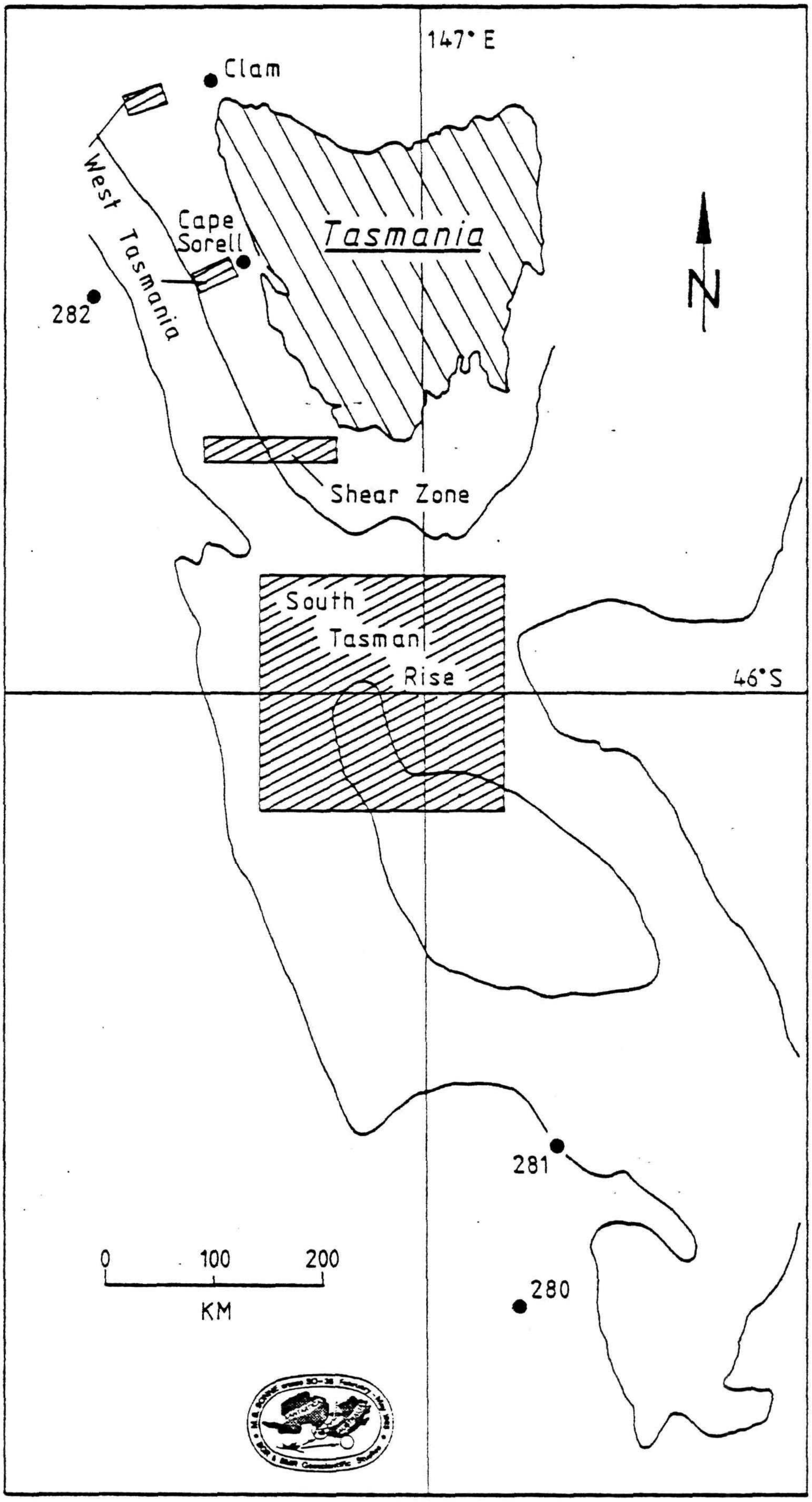


Figure 54: Location map of study areas and previous drill sites

The South Tasman Rise geochemical study area was distant from the DSDP Sites 280 and 281 (Figure 54).

TABLE 3 SO-36-III GEOCHEMICAL SAMPLING REGIONS

REGION NAME	STATION NR. START/END	NUMBER OF CORES/SAMPLES	SEISMIC LINE CONTROL
1) West Tasmania	SO-36-1/ SO-36-20	19 / 37	SO-36-B44, B45, B46, B47
2) Shear Zone	SO-36-21/ SO-36-37	8 / 18	SO-36-B48
3) South Tasman Rise	SO-36-38/ SO-36-56	14 / 17	SO-36-B50, B58, B59, B60, B61
		41 / 72	

Samples were taken with 10 cm O.D. piston and gravity corers of 5 or 10 metres length, the selection of which was determined by expected sediment type and in some cases, by weather. The temperature at the bottom of the core was taken directly after the removal of the plastic core liners. The latter were sectioned into metre intervals and then longitudinally halved. Depending on core recovery, two to four 10 cm intervals were sampled for geochemistry, generally in the deepest 50 cm and then spaced upwards to shallower core depths. Whenever possible the samples were collected in sediment sections with reducing (anoxic) conditions. This was determined by "punch-in" Eh electrode measurements immediately upon opening of the core liners. Simultaneously, pH measurements were taken with the electrode "punch-in" method. Sediment samples for gas determinations were quickly removed in sealed metal cans and kept cold until analysis (usually within 1/2 hour time lag).

Sediments are degassed (ca. 200 g wet weight) using a vacuum/acid apparatus developed in the BGR, Hannover. A 1 ml aliquot of the extracted gas is subsequently injected into a FID Gas Chromatograph which partitions and quantifies the hydrocarbons methane through n-pentane (C1 - C5, see table 4). The concentration of each hydrocarbon component is reported as the weight of gas /10^9 weight of sediment (ppb by wt.). The remainder of the gas after extraction is stored in glass gas sample bulbs, and returned after the cruise to BGR, Hannover for detailed gas chromatography and stable carbon isotope analysis.
Results are calculated using a HP 85 computer, then plotted using the shipboard VAX/V3.5 computer with Fortran V3.2 (CALCOMP).

TABLE 4 HYDROCARBON COMPONENT ABBREVIATIONS

NAME	FORMULA	ABBREVIATION
methane	CH4	C1
ethene	C2H5	C2:
ethane	C2H6	C2
propene	C3H9	C3:
propane	C3H10	C3
iso-butane	C4H12	i-C4
n-butane	C4H12	n-C4
iso-pentane	C5H14	i-C5
n-pentane	C5H12	n-C5

5.4.4 INITIAL SHIPBOARD RESULTS

A total of 72 sediment samples from 41 cores from the 3 Tasmanian regions were analysed geochemically (see footnote). The yields of the methane through n-pentane (C1 to n-C5) are listed chronologically in Appendix I. Correspondingly, the % of each component relative to the total hydrocarbons (vol % hydrocarbons) is listed chronologically in Appendix II, and the various molecular ratios are listed in Appendix III.

Shipboard analysis of the sediment gases immediately after sampling enabled the sampling programme to be modified according to the results obtained. This permits an effective utilization of a restricted number of samples stations that can be occupied due to time considerations.

WEST TASMANIA

The 37 samples from 19 cores in the first study area (Figure 62) exhibited a wide range in hydrocarbon yields (Table 5). The total C1-C5 yield, for example, has a mean of 317.9 ppb with a maximum of 1363.3 ppb (SO-36-1-2) and a minimum of 30.1 ppb (SO-36-10-3). Methane yields vary between a maximum of 585.6 ppb (SO-36-1-2) and a minimum of 29.3 ppb (SO-15-1). It is the dominant hydrocarbon present (mean 73,8 %, Table 5), constituting a maximum of 92,2 % (SO-36-10-3) and a minimum of 63,8 % (SO-36-8-1). Methane through propane is present in every sample, and the butanes (mean 2.9 ppb) and pentanes (mean 4.6 ppb) are also represented in most of the samples, albeit in varying amounts as listed in Table 5 and Appendix I.

FOOTNOTE: The piston cores from stations SO-36-42 and SO-36-45 were too short and disturbed for reliable geochemical sampling and was not analysed.

TABLE 5 STATISTICAL PARAMETERS
WEST TASMANIA REGION

Parameter	Mean	Std.Dev.	Var.	Max.	Min.	N
Total YHC	317.8900	322.2700	103858.5800	1363.4000	34.6000	36
YCH4	162.3750	162.1845	26303.8027	585.6000	29.3000	36
YC2H6	50.0056	47.3181	2239.0012	189.3000	4.4000	36
YC3H8	29.2889	32.3041	1043.5553	116.7000	0.1000	36
YC4H10	27.6943	31.0251	962.5565	120.4000	3.5000	35
YC5H12	50.7000	70.3735	4952.4351	355.6000	0.0000	35
CH4 %	73.7600	6.6311	43.9718	92.2000	63.8200	36
C2H6 %	12.9489	2.4747	6.1241	17.9000	7.2000	36
C3H8 %	4.6578	1.3839	1.9153	7.8700	0.1000	36
C4H10 %	3.5114	1.1827	1.3988	5.2000	0.8000	35
C5H12 %	5.0363	2.6664	7.1098	11.9000	0.0000	35

SHEAR ZONE

The second study area with 18 samples from 8 piston cores (Figure 68) is, in general, a region significantly poorer in surface sediment hydrocarbons (Table 6, Appendix I). In contrast to the mean yield of 317.9 ppb for the total hydrocarbons in West Tasmania, here the mean yield is only 93.6 ppb (max. 519.6 ppb, min. 9.8 ppb). With a mean of 77 %, methane is the main component, and the range of 92,9 % to 61,1 is similar to that of the first region (Tabel F). In several cases, the higher (C4-C5) hydrocarbons are absent or in very minor quantities.

Sample SO-36-23-1 taken at 0 - 10 cm sediment depth is a notable exeption in that much higher yield are measured. The total yield is 519.6 ppb of which the methane concentration in this sample is 190.2 ppb or 62,7 % (Appendix I). The yields of the higher hydrocarbons are also clearly

higher than in the neighbouring stations (Appendix I). A second, deeper sample from 70 - 80 cm (SO-36-23-2) also has somewhat higher yields for the region but are not so distinctive as the uppermost sample.
The Eocene (?) sandy peats discovered at SO-36-22 and SO-36-30 have very low gas concentrations, and despite obvious high organic carbon contents have a positive redox potential (+ 180 mV).

SOUTH TASMAN RISE
The hydrocarbon concentrations of the South Tasman Rise, the third survey (Figure 68), as was the case for the Shear Zone, are again lower than they are for the West Tasmania region. The mean total hydrocarbon is 80.1 ppb (max. 402.0 ppb, min. 4.4 ppb) comparable to 93.6 ppb in the Shear Zone (Table 7). Methane has the highest yields with a mean of 33.8 ppb (73,1 % hydrocarbons), and ranging from a maximum of 174.6 ppb at SO-36-56-2 to a minimum of 4.4 ppb at SO-36-40-1 (Appendix I). The yields of the higher hydrocarbons in the South Tasman Rise are also similar to the Shear Zone, e.g. mean ethane yields 12.6 ppb, mean pentane yields 16.5 ppb) as are the relative hydrocarbon percentages (Table 7). The core at SO-36-42 was not sampled due to its short and disturbed sand contents.

In general higher concentrations of hydrocarbons are recorded in some of the samples in the eastern portion of the South Tasman Rises than in the western or in the rift basins on the slope to the immediate northwest.

TABLE 6: STATISTICAL PARAMETERS - SHEAR ZONE

Parameter	Mean	Std.Dev.	Var.	Max.	Min.	N
Total YHC	93.6100	96.1800	9249.8800	519.5000	9.8000	19
YCH4	42.2500	45.1390	2037.5321	190.2000	8.3000	18
YC2H6	16.1778	23.0201	529.9231	96.2000	1.2000	18
YC3H8	9.8000	12.6317	159.5600	46.2000	0.1000	18
YC4H10	8.6278	15.3899	236.8504	62.5000	0.0000	18
YC5H12	16.7556	32.8890	1081.6840	124.4000	0.0000	18
CH4 %	77.0167	9.1758	84.1944	92.8700	61.1100	18
C2H6 %	12.1989	2.8285	8.0003	16.9100	5.4500	18
C3H8 %	4.7994	2.6586	7.0680	9.7100	0.4500	18
C4H10 %	2.3328	1.9490	3.7985	5.6900	0.0000	18
C5H12 %	3.0039	3.5742	12.7750	11.2700	0.0000	18

TABLE 7: STATISTICAL PARAMETERS - SOUTH TASMAN RISE

Parameter	Mean	Std.Dev.	Var.	Max.	Min.	N
Total YHC	80.1300	82.4500	6798.4100	402.0000	4.4000	17
YCH4	33.8471	41.0910	1688.4729	174.6000	4.4000	17
YC2H6	12.6059	18.2909	334.5556	64.9000	0.0000	17
YC3H8	9.8235	11.0960	123.1219	35.9000	0.0000	17
YC4H10	7.3294	13.4177	180.0335	44.4000	0.0000	17
YC5H12	16.5235	32.9931	1088.5469	113.1000	0.0000	17
CH4 %	73.1288	14.5423	211.4793	100.0000	47.2800	17
C2H6 %	11.0212	4.9480	24.4826	19.1700	0.0000	17
C3H8 %	7.1959	4.9070	24.0784	17.9400	0.0000	17
C4H10 %	2.9082	2.2811	5.2033	8.2900	0.0000	17
C5H12 %	4.6465	5.4183	29.3578	16.9900	0.0000	17

5.4.5 STATISTICAL DATA TREATMENT

The standard statistical treatment has been applied to the three study areas. Means, standard deviations, variance (sigma squared), maximum and minimun values, and the number of observations are presented in tabular form for West Tasmania, Shear Zone and South Tasman Rise as Tables 5, 6 and 7 respectively.

The number and shape of the sample populations in the three study regions can inspected by using the frequency distributions of the yields of the individual hydrocarbon species which are presented as a series of histogrammes in Figures 55 a-g, 56 a-g, 57 a-g.

The C1 - C5 hydrocarbon yields of the West Tasmania region are clearly distributed bimodally. The first population has a lower mean yield for C1, C2, C3, i-C4, n-C4, i-C5 and n-C5 of about 45 ppb, 25 ppb, 9 ppb, 5 ppb, 6 ppb, 10 ppb, and 10 ppb respectively (Table 8) and a higher mean yield of roughly 400 ppb, 120 ppb, 96 ppb, 52 ppb, 46 ppb, ca.140 ppb and ca. 140 ppb respectively for the C1 to C5 hydrocarbons of the second population (Figure 55 a-g). This bimodal distribution indicates that the samples with higher yields are not simply the high end values expected from a normal unimodal distribution, rather that the samples of the second population are anomalously higher and separate from the samples of the first population and thus warrant extra significance.

The bimodal distribution seen in West Tasmania is not nearly so distinct in the Shear Zone or the South Tasman Rise (Figures 56 a-g, 57 a-g). This is, only in part, due to a reduced number of samples from the second population. The mean yields of the lower population from the second and third study areas are less than those of West Tasmania as discerned by inspection (Figures 56 a-g and 57 a-g) and given in Table 8.

WEST TASMANIA

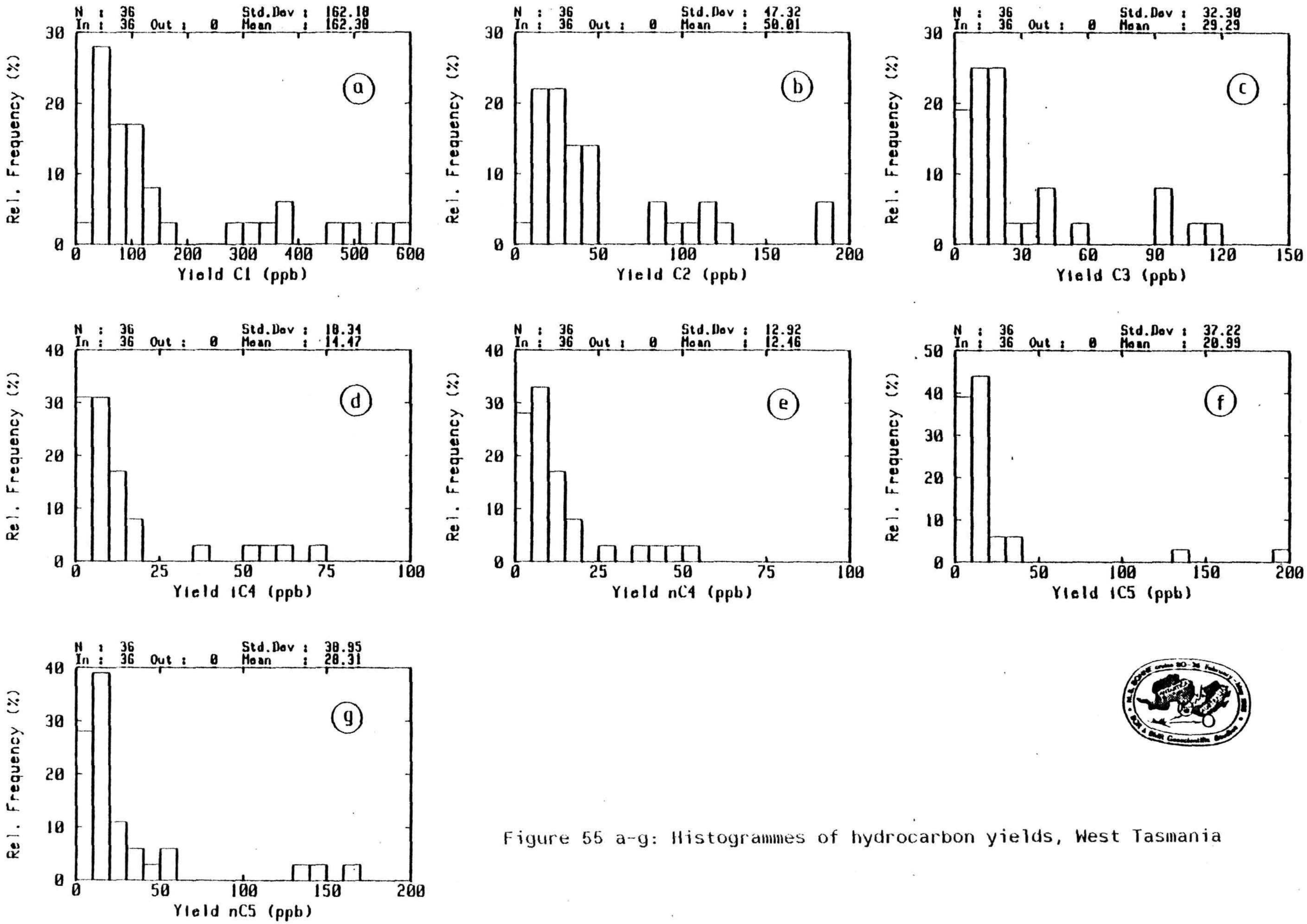


Figure 55 a-g: Histogrammes of hydrocarbon yields, West Tasmania

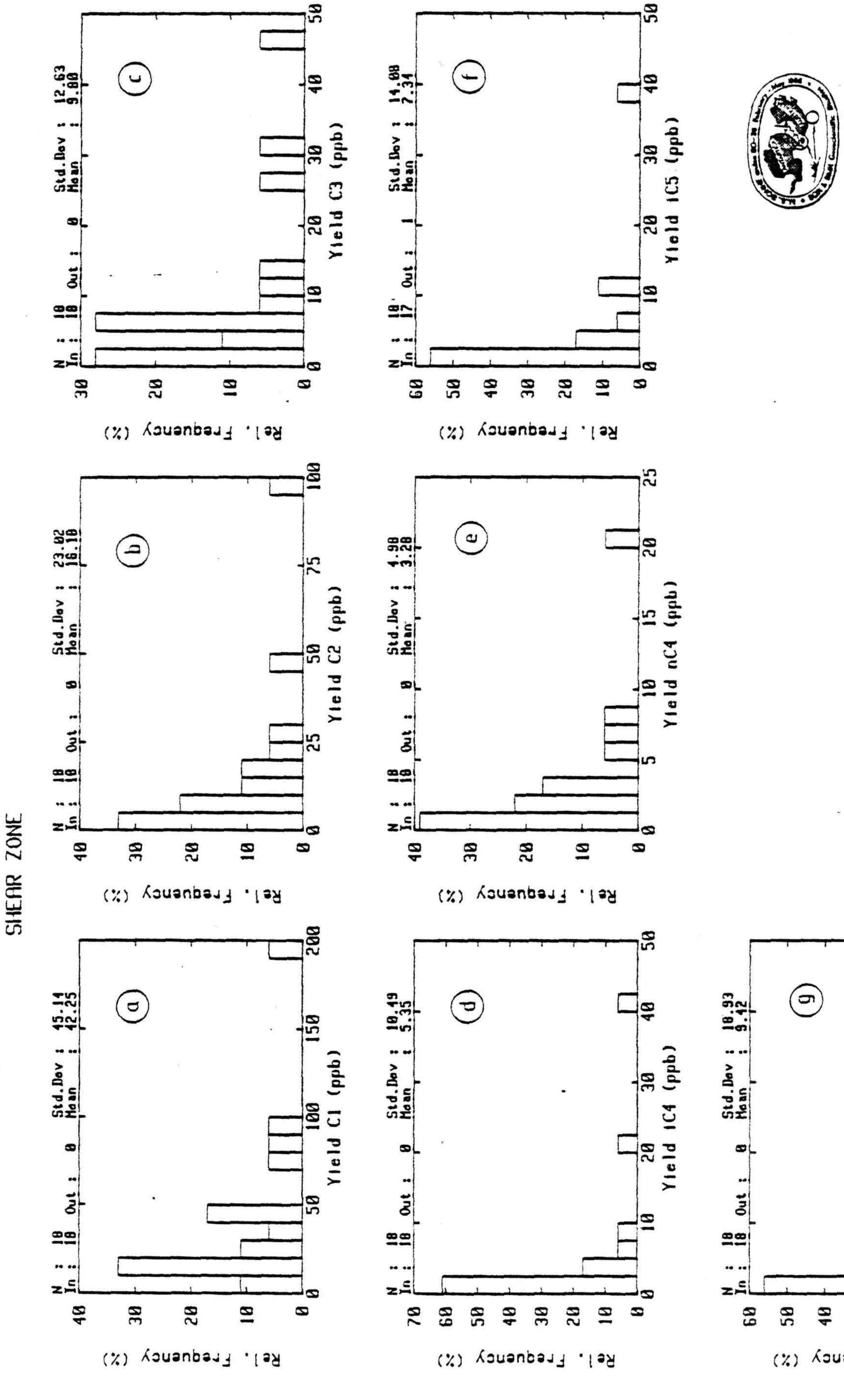
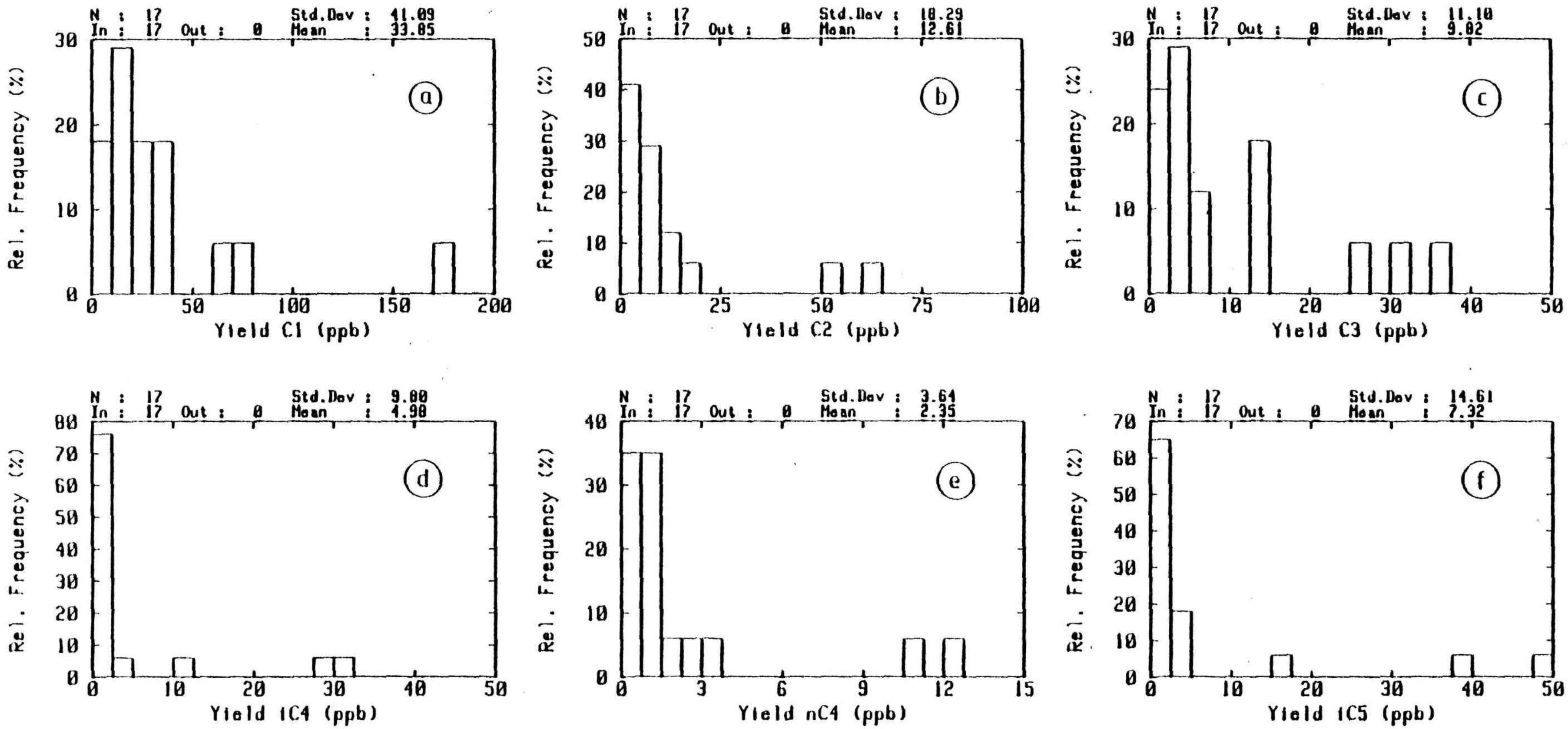


