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INDIAN OCEAN REGIONAL PANEL, ODP

Minutes

5-8 September 1984

Institut de Physique du Globe, Strasbourg, France

Members Present

R. Schlich
J. Cochran
U. von Rad
W. Prell
R. White
L. Tauxe
R. Herb
J. Honnorez (PCOM)
J. Pierce (Alt. for Gradstein)
J. Curray (Chairman)

Guests

A. Meyer, TAMU
C. Brenner, SS-SP
T. Juteau, LITHP
J. Weissel, TECP
K. Kaminuma, SO-RP

Members Absent

J. Sclater
J. Leggett

A joint meeting with the Southern Oceans Regional Panel was scheduled for afternoon of 5 September, so the agenda was organized for that morning for necessary introductory items and discussion of areas and objectives which overlap with that panel. These include Kerguelen-Gaussberg Plateau and Ridge, Agulhas Plateau, SE Indian Ridge, SW Indian Ridge, Crozet Basin and Plateau, and the continental margins of Australia and Antarctica. Objectives, tentative priorities, and means of sharing interest and/or responsibility for a proposal with another panel were discussed. Areas of tentative high priority were agreed to be: Kerguelen-Gaussberg, Agulhas, the SE Indian Ridge, and the S. Australia margin. The panel concluded that the most practical means of operating would be for one panel to act as the proponent/operator, with the support, endorsement, and assistance as needed from the other panel. SO-RP would act as operator for Kerguelen, and IND-RP for the other areas.

We agreed to propose that two legs be devoted to Kerguelen, including adjacent targets, in successive Austral summers of Jan.-Feb. 1988 and 1989, with lower-latitude Indian Ocean work before and between. The northern Indian Ocean has weather constraints as well -- to avoid mid-summer months -- but they are not as severe as the Kerguelen to Antarctic sites, and drilling is possible on the shoulders of the weather windows.

The joint meeting with SO-RP started with a background report by Honnorez on PCOM activities and decisions, on the status of SEDCO 471, and the problems of funding and cost overruns. Kennett then reviewed SO-RP recommendations; Curray reviewed IND-RP recommendations; and discussion followed.

SO-RP has two high-priority projects in the southern Indian Ocean: the Kerguelen-Gaussberg Plateau and Ridge and the east Antarctic continental margin south of Kerguelen Island. The continental margin of Adelieland is in the next priority group. They intend to propose these areas of drilling to PCOM, and IND-RP will support the proposal for two long legs in Kerguelen-Gaussberg.

Pros and cons were discussed of two Kerguelen legs in successive Austral summers vs. two legs in one Austral summer. The advantages of scheduling the work in two successive seasons appear to be: this would enable about 10 months of work in between in the northern Indian Ocean, planned to avoid the times of the worst weather in the north, a lessened chance of losing the whole Southern Ocean project because of one especially bad season, time to evaluate results of the first leg before laying final plans for the second leg, and some possible personnel usage benefits by permitting those especially interested in the region to participate in both legs if they wish. A plan of two successive legs straddling the optimum weather window might be possible with less transit time if a supply ship could meet the drilling ship in Kerguelen Island, but a ship large enough to supply SEDCO 471 and carry approximately 116 people for a complete personnel change would be very expensive. Consequently, both panels plan to recommend two legs in successive Austral summers which would be as long as possible to increase site time after long transit runs.

The other SO-RP high priorities are out of the overlap area between the two panels and were not considered by IND-RP. SO-RP did, however, offer encouragement and support to IND-RP to sponsor drilling on Agulhas Plateau and a transit of the SE Indian Ridge between Kerguelen Island and Broken Ridge. These will be discussed later. Other common targets of interest were discussed, but were not at present backed by either panel.

IND-RP met by itself on 6 and 7 September, with the same attendees, plus the guests listed above.

Curray explained his system of logging in all proposals and/or letters of intent received, regardless of whether they are mature proposals or whether they were submitted in the prescribed manner through the JOIDES Office. Justification for the system is an effort to assure that all letter suggestions or proposals receive a fair review and consideration by the panel. If the panel needs additional information or documentation to complete an immature proposal, a request will be made to the proponent.

