

Southern Ocean Panel

Minutes of meeting held September 3-5, 1984

Institut de Geophysik du Globe, Strasbourg, France

<u>Panel members</u>	<u>Liaison</u>	<u>Guests</u>
J. P. Kennett, Chairman	C. Brenner, IPOD Data Bank	K. Hinz, BGR
J. Anderson	J. Honnorez	R. Schlich
P. F. Barker	K. Hsu, ETH	J. Wannasson, IFP, (first day)
B. Bornhold	A. Meyer, TAMU/ODP	D. Whittaker, BGR
P. Ciesielski	J. K. Weissel, Tectonics Panel	A. Mauffret (third day)
H. Dick		
D. H. Elliot		
D. Fuetterer		
K. Kaminuma		
Y. Kristoffersen, NPI		
J. LaBrecque		
D. Needham		
E. Suess		

1. Introduction

a. Introductory remarks and status of Southern Ocean Drilling by J. Kennett (SOP Chairman).

b. The need for coordination with the Indian Ocean Panel, scheduled for the second half of Day 3, was noted.

c. Logging requirements. The new guidelines for drilling mandate logging all holes. The special conditions of Southern Ocean Drilling (weather and ice) potentially make logging of all holes an unreasonable demand, and the following resolution was passed: that potential logging problems make it inappropriate to log all sites and therefore, after logging priorities have

been established, the Chief Scientists should be given authority to decide on a site-by-site basis.

2. Review of individual sites

Discussion was centered on three topics: the status of possible site surveys by upcoming expeditions; the status of individual proposals; and safety problems.

K. Hinz reported that in 1985-86 BGR will carry out a detailed MCS (24 channel), gravity, magnetic, and Seabeam survey of the Caird margin (W4) as well as sediment sampling and heat flow measurements. A geochemical survey of surface sediments will be carried out and heat flow measured; present data suggest that any source must be deep but possible migration of fluids and gases is not known. The Chairman (JK) noted that advice must be sought from the Safety Panel.

Fifty-sixty days of ship time will be available; present plans call for concentration on the Caird margin including regions to SW and NE of site W4. There are no immediate plans for investigating the Astrid Ridge (W3) though this could be done in place of part or all of the survey to the NE of W4. Results of the NPI survey (see next paragraph) will be taken into consideration in detailed planning.

Y. Kristoffersen reported that the NPI expedition this coming season (84-85) will run MCS (24 channel), sediment sampling and heat flow measurements. Time constraints including support of shore-based operations limit the amount that can be accomplished. Two traverses of the Maud Rise (W1,2) will be made; a minimum of one day of site survey time will be available for crossing specific sites. The need for HRS was noted; much erosion and slumping has occurred and hence older reflectors probably accessible at shallow depth.

P.F. Barker reported that the UK will carry out MCS, magnetic (5 KH2), gravity and piston coring surveys next season (84-85) in the region of the South Orkneys (W5,6,7,8). Water guns and "Gloria" will not be on board. Work

in the region of W5 will be an "insight" survey; specific sites surveys will be conducted. The problems of slumping in the vicinity of W6,7,8 were noted.

J. Anderson (US) reported that an icebreaker cruise is planned for late December to early January (84-85). Iceberg distribution and movement will be surveyed; piston cores will be collected and single channel seismic lines run on the SW margin of the South Orkneys block. This will be a complementary survey to that of Barker. The cruise will also be in the Bransfield Strait area and could do work there if needed.

No programs are planned for the near future by Japan.

The need for basement penetration at all appropriate sites was noted and strongly endorsed. At oceanic basement sites penetration of 50 to 100 m is needed.

In summary, the panel

- (a) is pleased to note the good coordination of the site survey plans of NPI and BGR;
- (b) strongly recommends further site surveys for W1,2,3,4;
- (c) recommends that other contingency sites be identified as the site surveys are carried out;
- (d) believes no further site surveys are needed for W5, 10, and 11 (unless heat flow measurements are required for W10).

3. Adelie Coast: new proposal

J. Wanasson (IFP) presented a proposal for drilling off the Adelie Coast. Recent MCS surveys include 650 km of line tied to DSDP site 269. An outer basement high has been identified S of site 269; ponded sediments S of the high include three unconformities, the oldest possibly at about the K/T boundary; there is a considerable width of ocean crust continentwards of the oldest identified magnetic anomalies (of Cande and Mutter). The objectives are (1) the nature, age and cause of the regional unconformities, (2) the timing

of Australia-Antarctica break up, and (3) the magmatic processes associated with break up and the development of the oceanic basement high.

4. Subantarctic leg

Discussion centered on (a) the drilling season; site surveys; additional sites and (b) objectives.

(a) The drilling season would likely be March through May.