Figure 56 a-g: Histogrammes of hydrocarbon yields, Shear Zone

SOUTH TASMAN RISE



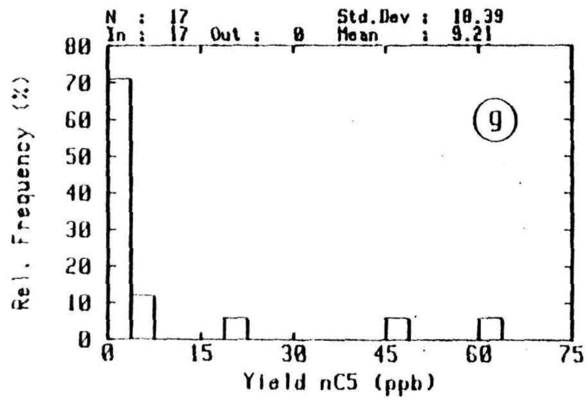


Figure 57 a-g: Histogrammes of Hydrocarbon yields, South Tasman Rise

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TABLE 8: ESTIMATED MEAN HYDROCARBON YIELDS OF UPPER AND LOWER POPULATIONS (ppb)

	WEST TASMANIA		SHEAR ZONE		SOUTH TASMAN RISE	
			populations			
C#	Upper/Lower		Upper/Lower		Upper/Lower	
C1	400	45	195	12	180	15
C2	120	25	98	4	58	5
C3	96	9	40	4	32	3
iC4	52	5	40	2	30	1
nC4	46	6	21	1	12	1
iC5	140	10	45	2	41	1
nC5	140	10	56	3	56	1

Although the data are bimodally distributed, the type of gas in each population can be the same, and that the yields vary as a result of non-source related processes such as migration or sorption properties. As mentioned, stable isotope analyses provide important information on gas genetic classification. The molecular data can also be of assistance as displayed by the cross plots of the individual hydrocarbon component yields from the three regions in Figures 58 a-d, 59 a-d, 60 a-d. Samples plotting colinearly are likely of a common origin. Methane and ethane in all three study regions essentially plot co-linearly, in fact the slopes from the three regions are also similar. Ethane - propane and propane - n-butane in West Tasmania and the Shear Zone approximate straight-line plots and are common sourced. The methane - n-pentane plots of the two study areas suggest a independent control of the pentane hydrocarbons, which could be related to source, solubility or migration. The higher hydrocarbon gas data from the South Tasman Rise are less homogeneous. The variance in the ethane - propane and propane - n-butane plots (Figures 60 b, 60 c) may be scatter, but could also indicate more than one source of the hydrocarbons in this region.

West Tasmania

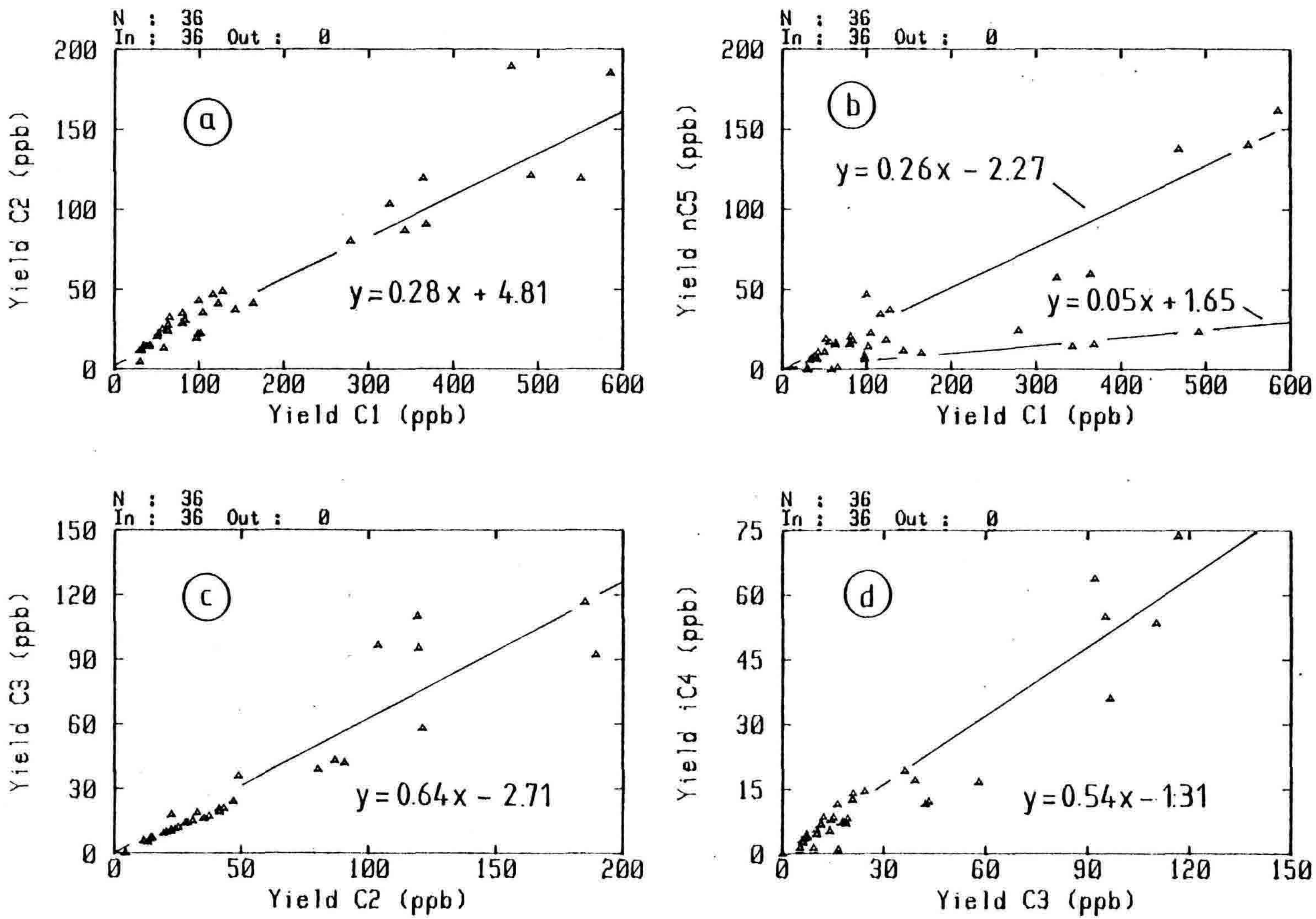

Figure 58 a-d: Cross plots of hydrocarbon component yields, West Tasmania

Shear Zone

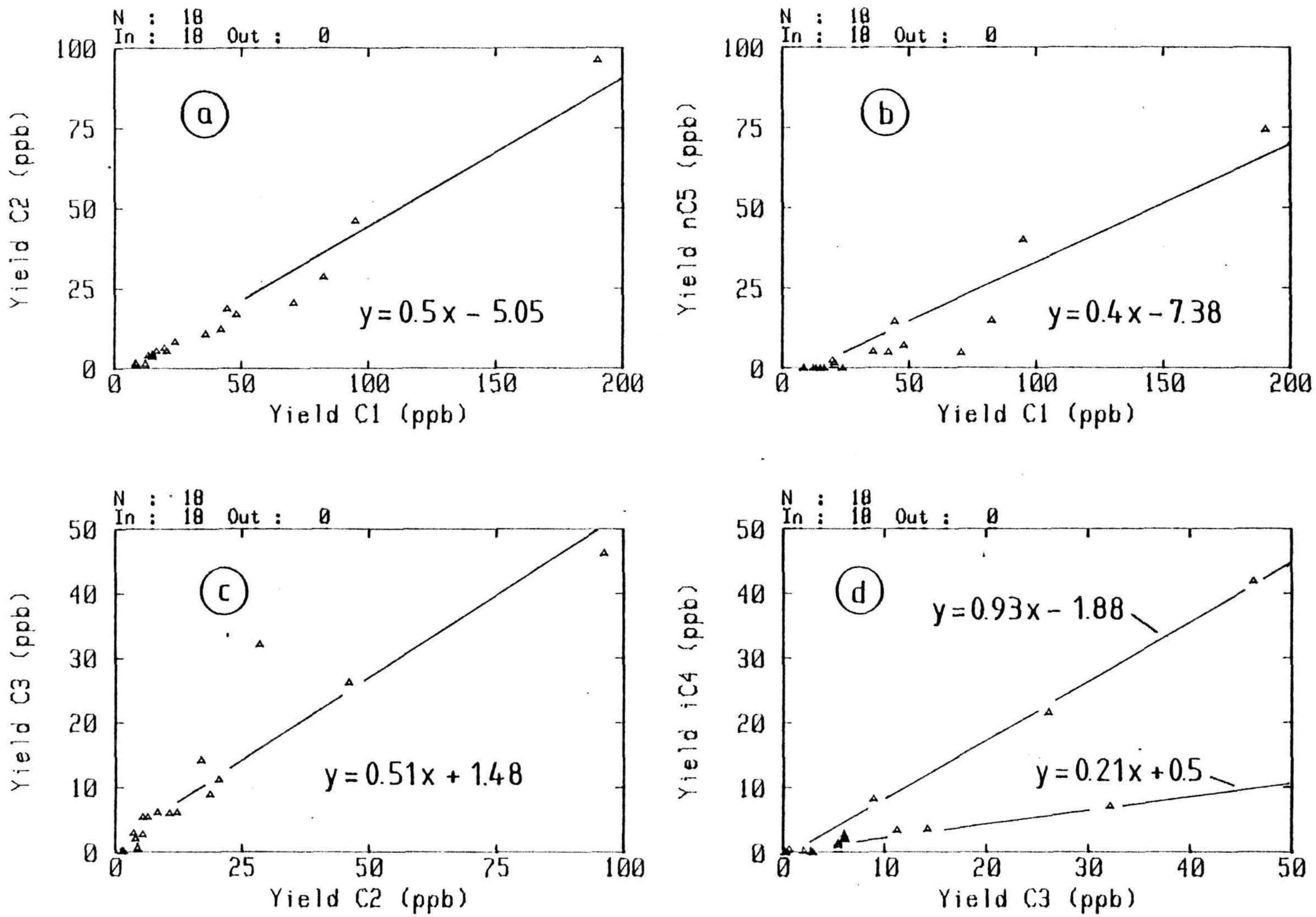

Figure 59 a-d: Cross plots of hydrocarbon component yields, Shear Zone

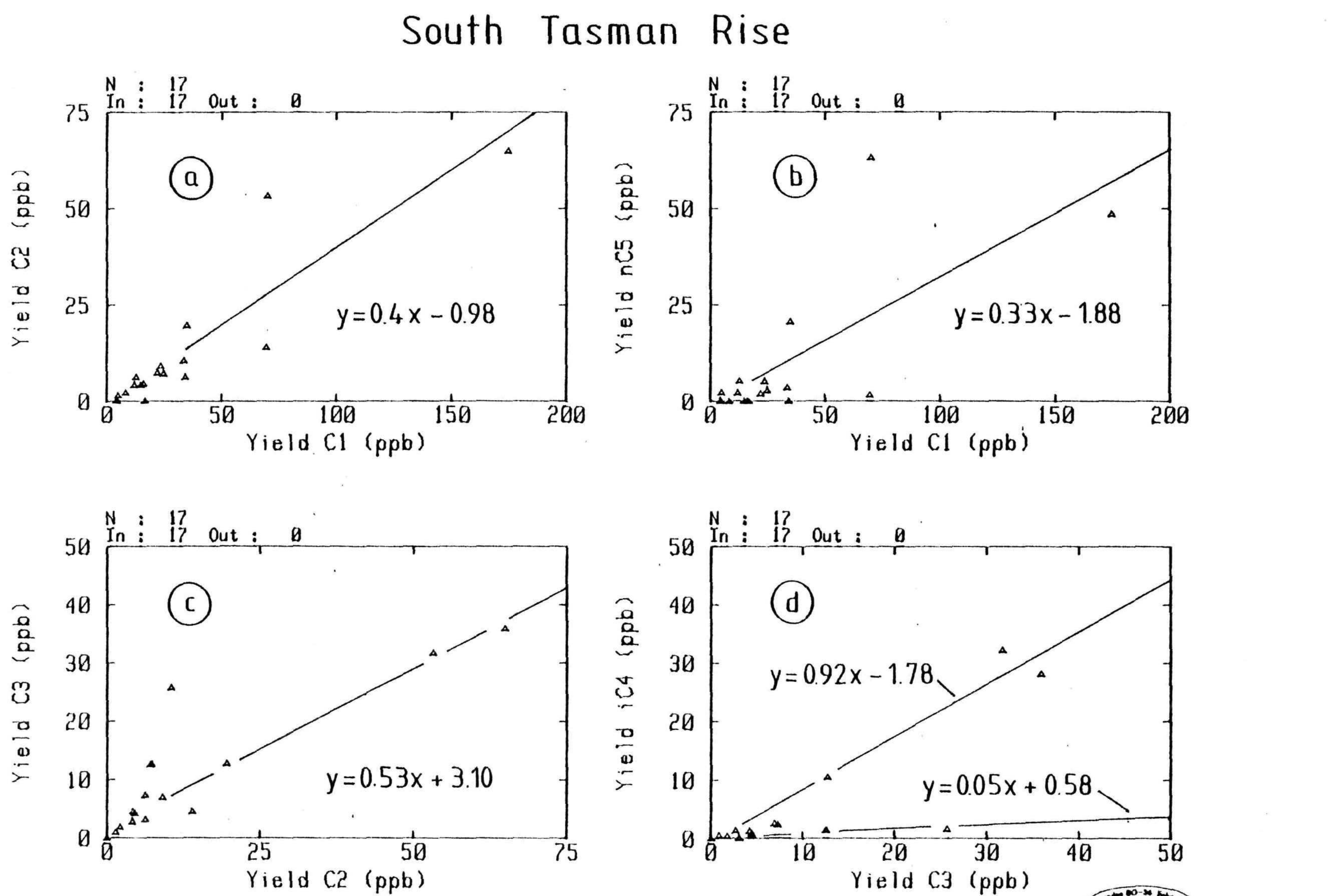

Figure 60 a-d: Cross plots of hydrocarbon component yields, South Tasman Rise

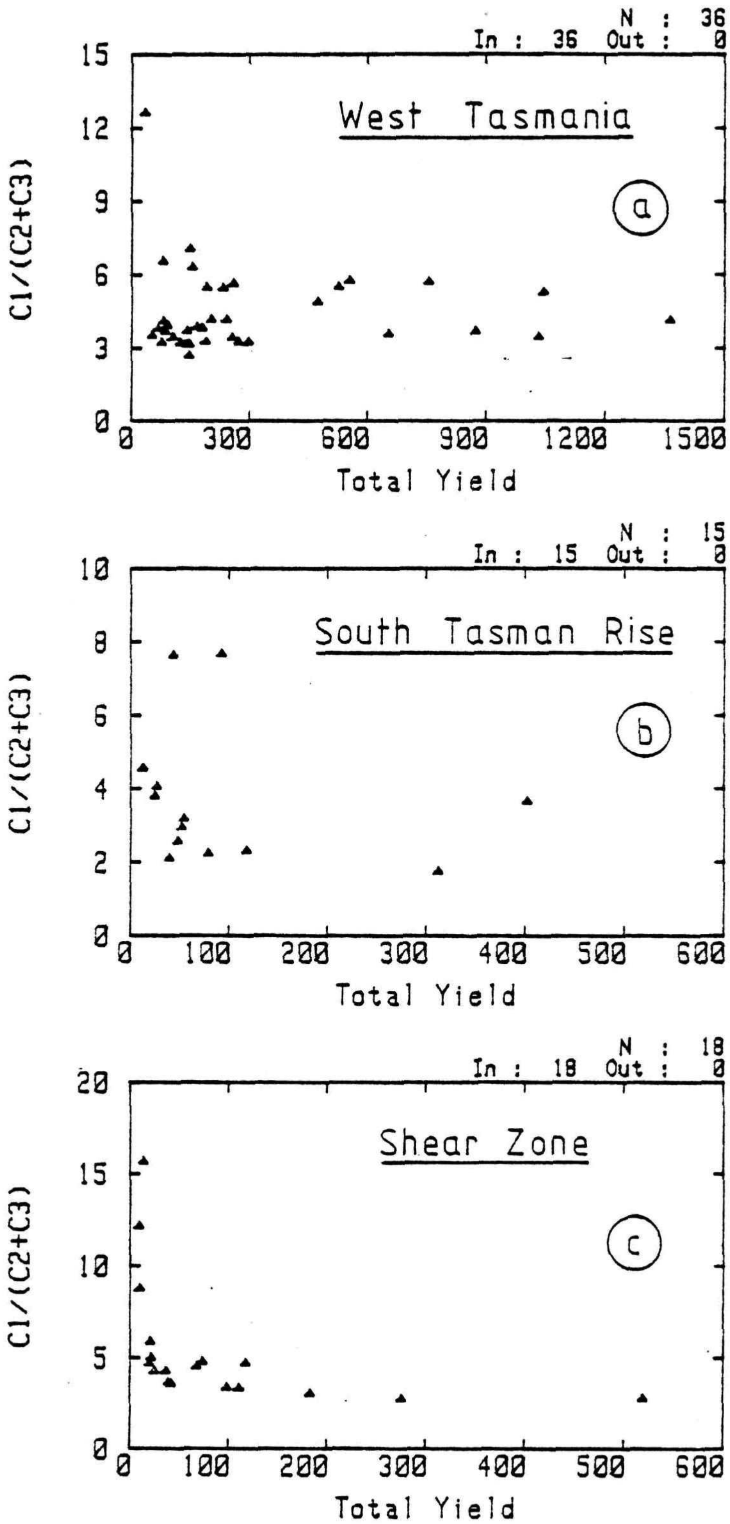

Figure 61 a-c: Cross plots of bernard parameter vs. total yield

An important observation made during the investigation is the independence of molecular composition on the total yield (Figure 61) above a certain background level of .....ppb. This confirms experiences elsewhere that above a certain minimum yield threshold the compositional data are uninfluenced.

5.4.6 PRELIMINARY GEOCHEMICAL INTERPRETATION

This initial interpretation is strongly coupled with the findings of the concurrent geophysical and geologic investigations of these areas, which are presented elsewhere in this report. It must be pointed out here that for a more complete and reliable geochemical interpretation substantial emphasis is placed on the stable carbon isotope analyses of the surface sediment gases. These post-cruise isotope analyses, to be conducted at BGR, Hannover, provide important, additional information about the genetic character of the hydrocarbons, and may also give estimates of the organic source type and maturity which have generated the hydrocarbons. Despite these constraints, the yield and molecular compositional data permit a general geochemical assessment of the study areas:

WEST TASMANIA

In this study area, the highest yields are obtained (Figures 63, 64, 65). Although methane is the major hydrocarbon component present, the gas composition in West Tasmania is described as a "wet gas", i.e. a large proportion of C2 - C5 higher homologes. The % wetness (sum C2-C4 / sum C1-C4 x 100) has high values frequently around 40 % to 45 % (Appendix III) which is associated with a thermogenic hydrocarbon source. Biogenic gases, produced by methanogenic bacteria are predominantly methane, with minor amount of ethane and only traces if any propane. This relationship is often expressed by the "Bernard Parameter" (C1 / (C2 + C3)). Gases of biogenic origin have a Bernard value of 5×10^2 to 1.0×10^5 or even higher. Thermogenic gases, richer in C2 and C3, have Bernard values less than 25. In the West Tasmania study area, the Bernard value was generally consistant around 1.7, varying little between 1.3 and a singular higher value of 6.7 (Figure 66).

In sediments from other areas, where the concentration of hydrocarbons is low, marking effects due to such processes as oxidation or diagenetic generation of higher hydrocarbons, become relevant, and make genetic gas-typing difficult. The higher hydrocarbon yields in this study area, however, diminish these interpretative problems. On the basis of the concentration and relatively uniform composition, the surface sediment hydrocarbons in West Tasmania appear to be of thermogenic origin. As mentioned, the yields are often high, but not uniformly so; a clear pattern of distribution could be developed. The total yield, methane yield and propane yield, illustrated in Figures 61, 62, and 63 have anomalously high values at the adjacent stations SO-36-5 and SO-36-14. This zone of elevated values extends around to the south including stations SO-36-8, -12, -13, -18 roughly following the 1,500 m isobath. Similarly on seismic line SO-36-44 further to the north, stations SO-36-1, -2, and -3 also have exceptionally high concentrations. The hydrocarbons in the sample from station SO-36-4 further offshore on the same seismic line are low, comparable to SO-36-10 and -20.

The distribution of these hydrocarbons in the surface sediments correlates well with the seismic information on the subsurface geologic situation. This relationship is depicted in Fig. 67 in a generalized schematic cross section traversing the shelf and slope of West Tasmania. In a structural sense, several stations occupy equivalent positions. The highest concentrations (So-36-1, and -14) are off the shelf and directly associated with shallow faults which possibly extend from Cretaceous into Neogene sediments. Station SO-36-1 is a location marked by a trough-like surface expression. Station SO-36-6 was also located in such a surface structure but has lower concentrations. The zone of higher values (stations SO-36-8, -12, -13, -18) is associated with the series of deep-seated rift faults and positioned over a system of shallow normal faults. Further offshore, at stations SO-36-9, -11, and -19 the concentrations start to decrease although they are in association with shallow faults, and retain the same compositional character as the previous stations. Station SO-36-7 has lower values and is not located near any obvious faults. Continuing westward, the zone of higher values is truncated by a structure tentatively

interpreted as a larger intrusive basalt body (Fig. 67). West of this intrusion (SO-36-10, -20) the concentration of hydrocarbons drops off sharply. The presence of thermogenic hydrocarbons continues even further offshore as was reported for the DSDP site 282.
Thus the concentration and composition of hydrocarbons in the surface sediments in the West Tasmania study area are indicative of active source units. The distribution appears to be strongly influenced by fault-directed migration. Without the additional geochemical well control data, or stable isotope evidence, the source sediments for the hydrocarbons is speculative. The Early/Middle Eocene have demonstrated source rock qualities, and although the depth of burial is probably too low, examples from the Otway Basin indicate that maturation can occur in Paleogene sediments of 1500 to 2000 m sediment depth (Otway Basin Conf., 1985). More likely, however, are the Cretaceous units. They are potentially attractive sources based on burial depth and thickness. In addition, the Cape Sorell 1 well encountered traces of oil in the Late Cretaceous sandstones and siltstones. The Cretaceous is thought to have been largely removed at the Cape Sorell 1 location (see geophysical report, Chapter 5.2.4.1) which, in combination to being located off-structure for a Late Cretaceous target, could account for absence of significant hydrocarbon accumulations at this drill site. A drill location further west offshore is more appealing and consistent with the preliminary geochemical findings.