It was agreed that our goal as a panel is to extract the best possible science from any input we receive, and to give a fair hearing to all input submitted in writing. For these reasons, we will continue to log in all input submitted in writing, but we will continue to remind all proponents to submit the required three official copies to the JOIDES Office. Proponents will also be reminded that PCOM will consider only "mature proposals." IND-RP will, however, in probably all cases merge overlapping proposals into "superproposals" which will include suggestions from all outside input, supplemented as necessary and appropriate, with input from our own panel members.

The list of proposals was recently more than doubled by distribution of the report of the U.S. Workshop on the Indian Ocean (Table 1). The panel considered all the proposals on the list and grouped them for consideration into "super-proposals," which grouping eventually resulted in Table 2. The panel, plus visitors, then divided itself into three parts for consideration of each of these "super-proposals," to report back later on the same day with recommendations. The recommendations for priorities, evaluation of survey status, estimates of necessary drilling time, and recommendations for a panel watchdog were then considered by the panel as a whole, as tabulated in Table 2. The A priority areas, and in some cases compatible B priority areas, were then put together into a strawman schedule, as shown in Table 3, based on the following assumptions:

(1) That the ship would come into the Indian Ocean after Weddell Sea drilling in about March 1987.

(2) That two legs would be devoted to the Kerguelen-Gaussberg-Antarctic region in Austral summers of 1988 and 1989.

(3) That the intervening ten legs would be devoted to Indian Ocean drilling objectives.

Carrying these assumptions one step further could mean the possibility of an eleventh Indian Ocean leg, following the second Kerguelen leg, as the drilling ship departs the Indian Ocean either northwest of Australia or south of Australia.

Brief reports were prepared by panel members present on each of these priority areas, plus one other area about which we do not have enough information, summarizing the scientific objectives, survey status, weather restrictions, and a drilling plan. These reports are attached to these minutes in the Appendix.

The Chairman was instructed to report the status of our deliberations on each of the proposals submitted in Table 1. The P.I.'s should be informed of our priorities, our tentative program, and be invited, if they wish, to submit additional supporting documentation.

The panel still feels the need for having another petrologist as a member in addition to Honnorez, who is ex-officio from PCOM. Many of the proposals we are considering require more petrologic expertise than we can muster on our own. A list of possible candidates was considered, and it was agreed to ask PCOM to appoint one of the following to become a full member of the panel -- Duncan, Frey, Langmuir, or Saunders.

Sites and dates for the next meetings were discussed, and it was recommended that the next meeting be held 10-12 December in La Jolla, California, with the following meeting to be in June 1985 in Bremerhaven, Germany, in order to see the drilling vessel.

<u>Action Items</u>

1. The Chairman is to request permission for holding the next meeting of IND-RP 10-12 December 1984 in La Jolla, California.

2. IND-RP requests TAMU to develop a system for orienting cores.

3. Watchdogs for each of the high-priority areas in Table 2 should, as soon as convenient, get site survey data to the data bank at LDGO to enable preliminary safety checks, even when proposals are at pre-maturity stages.

4. Prell will consider possible in-transit sites of opportunity for paleoceanographic objectives from our proposed tracks through the Indian Ocean.

5. IND-RP requests PCOM to appoint a formal Red Sea Working Group as follows:

   Cochran, Chairman
   Coleman, USGS
   Bäcker, Preussag
   Pautot, France
   Arthur, SOHP
   Whitmarsh, Britain
   Miller, Exxon

   Cochran would like to call this working group together for a meeting at LDGO in early November.

6. An informal working group, listed as follows, will further consider priorities between drilling Chagos-Laccadive-Muscarene Ridge vs. Ninetyeast Ridge.

   Curray (Chairman), Peirce, Herb, Falvey, Duncan, Prell, Brenner

7. IND-RP requests PCOM to appoint one of the following four petrologists to become a full member of the panel: Duncan, Frey, Langmuir, or Saunders.

Joseph R. Curray

Joseph R. Curray, Chairman

APPENDIX

1. AGULHAS PLATEAU (Herb)

A. Main Scientific Justifications

A.1. Paleoenvironment, Ocean Circulation History

The Agulhas Plateau holds a unique place for the reconstruction of the interoceanic seaways between the South Atlantic and the Indian Ocean. Changes in bottom circulation may have been enhanced during the earlier history, up to the Cretaceous/Tertiary boundary, by the postulated Agulhas fracture zone west of the Agulhas Plateau, as proposed in the literature. This, as well as the development of the surface circulation patterns during Late Cretaceous and the Paleogene, could be cleared up or approached by one good site on the plateau, where Late Cretaceous and Paleogene sediment (foram and nanno oozes) are expected, and have in fact been shown by piston cores.