At present the site surveys are largely inadequate; some surveys might be done on an opportunistic basis. Site surveys are particularly needed for sites SA7,8,9 for which minimal single channel data are available. J. LaBrecque has a proposal into NSF for a cruise that will cover this area; the objectives are to survey the NE Georgia Rise, SE part of the Georgia Basin and the Meteor rise. MCS and Seabeam will be used, and dredging conducted. The panel strongly endorses this proposed cruise because site surveys can be included for all sites except SA4 with a minimum of additional transit time and interference with the original proposal objectives. The need for long piston cores was noted. As a back up to this possible site survey cruise, P. Ciesielski suggested the Oca Balda, an Argentinian research vessel with CTD, single channel and dredge capabilities; PC has requested 30 days for other work but this might be modified.

(b) Sites SA1,2,3. These three, a N-S transect, should be considered as a package.

i. Paleo-oceanography. Sites are beneath or S of the Polar Front; the objective is its long-term (Cenozoic) evolution. Cores at different depths in area of outflow of intermediate and deep waters E of the Scotia Sea should yield a more detailed history of paleoclimate and a time plus time-latitude perspective. The outflow of waters is controlled by the tectonic evolution.

ii. Lithosphere. Basement penetration should give oceanic basalt samples from slow spreading crusts without mantle plume influence.

iii. Notes. Sites SA2 and W5, and SA3 and SA7, are complementary sites on opposite sides of the America-Antarctica Ridge.

Site SA4. The Tectonics Panel is not enthusiastic because one site is not sufficient. P. Barker pointed out that most other fore-arc sites do not have all the background information on the regional tectonic setting that is available for SA4.

Note: This should be raised with the Tectonics Panel for immediate feedback re site surveys during the next two field season.

Site SA5. The tectonic evolution of this aseismic ridge, possibly a fossil convergence zone, affects deep and intermediate water movement northward into the Argentine Basin. This site should yield a late Cretaceous and Paleogene record for comparison with the Falkland Plateau; the Paleogene record is potentially much better than that of the Falkland Plateau. This site can also be considered part of the N-S paleoenvironmental transect. The formation of this ridge is probably related to the evolution of the Malvinas Plate, deformation in the southernmost Andes, and the N Scotia Ridge accretionary prism.

Site SA6. No change.

Site SA7. Needs elaboration and rewriting. The site should be conjugate to SA3, hence may need relocating. The throat between the Meteor Rise and the Mid-ocean Ridge may have been very different to that at SA3 and hence paleo-oceanography may have been different. This site, together with SA9, should show the extent of lateral petrologic variability with time.

Site SA8. No change.

Site SA9. Needs elaboration and rewriting. This site should be conjugate with SA2. Rewriting of this site and SA7 will be done by LaBrecque and Kennett.

NB: K. Hsu reported that PCOM felt that insufficient emphasis has been given to tectonics.

A general point was raised about whether these Antarctic legs were using the full capacity of the new drilling vessel and whether new targets were being investigated rather than pursuing old incompleting Challenger objectives. The panel response is: the severe weather conditions of the Southern Ocean require a vessel with ice strengthening and greater capabilities than the Challenger; few of the original DSDP objectives for Southern Ocean Drilling have been met because of the lack of drilling.

(c) Shaka ridge. A new proposal.

John Sclater (UT) submitted a new proposal for drilling the Shaka Ridge, SE of the Meteor Rise. The drilling would be in water depths in excess of 2 km; sediment thickness is ca 300 m, and total penetration 500 m. The site is below the Polar Front and would be a paleo and basement site.

The Panel felt that sites SA5,6 covered the same paleo objectives, the only point being whether a carbonate record is present - which is regarded as uncertain or unlikely. Dredging may answer whether the Ridge is on the Bourret plume trace or not. Fracture Zone problems in general can be answered in low latitude sites.

5. Indian Ocean Leg: objectives

The major objectives were outlined in the original 1970 or 1971 submission to DSDP.

(a) Paleo-oceanography. The overall objective for drilling on the Kerguelen Plateau is to investigate, at the only site that spans the full width of the Southern Ocean up to the Polar Front, the development, long-term northward migration, and short-term fluctuations of the Polar Front and the history of ice-rafted debris. This has great significance in paleo-oceanography, paleoclimatology and paleobiogeography. Late Cretaceous, Paleogene and Neogene carbonate sediments have been recovered in piston cores.

Cores from shallow, intermediate and deep water locations should provide information on the development of intermediate and deep-water masses. Knowledge of basement geology is essential for understanding the tectonic evolution.

(b) The break up and subsequent evolution of the Antarctic continental margin at Prydz Bay. This location may be the site of a former Triple Junction. A two to three km section of dipping beds are present below a veneer of glacial debris.

