

MINUTES OF THE INDIAN OCEAN PANEL MEETING  
 31 MARCH - 1 APRIL, 1987  
 PALISADES, N.Y.

Members present :

H. Bäcker  
 A. Bosellini  
 J. Cochran  
 J. Curray  
 D. Falvey  
 J. Ludden, Secretary  
 W. Prell  
 R. Schlich, Chairman  
 J. Sclater  
 R. Scrutton (Alternate)  
 J. Segawa

Absent :

R. Duncan

Liaison members present :

C. Brenner, SSP  
 W. Hay, SOHP  
 C. Langmuir, LITHP  
 R. Larson, PCOM  
 T. Watts, TECP

Attending guests :

H. Dick, WHOI  
 L. Garrison, ODP-TAMU  
 D. Goldberg, ODP  
 A. MacDonald, ODP-TAMU  
 N. Piasias, PCOM  
 J. Weissel, LDGO

R. Scrutton attended the meeting as alternate for R. White (U.K.), T. Watts as replacement for J. Leggett (TECP). R. Larson (PCOM) attended March 31 only, W. Prell April 1st only, and H. Dick part of April 1st.

The IOP opened its meeting on March 31, 1987 with a special welcome to Dr H. Bäcker, replacing Ulrich von Rad as representative of F.R.G. Thanks were expressed to J. Cochran for hosting the meeting at L.D.G.O.

**1) Minutes of the previous meeting**

The final minutes of the Miami, November 20-22, 1987 meeting were adopted without any changes.

**2) IOP Membership replacement and rotation**

Replacement of L. Tauxe is still open. Several names were suggested at the Miami meeting.

According to PCOM policy two members, J. Curray and J. Sclater, have to rotate. The panel considering the weakness of the group in paleontology and biostratigraphy suggested the following names : D. Johnston, T. Davies, W. Berger, B. Berggren, L. Peterson, E. Vincent, W. Haq, R. Wise. Two other names were added to the list : F. Frey (hard rock specialist) and J. Weissel (geophysicist).

The first choices proposed to PCOM are :

- T. Davies (sedimentology)
- W. Haq (sedimentology)
- R. Wise (sedimentology)
- J. Weissel (geophysics)

### 3) Reports from Liaisons

#### 3.1. EXCOM (R. Larson)

- U.S.S.R. have announced their readiness to join the ODP as soon as possible. The status of their membership is however still in doubt.
- The deadline for the Indian Ocean Red Sea program is 19 January, 1987.

#### 3.2. PCOM (R. Larson)

- The Indian Ocean Red Sea drilling program has been cancelled due to lack of clearance.
- The Indian Ocean Makran drilling program has been eliminated due to lack of survey data.
- The Indian Ocean Southwest Indian Ridge drilling program has been delayed due to engineering requests.
- The Indian Ocean Drilling program is now scheduled as follows :
  - . Leg 115 Mascarene Plateau and Carbonate Dissolution Profile
  - . Leg 116 Intraplate Deformation (+ northern 90°E Ridge site)
  - . Leg 117 Neogene Package
  - . Leg 118 Southwest Indian Ridge
  - . Leg 119 Kerguelen I (northern sites and Prydz Bay)
  - . Leg 120 Kerguelen II (central and southern sites)
  - . Leg 121 Broken Ridge (+ central and southern 90°E Ridge sites)
  - . Leg 122 Exmouth Plateau
  - . Leg 123 Argo Abyssal Plain

Concerning leg 119 TAMU's position was that they would not go into Prydz Bay without an ice support boat. The Broken Ridge drilling program is acceptable only if site survey is endorsed. The Exmouth Plateau program is acceptable as one leg but contingent on safety input. For the Argo Abyssal Plain program PCOM agrees that this is the only Indian Ocean site where Jurassic crust can be reached : the one basement site program is accepted, but the two stratigraphy sites (one site penetrating basement) program is still in question.

- The following proposals were made by PCOM for the cochief scientists :

Leg 115 : R. Duncan, J. Backman

Leg 116 : J. Cochran and D. Stow

Leg 117 : W. Prell and N. Niitsuma

Leg 118 : R. von Herzen and P. Robinson

Leg 119 and 120 : still open (R. Schlich, K. Hinz).

### 3.3. LITHP (J. Ludden + C. Langmuir)

- Southwest Indian Ridge : LITHP strongly recommends extending Leg 118 to 56 days to allow sufficient time to deploy a guide-base and achieve the primary drilling objectives of the leg. Before deploying a guide-base LITHP favors a transect of single-bit, conventional rotary holes across the southern transform valley.