A.2. Tectonic History and Basement

The nature of the basement of the Agulhas Plateau has great implications for the reconstruction of the breakup between South America and Southern Africa. Oceanic basement is mainly postulated, but metamorphic rocks were dredged. The problem cannot be solved without drilling. Relations to the Falkland Plateau and the Maud Rise are first-order problems for the reconstruction of the southernmost Atlantic and the respective sector of the Southern Ocean. Two sites on the Plateau are proposed, since the present data show significant differences between the northern and the southern parts of the Agulhas Plateau.

B. Number of Sites

One good site on the plateau (with hydraulic piston coring) could meet the requirements for paleoceanographic purposes (southern site). A second site on the northern part would greatly improve the accuracy of the tectonic interpretation.

C. Status of Site Survey

Regional data are available in fairly good quality and have been published in papers by Barrett (1977) and Tucholke and Carpenter (1977). Site surveys should be done for choosing the actual drill sites.

2. WESTERN SOMALI BASIN (T-2c) (Brenner)

The opening of the Western Somali Basin marked the initiation of the present-day Indian Ocean. Recent geophysical studies of the area have dated the ocean crust of the Western Somali Basin at between 165 and 120 Ma and have characterized the crust of the basin as seismically oceanic (yet thinner than normal).

Site T-2c, situated in the center of the Western Somali Basin at approximately 4°S and 48°E, would penetrate the igneous crust at Anomaly M12. The hole would provide more exact dating for the Mesozoic magnetic sequence and would provide an age for the Western Somali Basin. In addition, the stratigraphy of the hole would yield the first information in much of the Mesozoic evolution of the embryonic Indian Ocean, a probable branch of Tethys.

The hole would have additional paleoceanographic concerns. The low-latitude Indian Ocean is rather poorly understood; bottom water flows energetically through the Amirante Passage into the Western Somali Basin and/or the Comoro Basin, but the history of this circulation and its path beyond the passage are mysteries. Site T-2c will help alleviate our present ignorance concerning the development and history of ocean currents in this area; previous studies in the Amirante Trench have been inconclusive on this question because of the many discontinuities present in the area.

3. <u>THE RED SEA</u> (Cochran)

The Red Sea occupies an elongate escarpment-bounded depression 250 to 450 km wide and more than 2250 km long between the uplifted Arabian and African shields. The depression was formed by a major episode of normal faulting and ramping which has been dated as late Oligocene-early Miocene (26-20 m.y.B.P.). Morphologically, the Red Sea consists of shallow continental shelves, a wide "main trough" which extends from about 15°N to the tip of the Sinai Peninsula (28°N) at a depth of 600 to 1000 m, and a narrow "axial trough" found from about 15°N to 24°N which is about 2000 m in depth, usually less than 50 km wide, and is characterized by steep walls and irregular bottom topography. South of about 18°N, the continental shelves broaden considerably and are underlain by carbonate banks and reefs which have effectively filled the main trough.

The Red Sea can be divided into three very distinct and different sections, each of which appears to illustrate a different stage in the developing continental margin. The southern Red Sea between 15°N and 21°N is characterized by a well developed axial trough characterized by rough bathymetry and high-amplitude magnetic anomalies. There is general agreement that the axial trough resulted from seafloor spreading, beginning about 5 Ma near 17°N and propagating to the north and south.

The origin and nature of the crust underlying the main trough have been difficult to determine, due in large part to the great thickness of Miocene evaporites (2-6 km) which underlie the entire main trough.

The axial trough becomes discontinuous north of about 20°N, and from there to about 25°N the central part of the Red Sea consists of a series of deeps quite often containing hot brine pools (Bäcker and Schoell, 1972) alternating with shallower "inter-trough zones" (Tramontini and Davies, 1969; Searle and Ross, 1975). The basins containing the hot brine deeps are very similar to the axial trough in appearance, with steep sides, a rough bottom, and large magnetic anomalies. In contrast, the inter-trough zones are shallower, with gently sloping sides, a smoother bottom, and significant magnetic anomalies appear to be completely lacking.