(c) Tectonic history of the Kerguelen Plateau. The subsidence (and/or uplift) history of the plateau will have profoundly affected circum-Antarctic flow.

(d) Paleoclimatology. The recovery of well-preserved non-marine palynomorphs of late Cretaceous to early Paleogene age and marine palynomorphs of Eocene age indicate the presence of a significant late Mesozoic and Cenozoic section on the continental shelf or beneath the ice.

(e) Glacial history. The E Antarctic Ice Sheet may have originated in the now subglacial Gamburtsev Mountains. The early record of glaciation and subsequent fluctuations may be recorded on continental shelf sediments.

(f) Early separation of Antarctica from India and Australia. Break up sequences and the continental margin. Seismic stratigraphy may allow correlation with sequences found on the Adelie Coast and the opposing coasts.

(g) Subantarctic paleoenvironments. The objective is to establish the inception, growth and fluctuations of the water masses now occupying the subantarctic belt, to establish the paleobiogeography, and to acquire an isotopic record to compare with that of the Campbell Plateau.

(h) Mantle heterogeneity. The aim is to examine the basement geochemistry along a mantle flow line that includes both normal mid-ocean ridge basalt and plume-generated basaltic rocks.

(i) Mantle petrology and geochemistry. The slow spreading on the SW Indian Ocean ridge system is associated with major fracture zones of high topographic relief along which abundant, variably altered, mantle peridotite has been dredged. The objective is to sample the mantle, test whether juxtaposition of cold and hot lithosphere leaves a geochemical signature, test the inference from ophiolites that the mantle is stratified, and to examine the influence of a mantle plume.

(j) Mantle heterogeneity. This proposal is concerned with the occurrence of great depth and low relief on a mid-ocean ridge that apparently yields basalts with a mantle plume signature.

(k) Tectonics and basement geology of the Agulhas Plateau. The nature, origin, and evolution are uncertain, although dredge hauls suggest that at least part is continental. The tectonic history is difficult to understand if the crust is continental. The evolution of the plateau is important in understanding early break up of Gondwana, and the paleoenvironments and early patterns of water mass flow into the widening southern Atlantic region. This site would complement the Maud Rise (W1,2) and Falkland Plateau (DSDP sites 327, 511, 512).

6. Indian Ocean Leg: site locations

(a) Kerguelen Plateau (objectives a and c). Eltanin 47 and 54 cruises provide the data base for the central and southern part; excellent French MCS data exist for the vicinity of the Kerguelen Islands, particularly to S and E. Neogene sediments, forming a reflective package, are comparatively rare. Below this reflective package is a transparent package bounded by a reflector seen over most of the Plateau; the age of the reflector is thought to be M. Eocene and the transparent sediments, nanno-foram chalks, to span the M. Eocene to M. Miocene. Subsidence of the Plateau is coincident with an increase in spreading rate and an erosive episode at about anomaly 18 or 19. A similar reflector is seen on the Falkland Plateau. Reflector B is believed to be Cenomanian to Turonian and is likewise very widespread. MCS survey in the northern part shows that another sediment package occurs below Reflector A and

above B, and pinches out away from the Kerguelen high. Piston coring has recovered sediment as old as late Cretaceous. This includes useful French data transmitted by L. Leclaire.

Sites (12) have been tentatively selected to cover the length of the Plateau and a range of water depths (see attached proposals). The number of sites will probably be reduced after further MCS surveys, etc. Emphasis will be placed on Eocene and younger sections because of their importance in paleo-environmental studies. Older sediments will be cored for the long-term record and basement will be penetrated at two or more sites.

There is clear need for further site survey (MCS, coring) in the central and southern parts of the Plateau. A proposed Australian survey (MCS, magnetics, gravity) for austral summer 84-85 together with further French surveys in 85-86 should provide a much improved data base for site selection. The Southern Ocean Panel strongly endorses these cruises.

(b) Prydz Bay, Antarctica (objectives b,d,e,f). Refraction seismic lines run by Soviet and Australian Antarctic programs clearly indicate that the Lambert Glacier area - Amery Ice Shelf region, of which Prydz Bay is an extension, is a graben with a much diminished crustal thickness of 20 km (cf 40 km for the adjacent flank of the graben). The conjugate point for this region lies near the NW part of the Bengal Fan; this may have been a triple junction. MCS data for Prydz Bay have been interpreted by Stagg as showing five sediment packages, the four oldest forming a gently dipping sequence beneath a young veneer (package five). Piston cores from the continental margin suggest late Mesozoic and Cenozoic sediments are present. Twenty-two (22) percent of the E Antarctic ice sheet drains out through the Amery Ice Shelf and includes one flank of the Gamburtsev Mountains on which ice sheets may have been initiated. A transect of four sites is suggested in order to minimize drilling time. This transect will yield information on Antarctic paleoclimates, the early evolution and development of the continental margin, and the glacial record of the E. Antarctic ice sheet.