SHEAR ZONE

Several different stratigrahic formations were cored on this W-E profile (Fig. 15) across the faulted and sheared southwestern continental margin of Tasmania (see geophysical interpretation, Chapter 5.2.4). Cores at station SO-36-21, -24, -25, and -27 recovered only Pleistocene sediments, whereas sandy Eocene (?) peats were encountered at SO-36-22 and -30. Station SO-36-23, and the neighbouring SO-36-26 are of Late Miocene/Early Pliocene age. It is currently unclear why the hydrocarbon concentrations at these latter two stations, (SO-36-23 in particular) are significantly higher than the others (Figs. 69, 70, 71). They are situated over the sector of the basin with the greatest pre-Tertiary sediment depth, but shallower faulting

has not been identified which could create preferential migration pathways (Fig. 74). The thermogenic character of the hydrocarbons, based solely on the molecular ratios does not change greatly along the traverse, so the increase in concentration does not indicate a gas-type change. Again, the Cretaceous or perhaps Late Eocene must be condidered among the potential source units of the hydrocarbons.
The sandy peats habe low hydrocarbon concentrations, possibly due to poor sorption characteristics. Biogenic methane often associated with such sediments of higher organic carbon content is absent at these stations due to the prevailing strong oxic conditions. Methanogens are strict anaerobes and can not operate in this environment.

SOUTH TASMAN RISE

Thermogenic hydrocarbons are found on the South Tasman Rise. The concentrations vary considerable as does the surface distribution (Figs. 68,69, 70, 71). The four most northwesterly stations in the rift basins on the northern flank of the Rise (SO-36-38, -39, -40, -41, Fig. 74) are relatively poor in hydrocarbon yields. Similarly, directly on top of the western block of the Rise station (SO-36-49) and just to the west, at station SO-36-50, the yields are very low. The yields continued to be low moving off the Rise and over the western rift basins (So-36-46 to 48), despite the appparent deep and shallow fault system (Fig. 75).
In contrast, three stations (SO-36-51, -53, -56) in the eastern sector of the Rise have higher yields with a thermogenic signature. The first two are adjacent to and on top of the eastern block (Fig. 75), while the latter is further eastward off the Rise and in a deeper rift basin. The explanation for the high gas concentrations in the thin sediment package on the Rise could represent migration from the adjacent basins to the southeast or northeast, although the sampling density is too low to define this.
The stable isotope data may improve the classification of the hydrocarbon potential of these regions, however based on this current evidence, the basins on the eastern side appear to be more active.

5.4.7 CONCLUSIONS

Thermogenic hydrocarbons, sometimes in substantial concentrations are found in the offshore surface sediments in West Tasmania, the Shear Zone and the South Tasman Rise. The distribution of hydrocarbons could be more easily defined in West Tasmania, but the basins on the south Tasman continental margin, and on the eastern side of the South Tasman Rise are also geochemically interesting.

In several instances, the concentration of the gases could be related to subsurface structures identified by seismic studies. In particular, the presence of faults in the rift basins seem create preferential migration which accentuates the hydrocarbon yields.

An important result was the occurrence of sorbed hydrocarbons even in highly oxic and often sandy sediments.

REFERENCES

1) Kennett et al.: 1973, DSDP Vol 29

2) Erdmann, Schorno and Scalan: DSDP Vol 31, Appendix IV

3) Hunt: Appendix II, DSDP Vol 31

4) Otway Basin Conference, Feb. 1985: Abstract Volume, Publ. Geol. Soc. of Victoria and South Australia