An axial trough is not present north of 25°N, the northern limit of the large deeps, and there is no morphological or geophysically identifiable feature in the northern Red Sea that can be interpreted as a localized mid-ocean spreading center. There is a series of deeps, including several just discovered within the past year, which extend to the northern end.

The panel has received five separate proposals for drilling in the Red Sea. A feature common to all of them is an interest in the deeps. There are, however, a number of various problems that are addressed:

A. Nature of earliest (pre-seafloor spreading) basalts and possible changes in composition as the axis develops. This is to be approached by a series of holes in the small northern basins which become shallower and smaller to the north.

B. Hydrothermal circulation in the deeps and plumbing of hydrothermal cells.

C. Metallagenesis.

There were also some proposals to drill off-axis in the main trough to address the problems of:

A. Early sedimentation history (evaporites and pre-evaporite sediments).

B. Nature of crust away from the center of the Red Sea.

C. Various sedimentological questions involving evaporites.

The panel decided that the Red Sea rated very high as an objective, but that because of the great number, complexity, and inter-relationship of the problems that can be addressed, a working group should be formed to put together a program that addresses as many as possible.

The regional coverage for site surveys is quite good, especially after recent French and U.S. cruises in the northern Red Sea. Almost all the deeps that might be drilled have been mapped with SEABEAM. Some additional heat flow will be required prior to any study aimed at hydrothermal problems. There are several cruises planned by German, U.S., and French institutions prior to drilling and including diving, so detailed or special site survey requirements should be able to be met, once the working group picks the specific sites.

4. THE MAKRAN ACCRETIONARY PRISM (White)

The Makran is an excellent example of a fully developed accretionary prism with a large sediment input. Geometrically, the deformation is simple, regular, and well controlled by Cambridge University surveys for 1975, 1980, and already funded and scheduled surveys for February 1986. Specific site surveys may be included in the 1986 work, which will have a multichannel profiling system, the Cambridge deep tow, 3.5 kHz and seismic reflection profiler, and which will take a suite of piston cores across the accretionary prism. The Makran prism is also exposed on land, and a group from Imperial College, London and Oxford is already working on land.

We propose a suite of up to 7 holes (35 to 40 days drilling time) across the margin to document the rates of accretion, the processes of deformation, and the patterns of sedimentation. These results can be combined with data from the exposed uplifted part, a unique opportunity compared to other more complex accretionary systems. Although the geometry of the Makran prism is very well mapped by geophysical methods, nothing is known, or can be found, of the rates of processes (sedimentation, accretion, uplift) other than by drilling, and this is why we consider it such an important target for ODP.

5. ARABIAN SEA (Prell)

The Indian Ocean summer monsoon is an important component of global climate. Combined with the physiography of the Arabian Sea and adjacent marginal seas and uplift of the Himalayas, the monsoon circulation dominates the paleoenvironment-sediment history of the Arabian Sea.

This proposal investigates three separate but related aspects of this history: 1) the evolution of monsoonal upwelling, 2) the history of anoxic sediments in the Oman margin oxygen minimum zone, 3) the long-term evolution of the Indus Fan in response to changes of climate and uplift rate of the Himalayas.

A. <u>Monsoonal Upwelling</u>

The Owen Ridge contains a section of pelagic sediments that record the strength of upwelling induced by SW monsoon winds. Background is found in the proposal by Prell (5-1) in the U. S. workshop report.

We propose to core two sites (double HPC) to 300 m to obtain the past 5 m.y. to 10 m.y. record of upwelling. Continuous recovery and complete sections are required to test existing ideas on the control of monsoon inducted upwelling. Approximately 10 days site time are required. Regional survey is adequate, but detailed site selection data (preferably water gun seismics) are required.

B. <u>Anoxic Sediments</u>

The margin of Oman contains anoxic sediments in the upper slope oxygen minimum layer. These sediments record the proximal monsoon upwelling, the diagenesis of organic-rich sediments, and are high-resolution paleoclimate records.

We propose to obtain a transect of 3 HPCS (200 m) across the O_2 minimum (500 m, 1000 m, 1500 m) along a spur of the Oman margin. Total site time about 5 days. Regional survey identifies problem, but a detailed survey is required to select sites.