MCS data for site selection is excellent and it is anticipated that it will be made available by H. Stagg, Australia. There is need for single channel seismic data and coring; J. Anderson will be proposing an icebreaker cruise to that region for the 85-86 season.

(c) Agulhas Plateau (objective k). Numerous single channel seismic lines cross the Plateau and there is a good coverage of piston cores and dredge hauls. The information is probably sufficient for a single site.

(d) Crozet Plateau (objective g,i). Crozet Plateau, a subantarctic paleoenvironments locality at shallow depths, lacks adequate coverage for site selection; one single channel profile and some data collected by the Marion Dufresne are available. Reconnaissance and detailed surveys are needed. Dredge hauls and surveys across the Antarctica-Africa ridge allow the identification of fracture zones for objective i sites. Three sites in a northerly FZ, either the Melville or Atlantic FZs, and one site in a southern site just north of the Crozet Plateau and adjacent to the Crozet plume. The Melville and Atlantic FZs are major conduits for bottom water transport north into the Indian Ocean. There is good bathymetry and dredge sampling. A major requirement is for seismic lines along the length of the FZ troughs to establish sediment thickness. Further detailed magnetic and single channel seismic surveys and dredging of the FZs is necessary to establish that inferences are correct. Objective i could clearly be met by drilling on two different legs.

(e) Kerguelen Plateau--St. Paul-Amsterdam Islands--Broken Ridge transect (objectives g and h). This transect is designed to meet the requirements of a subantarctic deep water paleoenvironments transect, the proposal for investigating hydrothermal activity in the sedimentary pile, and the examination of mantle heterogeneity along a mantle flow line. Further surveys are required before site selection can be made. Furthermore, it is mandatory that surveys be conducted to establish whether this transect meets the needs of the paleoenvironments proposal which is based on known and already examined piston core sites; on this proposed flowline transect the sediments are known to thin due to scouring.

(f) Central Antarctica-Australia mid-ocean ridge (objective j). This is the locality where a mantle heterogeneity anomaly is found (the "Cold Spot Trace"). The anomaly is based on a number of dredge samples. The proposal requests ten sites; the panel feels a fewer number may achieve the same results and ask whether further dredging could provide more information (thus reducing the need for drill sites).

(g) Adelie Land Coast. This set of three sites should be considered for inclusion in a South Pacific Leg. This set of sites is complementary to a set proposed by Cande and Mutter for the Otway Basin. Site surveys are adequate.

7. South Pacific drilling

Little time was spent on this topic. Sediment and ocean history, the decoupling of the N and S Pacific Plates (by paleomagnetic studies), and Ross Sea (+ Adelie Coast) continental margin drilling were discussed briefly.

8. ODP status

A. Meyer reported on the current status of ODP. J. Honnorez reported on fiscal matters concerning ODP.

9. PCOM concerns

The Panel took note of remarks by K. Hsu regarding PCOM concerns, in particular: ODP emphasis in bare rock and basement drilling (but with adequate justification for the latter); high latitude drilling in those cases that bear on problems of global interest; Indian Ocean drilling.

10. Joint meeting with the Indian Ocean Panel

J. Kennett, SOP Chairman, presented a summary of SOP objectives for the Indian Ocean sector of the antarctic and subantarctic. J. Curry, IOP Chairman, presented their deliberations on the subantarctic; there is general agreement about objectives but some differences exist on priorities. J. Honnorez indicated that the thematic panels will assign priorities to the various objectives, such as the subantarctic paleoenvironments and FZ studies.

There was considerable discussion about whether the objectives of the IOP and the SOP (for the Indian Ocean sector) could be achieved in one season of drilling (one to one and a half for IOP objectives). One problem is transit time: Reunion to Kerguelen - 6-1/2 days; Diego Garcia to Kerguelen - 12 days; Freemantle to Kerguelen - 14 days. There was some discussion of a single

four-month Antarctic leg with a crew and science personnel change over in the middle, which would have to be supported by a vessel with berths for 116. There is unanimous agreement that a much more effective drilling program can be developed if there are two austral summer legs to Antarctica in the Indian Ocean sector (estimated total drilling time for Kerguelen Plateau and Prydz Bay is 91+ days), and there are two Indian Ocean seasons which then can better accommodate the weather windows in the northern part of the ocean. It is too early for resolving questions of which panel has responsibility for which sub-Antarctic (overlap) sites and what priorities should be placed on them.

11. Next meeting

Tentatively scheduled for April 29 - May 1, 1985, at the University of Florida.