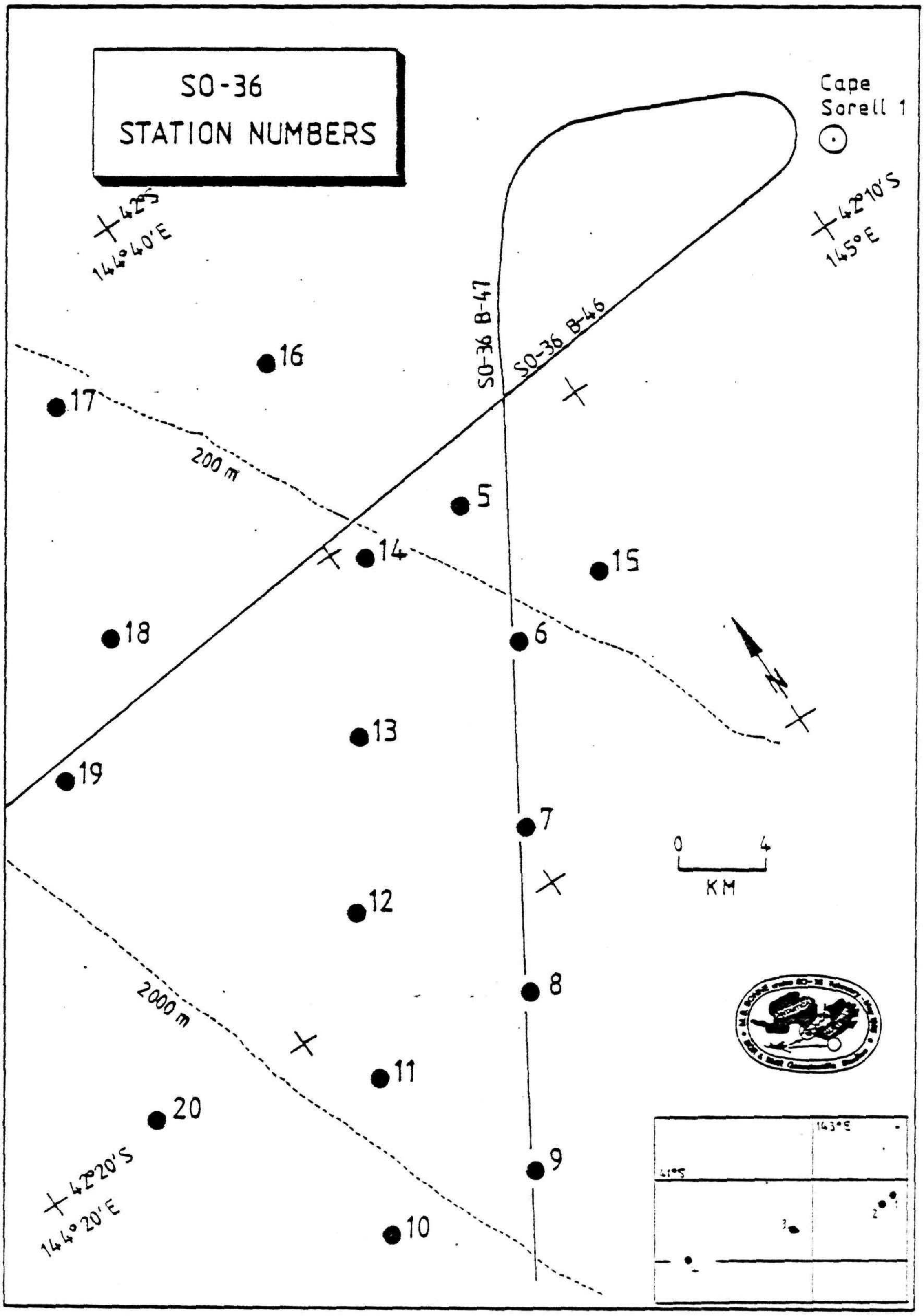

Figure 62: Location of sampling points, West Tasmania

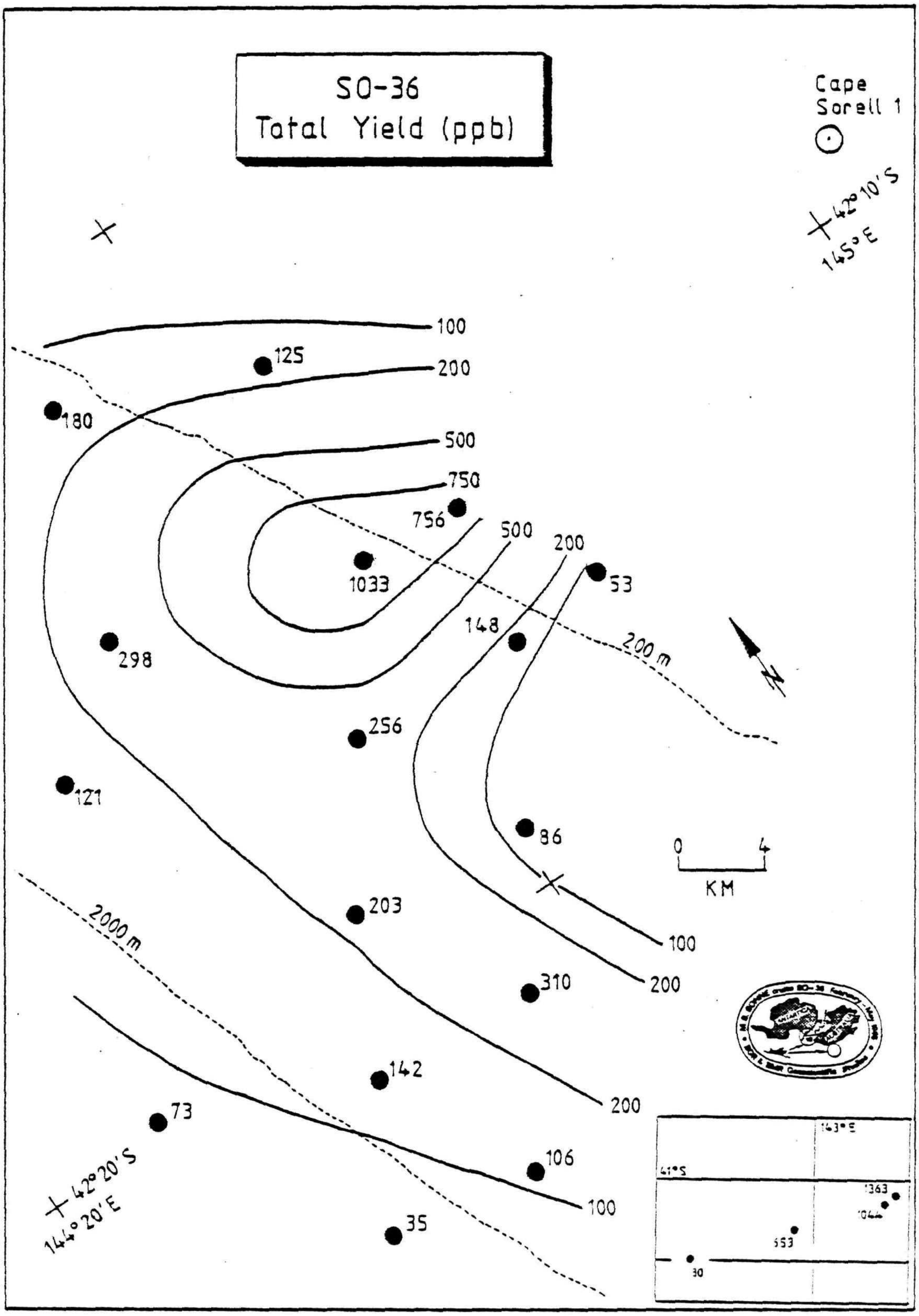

Figure 63: Areal distribution of total hydrocarbon yield, West Tasmania

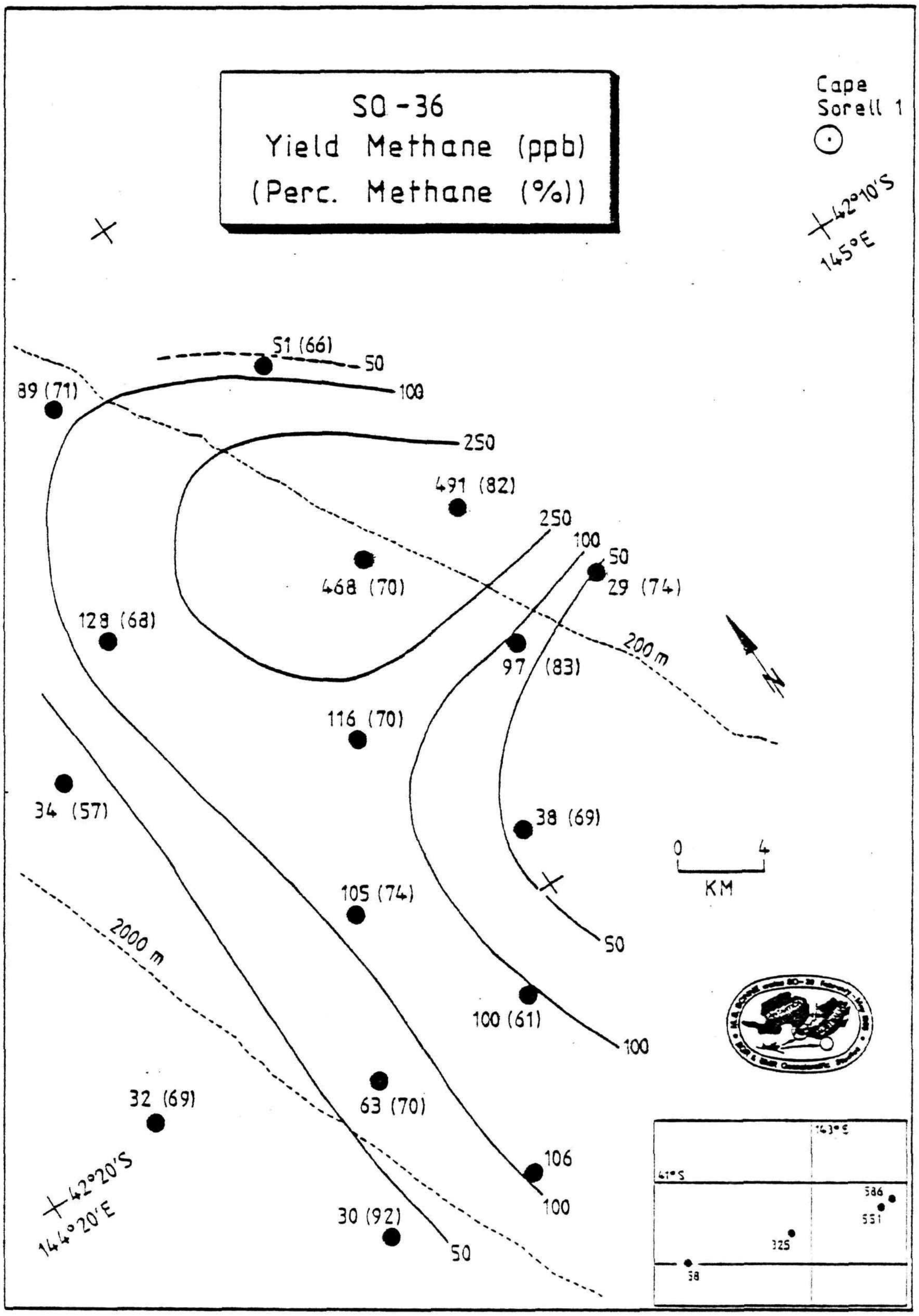

Figure 64: Areal distribution of methane concentrations, West Tasmania

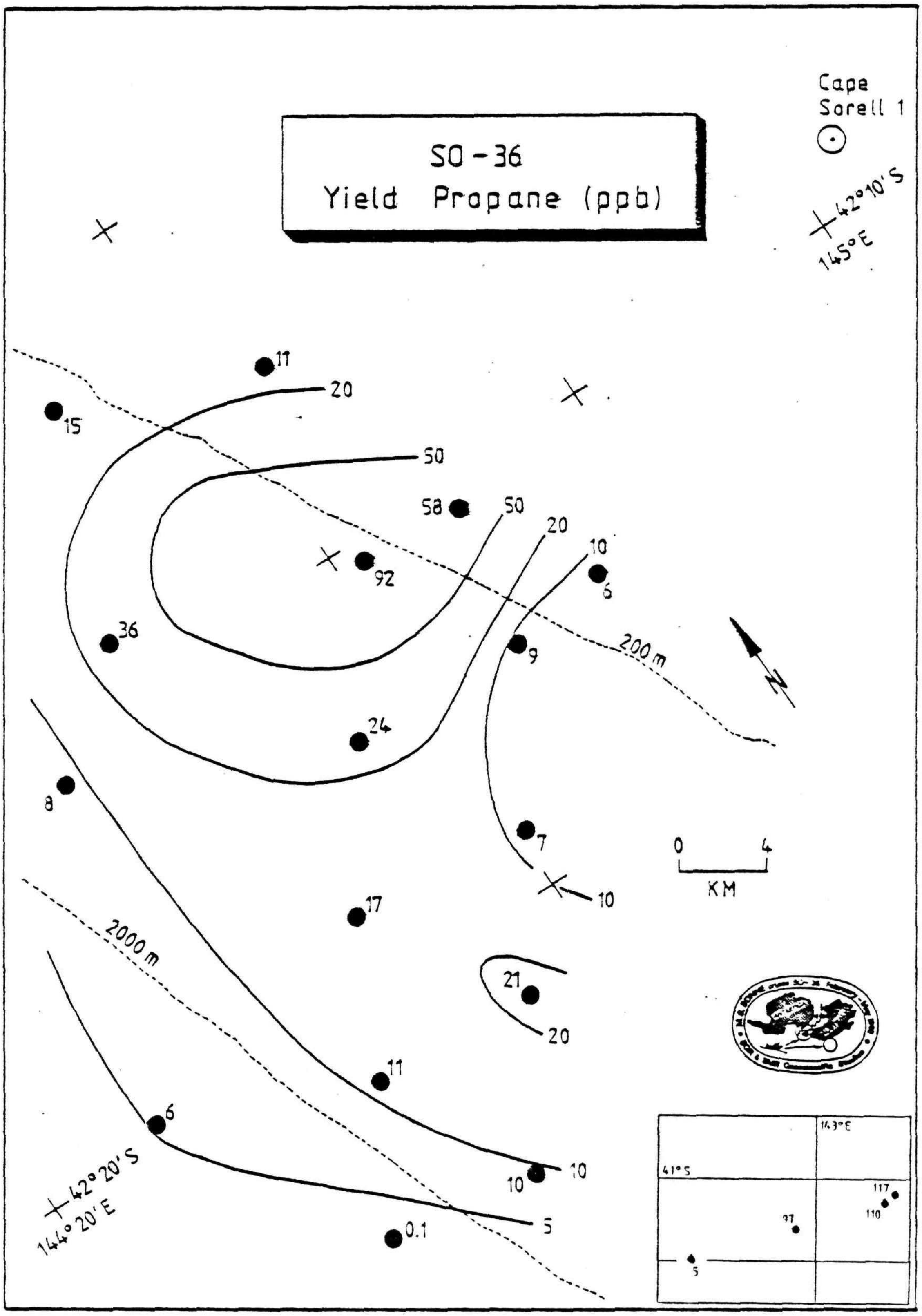

Figure 65: Areal distribution of propane concentrations, West Tasmania

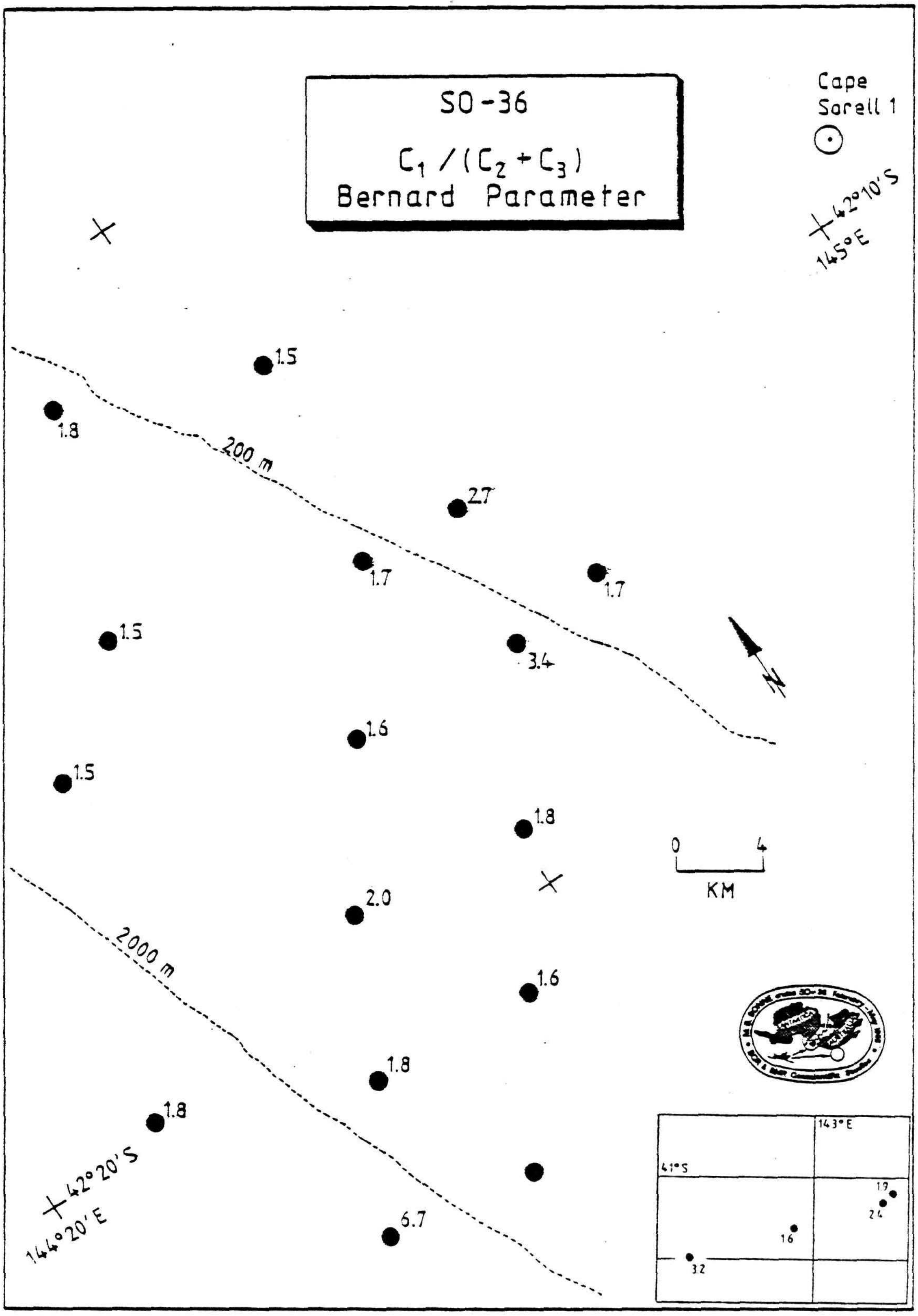

Figure 66: Areal distribution of bernard parameter, West Tasmania

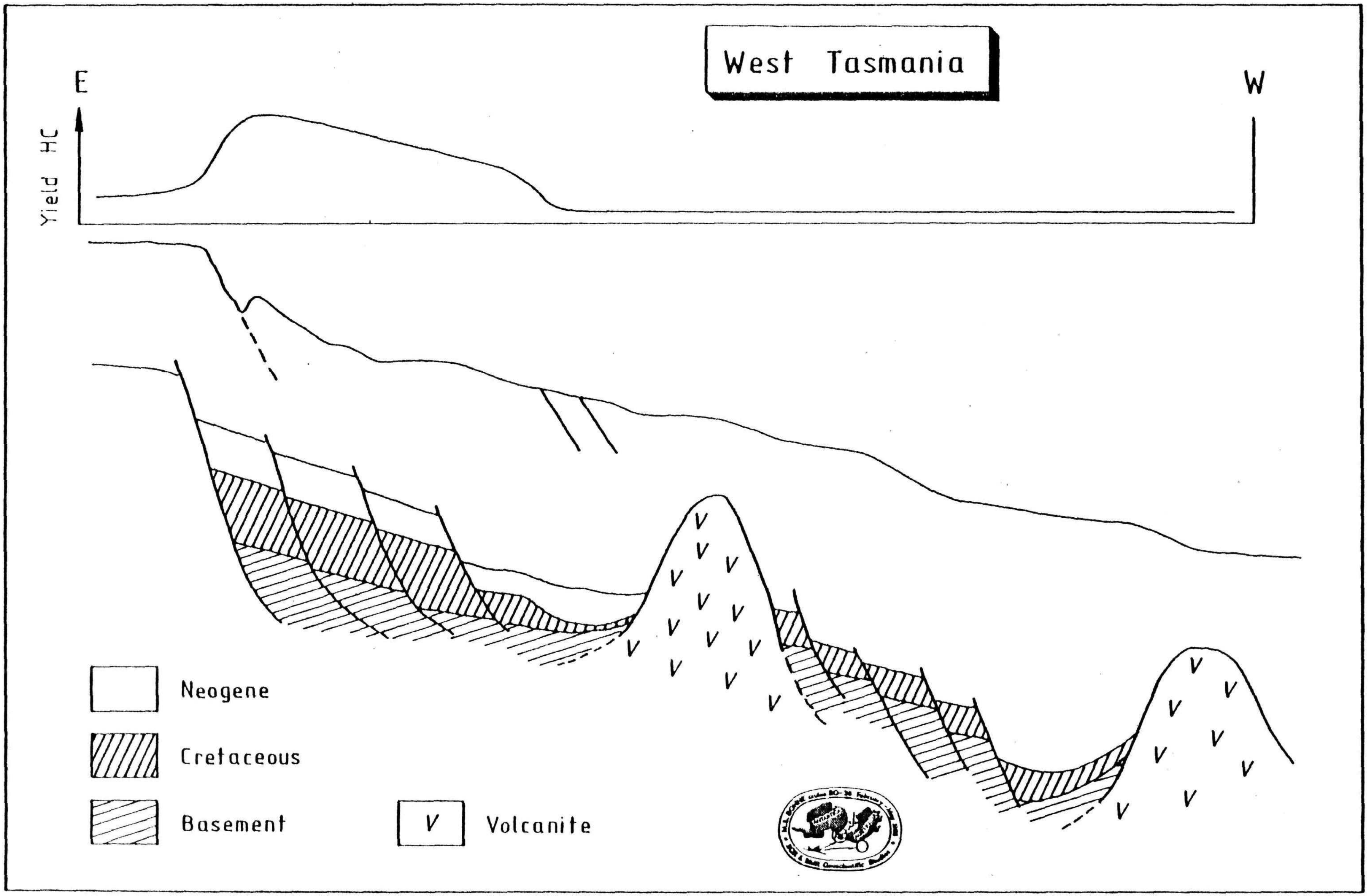

Figure 67: Schematic cross section of West Tasmania study region

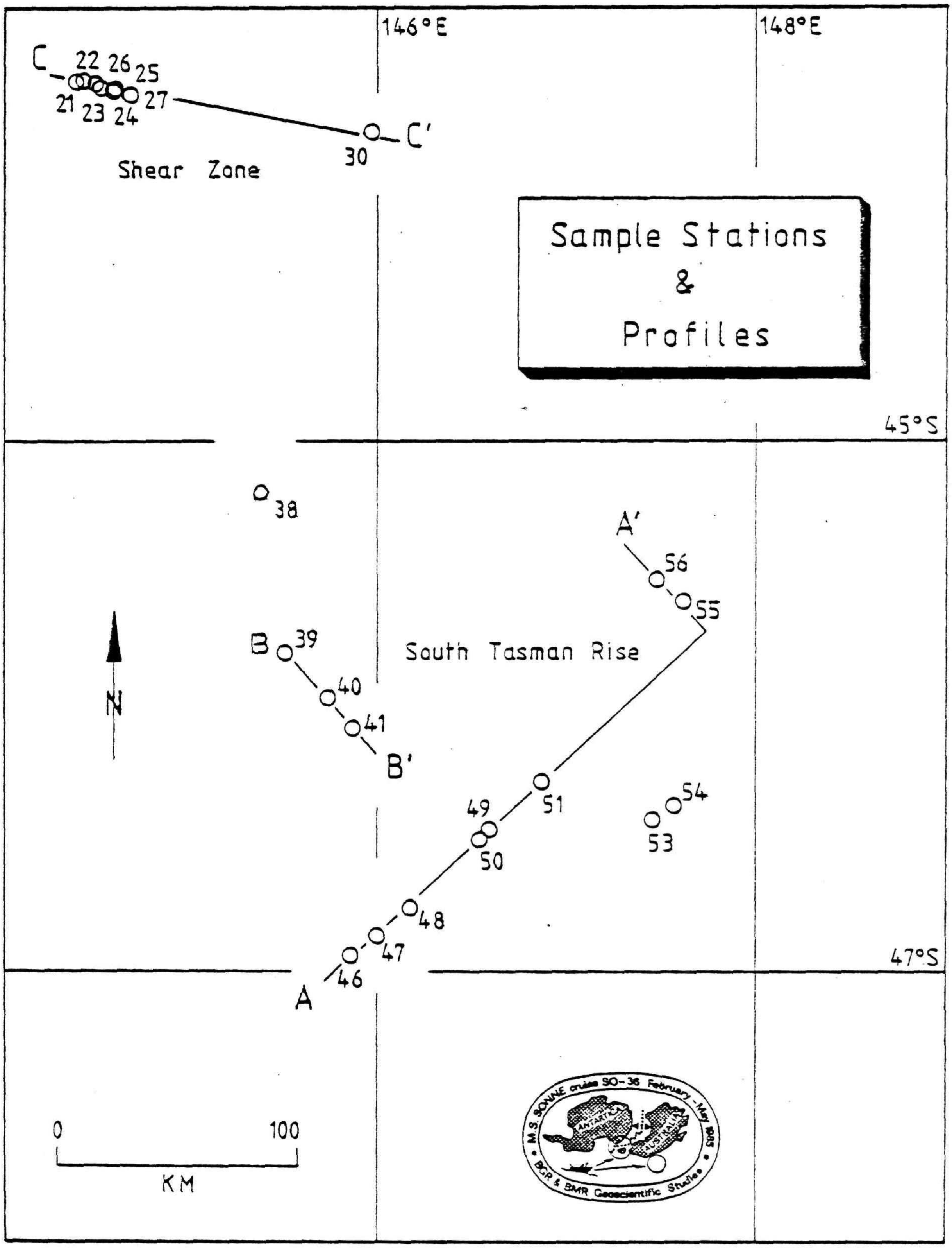

Figure 68: Location of sample points, Shear Zone and South Tasman Rise

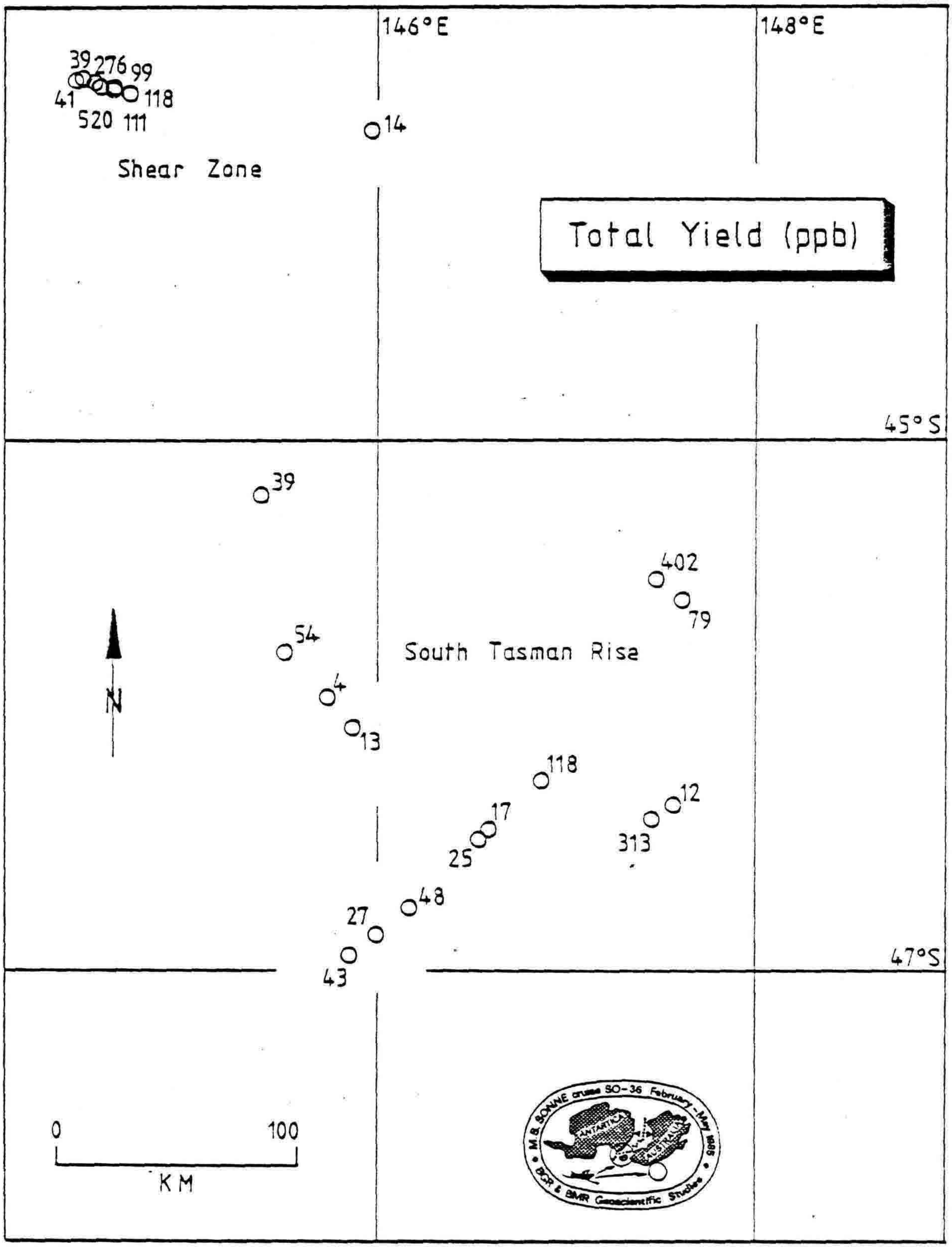

Figure 69: Areal distribution of total hydrocarbon yield, Shear Zone and South Tasman Rise

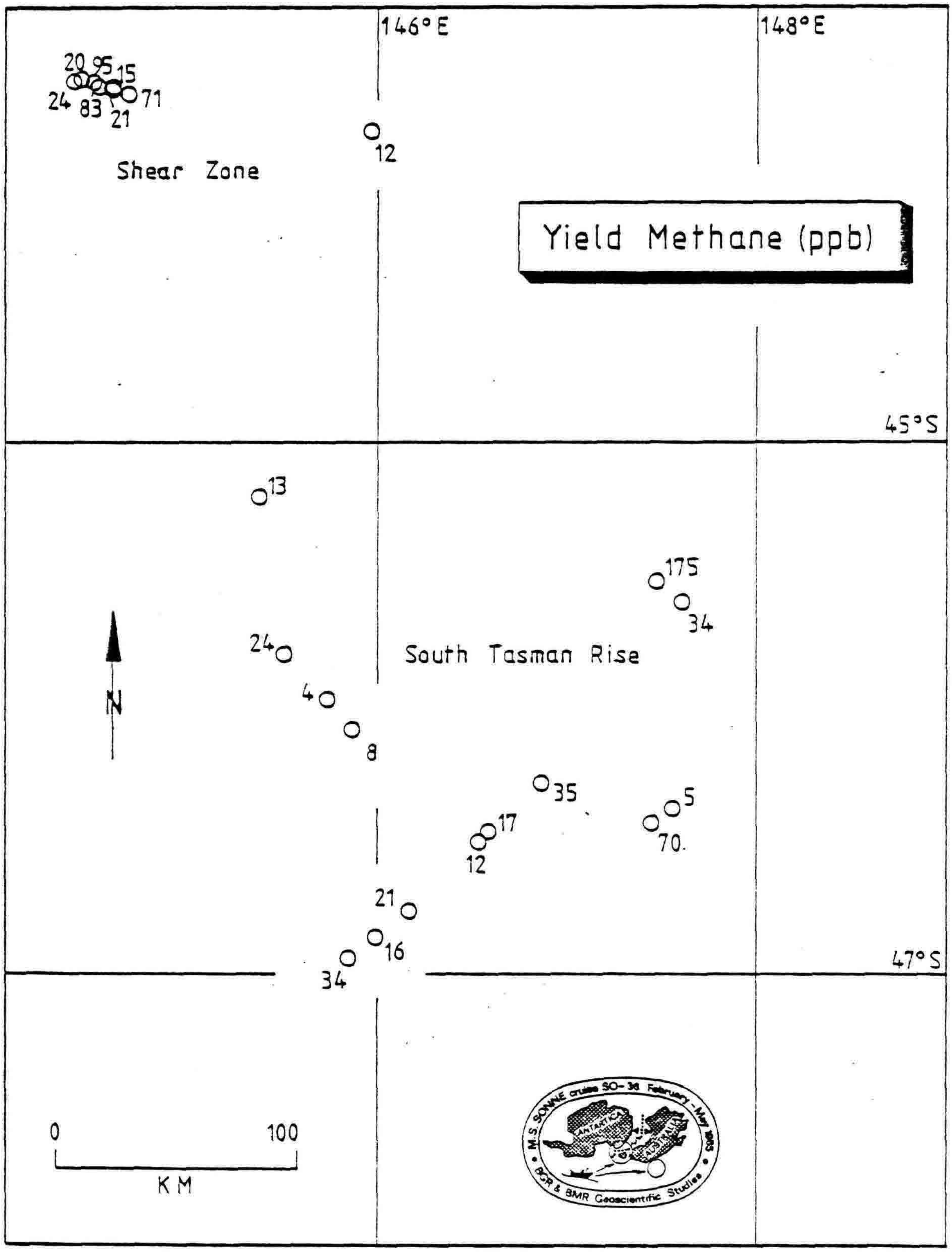

Figure 70: Areal distribution of methane concentrations, Shear Zone and South Tasman Rise

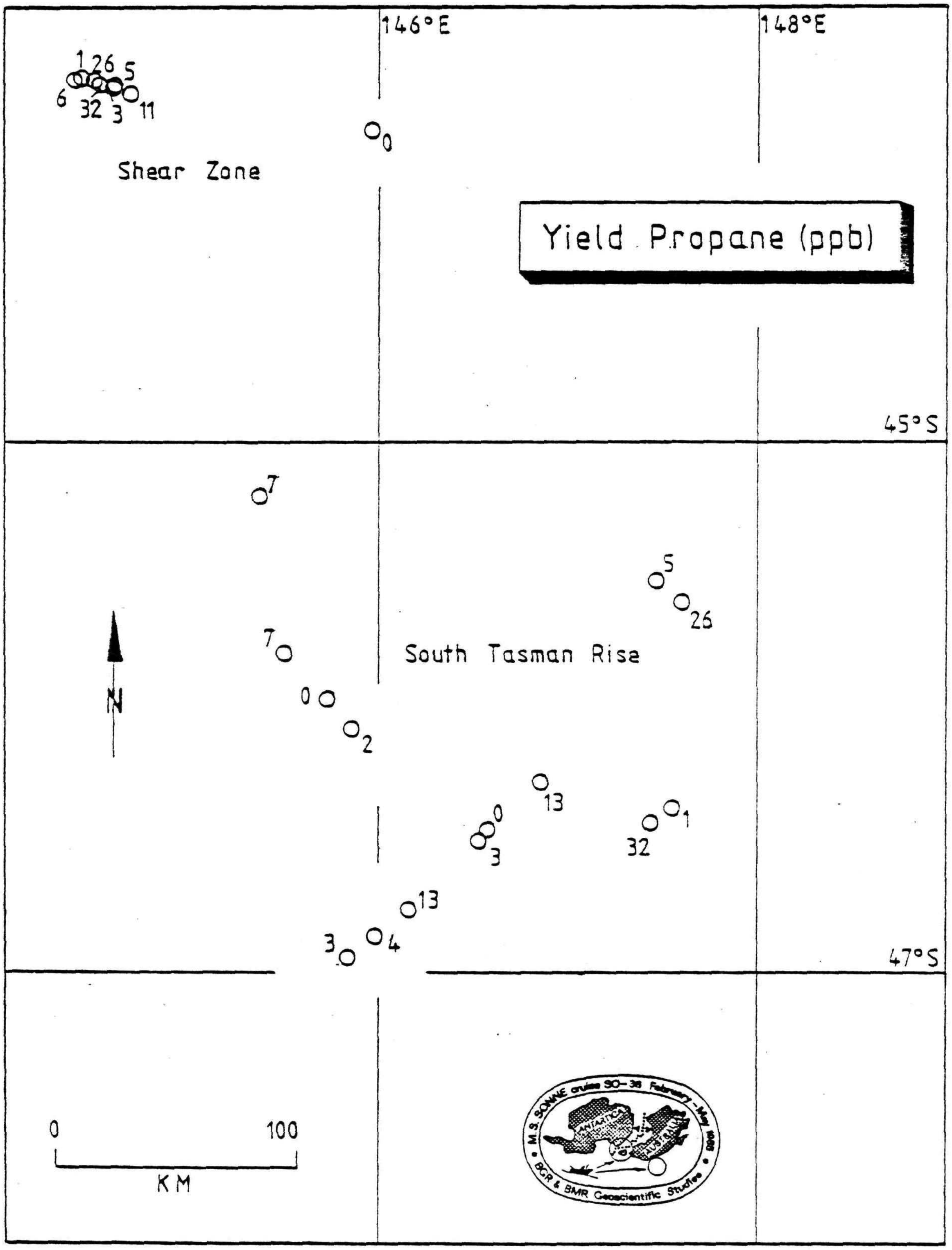

Figure 71: Areal distribution of propane concentrations, Shear Zone and South Tasman Rise

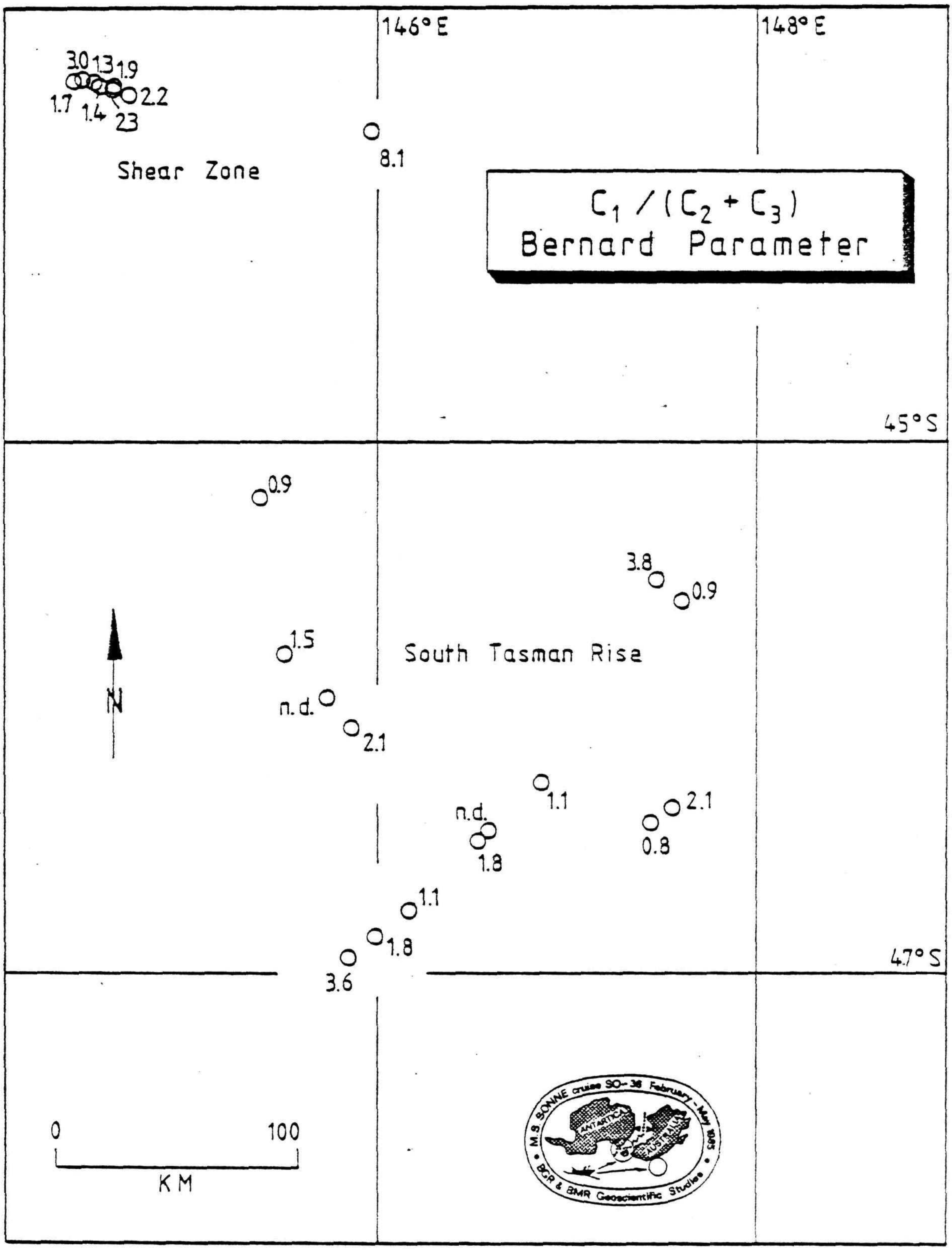

Figure 72: Areal distribution of Bernard parameter, Shear Zone and South Tasman Rise