C. <u>Indus Fan</u>

The distal Indus Fan should contain a record of the changes in fan sedimentation over long time intervals in contrast to the proximal fan. Because the Siwalik sedimentary basins at the base of the Himalayas are so well dated, the Indus Fan sediments offer the best chance to relate continental uplift and climate patterns to deep-sea terrigenous deposition patterns.

We propose to core two HPC cores to about 500 m to obtain high-quality sections for paleomagnetic, sedimentologic, and biostratigraphic studies. Site time about 15 days. Regional data exist, but need to be synthesized.

6. CHAGOS-LACCADIVE RIDGE (Peirce)

The Chagos-Laccadive Ridge-Mascarene Plateau is a feature where several different prime objectives can be combined.

A. N/S transect

3 holes into basement on C-L Ridge
2 holes into basement on Mascarene Plateau

B. E/W depth transect

3 HPC holes (one part of NS transect) on top/side/bottom of equatorial part of C-L Ridge

The NS transect tests the origin of the C-L/Mascarene Plateau lineament and allows for the same geochemical and paleomagnetic experiments as have been done successfully on the Ninetyeast Ridge. It also provides the opportunity to recover a complete suite of calcareous sections covering the entire Tertiary from different latitudes. The equivalent sections on the Ninetyeast Ridge were not completely sampled.

The E-W depth transect will recover continuous Neogene sections which will record vertical dissolution gradients in a small area independent of productivity variations.

The depth transect and survey of complete Tertiary calcareous sections could be done on the Ninetyeast Ridge, but the first-order tectonic problems have already been solved there.

Estimated drilling time is 45 days, depending on depth of section at specific sites which have not yet been identified.

7. CENTRAL INDIAN OCEAN BASIN AND LOWER BENGAL FAN (Curray)

A remarkable example of intraplate deformation is found in the central Indian Ocean Basin south of India in the lower part of the Bengal Deep-Sea Fan. Oceanic crust and overlying sediments are deformed into long wave length (about 200 km) undulations and are disrupted by closely-spaced (about 5-10 km) faults showing reverse sense of motion. Gravity anomalies suggest that the surface of oceanic MOHO is deformed into undulations similar to those observed in the surface of the crust. This is also the site of intraplate earthquakes, whose foci lie beneath the oceanic crust, and of abnormally high heat flow suggestive of upward flow of water. The style deformation and focal mechanisms suggest that the Indo-Australian plate is deforming under lateral (about N-S) compression, probably dating from late Miocene time, as determined from a regional unconformity probably of that age correlated from earlier DSDP drilling farther to the north in the Bengal Fan.

Several important aspects of the nature and history of these phenomena can be resolved only by means of drilling. Specific objectives include determination of age of onset of the deformation and subsequent history of movement of individual fault blocks, and an understanding of the relationship of the fault zones to the upward water flow. Drilling in this part of the lower

Bengal Fan can also help to resolve some questions about deep-sea fan depositional processes and the tectonic history of uplift of the Himalayas and deposition of the fan.

The chronology of seismic stratigraphy throughout the Bengal Fan has been based largely on correlation of two regional unconformities throughout the entire fan. The upper, preliminarily judged to be of late Miocene age from DSDP 218, occurs in these lower fan deformational hills, but can also be found farther to the north in the central part of the fan over the 85°E Ridge and along the flanks of the Ninetyeast Ridge. The lower unconformity, judged in a very tenuous way from DSDP 217 to be Paleocene-Eocene in age, occurs primarily along the flanks of the Ninetyeast Ridge and would also appear to represent some kind of intraplate deformation. Both unconformities appear to bear a possible relationship to tectonic events in the Himalayas related to the collision and uplift history.

About five to six sites are proposed, largely around the abyssal hills representing the upper Miocene unconformity and intraplate deformation. Age of the unconformity can be precisely delineated from drilling on the "backsides" of rotated fault blocks, while the problem of fluid flow may be resolvable from drilling through the faults on the front sides of the hills. Careful selection of sites, plus a possible additional supplementary site along the flank of the Ninetyeast, may also help to resolve some problems of the tectonics of the Himalayas, and possibly also depositional processes of deep-sea fans.

Regional survey status is probably all right, but additional site surveys are needed. Site time sould be approximately 45 days.