After discussion the IOP was asked to vote on the following resolution :

"Given the present time allocation should the leg be dedicated to a deep hole, or should we have an exploratory drilling section followed by a deep hole".

Given a 42 days leg IOP maintained the proposition made at Miami (November 20-22, 1987) and recommended to dedicate the leg to a deep hole. If the leg is extended to 56 days IOP would reconsider their position.

- Mascarene Plateau : LITHP strongly endorses the Mascarene Plateau drilling program as a complement to the 90°E Ridge sites. LITHP supported this program as a half-leg to be drilled as a replacement of Makran.

- Kerguelen Plateau : LITHP is concerned that only one site on the Kerguelen Plateau is likely to reach basement. LITHP recommends the Kerguelen Working Group, and both the SOP and IOP, to develop a more balanced drilling program to achieve the paleo-oceanographic and basement objectives.

- Argo Abyssal Plain : LITHP favors drilling AAP-1B into basement as either a single bit (bit destruction) or re-entry (> 200 m) hole to serve as a geochemical reference hole for the old Indian Ocean crust.

### 3.4. TECP (T. Watts)

- TECP discussed in some details the Makran drilling program which has now been eliminated.
- In order to evaluate the 3D structure of a fracture zone (SWIR) TECP strongly recommends to drill a transect of holes penetrating a few meters into basement rather than a deep hole on the median ridge using a guide-base.

### 3.5. SOHP (W. Hay)

- Carbonate Saturation Profile : SOHP is delighted to see this program included in leg 115. The primary objective of this program is a depth transect of four HPC sites. SOHP supports the suggestion made by Backman, Shakleton and others to shallow three of the Carbonate Saturation sites by 600 m ; the time saved should be allocated to the MLD-2 Maldives site. If further time is available SOHP recommends to drill site MLD-1 and encourages HPC at MP-1, but considers this to have a lower priority than the Carbonate Saturation sites or the Maldives sites. The Maldives sites will provide an aragonite saturation profile.

TAMU comments that this program (Maldives) will need three international clearances : Mauritius, Maldives, Seychelles.

- Exmouth Plateau and Argo Abyssal Plain : giving the directive of one leg on Exmouth Plateau and one leg on Argo Abyssal Plain, SOHP re-evaluated its priorities and recommends the following sites in order of priority : EP-7, EP-10A, EP-2A, EP-6 and EP-9B. The SOHP also reviewed the proposal for Argo Abyssal Plain and concluded that most of their objectives can be met at one drilled site (AAP-1B). The second site in the Argo Abyssal Plain is of lower priority compared to the Exmouth Plateau sites.

## **4) Mascarene Plateau and Carbonate Dissolution Profile (Leg 115)**

- Three sites have been selected on the Mascarene Plateau (MP-1, MP-2 and MP-3). They have been located between 13°S and 19°S, at a water depth of about 2 500 m. Basement should be penetrated at each of these sites (50 m).
- For the Carbonate Dissolution Profile program, four sites (CARB-1, CARB-2, CARB-3 and CARB-4) have been selected between 4°S and 8°S, ranging between 1 500 m and 4 500 m water depth. CARB-1 site now includes 50 m penetration into basement.
- Two complementary sites have been proposed on the Maldives (MLD-1 and MLD-2).

- IOP recommends drilling the Maldives sites only if the Mascarene Plateau and Carbonate Dissolution Profile sites have been completed. If time is available for the Maldives program, IOP agrees with SOHP that MLD-2 site is of first priority compared to site MLD-1.
- All proposed sites have been surveyed and drilling permission is requested.

### **5) Intraplate Deformation (Leg 116)**

- IOP reconsidered the original five site Intraplate Deformation drilling program and made the following recommendations and comments :

- . IOP recommends an additional site (site 6) located south of site 5, between the fault and the area of high heat flow. The hole would be about 400 m penetration and is designed to investigate the possibility that the region of high heat flow results from the migration of water away from the fault possibly along bedding planes.

- . The time estimates for the original five site program is 36 days. Some additional time might be necessary depending which packer is used on site 5. Elimination of site 4 as unnecessary and addition of site 6 will result in a 37 day program, again depending on what packer is used on sites 5 and 6.