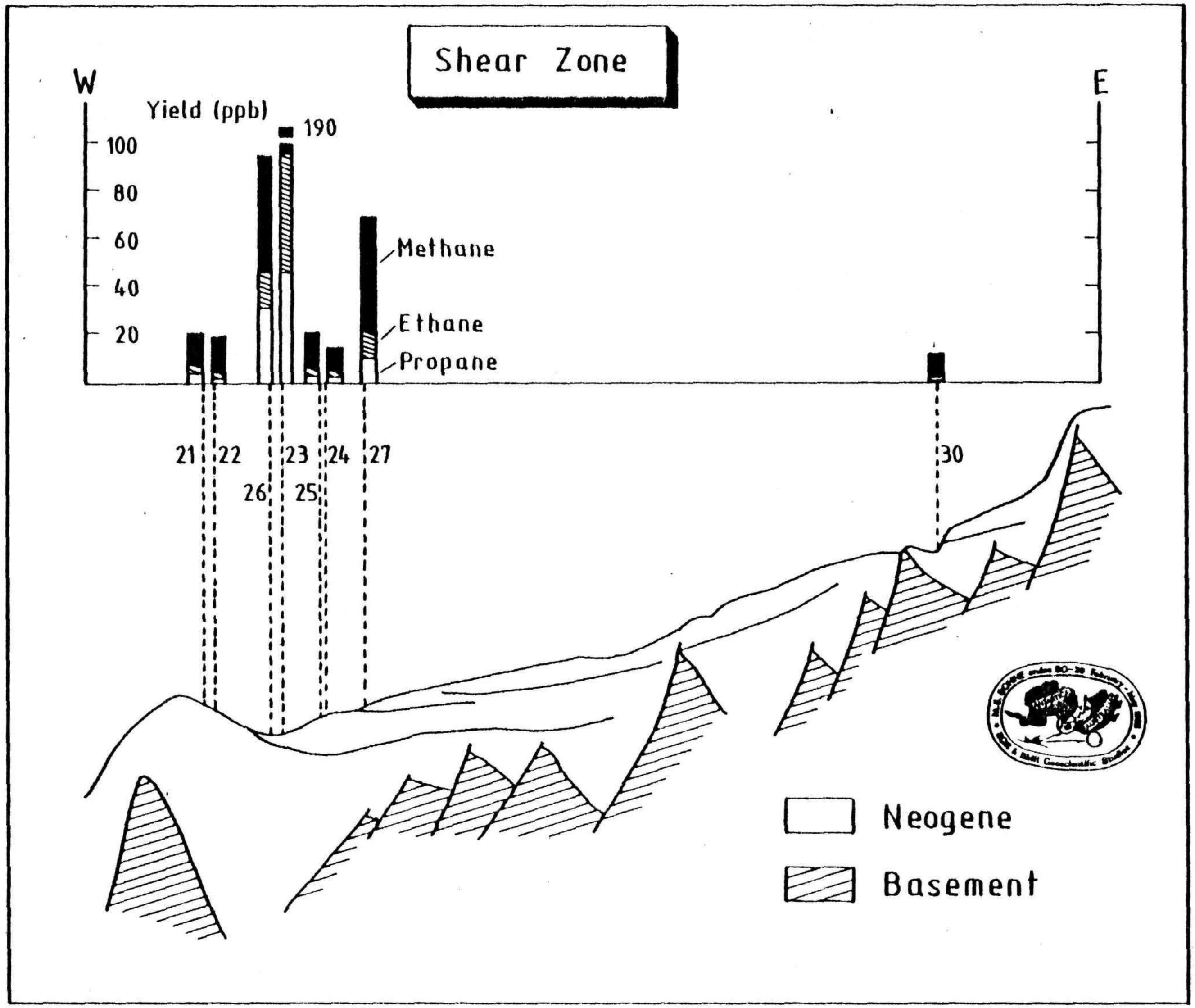

Figure 73: Concentration profiles and schematic cross section,
Shear Zone

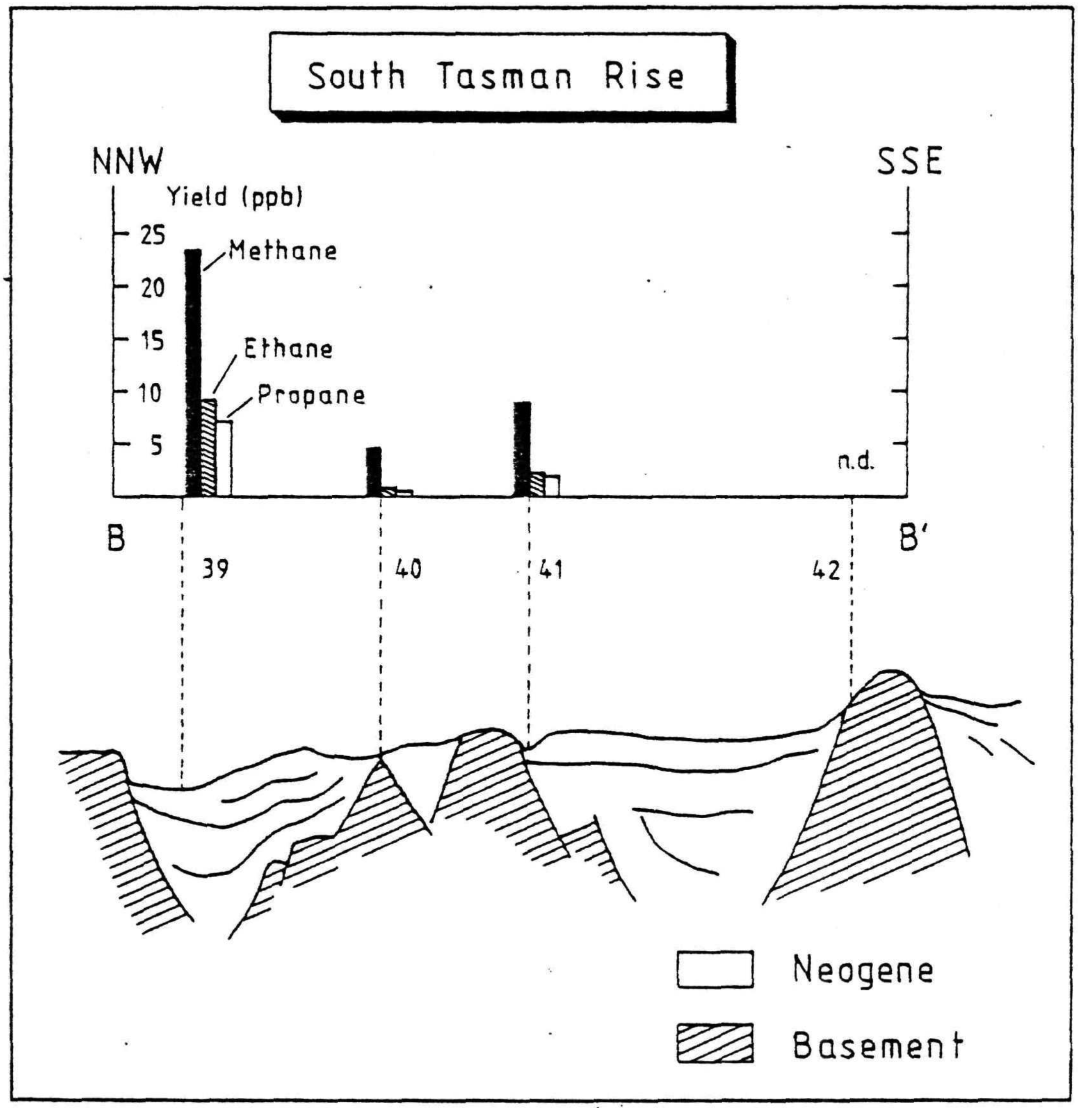

Figure 74: Concentration profiles and schematic cross section, South Tasman Rise (SO-36-39 to -42)

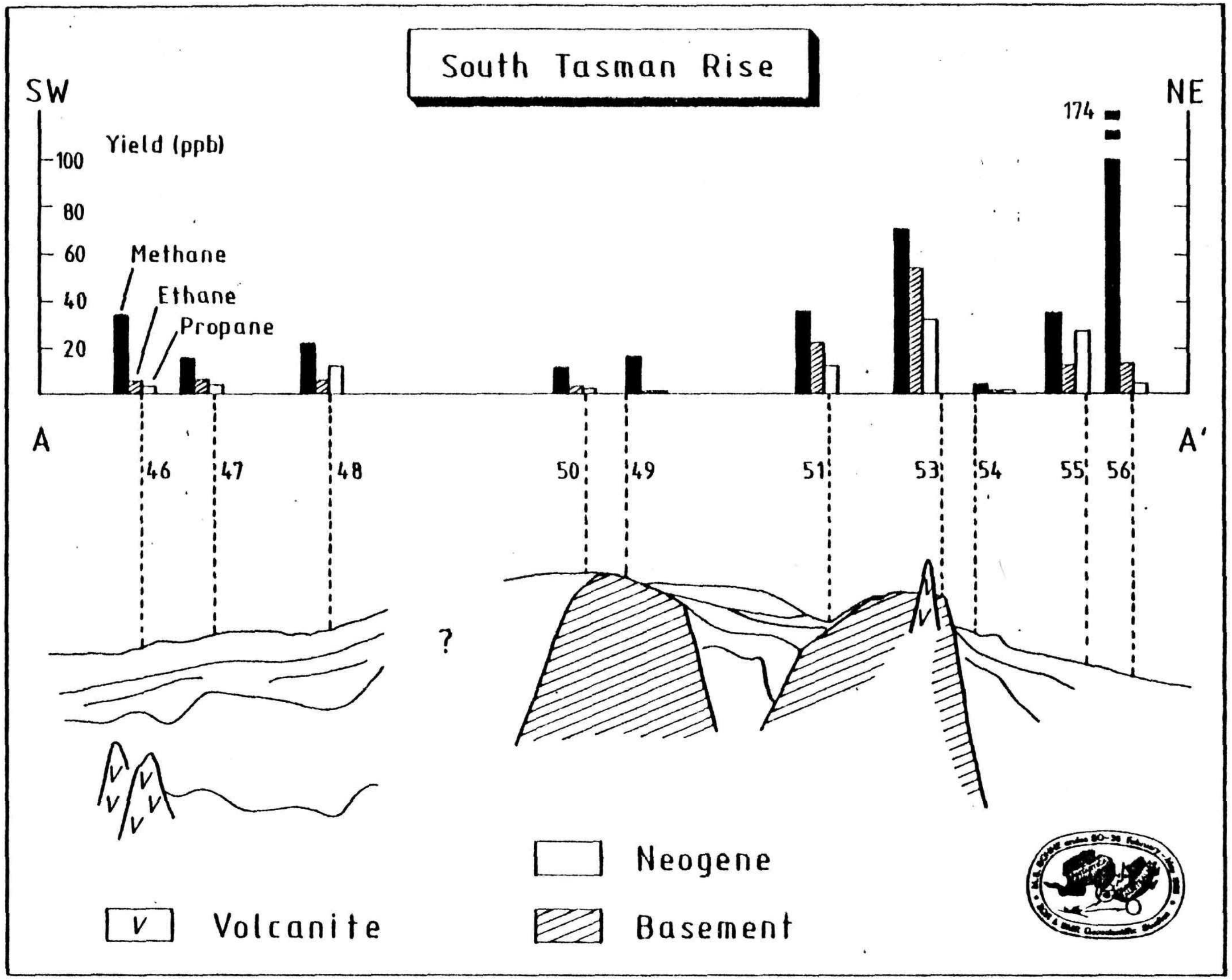

Figure 75: Concentration profiles and schematic cross section, South Tasman Rise (SO-36-46 to -56)

5.5 POSITIONIERUNG UND NAVIGATION
POSITIONING AND NAVIGATION
by L. Gorling

5.5.1 MEßGEBIETE, NAVIGATIONSHILFEN UND FIXBESTIMMUNGSVERFAHREN

Die Beschreibung der Positionierung wird wegen der unterschiedlichen geographischen Lage der Meßgebiete (South-Tasman-Rise and Lord-Howe-Rise) und der unterschiedlichen Aufgabenstellung der einzelnen Fahrtabschnitte (geophysik. Messungen auf den Fahrtabschnitten A und B, geolog. Beprobung im Abschnitt C) in zwei Teile gegliedert:

a) Positionierung im Gebiet westlich Tasmaniens und auf dem Tasman-Rise
   und
b) im Gebiet des Lord-Howe-Rise

In beiden Meßgebieten wurden die auf FS SONNE vorhandenen, zu einem integrierten System zusammengefaßten, Navigationshilfen eingesetzt, bestehend aus:

a) Satellitenempfänger für Satelliten des TRANSIT- oder NNSS-Systems (Typ MX-701A von Magnavox)
b) Koppelnavigationsgeräte, wie Doppler-Sonar, EM-Log und Kreiselkompaß

Wie schon auf dem 1. Fahrtabschnitt war auch im Seegebiet um Tasmania keine Radionavigation nach LORAN-C vorhanden, mit der eine laufende absolute Ortsbestimmung möglich gewesen wäre.
Der von der TU-Hannover freundlicherweise zur Verfügung gestellte und von ihr betriebene Satellitenempfänger nach dem neuartigen GPS-Navigationssystem (Global-Positioning-System), entfiel für die Abschnitte B und C gänzlich, da der Empfänger leider für andere Meßreisen benötigt wurde.

Eine absolute Ortsbestimmung wurde deshalb nur nach dem von der BGR entwickelten Programmpaket SATFIX (ausführliche Beschreibung s. Gorling, Roeser Geol. Jb. (im Druck)) zur Berechnung von Satellitenfixen nach dem TRANSIT-System durchgeführt.

Dieses Verfahren wurde schon mit großem Erfolg auf den Meßfahrten SO-23 und SO-27 eingesetzt (s. Fahrtberichte). Durch einen besonderen Algorithmus zur Berechnung des Fixes unter Einfluß des sich durch eine Wasserströmung verdriftenden Schiffes, wird versucht, die Abhängigkeit des Satellitenfixes von dieser Geschwindigkeit weitgehend zu beseitigen. Dadurch können bessere Positionen und vor allem bessere Stromvorhersagen gemacht werden. Durch Eingabe dieser Stromwerte in die integrierte Navigationsanlage kann eine 30 - 50 % bessere Positionierung online erreicht werden.

5.5.2 AUFDATIERUNGEN UND STROMVERHALTEN IM SEEGEBIET VON WEST TASMANIA UND AUF DEM SÜD TASMAN RÜCKEN

In diesem Seegebiet sind auf dem 2. Fahrtabschnitt geophysikalische Messungen mit digitaler Mehrspurseismik, Gravimetrie, Magnetik und Bathymetric (Sea beam und Subbottom profiler); auf dem 3. Fahrtabschnitt schwerpunktmäßig geologische Beprobungen und bathymetrische Messungen durchgeführt worden.
Auf dem 2. Fahrtabschnitt mit Schwerpunkt Geophysik wurde großer Wert auf die online-Positionierung gelegt. Insbesondere galt es, den Schußpunktabstand so genau wie möglich konstant zu halten, um eine kontinuierliche Überdeckung zu erhalten.
Leider war die See oft so rauh (8-10 Beaufort), daß sich unter dem Schwinger des Doppler-Sonars Luftblasen bildeten. Das Gerät täuschte dann Geschwindigkeitsschwankungen von 1 - 2 kn innerhalb 30 Sekunden vor, die eine genaue Koppelnavigation oder Stromvorhersagen praktisch unmöglich machten.
Aus diesem Grund mußte sehr oft mit dem EM-Log gefahren werden, dessen Prinzip zwar einen wesentlich ruhigeren Geschwindigkeitsverlauf ergibt, im Gegensatz zum Doppler-Sonar jedoch durch seine Anordnung aber nur Geschwindigkeiten parallel zur Längsachse des Schiffes mißt. Durch Wind und Wasserströmungen hervorgerufene Querabweichungen können also nicht gemessen werden. Schwankungen von 0.1 - 0.2 kn/min, oft aber auch mehr, wurden bei diesen Wetterbedingungen auch mit dem EM-Log festgestellt.

Unsere Beobachtungen zeigten deshalb auch, daß die nach dem SATFIX-Verfahren berechneten Aufdatierungen und Stromvorhersagen gut sind, wenn die Profilrichtung mit der Stromrichtung zusammenfällt, kein wechselnder Windeinfluß vorhanden ist und die Intervalle zwischen Aufdatierungen nicht zu groß sind (60 - 90 Min.). Aus diesem Grund wurde in Kurvenfahrten zwischen den Profilen der Stromwert jedesmal zu Null gesetzt und die Methode der Stromberechnungen nach Beginn des Profils wieder von vorn begonnen.

Die Tagesmittel der Aufdatierungsbeträge lagen zwischen 800 - 1.500 m, aber auch Beträge von 3 km und mehr wurden beobachtet, deren Ursache oben geschildert worden ist. Hinzu kommt, daß oft lange Beobachtungslücken (2-3 Std.) zwischen brauchbaren Satellitendurchgängen vorhanden waren.

Während einiger Phasen von ruhiger See konnte das Doppler-Sonar im Water-Track operieren. Es zeigte sich hier, daß die Beträge der Stomgeschwindigkeiten kaum größer als 1 Knoten waren (meistens zwischen 0.5 - 0.8 kn) und Richtung und Betrag konstant blieben.

Bei der geologischen Beprobung wurde kein großer Wert auf eine gute online-Positionierung gelegt, da die einzelnen von der seismischen Vermessung ausgesuchten Probenpunkte anhand der Sea-Beam- und Echolotaufzeichnungen wiedergefunden wurden. Außerdem wurde beim Fahren mit dem EM-log an den einzelnen Stationspunkten kein Stromwert eingegeben. Versätze von 3-5 km, manchmal sogar 5-10 km, waren deshalb die Folge.

5.5.3 AUFDATIERUNGEN UND STROMVERHALTEN IM GEBIET DES LORD HOWE RISE

In diesem Seegebiet war das Wetter so schlecht, daß generell dieselben Aussagen über den Einsatz des Doppler-Sonars und des EM-Logs wie in 5.5.2 gemacht werden können.

Der Einsatz von GPS im 1. Abschnitt von SO-36 zeigte aber, daß das Stromverhalten sich von dem des Süd-Tasman-Rückens erheblich unterscheidet. Während nämlich die Stromvorhersagen über einige Stunden konstant blieben, konnte sich der Betrag aber sehr schnell ändern. Stromänderungen von 0.5 kn/30 min waren nicht selten, manchmal wurden auch Änderungen von 1 kn/30 min festgestellt.

Wird unter diesen Bedingungen das EM-Log eingesetzt, ergeben sich bei häufigen Kurswechseln, wie sie bei der geologischen Beprobung üblich sind, unzuverlässige Stromverhersagen, die nachfolgende Aufdatierungen groß machen. Aufdatierungsbeträge von 1.8 - 3.2 km waren deshalb die Folge, in Ausnahmefällen sogar mehr als 8 km. Beim Einsatz vom Doppler-Sonar konnten Stromwerte von 0.2 - 1.8 kn beobachtet werden. Durch die größere Nähe zum Äquator betrug die Beobachtungslücke zwischen aufdatierbaren Satellitenfixen oft mehr als 4 Stunden, im Mittel konnte alle 2 Stunden ein Fix aufdatiert werden.

5.6 GRAVITY

by J. Fritsch

5.6.1 INSTRUMENTAL CONSIDERATION

As usual on BGR cruises, the gravity measurements were performed with two gravitymeters. On former cruises both gravitymeters were of type GSS 3 (ASKANIA) and were mounted on the same stabilized platform (ANSCHÜTZ). So their gravity outpout could be compared directly because of the same accelerations perceived by both instruments. Any differences beween their gravity outpout could be explained by their different drift and/or by inaccurate scale values. The drift can be taken into account after completion of the cruise when the real gravity difference between starting and final points in the ports is compared with the measured ones by the gravitymeters. The influence of inaccurate scale values on the gravity difference between the gravitymeters can be seen if this difference is proportional to the difference between actual gravity and harbour value, i.e. including the Eötvös effect.

On cruise SO-36 we used for the first time the new developed sea gravitymeter-system KSS 31 (see cruise report of Leg 1 of SONNE cruise SO-36) together with the sea gravitymeter GSS 3 No. 53 on the ANSCHÜTZ-platform. The new gravitymeter has its own platform.
The differences of the gravitymeter outputs include in this case also the effects of different deviation from the vertical due to the different behaviour of both platforms.

Figure 76 shows the curves of differences in the gravity output (with time marks every hour), the curve of difference between actual gravity and reference value from next harbour (thin line) and for the quotient of both values. Full scale is 100 mGal for the gravitymeter differences, 1000 mGal for the harbour related gravity difference and 0.2 for the quotient.

It can be seen from diagrams a) und b) (data from SO-36/1) that after drift correction the gravimeter differences become small, but the remaining values apparantly are still correlated to the harbour related gravity differences, i.e. the scale value at least for one gravitymeter is not reliable.

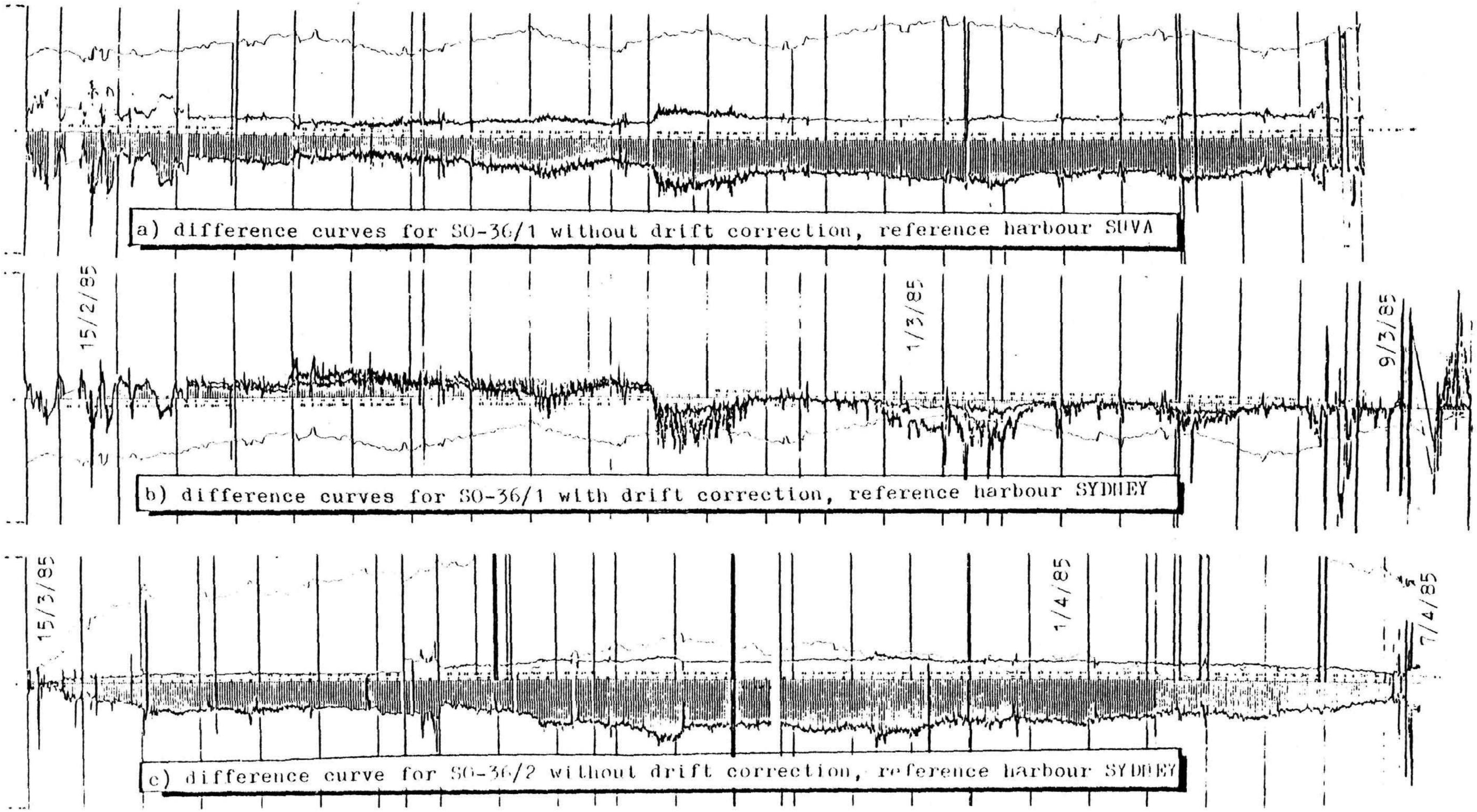

Figure 76: Gravity differences between KSS 31/22 and GSS 3/53

Regarding diagram c) with uncorrected data of SO-36/2, there is a strong correlation between the curves of the gravitymeter differences and the harbour related gravity differences. Therefore, we have to change one or both scale values of the gravitymeters.
Apart from further processing of the data (drift correction), it cannot excluded that there is a dependance of the scale value from the absolute gravity value.
Taking into consideration these results, we can estimate that the internal accuracy of the gravitymeters for anomalies of short wavelength is in the range of 1 mGal (see short-time variations in the curve). For larger wavelengths we cannot be sure of the exact datum within several mGals.

5.6.2 FIRST RESULTS

As noted already in the cruise report of the 1st leg from Suva to Sydney, the output of the new system KSS 31 is by far better than that from the old gravitymeter GSS 3. Therefore, the following results were obtained using gravity data from KSS 31 only.
The gravity anomalies (free air anomalies) are calculated from the International Gravity Formula of 1967. For every line the gravity anomalies are plotted together with the seismic line drawings (see Figures 28 to 42).

The gravity anomalies depend on the horizontal variations of several density boundaries:

- seafloor with a density contrast of appr. 1.30 g/ccm between seawater and sediments;
- internal sedimentary boundaries with relatively small density contrasts up to 0.3 g/ccm;
- basement surface with a density contrast of up to 0.6 g/ccm depending of the upper sedimentary layer;
- Moho with a density contrast of appr. 0.5 g/ccm between crustal material (of oceanic or continental origin) and mantle material.