8. SOUTHEAST INDIAN RIDGE TRANSECT (Meyer)

We propose drilling a transect of sites on one or both flanks of the Southeast Indian Ridge for several reasons. First, such a transect will provide long continuous sequences of Neogene sediments in high southern latitudes to allow comparison of the evolution of low- and high-latitude faunas and floras during the late Neogene. Second, the transect could be located so the sites cross the subtropical convergence and Antarctic Polar Front to record Neogene movement of these oceanographic boundaries and provide detailed information on climatic fluctuations in these latitudes.

In addition to the paleoceanographic objectives, this same transect of sites should provide appropriate sediments for the determination of historical hydrothermal activity along a moderate-rate spreading ridge, which is critical for long-term geochemical budget-balance studies. These results would be compared with those from DSDP Leg 92 across the southern East Pacific Rise to investigate the role spreading rate plays with hydrothermal flux. And finally, sampling of the basement will allow assessment of time variations of upper mantle geochemical homogeneities recorded in oceanic crust along plate motion flow lines away from two hotspots: Kerguelen and Amsterdam.

The measured progression of basement ages along the Ninetyeast Ridge (Duncan, 1978), paleomagnetic latitudes from basalts and overlying sediments (Pierce, 1978), and geochemical character of the basalts (Whitford and Duncan, 1978; Dosso et al., 1979; Dosso and Murthy, 1980; Mahoney et al., 1983) indicate that the Ninetyeast Ridge and adjoining Rajmahal Traps were formed over the Kerguelen hotspot. Following opening between Australia and Antarctica, the Southeast Indian Ridge rode northeastward over the Kerguelen hotspot, severing the connection to the Ninetyeast Ridge at about 38 m.y.B.P. (DSDP Site 254). Production of oceanic crust at the Southeast Indian spreading ridge in the wake of this separation results from the mixing of two distinct mantle source regions: the MORB source underlying the present spreading ridge and the Kerguelen hotspot. The hotspot influence should decrease with time (toward the spreading ridge). Young volcanism at Amsterdam/St. Paul is thought to reflect a recently initiated hotspot which is geochemically distinct from Kerguelen and which has not yet left a volcanic trail (Morgan, 1981; Duncan, 1981).

The Southeast Indian Ridge Transect should consist of three holes, one of which will be drilled as the deep slope site during drilling on the northern Kerguelen Plateau. The remaining two sites to be drilled during the Southeast Indian Ridge leg will be located in approximately 3000-3500 meters water depth. Each of these sites should be double-cored with an HPC/XCB. Penetration would be about 600 m of sediment and at least 50-100 m of basement. One hole at each of these two sites should be logged. Total drilling time for these sites would be about 25 days. Regional site surveys available in the area are sufficient; a site-specific survey will be necessary before actual drilling targets can be identified.

9. NORTHWEST AUSTRALIA (von Rad)

A. Background and Objectives

1. Exmouth Plateau

Exmouth Plateau is one of the best examples of an extensional marginal plateau at a very old (155 Ma) starved passive margin, where the pre-rift, early-rift, breakup, and post-breakup subsidence history of a rifted, sediment-starved, wide margin can be easily studied by deep-sea drilling (it is certainly the only such margin in the Indian Ocean). It is also probably the best-studied margin of this type (see below). The following objectives should be addressed by an ODP project:

a) Early-rift history: stretching, graben formation, mechanism of continental crustal attenuation, rift-valley clastic sedimentation, early rift volcanism, transform faulting.

b) Transition from rifting to drifting: date and cause of breakup, Liassic transgression of the Tethys Sea onto the subsiding margin.

c) Jurassic regression: (deltaic sedimentation, coal measure sequence).

d) Post-breakup volcanism:

e) Juvenile ocean stage: restricted marine environment, progradation, subsidence rates, Wealden-type sedimentation.

f) Mature ocean stage: fully marine environment with decreasing subsidence and sedimentation rates, distribution of hiatuses as a function of boundary currents, climate, and fertility changes. History of eolian supply vs. paleoclimate in Australia (comparison with the somewhat similar NW African margin). Upwelling events?

g) Correlation with a possible conjugate margin and with Mesozoic passive margins on land (e.g. Alps).