- . IOP recommends that leg 116 concentrate on the Intraplate Deformation area at 1°S and that the northern 90°E Ridge site be drilled on leg 121. The northern 90°E Ridge site requires 10-12 days of drilling time and would need two additional days of transit. This would leave 24-26 days at the 1°S sites. A minimal program for the Intraplate Deformation objectives (sites 1,2,5, and 6) requires 31-32 days and could not be achieved in the reduced time.

- The IOP priorities are :

- . Site 1 : reference hole for seismic stratigraphy and physical properties ;
- . Sites 2 or 3 : hole to establish seismic stratigraphy correlation and history of deformation ;
- . Site 5 : hole to characterize fault zone ;
- . Site 6 : hole to measure pressure, temperature and fluid characteristics on a heat flow anomaly.

### **6) Neogene Package (Leg 117)**

IOP is satisfied with the Neogene Package program as it stands. The selected sites are now undergoing documentation for the cruise prospectus .

### **7) Southwest Indian Ridge (Leg 118)**

- H. Dick (invited guest) presented the results of a detailed regional site survey of the Atlantis II Fracture Zone, conducted by R/V Conrad in October, 1986, discussed the drill targets and priorities, and the possible operational scenarios.

- IOP recalls that the primary objective of this program is to drill a deep hole in exposed upper mantle peridotite on a median ridge of the fracture zone with the aid of a hardrock guide-base. With the present time allocation it is obvious that the objective will not be reached and IOP has been asked to consider the possibility of delaying legs 119 and 120 on the Kerguelen Plateau.

IOP voted on the following questions :

. If Prydz Bay drilling is cancelled, should the Kerguelen program start on December 9, 1987 ? 3 Yes, 3 No, and 1 abstention.

. If Prydz Bay drilling is in the program, should the Kerguelen program be delayed until December 19, 1987 ? 4 Yes, 2 No, and 1 abstention.

Considering a possible extension of the time allocated to the leg, IOP agrees with the LITHP and TECP proposed drilling strategy.

### **8) Kerguelen Plateau and Prydz Bay (Leg 119, Leg 120)**

- IOP supports the Kerguelen Working Group proposal (11-12 March, 1987) and suggests some small modifications to allow a 60/60 day schedule.

- . Leg 119 : KHP 1 Neogene paleoceanographic site ;
- KHP 3 Paleogene-Mesozoic stratigraphic site ;
- PB1-PB4 Prydz Bay stratigraphic sites ;

- . Leg 120 : SKP 1 Basement site ;
- SKP 2 Neogene paleoceanographic site ;
- SKP 3 Paleogene-Mesozoic stratigraphic site ;
- SKP 4A Deep basement site ;
- SKP 6A Basement site.

- IOP recommends :

. Drilling on the Kerguelen Plateau is done in optimum weather window which is 15 December-15 March.

. Combining Kerguelen and Prydz Bay the overall best weather window would be 15 December-15 April.

. Endorses complete program including Prydz Bay.

. Retains site SKP-6B as alternate, if Prydz Bay cannot be entered.

### **9) Broken Ridge and 90°E Ridge (Leg 121)**

- IOP recommends to incorporate a complete Broken Ridge program (4 sites) and a two site 90°E Ridge program.
- IOP priorities are (in order) :
  - . a north-south transect of 4 sites on Broken Ridge,
  - . a northern 90°E Ridge site at about 3°N (90°ER-1),
  - . a central 90°E Ridge site at about 17.5°S (90°ER-2),
  - . the southern site (90°ER-5) at about 27°.5°S is retained as an alternate to the central site pending evaluation of data by J. Sclater.

### **10) Exmouth Plateau (Leg 122)**

- IOP considers the order of priority given by SOHP and agrees on the three first priorities : EP-7, EP-10A, and EP-2A. The next priority should be either EP-6 or EP-9B depending on input from U. von Rad. Decision to be taken at the next meeting.
- IOP recommends that the Exmouth Plateau is a 50 day operational leg.

### **11) Argo Abyssal Plain (Leg 123)**

- The proposed AAP-1B site represents 17.5 drilling days, not including heat flow measurements (3 days), 200 m basement penetration (10 days), and re-entry (5 days).
- IOP recommends :
  - . At site AAP-1B a re-entry hole with a 200 m basement penetration, plus complete logging and heat flow measurements ( 30 days).
  - . If legs 122 and 123 are in competition, IOP priority is to complete drilling on the Exmouth Plateau if not completed during leg 122.
  - . If Exmouth Plateau has been completed during leg 122 and if there is time available on leg 123, IOP proposes drilling only the Cretaceous-Jurassic section at site AAP-2.