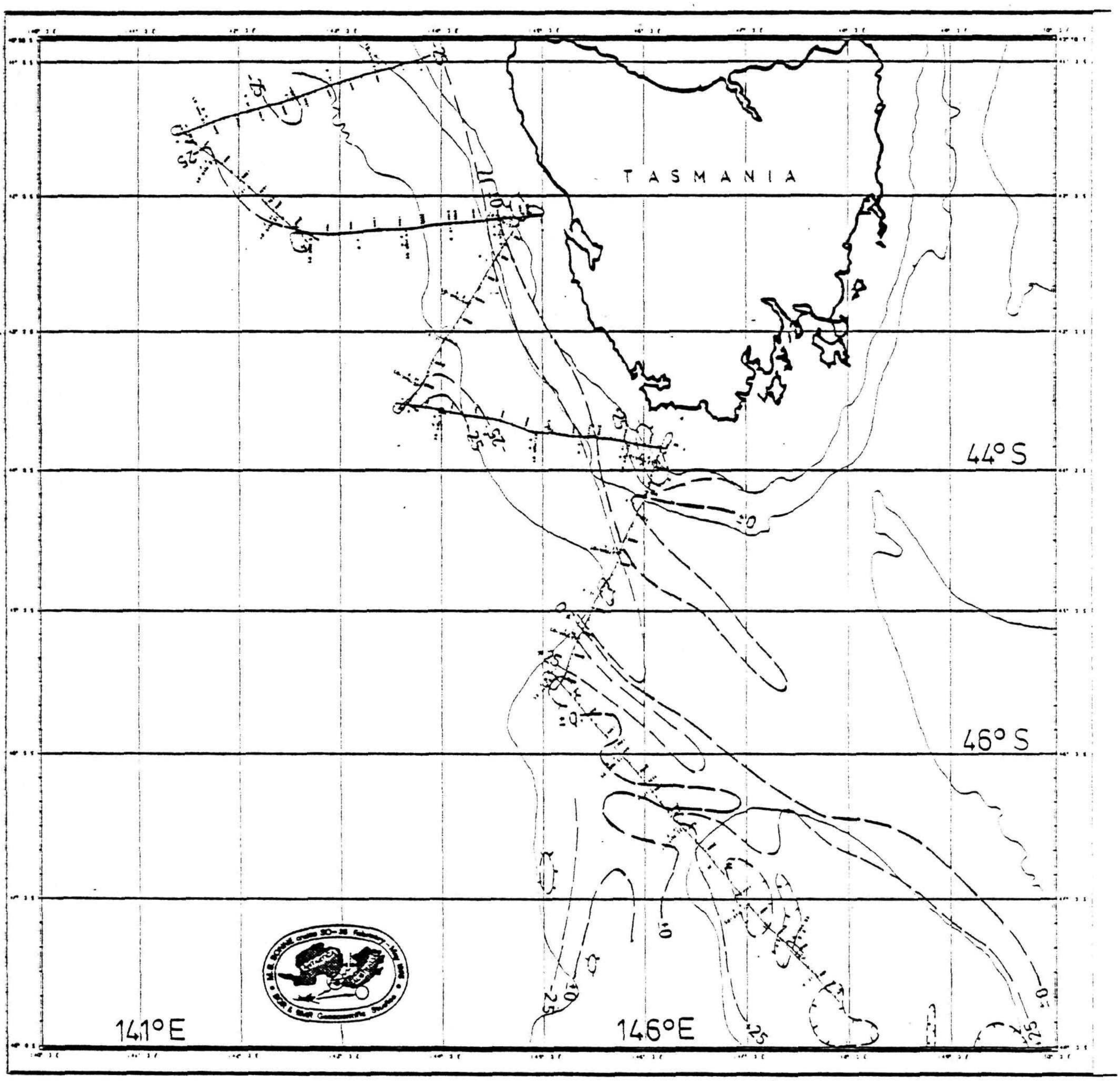

Figure 77: Preliminary gravity map off Western Tasmania

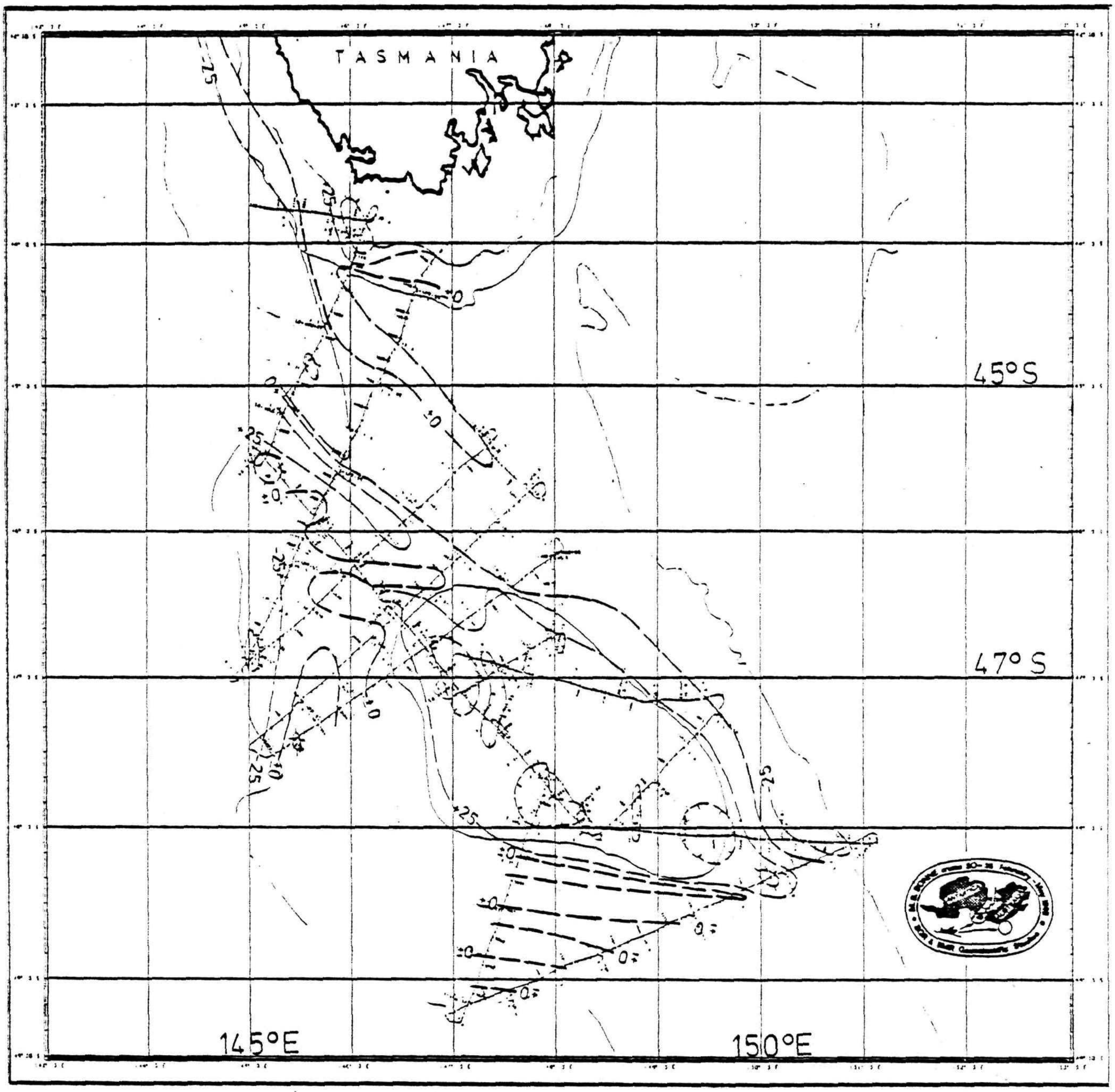

Figure 78: Preliminary gravity map of the South Tasman Rise

Without going into detailed calculations, one can see from Figures 28 to 42, especially for the area of the South Tasman Rise, that the gravity anomalies reflect mainly the basement surface.

The gravity map with isolines every 25 mGals has been drawn in two parts:
- Western Tasman area (Figure 77),
- South Tasman Rise (Figure 78).

West of Tasmania we observe the descend of the gravity anomalies towards the sea. Only where the lines are close enough to the coast we see pronounced gravity highs which can be explained as the positive part of the edge effect accompanying the crustal block of Tasmania.

On the South Tasman Rise there are in general positive anomalies with superposed undulations of 25 mGal amplitude. Due to the large spacing of the lines, it is not possible to draw the isanomalies on the Rise with certainty. The two relative anomaly lows at latitude 47 degree south show a north-south trend. The general trend of the isolines is NW-SE according to the morphology of the Rise and its prolongation towards the Tasman Island.

Another interesting feature is the succession of positive and negative anomalies with amplitudes less than 25 mGal in the southwestern corner of the Rise.

5.7 MAGNETIC ANOMALIES SOUTH AND WEST OF TASMANIA

by H.A. Roeser

For the area off Tasmania foreign magnetic data are available in the following forms:

1. Map of the BMR surveys of the years 1970 - 1973 in the scale 1 : 1,000,000 in conformal Lambert projection.
2. Map with the magnetic anomalies available in the Lamont data bank in the scale 1 : 2,500,000 at 46 degrees latitude.
3. Magnetic anomaly map of Australia in the scale 1 : 2,500,000; presumably conformal Lambert projection.

The first map is of excellent quality, whereas the third map is useless because the line spacing is to large. The Lamont map suffers from inadequately reduced data with to large point spacing on the lines. Nevertheless it is quite useful.

West of Tasmania three areas can be distinguished by their magnetic anomaly character:
In a 30 km wide strip along the coast the anomalies have short periods, in part they are higher than 500 nT. This strip continues in direction NNW to the Australian mainland, with decreasing anomaly amplitudes in the northern part. These anomalies may be caused by shallow magmatism.
To the west the anomalies are weaker and smoother. Its western boundary is approximated by a line through the points 40° S, 140° E - 42,5° S, 143° E - 45° S, 144,5° E. In this area some N-S striking anomalies south of King Island should be mentioned. Due to the large line spacing it is not clear whether they are continuous. They may indicate intrusions along N-S striking fault zones. Otherwise shallow magnetic bodies do not exist, and the upper part of the crusts consist mainly of sediments or weakly magnetized metamorphic rocks.
To the west an area is adjoining whose anomalies look like sea-floor spreading anomalies. Because of the large line spacing reliable correlations cannot be seen. Although it is assumed that this is a shear zone the mere existence of the anomalies indicates that the blocks cannot be very small.

The first anomaly seaward ot the "quiet zone" requires a normal magnetization. The same is observed for all the slope anomalies along many continental margins whose nature is not known until now. The existence of a slope anomaly along a sheared margin would be very important.

Due to the large line spacing the data from the cruise SO-36 (Figure 79) cannot contribute considerably to the understanding of the magnetic anomalies in this area. In some cases volcanic features are observed by the reflection seismic measurements, however, most of them cannot be correlated with magnetic anomalies.

For the area south of Tasmania only the Lamont map is available. The data quality is so poor that the map is nearly useless. Our data allow the distinction of several magnetic provinces (Figure 80):
In the northern part of the trough between Tasmania and the South Tasman Rise the magnetic anomalies are weak, their mean level is near 0. South of this area the anomalies become larger, and the mean anomaly values increase. The deeper parts of the rise show mainly weak anomalies. The mean level of the field is at or slightly below zero. The higher level of the field indicates a certain magnetization over a large depth range of the crust (cf. Report on Cruise SO-36, Lord Howe Rise). This may be considered as an indication of the continental character of the crust of large parts of the South Tasman Rise.
In some places of the area shallower than 2,000 m we observe narrow anomalies of up to 500 nT which may be caused by shallow intrusions. Some of the Lamont lines show similar anomalies at 148.5° E also south of the shallow part of the South Tasman Plateau.

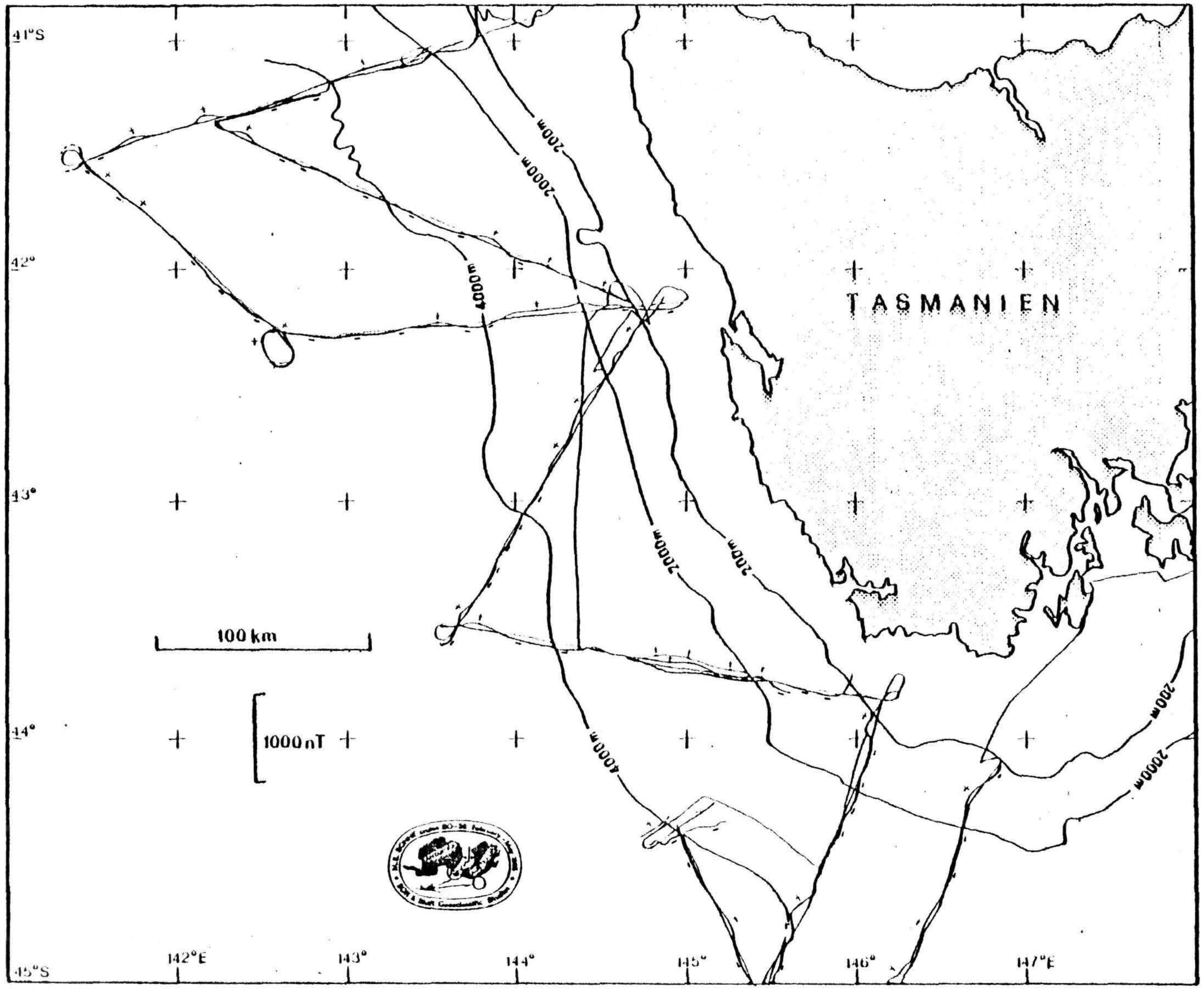

Figure 79: Magnetic anomalies off Western Tasmania

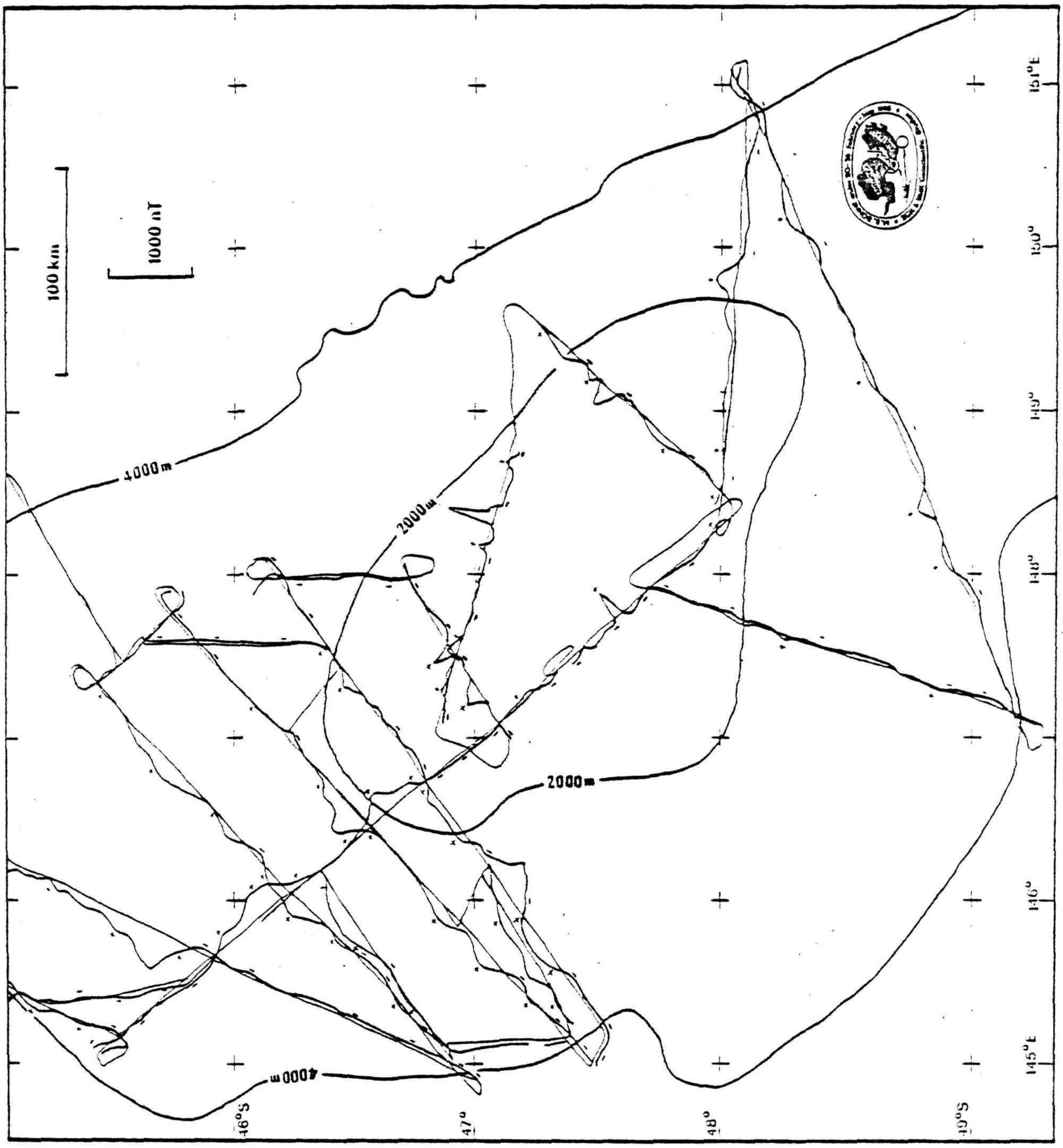

Figure 80: Magnetic anomalies on the South Tasman Rise

6. FINAL REMARKS

The 2nd and 3rd Leg of SONNE cruise SO-36 were designed to investigate the structure, geological development and hydrocarbon potential of two frontier areas, namely the western and southwestern continental margin of Tasmania and the South Tasman Rise.
Despite some very bad weather in the "Roaring Forties", seismic lines with a total length of 4,290 km were measured, 10,660 km were surveyed with magnetics, gravitymeter, sea-beam and 3.5 kHz subbottom profiler and 63 stations were sampled by dredging and coring.
This results would not have succeeded without the expertise of the officers and crew of R/V SONNE and the excellent work and efforts of technicians and scientists aboard.
In particular, K. Hinz acknowledges the assistance of the German Embassy, the German Consulate General, the involved Australian government agencies, the Projektleitung Rohstofforschung der KfA Jülich and BGR's administration in the preparation of the cruise.
Although a great deal of work remains to be done by both the BGR, Hannover, and the BMR, Canberra, to fully evaluate the results of the R.V. SONNE cruise, the results at hand already improved the knowledge about the geological structure and development of the two frontier areas considerably, and enabled us to reassess the petroleum potential of the west Tasmanian margin.
SONNE cruise No. 36 was financed by the Federal Ministry of Research and Technology .

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18. Abstract

The 2nd and 3rd Leg of SONNE cruise SO-36 were designed to investigate the structure, geological development and hydrocarbon potential of two frontier areas, the western continental margin of Tasmania and the South Tasman Rise.
Seismic lines with a total length of 4,290 km were measured, 10,660 km were surveyed with magnetic, gravity, sea-beam and 3.5 kHz sub-bottom profiler, and 63 stations were sampled by coring and dredging.

Seven regional seismic unconformities were recognized and sampled, and the structural style of both areas was established.
Thermogenic hydrocarbons in substantial concentration were found in the surface sediments at the western Tasmanian slope.

19. Keywords

Tasmania, South Tasman Rise, seismic unconformities, pre-Tertiary rocks, transtension, thermogenic hydrocarbons, magnetics, gravity

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18. Kurzfassung:

Auf dem 2. und 3. Fahrtabschnitt der SONNE-Fahrt SO-36 sollten mit Hilfe geophysikalischer Messungen und geologisch-geochemischer Studien der geologische Bau und das Kohlenwasserstoff-Potential des Kontinentalrandes von West Tasmania und des Süd Tasman Rückens untersucht werden.
Profile mit einer Gesamtlänge von 4.290 km sind reflexionsseismisch erkundet worden, 10.660 km sind magnetisch, gravimetrisch und mit Seabeam sowie dem 3.5 kHz Sedimentechograph vermessen worden. Auf 63 Stationen sind geologisch-geochemische Studien durchgeführt worden.
Sieben regionale Schichtlücken sind sind nachgewiesen worden. Der geologische Baustil beider Gebiete konnte in groben Zügen geklärt werden.
Thermogene Kohlenwasserstoffe in beachtlicher Konzentration sind in den meeresbodennahen Sedimenten des Kontinentalabhanges von West Tasmania nachgewiesen worden.

19. Schlagwörter:
Tasmania, Süd Tasman Rücken, Schichtlücken, prä-tertiäre Gesteine, Transtension, thermogene Kohlenwasserstoffe, Magnetik, Gravimetrie

20.

21.