2. Argo Abyssal Plain Site

a) Mesozoic-Cenozoic paleoceanography and paleobiogeography. Oldest crust of Indian Ocean (M-25, ca. 155 Ma). Dating of M-anomalies. Site 261 has only been spot-cored (23% recovery) and is younger than M-25 crust.

b) Remnant of Tethys Superocean, comparison with Sites 534, 105, 603, 367 in Atlantic. Paleogeography. Superocean connections. Jurassic abyssal communities.

c) Subsidence history and paleobathymetry.

3. Wallaby Plateau

a) Formation of marginal high by abnormally intensive volcanic activity during a breakup/early-drift event about 120-125 Ma ago, as an "epilith" similar to Iceland, at the same time that spreading started at the Cuvier Abyssal Plain, or

b) Formation of Wallaby Plateau as part of the Australian continent, and it may have formed like Carnarvon Terrace underlain by continental crust with subsequent volcanism along marginal faults.

B. Survey Status

The Exmouth Plateau is probably the best explored marginal plateau in the world. Several thousand km of single-channel and several thousand km of industry multichannel seismic reflection data are available, and more are funded and scheduled. Furthermore, two-ship expanding spread seismic profiles will be run in 1985 by BMR and L-DGO. Data from commercial wells are also available from the eastern plateau and shelf. More site specific surveys are necessary.

The Wallaby Plateau also has considerable seismic and dredge data available. Region survey status is probably sufficient, but more site specific surveys are necessary.

C. Suggested Sites

We propose a transect of three sites, with two on the N. Exmouth Plateau and one on the adjacent Argo Abyssal Plain. Total site time, about 39 days. One site about 9 days should suffice for the central Wallaby Plateau.

10. EASTERN SOUTHERN AUSTRALIAN MARGIN (Falvey)

This margin is one of the world's type passive rifted margins with the following special characteristics:

A. Breakup initially at 90 m.y.B.P. -- slow spreading to 65 m.y.B.P. -- followed by fast normal spreading. Most probable kinematics.

B. Apparently well defined unconformities of both ages corresponding to tectonic events, plus rift onset.

C. Very high-quality MCS data defining both pre- and post-breakup sections from shelf basin to continent-ocean boundary.

D. Structural style associated with rifting of breakup well defined by planar normal faults -- both steep and shallower dips.

E. Excellent shelf drilling data -- all open file -- extending through post-breakup section well into pre-breakup section. Well defined thermal and geohistory curves.

F. Regional and site survey data now available, or programmed by BMR. Site definition awaiting results of further BMR cruise (MCS, dredging, heat flow) in mid-1985.

Drilling on mid-slope and deep slope should provide age, depositional environment, and thermal data on well defined seismic intervals nearer to continent-ocean boundary. This will provide more complete thermal and geohistory data across passive margin which (together with structural style) can be expected to discriminate between pre-breakup subsidence mechanisms.

Three sites are indicated -- each about 1500 m at water depths of roughly 2000 m, 3000 m, and 4000 m. This constitutes a full leg.

11. RODRIGUEZ TRIPLE JUNCTION (Schlich)

The Rodriguez Triple Junction (25°30'S and 70°E), which corresponds to the junction of three active ridges with different spreading rates (1.5, 3.8, and 6.8 cm/yr) offers the possibility of investigating processes of magma generation and mantle heterogeneities in specific conditions. Drilling of this RRR junction is proposed to assess the origin and evolution of the erupted basalts and to constrain the nature of the underlying mantle and the characteristics of the corresponding magma chambers. The proposed sites should be deep sites, penetrating at least for one of them 300 to 400 m of basalts. The reference site should be located on the southeast Indian Ridge (6.8 cm/yr), which corresponds to a medium fast spreading ridge versus the slow Atlantic and fast Pacific ridges. The following two sites should be drilled close to the junction itself, respectively, on the southeast Indian Ridge and the southwest Indian Ridge. The next site (if possible) should be located on the central Indian Ridge, close to the triple junction. The penetration of these three last sites should be at least 200 to 300 m. The proposed drilling program will cover a whole leg.

This program will probably correspond to the first drilling of zero-age basalts on bare crust. The geographic locations of the sites present optimal conditions with respect to weather conditions and distance to port. The Rodriguez Triple Junction is one of the best exposed RRR junctions in the world. Site surveys have been done (SEABEAM, magnetism, gravimetry, dredges, camera).