### **12) Nomination for co-chief scientists for Indian Ocean legs**

Co-chief nominations have been made for legs 115 through 118. Revision of IOP co-chief recommendations are given for the subsequent legs.

#### **Legs 119 and 120 :**

- . Geophysicists : R. Schlich<sup>(\*)</sup>, D. Falvey<sup>(\*)</sup>, K. Hintz<sup>(\*)</sup>, J. Mutter, D. Hayes ;

. Sedimentologists : S. Wise<sup>(\*)</sup>, B. Berggren<sup>(\*)</sup>, J. Baron, P. Webb, J. Anderson<sup>(\*)</sup>, Schrader, L. Leclaire, K. Perch-Nielsen, J. Hays<sup>(\*)</sup>, W. Hacq, G. Keller.

Leg 121 :

. Geophysicists : J. Sclater, J. Weissel<sup>(\*)</sup>, J. Curray, F. Frey ;  
 . Sedimentologists : J. Pierce<sup>(\*)</sup>, R. Herb, J. Ludden, L. Dimitriev.

Leg 122 :

. Geophysicists : J. Mutter<sup>(\*)</sup>, R. Larson, M.C. Williamson ;  
 . Sedimentologists : U. von Rad<sup>(\*)</sup>, N. Exxon.

Leg 123 :

. Petrologists : C. Langmuir<sup>(\*)</sup>, J. Ludden, J. Honnorez, L. Dimitriev ;  
 . Sedimentologists : F. Gradstein<sup>(\*)</sup>.

(\*) corresponds to the IOP first choices.

**13) Liaison Members to upcoming meetings**

TEDCOM will meet at College Station 30 April-2 May, 1987. J. Cochran is designated as representative for the Indian Ocean Panel.

**14) Next meeting**

The next IOP meeting will be sometime between 30 September and 30 October, 1987 in Europe. Three possibilities have been considered :

- . Rome (Italy) between 20 and 30 October, 1987 (A. Bosellini) ;
- . Hanover (F.R.G.) between 30 September and 2 October, 1987 (H. Bäcker) ;
- . Edinburgh or Cambridge (U.K.) first week of November, 1987 (R. Scrutton).



Leg 116

TABLE 1: PROPOSED LEG 116 DRILLING PROGRAM

Site	Location	Travel Time (days)	Time at Site (days)	Departure Date (approximate)
Depart: Colombo (Sri Lanka)				July 04, 1987
	Underway*	2.2		
1111 Site 1	00°55.825'S 81°24.000'E (675)		10.8	July 18, 1987
	Transit	0.1		
1115 Site 2	00°57.425'S 81°23.926'E (350)		6.5	July 25, 1987
	Transit	0.1		
1120 Site 3	00°58.000'S 81°23.926'E (700)		4.2	July 30, 1987
	Transit	0.1		
1137 Site 4	00°59.575'S 81°23.950'E (675)		3.2	August 3, 1987
1130	Transit	0.1		
1134 Site 5	01°02.100'S 81°24.049'E (575)		9.0	August 13, 1987
	Transit*	7.4		
Arrive: Karachi (Pakistan)				August 21, 1987
?	Site 6.	10.0	33.7	48 days**

\*: estimated at 10 knots.

\*\* : 4 operational days are presently unemployed.

Note: Glen Foss recommends to drill Site 5 or Site 2 before Site 1 to better estimate the possibility of reaching 750 m with the XCB.

March 30, 1987

TABLE 2  
DRILLING PROGRAM

PROGRAM WITH PRYDZ BAY DRILLING

LEG 119		LEG 120	
SITE	DRILLING TIME	SITE	DRILLING TIME
KHP-1	7.3 Days	SKP-2	5.6 Days
KHP-3	17.0 Days	SKP-3	11.4 Days
SKP-1	5.3 Days	SKP-4A	12.5 Days
PB-1	3.5 Days	SKP-6A	5.7 Days
PB-2	3.5 Days	SKP-8	6.4 Days
PB-3	3.5 Days		
PB-4	3.5 Days		
Drilling Time = 43.6 Days		Drilling Time = 41.6 Days	
Transit Time = 26.7 Days (10 kt)		Transit Time = 24.0 Days (10 kt)	
Total 70.3 Days		Total 65.6 Days	
Transit Time = 21.7 Days (12 kt)		Transit Time = 19.4 Days (12 kt)	
Total 65.3 Days		Total 61.0 Days	