22. Preis:

HYDROCARBON YIELD DATA (WT. PPB)

STA NR	DEPTH	SUM Y	YC1	YC2	YC3	YIC4	YNC4	YIC5	YNC5
SO-36-1-1	105	874.1	363.8	119.5	95.2	55.0	42.2	138.4	59.8
SO-36-1-2	60	1363.3	585.6	185.1	116.7	73.7	46.7	193.9	161.7
SO-36-2-1	150	1044.3	550.5	119.2	110.1	53.6	39.4	31.3	140.1
SO-36-2-3	245	191.4	101.6	22.5	17.9	7.7	12.5	15.2	14.0
SO-36-3-1	43	653.2	324.6	103.6	96.6	36.0	19.2	15.8	57.5
SO-36-4-1	5	80.1	58.3	13.2	5.2	1.3	2.2	0.0	0.0
SO-36-5-1	150	755.5	491.4	121.2	57.9	16.7	26.2	18.6	23.5
SO-36-5-2	65	154.0	98.3	22.3	10.2	4.5	3.5	8.7	6.5
SO-36-6-1	225	147.9	96.7	19.4	9.3	1.3	2.3	10.8	8.1
SO-36-7-1	350	86.1	37.7	14.2	7.2	4.6	5.6	8.3	8.5
SO-36-7-2	150	139.9	56.2	25.2	12.1	8.5	7.1	13.6	17.2
SO-36-8-1	265	272.2	99.7	43.1	20.9	14.1	10.8	36.9	46.8
SO-36-8-2	150	160.1	65.5	32.6	18.9	7.0	9.6	11.4	15.1
SO-36-9-1	245	105.5	105.5	0.0	0.0	0.0	0.0	0.0	0.0
SO-36-10-3	225	34.6	30.1	4.4	.1	0.0	0.0	0.0	0.0
SO-36-11-2	114	142.1	62.8	23.9	11.4	6.8	5.8	15.9	15.5
SO-36-12-1	245	202.8	104.6	35.5	16.6	1.1	10.2	12.1	22.6
SO-36-13-1	400	256.1	116.4	46.9	24.3	14.5	14.0	5.6	34.4
SO-36-14-1	295	1032.5	468.2	189.3	92.1	63.9	51.7	29.7	137.6
SO-36-15-1	395	52.8	29.3	11.5	6.1	2.6	2.7	.3	.4
SO-36-16-1	350	124.9	51.3	22.4	11.2	6.8	7.2	6.8	19.2
SO-36-17-1	350	179.9	83.5	30.8	15.1	8.4	7.5	16.5	18.1
SO-36-18-1	0	297.9	127.6	48.9	36.1	19.2	8.1	20.9	37.0
SO-36-19-1	70	77.1	34.1	14.7	7.5	3.9	3.8	5.8	7.4
SO-36-20-1	20	66.1	31.9	11.7	5.7	3.3	2.8	4.7	5.9
SO-36-21-1	155	42.1	23.8	8.3	6.1	2.0	1.8	0.0	0.0

HYDROCARBON YIELD DATA (WT. PPB)

STA NR	DEPTH	SUM Y	YC1	YC2	YC3	YIC4	YNC4	YIC5	YNC5
SO-36-22-2	70	20.6	14.9	4.4	.6	.5	.3	0.0	0.0
SO-36-22-1	30	39.1	19.7	6.4	5.4	1.5	1.6	2.0	2.5
SO-36-23-1	0	519.6	190.2	96.2	46.2	41.9	20.6	50.1	74.3
SO-36-23-2	75	183.1	82.4	28.5	32.1	7.1	6.5	11.7	14.8
SO-36-24-1	180	21.5	15.0	3.6	2.9	0.0	0.0	0.0	0.0
SO-36-21-2	55	25.0	16.5	5.4	2.7	.1	.2	0.0	0.0
SO-36-21-3	30	19.6	13.3	4.0	2.0	.2	.2	0.0	0.0
SO-36-25-1	335	36.8	20.7	5.4	5.4	1.1	1.3	1.3	1.6
SO-36-11-1	50	241.9	122.8	41.1	20.7	12.5	12.2	14.4	18.2
SO-36-26-1	105	275.7	94.8	46.0	26.1	21.6	8.5	38.5	40.1
SO-36-9-2	143	105.6	49.9	20.5	9.9	5.5	4.8	4.3	10.8
SO-36-27-1	255	117.5	70.5	20.4	11.2	3.4	3.5	3.7	4.7
SO-36-27-2	90	67.9	35.8	10.7	6.0	2.8	3.5	4.0	5.1
SO-36-8-3	45	188.9	80.7	35.1	16.2	11.5	8.3	16.3	20.7
SO-36-10-2	50	165.8	79.7	28.8	14.3	7.8	6.7	12.5	15.9
SO-36-10-1	150	146.5	63.0	27.8	14.0	5.2	6.6	13.2	16.7
SO-36-16-4	50	233.2	143.0	37.3	17.4	7.2	7.9	9.0	11.5
SO-36-24-3	50	111.1	44.2	18.7	8.9	8.2	5.2	11.4	14.5
SO-36-30-1	50	13.7	12.2	1.3	.2	0.0	0.0	0.0	0.0
SO-36-24-2	90	10.1	8.3	1.6	.2	0.0	0.0	0.0	0.0
SO-36-18-4	50	473.5	278.8	80.2	39.1	17.0	15.2	19.1	24.2
SO-36-30-2	150	9.8	8.5	1.2	.1	0.0	0.0	0.0	0.0
SO-36-12-2	150	80.6	41.2	14.2	6.7	3.6	3.1	5.2	6.6
SO-36-6-3	150	526.4	342.6	86.9	43.2	12.1	16.0	11.3	14.4
SO-36-9-3	45	91.6	42.0	15.1	7.1	4.3	3.8	8.5	10.8
SO-36-2-2	25	554.6	367.6	90.7	42.1	11.5	14.6	12.5	15.8

HYDROCARBON YIELD DATA (WT. PPB)

STA NR	DEPTH	SUM Y	YC1	YC2	YC3	YIC4	YNC4	YIC5	YNC5
SO-36-6-2	50	259.5	164.5	41.4	19.3	8.2	8.1	8.0	10.1
SO-36-25-3	80	98.7	47.9	16.9	14.2	3.6	3.5	5.5	7.0
SO-36-26-2	25	73.6	41.8	12.2	6.1	2.3	2.3	3.9	4.9
SO-36-38-1	160	39.3	12.6	6.2	7.3	2.3	1.6	4.1	5.2
SO-36-39-1	260	53.8	23.5	9.1	6.9	2.5	2.6	4.1	5.1
SO-36-40-1	215	4.4	4.4	0.0	0.0	0.0	0.0	0.0	0.0
SO-36-41-1	205	12.9	8.1	2.1	1.8	.4	.4	0.0	0.0
SO-36-46-1	215	43.4	34.0	6.2	3.1	0.0	0.0	0.0	0.0
SO-36-47-1	335	26.8	15.9	4.5	4.2	1.2	1.0	0.0	0.0
SO-36-48-1	275	47.7	21.8	7.3	12.6	1.4	1.4	1.5	1.9
SO-36-49-1	250	16.6	16.6	0.0	0.0	0.0	0.0	0.0	0.0
SO-36-50-1	320	24.7	11.9	4.1	2.7	1.3	1.0	1.7	2.1
SO-36-51-1	250	118.0	34.8	19.6	12.7	10.5	3.5	16.3	20.6
SO-36-53-1	210	312.5	70.0	53.2	31.7	32.2	12.2	49.9	63.2
SO-36-54-1	60	12.2	4.9	1.4	.9	.5	.5	1.8	2.2
SO-36-55-1	735	79.1	33.5	10.5	25.7	1.6	1.4	2.8	3.5
SO-36-56-1	435	92.3	69.5	13.9	4.5	.5	1.1	1.2	1.6
SO-36-56-2	235	402.1	174.6	64.9	35.9	28.1	11.2	38.9	48.4
SO-36-56-3	65	25.0	14.7	4.2	4.5	.8	.7	0.0	0.0
SO-36-55-2	300	51.7	24.6	7.1	12.5	1.4	1.3	2.1	2.7
SO-36-58-1	250	29.7	17.8	7.1	3.8	.4	.3	.1	.2
SO-36-59-1	150	8.8	5.7	1.8	1.0	.1	.1	.0	.0
SO-36-60-1	250	10.8	7.0	2.4	1.1	.1	.1	.0	.0
SO-36-61-1	265	12.3	8.7	2.5	1.1	0.0	0.0	0.0	0.0
SO-36-62-1	65	96.6	42.9	10.8	7.0	5.8	2.4	12.2	15.5

RELATVE HYDROCARBON PERCENTAGES (VOL. %)

STA NR	DEPTH	%C1	%C2	%C3	%IC4	%NC4	%IC5	%NC5
SO-36-1-1	105	68.2	12.0	6.5	2.8	2.2	5.8	2.5
SO-36-1-2	60	69.8	11.8	5.1	2.4	1.5	5.1	4.3
SO-36-2-1	150	76.7	8.9	5.6	2.1	1.5	1.0	4.3
SO-36-2-3	245	76.9	9.1	4.9	1.6	2.6	2.6	2.4
SO-36-3-1	43	72.7	12.4	7.9	2.2	1.2	.8	2.9
SO-36-4-1	5	85.2	10.3	2.7	.5	.9	0.0	0.0
SO-36-5-1	150	82.0	10.8	3.5	.8	1.2	.7	.9
SO-36-5-2	65	82.1	9.9	3.1	1.0	.8	1.6	1.2
SO-36-6-1	225	83.4	8.9	2.9	.3	.5	2.1	1.6
SO-36-7-1	350	69.0	13.9	4.8	2.3	2.9	3.4	3.4
SO-36-7-2	150	65.8	15.7	5.1	2.7	2.3	3.5	4.5
SO-36-8-1	265	63.8	14.7	4.9	2.5	1.9	5.3	6.7
SO-36-8-2	150	65.3	17.4	6.9	1.9	2.6	2.5	3.3
SO-36-9-1	245	100.0	0.0	0.0	0.0	0.0	0.0	0.0
SO-36-10-3	225	92.2	7.2	.1	0.0	0.0	0.0	0.0
SO-36-11-2	114	69.4	14.1	4.6	2.1	1.8	3.9	3.8
SO-36-12-1	245	74.3	13.5	4.3	.2	2.0	1.9	3.6
SO-36-13-1	400	69.6	14.9	5.3	2.4	2.3	.7	4.6
SO-36-14-1	295	69.6	15.0	5.0	2.6	2.1	1.0	4.5
SO-36-15-1	395	74.2	15.5	5.6	1.8	1.9	.2	.2
SO-36-16-1	350	66.4	15.5	5.3	2.4	2.6	2.0	5.5
SO-36-17-1	350	70.9	13.9	4.7	2.0	1.8	3.1	3.4
SO-36-18-1	0	67.8	13.9	7.0	2.8	1.2	2.5	4.4
SO-36-19-1	70	68.3	15.7	5.5	2.2	2.1	2.6	3.3
SO-36-20-1	20	71.8	14.1	4.7	2.1	1.7	2.3	3.0
SO-36-21-1	155	75.3	14.0	7.0	1.8	1.6	0.0	0.0

RELATVE HYDROCARBON PERCENTAGES (VOL. %)

STA NR	DEPTH	%C1	%C2	%C3	%IC4	%NC4	%IC5	%NC5
SO-36-22-2	70	83.1	13.0	1.2	.8	.4	0.0	0.0
SO-36-22-1	30	72.8	12.6	7.3	1.5	1.7	1.6	2.1
SO-36-23-1	0	62.7	16.9	5.5	3.8	1.9	3.7	5.4
SO-36-23-2	75	68.5	12.7	9.7	1.6	1.5	2.2	2.7
SO-36-24-1	180	82.6	10.7	5.8	0.0	0.0	0.0	0.0
SO-36-21-2	55	79.7	13.9	4.7	.2	.2	0.0	0.0
SO-36-21-3	30	81.8	13.0	4.4	.3	.3	0.0	0.0
SO-36-25-1	335	76.7	10.6	7.3	1.2	1.3	1.1	1.3
SO-36-11-1	50	73.6	13.1	4.5	2.1	2.0	1.9	2.4
SO-36-26-1	105	61.1	15.8	6.1	3.8	1.5	5.5	5.8
SO-36-9-2	143	70.5	15.4	5.1	2.1	1.8	1.3	3.4
SO-36-27-1	255	78.9	12.1	4.5	1.0	1.1	.9	1.2
SO-36-27-2	90	75.2	12.0	4.6	1.6	2.0	1.9	2.4
SO-36-8-3	45	67.5	15.7	4.9	2.7	1.9	3.0	3.8
SO-36-10-2	50	71.3	13.7	4.7	1.9	1.7	2.5	3.2
SO-36-10-1	150	67.5	15.9	5.4	1.5	2.0	3.1	4.0
SO-36-16-4	50	80.1	11.1	3.5	1.1	1.2	1.1	1.4
SO-36-24-3	50	65.8	14.9	4.8	3.3	2.1	3.8	4.8
SO-36-30-1	50	92.9	5.5	.5	0.0	0.0	0.0	0.0
SO-36-24-2	90	89.8	9.4	.8	0.0	0.0	0.0	0.0
SO-36-18-4	50	78.3	12.0	4.0	1.3	1.2	1.2	1.5
SO-36-30-2	150	91.1	7.0	.5	0.0	0.0	0.0	0.0
SO-36-12-2	150	73.4	13.5	4.4	1.8	1.5	2.1	2.6
SO-36-6-3	150	81.8	11.1	3.7	.8	1.1	.6	.8
SO-36-9-3	45	70.5	13.5	4.4	2.0	1.8	3.2	4.0
SO-36-2-2	25	82.3	10.8	3.4	.7	.9	.6	.8

RELATVE HYDROCARBON PERCENTAGES (VOL. %)

STA NR	DEPTH	%C1	%C2	%C3	%IC4	%NC4	%IC5	%NC5
SO-36-6-2	50	81.1	10.9	3.5	1.1	1.1	.9	1.1
SO-36-25-3	80	70.9	13.3	7.6	1.5	1.4	1.8	2.3
SO-36-26-2	25	77.6	12.1	4.1	1.2	1.2	1.6	2.0
SO-36-38-1	160	57.2	15.0	12.1	2.9	2.0	4.2	5.3
SO-36-39-1	260	68.0	14.1	7.3	2.0	2.1	2.6	3.3
SO-36-40-1	215	100.0	0.0	0.0	0.0	0.0	0.0	0.0
SO-36-41-1	205	78.9	11.0	6.3	1.1	1.1	0.0	0.0
SO-36-46-1	215	88.4	8.6	3.0	0.0	0.0	0.0	0.0
SO-36-47-1	335	77.4	11.7	7.4	1.6	1.4	0.0	0.0
SO-36-48-1	275	67.4	12.1	14.2	1.2	1.2	1.0	1.3
SO-36-49-1	250	100.0	0.0	0.0	0.0	0.0	0.0	0.0
SO-36-50-1	320	70.6	12.8	5.7	2.1	1.6	2.2	2.8
SO-36-51-1	250	56.0	16.9	7.4	4.6	1.6	5.8	7.4
SO-36-53-1	210	47.3	19.2	7.8	6.0	2.3	7.5	9.5
SO-36-54-1	60	65.5	9.9	4.5	1.9	2.0	5.3	6.7
SO-36-55-1	735	64.2	10.8	17.9	.9	.7	1.2	1.5
SO-36-56-1	435	86.8	9.2	2.0	.2	.4	.3	.4
SO-36-56-2	235	68.8	13.6	5.2	3.1	1.2	3.4	4.2
SO-36-56-3	65	77.3	11.8	8.6	1.2	1.0	0.0	0.0
SO-36-55-2	300	69.3	10.7	12.8	1.1	1.0	1.3	1.7
SO-36-58-1	250	75.3	16.0	5.8	.4	.4	.1	.2
SO-36-59-1	150	78.7	13.6	5.0	.4	.4	.1	.1
SO-36-60-1	250	79.3	14.2	4.4	.4	.3	.1	.1
SO-36-61-1	265	82.8	12.4	3.9	0.0	0.0	0.0	0.0
SO-36-62-1	65	72.0	9.7	4.3	2.7	1.1	4.5	5.8

HYDROCARBON RATIOS

STA NR	DEPTH	SUM Y	C1/CN	BERN	%WET	I/NC4	C1/C3
SO-36-1-1	105	874.1	.42	1.7	46.2	1.30	3.8
SO-36-1-2	60	1363.3	.43	1.9	41.9	1.58	5.0
SO-36-2-1	150	1044.3	.53	2.4	36.9	1.36	5.0
SO-36-2-3	245	191.4	.53	2.5	37.3	.62	5.7
SO-36-3-1	43	653.2	.50	1.6	44.0	1.88	3.4
SO-36-4-1	5	80.1	.73	3.2	27.2	.60	11.3
SO-36-5-1	150	755.5	.65	2.7	31.1	.64	8.5
SO-36-5-2	65	154.0	.64	3.0	29.2	1.29	9.6
SO-36-6-1	225	147.9	.65	3.4	25.1	.55	10.4
SO-36-7-1	350	86.1	.44	1.8	45.7	.82	5.2
SO-36-7-2	150	139.9	.40	1.5	48.5	1.19	4.7
SO-36-8-1	265	272.2	.37	1.6	47.2	1.31	4.8
SO-36-8-2	150	160.1	.41	1.3	51.0	.73	3.5
SO-36-9-1	245	105.5					
SO-36-10-3	225	34.6	.87	6.7	13.0		
SO-36-11-2	114	142.1	.44	1.8	43.3	1.17	5.5
SO-36-12-1	245	202.8	.52	2.0	37.8	.11	6.3
SO-36-13-1	400	256.1	.45	1.6	46.1	1.04	4.8
SO-36-14-1	295	1032.5	.45	1.7	45.9	1.23	5.1
SO-36-15-1	395	52.8	.55	1.7	43.8	.97	4.8
SO-36-16-1	350	124.9	.41	1.5	48.1	.94	4.6
SO-36-17-1	350	179.9	.46	1.8	42.5	1.12	5.5
SO-36-18-1	0	297.9	.43	1.5	46.8	2.37	3.5
SO-36-19-1	70	77.1	.44	1.5	46.7	1.04	4.5
SO-36-20-1	20	66.1	.48	1.8	42.6	1.19	5.5
SO-36-21-1	155	42.1	.57	1.7	43.4	1.10	3.9

HYDROCARBON RATIOS

STA NR	DEPTH	SUM Y	C1/CN	BERN	%WET	I/NC4	C1/C3
SO-36-22-2	70	20.6	.72	3.0	27.7	2.06	25.6
SO-36-22-1	30	39.1	.50	1.7	43.1	.91	3.6
SO-36-23-1	0	519.6	.37	1.3	51.9	2.03	4.1
SO-36-23-2	75	183.1	.45	1.4	47.4	1.09	2.6
SO-36-24-1	180	21.5	.70	2.3	30.3		5.2
SO-36-21-2	55	25.0	.66	2.0	33.8	.78	6.2
SO-36-21-3	30	19.6	.68	2.2	32.0	1.17	6.8
SO-36-25-1	335	36.8	.56	1.9	39.0	.86	3.8
SO-36-11-1	50	241.9	.51	2.0	41.3	1.02	5.9
SO-36-26-1	105	275.7	.34	1.3	51.9	2.53	3.6
SO-36-9-2	143	105.6	.47	1.6	44.8	1.15	5.0
SO-36-27-1	255	117.5	.60	2.2	35.3	.96	6.3
SO-36-27-2	90	67.9	.53	2.1	39.1	.80	6.0
SO-36-8-3	45	188.9	.43	1.6	46.9	1.39	5.0
SO-36-10-2	50	165.8	.48	1.9	42.0	1.17	5.6
SO-36-10-1	150	146.5	.43	1.5	46.0	.78	4.5
SO-36-16-4	50	233.2	.61	2.6	32.8	.92	8.2
SO-36-24-3	50	111.1	.40	1.6	48.1	1.57	5.0
SO-36-30-1	50	13.7	.89	8.1	11.0		71.6
SO-36-24-2	90	10.1	.82	4.5	18.1		40.6
SO-36-18-4	50	473.5	.59	2.3	35.2	1.12	7.1
SO-36-30-2	150	9.8	.86	6.3	13.7		72.9
SO-36-12-2	150	80.6	.51	2.0	40.1	1.14	6.1
SO-36-6-3	150	526.4	.65	2.6	31.6	.76	7.9
SO-36-9-3	45	91.6	.46	1.9	42.0	1.14	5.9
SO-36-2-2	25	554.6	.66	2.8	30.2	.79	8.7

HYDROCARBON RATIOS

STA NR	DEPTH	SUM Y	C1/CN	BERN	%WET	I/NC4	C1/C3
SO-36-6-2	50	259.5	.63	2.7	31.9	1.01	8.5
SO-36-25-3	80	98.7	.49	1.5	44.4	1.04	3.4
SO-36-26-2	25	73.6	.57	2.3	35.4	1.00	6.9
SO-36-38-1	160	39.3	.32	.9	58.1	1.41	1.7
SO-36-39-1	260	53.8	.44	1.5	47.3	.94	3.4
SO-36-40-1	215	4.4	1.00		0.0		
SO-36-41-1	205	12.9	.63	2.1	36.9	1.00	4.5
SO-36-46-1	215	43.4	.78	3.6	21.5		10.8
SO-36-47-1	335	26.8	.59	1.8	40.7	1.17	3.8
SO-36-48-1	275	47.7	.46	1.1	51.0	.96	1.7
SO-36-49-1	250	16.6	1.00		0.0		
SO-36-50-1	320	24.7	.48	1.8	42.9	1.33	4.5
SO-36-51-1	250	118.0	.30	1.1	57.1	2.98	2.7
SO-36-53-1	210	312.5	.22	.8	64.9	2.64	2.2
SO-36-54-1	60	12.2	.40	2.1	40.9	.96	5.3
SO-36-55-1	735	79.1	.42	.9	54.0	1.16	1.3
SO-36-56-1	435	92.3	.75	3.8	22.3	.41	15.5
SO-36-56-2	235	402.1	.43	1.7	44.5	2.51	4.9
SO-36-56-3	65	25.0	.59	1.7	41.1	1.17	3.3
SO-36-55-2	300	51.7	.48	1.3	47.5	1.07	2.0
SO-36-58-1	250	29.7	.60	1.6	39.3	1.05	4.7
SO-36-59-1	150	8.8	.65	2.0	34.9	.98	5.7
SO-36-60-1	250	10.8	.65	2.0	34.3	1.47	6.6
SO-36-61-1	265	12.3	.71	2.4	29.2		7.7
SO-36-62-1	65	96.6	.44	2.4	37.7	2.44	6.1

List of geophysical Lines of cruise SO - 36 B

Line	Start: Day 1985	Start: Time GMT	Start: Latitude S	Start: Longitude E	Start: SP No.	End: Day 1985	End: Time GMT	End: Latitude S	End: Longitude E	End: SP No.	Remarks
SO36-041	74	02:38	34°04,962'	151°17,326'		74	20:58	37°57,439'	150°09,069'		
SO36-042	74	20:59	37°34,539'	150°05,456'		75	20:00	39°35,968'	144°25,970'		
SO36-043	75	20:01	40°00,010'	144°25,844'		76	00:47	40°51,902'	144°13,117'		
SO36-044	76	05:55	41°00,747'	143°35,894'	1	77	02:29	41°32,509'	141°23,233'	3795	
SO36-045	77	04:39	41°29,465'	141°25,634'	1	77	19:39	42°19,879'	142°41,098'	2725	
SO36-046	77	23:10	42°16,130'	142°34,199'	1	78	20:00	42°08,446'	144°58,604'	3905	
SO36-047	78	22:46	42°07,842'	144°48,854'	4	79	18:50	43°33,997'	143°37,012'	3744	
SO36-048	79	20:54	43°31,274'	143°35,930'	1	80	19:06	43°50,546'	146°11,354'	4231	
SO36-049	80	22:18	43°48,232'	146°10,607'	1	81	20:40	45°32,251'	145°08,795'	4180	
SO36-050	81	23:46	45°26,409'	145°05,039'	25	83	05:55	47°23,365'	147°31,131'	5669	
SO36-050A	83	10:07	47°23,031'	147°29,447'	1	83	20:21	48°01,967'	148°20,112'	1908	
SO36-051	84	03:54	47°40,309'	147°54,940'	40	85	01:31	49°14,965'	147°05,751'	3582	Rec.3595
SO36-052	85	03:57	49°12,998'	146°59,996'	1	86	14:37	48°04,379'	150°58,225'	6221	
SO36-053	86	18:34	48°05,999'	150°58,002'	1	87	15:08	47°59,982'	148°24,983'	3676	

List of geophysical Lines of cruise SO-36 B

Line	Start: Day 1985	Start: Time GMT	Start: Latitude S	Start: Longitude E	Start: SP No.	End: Day 1985	End: Time GMT	End: Latitude S	End: Longitude E	End: SP No.	Remarks
SO36-054	87	18:41	48°01,996'	148°27,993'	1	88	08:36	47°12,735'	149°36,150'	2287	
SO36-055	88	22:46	47°08,495'	148°46,197'	2	89	13:26	46°50,799'	147°06,551'	2620	
SO36-056	89	19:21	47°06,912'	147°00,148'	5	90	05:34	46°42,012'	148°02,747'	1740	
SO36-057	90	09:19	46°45,000'	147°59,711'	1	90	16:27	46°08,007'	147°58,165'	1279	
SO36-058	90	19:35	46°08,635'	148°02,710'	10	92	00:13	47°31,144'	145°15,224'	5179	
SO36-059	92	04:01	47°25,025'	145°06,033'	1	93	12:12	45°42,041'	147°48,009'	5510	
SO36-060	93	15:18	45°45,004'	147°47,499'	1	93	21:12	45°24,484'	147°18,988'	1087	
SO36-061	94	00:37	45°24,387'	147°21,985'	11	95	02:00	46°53,098'	145°00,014'	4836	
SO36-062	95	06:12	46°59,017'	144°55,061'	1	96	18:55	44°07,240'	146°47,429'	6880	
SO36-063	97	10:12	43°15,00'	148°05,00'		99	18:50	34°00,00'	151°21,00		