PROGRAM WITHOUT PRYDZ BAY DRILLING  
(include SKP-6B)

LEG 119 (ALTERNATE)		LEG 120 (ALTERNATE)	
SITE	DRILLING TIME	SITE	DRILLING TIME
KHP-1	7.3 Days	SKP-2	5.6 Days
KHP-3	17.0 Days	SKP-3	11.4 Days
SKP-1	5.3 Days	SKP-4A	12.4 Days
SKP-6B	13.7 Days	SKP-6A	5.7 Days
		SKP-8	6.4 Days
Drilling Time = 43.3 Days		Drilling Time = 41.5 Days	
Transit Time = 22.3 Days (10 kt)		Transit Time = 24.0 Days (10 kt)	
Total 65.6		Total 65.5 Days	
Transit Time = 18.6 Days (12 kt)		Transit Time = 19.4 Days (12 kt)	
Total 61.9 Days		Total 60.9 Days	

NINETYEAST RIDGE DRILLING PROGRAM

NINETY

Site - Location	Water Depth (m)	Penetration (m)		Operations	Time on site (day)	
		Total	Bsm't		Total	Logging
90ER-1 (North) 6°N - 90°E	2500	750(?)	50	Rotary core	9.5+	1.5+
90ER-2 (Central) <del>16°30'S - 88°E</del> 17°S 88°15'E	1800	<del>500</del> 500(?)	50	Rotary core	6.5-	1.5-
90ER-5 (South) <del>29°S - 87°30'E</del> 27°S 87°30'E	2300	<del>250</del> 250(?)	50	Rotary core	4.5-	1.5-

Total times on site are still estimates which have to be adjusted according to the results of the recent site surveys. The program (drilling and logging) requires about 22 days on site and has to be combined with two other drilling programs in the Eastern Indian Ocean (Intraplate Deformation and Broken Ridge or Broken Ridge and Argo Basin).

STATUS OF SITE SURVEY

Site 90ER-1 was surveyed by J. Curray in July, 1986 from the *Conrad*. Sites 90ER-2 and 90ER-5 were surveyed by J. Sclater and J. Weissel in subsequent *Conrad* cruises in August and September, 1986 respectively.

Further details is available from the following proposals : PCOM n°98/B (Rea), n°116/B (Oberhänsli and Herb), n°150/B (Frey and Sclater), n°196/B (Pierce).

Five DSDP holes have been drilled on the Ninetyeast Ridge in 1972. Site 216 (01°28'N, 90°12'E), site 214 (11°20'S, 88°43'E), site 253 (24°53'S, 88°22'E), and site 254 (30°58'S, 87°54'E) have reached and sampled basement.

## SUMMARY OF THE NINETYEAST RIDGE DRILLING PROGRAM

This study combines the two major regional objectives of the collision history of India with respect to Asia and the geochemical evolution of magmas associated with the Kerguelen hot-spot track. These objectives will be addressed by drilling at three sites on the 90°E Ridge.

### DRILLING OBJECTIVES

#### i) Petrological

From a geochemical perspective the Indian Ocean floor is especially interesting due to the presence of an isotopically distinct "end-member" composition which is defined by magmas erupted at Kerguelen Island. By drilling basement at three sites along the 90°E Ridge, in combination with existing data from DSDP sites 216, 214, 253, and 254, it will be possible to constrain the processes which create heterogeneities in the oceanic crust and the length of time that such heterogeneities can exist in a convecting mantle.

#### ii) Tectonic

Drilling a north-south transect of the 90°E Ridge will provide samples for a high-resolution study of the northward motion of India with respect to Asia. It will be possible to relate changes in plate velocity to the onset of the Himalayan orogeny and tectonic events in Southern China. Current data indicate that the Indian Ocean plate slowed down by a factor of three after colliding with Eurasia.

#### iii) Paleceanography

In addition to the two major objectives the north-south transect, with a total of 35° latitude extent, will be used to detect climatic and paleoceanographic changes such as a record of the aeolian transport from Western Australia through the Tertiary.

### PROPOSED SITES

The sites proposed are numbered from north to south ; they correspond to the original selected sites 90ER-1,2, and 5. All have the same objectives : basalt geochemistry, northward motion, paleoenvironment.

Details of these sites are given in the table following.