List of refraction seismic stations

Station	Start: Line	Start: Day 1985	Start: Time GMT	Start: Latitude S	Start: Longitude E	Start: SP No.	End: SP No.	End: Ft.	Remarks
S036- XI	S036- 048	80	07:49	43°41,388'	144°53,854'	2117	2535	400	
S036- XII	S036- 049	81	07:26	44°32,258'	145°46,338'	1740	2020	60	
S036- XIII	S036- 049	81	09:11	44°40,361'	145°41,125'	2070	2485	60	
S036- XIV	S036- 049	81	18:42	45°23,511'	145°13,512'	3820	4165	60	
S036- XV	S036- 050A	83	11:03	47°27,461'	147°34,570'	170	540	60	
S036- XVI	S036- 058	91	04:20	46°35,447'	147°09,870'	1600	1800	60	

SO-36C

List of geophysical lines of cruise SO-36C

line number		date	time	latitude	longitude
SO-36-064	from	12.04.85	07.10	34 4.350'S	151 22.170'E
	to	13.04.85	02.30	37 58.870'S	150 17.150'E
SO-36-065	from	13.04.85	02.30	37 58.870'S	150 17.150'E
	to	14.04.85	07.22	40 51.980'S	144 12.680'E
SO-36-661	from	14.04.85	07.23	40 52.030'S	144 52.180'E
	to	14.04.85	14.20	41 5.840'S	143 19.950'E
SO-36-662	from	14.04.85	14.50	41 3.756'S	143 20.256'E
	to	14.04.85	16.10	41 1.213'S	143 29.968'E
SO-36-663	from	15.04.85	09.03	41 18.831'S	142 26.598'E
	to	15.04.85	11.03	41 21.447'S	142 14.630'E
	to	15.04.85	12.34	41 19.222'S	142 23.765'E
SO-36-067	from	15.04.85	20.07	41 22.754'S	142 16.047'E
	to	16.04.85	07.05	42 10.042'S	144 45,589'E
SO-36-068	from	17.04.85	19.12	42 20.906'S	144 24.028'E
	to	18.04.85	07.05	43 21.616'S	144 21.847'E
SO-36-069	from	21.04.85	09.45	44 16.202'S	145 2.508'E
	to	21.04.85	12.30	44 24.785'S	144 45.851'E
SO-36-070	from	21.04.85	13.20	44 26.985'S	144 47.482'E
	to	21.04.85	16.45	44 16.576'S	145 8.551'E
SO-36-071	from	22.04.85	00.37	44 21.109'S	144 56.382'E
	to	22.04.85	04.55	45 3.633'S	145 25.789'E
SO-36-072	from	22.04.85	14.57	45 13.875'S	145 22.107'E
	to	22.04.85	18.05	45 47.692'S	145 30.943'E
SO-36-073	from	23.04.85	08.10	46 21.679'S	146 12.458'E
	to	23.04.85	13.42	46 54.093'S	145 2.032'E
SO-36-074	from	23.04.85	18.16	46 54.926'S	145 7.600'E
	to	23.04.85	21.25	47 22.170'S	145 9.925'E
SO-36-075	from	24.04.85	02.23	47 22.778'S	145 16.126'E
	to	24.04.85	06.10	47 4.309'S	146 12.073'E
SO-36-076	from	25.04.85	22.24	46 22.658'S	147 33.999'E
	to	26.04.85	02.30	45 36.193'S	147 34.745'E
SO-36-077	from	26.04.85	13.30	45 30.611'S	147 29.906'E
	to	28.04.85	00.15	41 37.137'S	155 15.126'E
SO-36-078	from	28.04.85	00.15	41 37.137'S	155 15.126'E
	to	29.04.85	00.48	37 11.830'S	156 7.052'E
SO-36-079	from	29.04.85	00.58	37 11.106'S	156 7.228'E
	to	29.04.85	05.30	36 47.622'S	156 12.641'E
SO-36-080	from	30.04.85	09.00	31 58.882'S	157 0.191'E
	to	30.04.85	16.10	31 40.575'S	157 34.062'E
SO-36-081	from	30.04.85	17.32	31 46.166'S	157 33.883'E
	to	30.04.85	21.08	31 58.193'S	157 16.229'E
SO-36-082	from	1.05.85	07.30	31 53.397'S	157 24.944'E
	to	1.05.85	10.30	32 21.053'S	157 17.678'E
SO-36-083	from	1.05.85	10.30	32 21.053'S	157 17.678'E
	to	1.05.85	23.58	32 21.223'S	158 46.634'E
SO-36-084	from	1.05.85	23.58	32 21.223'S	158 46.634'E
	to	2.05.85	20.40	30 55.715'S	160 56.233'E
SO-36-085	from	3.05.85	08.35	30 32.022'S	161 27.122'E
	to	3.05.85	23.35	28 36.070'S	162 58.158'E
SO-36-086	from	3.05.85	23.55	28 35.001'S	162 58.547'E
	to	4.05.85	01.20	28 30.405'S	163 3.608'E
SO-36-087	from	4.05.85	01.37	28 30.159'S	163 2.992'E
	to	4.05.85	02.40	28 34.828'S	162 59.494'E
SO-36-088	from	4.05.85	13.33	28 34.246'S	163 2.596'E
	to	5.05.85	18.00	25 45.211'S	166 52.495'E

F.S. Sonne 10.April 1985

H.Hoffmann
R.Heygen
H.Haensel

Wartungs- und Reparaturbericht Elektronik SO 36 B
Berichtszeitraum: 15.03.85 - 10.04.85

Inhalt: Magnavox
VAX - Computer
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Verschiedenes

Verteiler: Fahrtleitung
Schiffsfuehrung
Reederei
Preussag
Bordakte

Magnavox-Anlage

Waehrend dieser Ausfahrt wurde das Sat.-Nav. System mit Doppler-Sonar zur Koppelnavigation benuetzt. Bei starkem Seegang musste des E.M.-Log verwendet werden.
Die auf dem Magnavox-Mag.-Tape gespeicherten Daten werden wieder ueberspielt, da die Benutzer ihr eigenes Datenerfassungssystem verwendet haben.
Mit den TTY-Schreibern (Silent 700) traten erneut Schwierigkeiten auf. Um weiteren, teuren Reparaturen vorzubeugen sollten zwei neue TTY-Schreiber besorgt werden.
Die Navigationsgenauigkeit lag bei ca. 500-700 m.
Bei einem kurzfristigen Ausfall der Seismiktriggerung handelte es sich um einen Kotaktfehler auf der Relaisplatine (I/O - Board).

VAX - Computer

Die VAX - Anlage arbeitete ohne Ausfaelle waehrend der gesamten Ausfahrt. Eine On - Line Datenerfassung von Sea - Beam konnte noch nicht in Betrieb genommen werden, da die Programmdokumentation von Fa. ELSA nicht mitgeliefert wurde.
Hr. Kewitsch (BGR) bekommt entsprechende Unterlagen in Sydney.

Sea - Beam

Bei Inbetriebnahme der zweiten Bandeinheit traten mehrfach Computer-Stops auf. Da die Anlage bis Sydney durchgehend in Betrieb ist, koennen weitere Tests erst waehrend der Hafenzeit durchgefuehrt werden. Die Hydrofone und Projektoren werden ebenfalls waehrend der Hafenzeit ueberprueft.
Die Power Amplifier 9 und 13 hatten bei schlechtem Wetter mehrfach Ausfall der +180 V Spannung (ca. 15 Sicherungen). Eventuell handelt es sich hierbei um einen hochohmigen Masseschluss eines Projektors.
Die Aufzeichnungen waren waehrend der ganzen Reise gut.
Bis auf die oben erwaehnten Ausfaelle lief die Sea - Beam Anlage einwandfrei.

Nautomat

Das Nautomatprogramm musste einmal neu geladen werden.
Im Monitor wurde eine Leitungsunterbrechung beseitigt.

ORE 3,5 kHz SBP

Der ORE - Subbottomprofiler lief waehrend der gesamten Reise einwandfrei. Der EPC - Recorder wurde mehrfach gereinigt.

Grundig Bord TV

Im Monitor (FNr. 1357) wurde die Bildroehre gewechselt sowie das Poti R-353 und das Rèlais R1-A ausgetauscht. Anschliessend wurde ein Grundabgleich vorgenommen.
Am Monitor (FNr. 1046) wurde ebenfalls ein kompletter Grundabgleich vorgenommen.
Die offenen Eingaenge der Kreuzschiene wurden mit 75 Ohm Widerstaenden abgeschlossen.
In der Kamera an der Speicherwinde fiel das Videosignal zeitweise aus. Es wurde die Induktivitaet L 1 und der Transistor T 33 (BSY 79) ausgetauscht.
Im Ausgangsverstaerker 7 an der Kreuzschiene wurde ein Poti gewechselt.

ELAC - Echolotanlage

Die NBS - Anlage lief waehrend der gesamten Reise ohne Stoehrung.
Die 12 kHz Sedimentlotanlage wurde nicht benutzt.

Philips RFA/RDA

Die Inbetriebnahme des zweiten Generators der RFA war mit erheblichen Schwierigkeiten verbunden, da das Geraet nur Netzseitig (220 V) angeschlossen war.
Bei saemtlichen Relais mussten die Kontakte gereinigt werden.
Im Stromkreislauf war ein Drahtbruch an der Drossel S 2 Fehlerursache fuer den Ausfall der Anlage.
Saemtliche Kabel wurden fachgerecht verlegt (einschl. Strahlendosim.- und Interfacekabel).
Zwei poroese Kuehlwasserschlaeuche wurden erneuert.
Die Sicherheitskreislaeufe mit den Lampen X-RAY ON wurden entsprechend verschaltet.
Fuer die Kuehlwasserleitungen und elektrischen Kabel wurden neue Kabelschaechte montiert.
Saemtliche Rueckwaende wurden angebaut.
Im Interface wurden die Anzeigedioden in den Originalzustand zurueckgetauscht.

zu Philips RFA/RDA

Beim Testlauf stellte sich heraus, dass das im September letzten Jahres in die RDA eingebaute Geiger-Mueller-Zaehlrohr defekt war. Wahrscheinliche Fehlerursache war die Direkteinstrahlung bei einem Winkel von 0 Grad. Aus diesem Grunde wurde der Sicherheits-mikroschalter so justiert, dass die Strahlung bei 3 Grad abgeschaltet wird.
Neue G.M.-Zaehlrohre wurden telegrafisch bestellt da nach dem Einbau des neuen Rohres kein weiterer Ersatz an Bord vorhanden ist.
Es wurden diverse Teste durchgefuehrt wobei beide Anlagen einwandfrei arbeiteten.
Ein Umstecken der Kabel ist jetzt nicht mehr notwendig.
Neue Filter fuer den Kuehlkreislauf wurden ebenfalls bestellt.

Verschiedenes

Mehrfache Reparatur und Reinigung des Minolta-Kopierers.
Es wurden div. Ersatzteile bestellt.

Reparatur des Tektronic Speicheroszillographen 466.
Die Speicherung arbeitete nicht mehr. (div. defekte Transistoren wurden ersetzt.).

Reparatur des Fluke - Frequenzcounters.
(Resetknopf und Sieben-Segment-Anzeige ausgetauscht).

Im zweiten Monitor des Omega-Empfaengers wurde ein 10 kOhm Poti ersetzt und ein 4700 uF Elco zur besseren Glaettung der +15 V Spannung eingebaut.

Bau der Triggerbox fuer die Quantum-Anlage wurde weitergefuehrt.

Bau eines neuen Seiltagebuchs fuer das Geologielabor mit Spitzen- und Niedrigwertspeicher sowie einer neuen Analoganzeige.

R. Meyer

F.S. Sonne 09. Mai 1985

H.Hoffmann
R.Heygen
H.Haensel

Wartungs- und Reparaturbericht Elektronik
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Inhalt:
VAX 11/750
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Verschiedenes

Verteiler:
Fahrtleitung
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Preussag
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Bordakte

Beim Ueberspielen von Daten im Backup-Mode von den Disc-Einheiten auf die CDC-Mag-Tape-Units traten beim Verify-Lauf (1600 BPI) CRC-Errors und recoverable redundancy Error auf. Die Fa. Transtec bestaetigte per Telex unsere Vermutung, dass es sich bei den recoverable redundancy Errors um Fehler handelte die Software maessig korregiert wurden.
Es traten bei weiteren Testlaeufen erneut CRC-Errors auf. Dabei fiel auf, dass besonders haeufig Fehler bei den Sea-Beam Daten, speziell beim Ueberspielen von langen Datenbloecken, auftraten. Ausserdem zeigten sich diese Fehler meistens auf der neuen 400 M-Byte Disc-Unit M 2351 A. Daraufhin wurde im Tape-Controller (TS 12 /Emulex) Switch 1-2 gesetzt wodurch sog. Inter-Gap-Blocks im Streaming Mode erzeugt werden. Nach dieser Massnahme traten nur noch aeusserst selten CRC-Errors auf. Nach dem Austausch der Controller (TS 12) Rev D gegen Spare-Controller (TS 12) Rev E liefen beide Mag-Tape-Einheiten fehlerfrei.
Da es sich hier eindeutig um Zeitprobleme handelt, vermuten wir, dass der Controller (TS 12) Rev E durch seine Modifikation (er wurde auf den Standard des DEC-Controllers Rev K gebracht.) schneller ist als der TS 12 Rev D.
Bitte fragen Sie bei der Fa. Transtec nach ob aehnliche Schwierigkeiten mit den Mag-Tape-Controllern in Verbindung mit den neuen Disc-Units M2351A, welcher bedeutend schneller ist, bekannt sind. Eventuell muesste unser jetziger Reserve-Controller TS 12 Rev D modifiziert werden.

Es wurden beide Verbindungskabel (Controller - Formatter) ausgetauscht, da in einem Stecker ein Kontakt gebrochen war.
Entsprechende Stecker und Kabel wurden bestellt.

An den beiden Mag-Tape-Einheiten wurden folgende Arbeiten durchgefuehrt

1. Abgleich des Read-Gates
2. " des Write-Deskews
3. " der Tension-Arms
4. " des Forward-Speeds
5. " des Reverse-Speeds
6. " der Ramp-Time
7. " der Read-Amplitude NRZI
8. " der Read-Amplitude PE

Fuer Testzwecke wurde ein All-Zero-Tape fuer 1600 BPI-PE Mode hergestellt.

weiter VAX 11/750

Da beim Einschalten (Load der Tensionarms) der Tape-Units Baender beschaedigt wurden sind beide Tueren abgenommen worden. Die Sicherungsschalter wurden mechanisch festgesetzt.
Es sollten die sog. UPGRADE fuer VAX 3.5 VERSION bestellt werden. Es handelt sich dabei um die laufenden Softwareaenderungen die von DEC im System vorgenommen werden.
Fuer das Chemielabor (trocken) wurde eine V 24 Schnittstelle zur VAX-Anlage verlegt.

Sea - Beam

Die Sea-Beam-Anlage arbeitete bis auf mehrfaches wechseln der PA-Sicherungen einwandfrei. Die Anlage wurde zwei-mal bei extrem schlechtem Wetter abgeschaltet, da laufend Pitch- und Roll-Errors angezeigt wurden. Zu dieser Zeit waren keine Aufzeichnungen mehr moeglich und es wurde somit die Mechanik des Roll- und Pitch-Ausgleiches geschont.
Ein kurzzeitiger Ausfall der Anlage war nach Reinigung des Luftfilters behoben. (Abschalten des FAN-Schalters)
Das z.Zt. fuer den Sea-Beam-Plotter verwendete Papier zeigt keine Unterschiede beim Transport bzw. der Aufzeichnung gegenueber dem Originalpapier.
Die Hydrofon-Messungen werden in Honolulu vorgenommen, da die Anlage durchgehend bis Fiji in Betrieb ist. Es waere guenstiger wenn diese Messung nur alle drei Monate vorgenommen werden wuerde da das Ab- und Anklemmen der Kabel leicht zu Aderbruechen fuehren koennte. (Bitte senden Sie uns Ihr Einverstaendnis fuer die vorgeschlagene drei-monatliche Messung.)
An der Umstellung der Tape-Units wird noch gearbeitet.

Magnavox-Anlage

Die Magnavox-Anlage arbeitete waehrend der ganzen Reise stoerungsfrei. Die Magnet-Baender wurden, wie schon auf der letzten Reise, nicht benutzt da die BGR ihr eigenes Datenerfassungs-System hat. Vor dem Einlaufen in Suva wird die Anlage wieder in den Originalzustand gebracht, d.h. Anschluss des Fernbedienungspults (Bruecke) fuer den Satellitenempfaenger und zweite TTY im Magnavoxraum.
Zur Koppelnavigation musste meistens das EM-Log verwendet werden da das Doppler-Sonar bei starkem Seegang die bekannten Schwankungen zeigte.

Nautomat

Der Nautomat hatte waehrend der gesamten Reise keine Ausfaelle. Ein zweistuendiger Test der Programmsteuerung lief einwandfrei. Der HP-Plotter wurde ueberholt und gereinigt. (Einbau neuer Wiper Assembly, reinigen der Kontakthalteschienen und Erneuerung der Festhaltefolie.)

ELAC-Anlage

Die NBS-Anlage arbeitete ohne Stoerungen. Ein kurzfristiger Triggerausfall (ELAC und Sea-Beam) war auf einen Masseschluss im Bordnetz zurueckzufuehren.
Im Tochterschreiber auf der Bruecke wurden im Kassettenantrieb zwei defekte Transistoren ausgetauscht und das Getriebe gereinigt.
Die Schwingerstabilisierung wurde abgeschmiert.
Die 12kHz Sediment-Lotanlage wurde zur Pingeraufzeichnung fuer die Geothermik benutzt.
Die Kassette des Tochterschreibers im Geophysiklabor wurde ueberholt.

RFA / RDA

Die Anlage wurde waehrend dieser Ausfahrt nicht benutzt.

ORE 3.5 kHz SBP

Der Subbottomprofiler lief waehrend der gesamten Reise ohne Ausfaelle. Der EPC-Recorder wurde mehfach gereinigt.

Bord - TV - Anlage

In die Kreuzschiene der Grundig TV-Anlage wurde ein Testgenerator eingebaut. Es kann jetzt ueber die Anwahlschalter ein Testbild auf die Monitore gegeben werden.
In der Kamera an der Speicherwinde wurde ein Kontaktfehler beseitigt. Die Kamera an der Friktionswinde fiel aus, es mussten T1, T2 und T3 auf der Vorverstaerkerplatine gewechselt werden.
Die Schiffsfuehrung teilte uns mit, dass die in Kuerze angelieferte Kamera zur Beobachtung der Bathysonden-Winde vorgesehen ist und waehrend der Werftzeit in Honolulu installiert werden soll. Es wurde von uns die Verdrahtung in den Anwahlpulten und in der Kreuzschiene geaendert.
Wir moechten darauf hinweisen, dass wir nach Installierung der neuen Kamera keine Ersatzkamera haben.

Verschiedenes

1. Diverse Noise-Messungen fuer den Einbau des RS 904 - Honeywell - Systems.
2. Reparatur des KW-Empfaengers fuer den Funkoffizier. (defekte Diode ausgetauscht.)
3. Mehrfache Reinigung des Kopiergeraetes.
4. Einbau eines neuen Seiltagebuchs im Geologielabor mit Analog-MP-Anzeige sowie Spitzen- und Niedrigstwertspeicher mit Plotterausgang. Zur Zeit wird das Geraet noch so ausgebaut, dass es fuer Tiefsee- und Kurrleinenwinde benutzt werden kann. Das neue Seiltagebuch wurde von den Benutzern sehr positiv aufgenommen.
5. Fuer den Funkoffizier wurde ein neuer Werkzeugkoffer bestellt da bei der letzten Funkueberpruefung in Honolulu das im Funkraum befindliche Werkzeug bemaengelt wurde.
   Das Beckmann Multimeter 3020 soll ebenfalls mit in die Ausruestung des Funkers uebernommen werden ,da sein jetziges Geraet defekt ist. Das neu bestellte Multimeter besitzt eine 4½-Stellen-Anzeige und die Genauigkeit betraegt 0,05 % und ist somit fuer unsere Zwecke besser geeignet.

PRESS RELEASE

The geological research vessel "SONNE" from the Federal republic of Germany has just completed the third of three one-month cruises in Australian and nearby waters.

The cruises were carried out as a co-operative project by the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) - the German Geological Survey - and the Australian Bureau of Mineral Resources (BMR), under the umbrella of the Australian/German Science and Technology Agreement. Chief scientist were Professor Karl Hinz and Dr. Hans Roeser from BGR, Hannover, and captain was Hartmut Andresen.

The cruises were designed to investigate the geological development and petroleum potential of three frontier areas: the Lord Howe Rise east of Australia, the western and southwestern continental margins of Tasmania, and the hitherto poorly surveyed South Tasman Rise south of Tasmania. They were part of a long-term BGR program of investigation of continental margins around the world-especially from the viewpoint of plate tectonics. BMR's interest is, in contrast, confined to the Australian region.

The first two cruises used various geophysical techniques, the most important being multichannel reflection seismic profiling, to investigate the three areas. On the Lord Howe Rise, a continental plateau extending southeastward beneath Lord Howe Island from west to New Caledonia to west of New Zealand, 3500 km of multichannel seismic profiles were recorded in water depth of 1200 - 4000 m. Off western Tasmania and on the South Tasman Rise - an offshore plateau with an area nearly as large as Germany - 3800 km of multichannel seismic profiles were recorded in the Roaring Forties in water depth of 200 - 4500 m.

The aim of the third cruise, which started in Sydney on 12th April, 1985 and ended in Suva one month later, was to sample the old rock strata revealed on the first two cruises, and hence to provide more information about the seismic sequences mapped during those cruises. Sampling was by dredging and coring to the seabed - older rocks being exposed in steep slopes and canyons. Special satellite navigation techniques, and the Seabeam seafloor mapping system, allowed targets found earlier to be precisely located and sampled.

Samples came from 33 stations off Tasmania, 23 on the South Tasman Rise, and seven in the Lord Howe Rise region. Most seismic sequences were successfully sampled in the first two areas, and the South Tasman Rise was shown to be built of continental metamorphic and igneous rocks. The South Tasman Rise proved to have a geological history related to both the Australian and Antarctic continental margins, having been located between them before they broke apart since the last 90 million years. In contrast to Tasmania the South Tasman Rise is extremely bevelled which probably is the result of abrasion by ice. This strong abrasion occured around 25 million years before present, indicating that the South Tasman Rise was in an Antarctic environment at that time.

Reconnaissance geochemical sampling of sediments from the seafloor suggests that specially the Tasmanian shelf is underlain by source rocks generating hydrocarbons.

Bad weather restricted sampling in the Lord Howe Rise area, but two dredge hauls were of particular significance: one proved that the long Dampier Ridge, lying parallel to and between Australia and the Lord Howe Rise, is underlain by granites and is hence a long-lost part of Australia like the Lord Howe Rise itself. The second was located where the Venning-Meinesz Fracture Zone, a fault-line, cuts the eastern edge of the Lord Howe Rise, some 250 nautical miles northeast of Lord Howe Island. The dredge obtained a large haul of metallic minerals from immediately above the continental basement. These are hydrothermal minerals deposited by hot metal-bearing fluids at or near the seabed; this is the first such occurence on continental crust in the region.

A great deal of work remains to be done by both BGR, Hannover, and BMR, Canberra, to fully evaluate the results of the R.V. SONNE cruise, but an initial cruise report will be available within six months. Despite some very bad weather, the three legs of SONNE cruise no. SO-26 were very successful, and excellent examples of international co-operation in a high -technological field.