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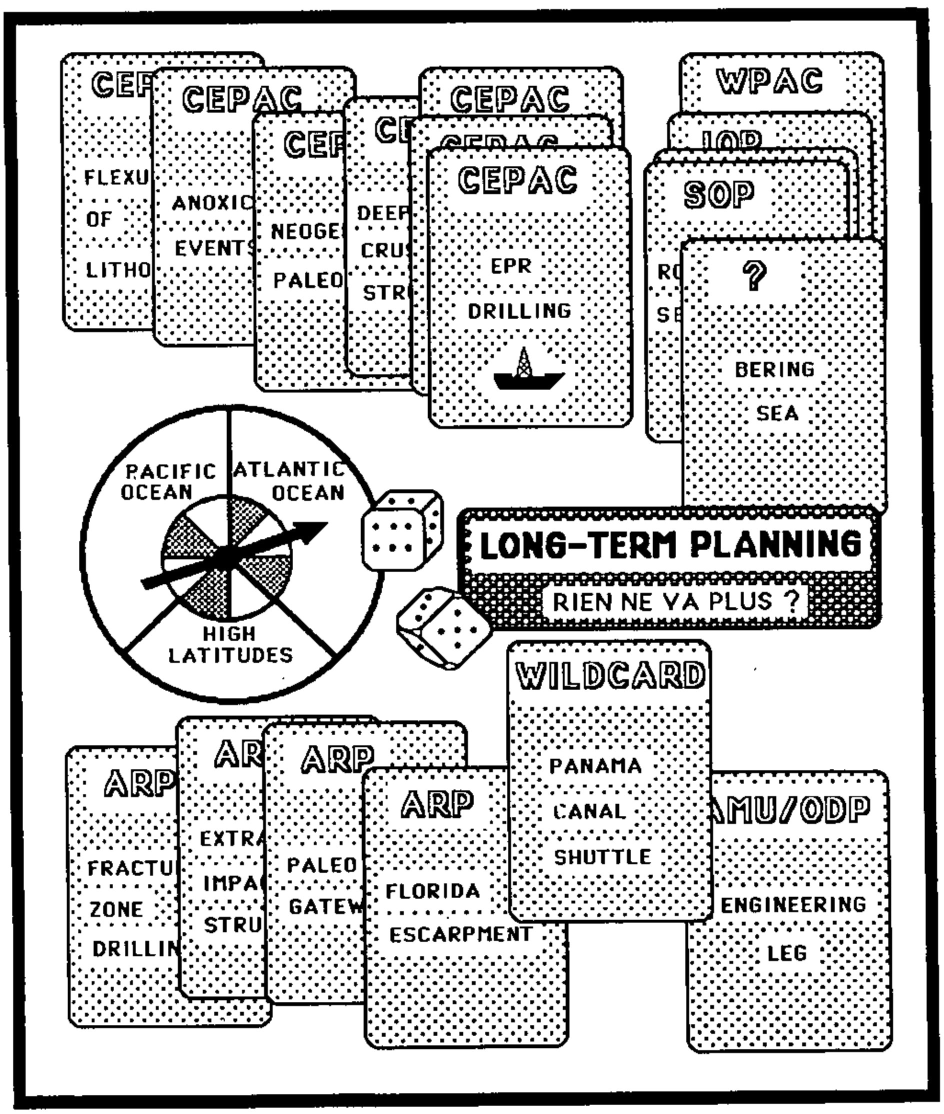
JOIDES Journal

VOL. XIV, No. 1, February, 1988



JOIDES Journal

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FOCUS

Part of the mandates for the JOIDES Planning Committee is to provide a four-year science plan for ODP each year. At its annual meeting held this past December in Oregon, PCOM outlined such a plan. Discussed elsewhere in this issue is the firm schedule used to develop the ODP FY89 Program Plan, the first year of drilling in the western Pacific, a tentative schedule for the second year drilling in the western Pacific, and finally, an outline of 18 months of drilling in the central and eastern Pacific. This issue of long-range planning raises many problems and questions for the JOIDES panels and the scientific community which supports ODP. The intent of this and the next few issues of the JOIDES Journal is to present some of these to the JOIDES community.

Starting with this issue, we will be publishing summaries of the "White Papers" prepared by the three thematic panels, beginning with the Lithosphere Panel report. The white papers of the Tectonics and Sediment and Ocean History Panels will follow. These papers are presented so that those planning to submit proposals will be more fully aware of how the thematic panels have ranked global themes to be addressed by ODP. With the recent changes in the proposal review process, in which thematic panels provide a first evaluation, it is important that proposals clearly present how the proposed drilling will address the thematic objectives of ODP. It is our hope that this will help improve proposals being submitted to JOIDES.

The cover of this issue of the Journal raises a key question in long-range planning: After the "four" years of drilling outlined for the Pacific where should the JOIDES RESOLUTION head? At the next annual meeting, when we again formulate a four-year plan, PCOM must make this decision. Input from the panels, and ultimately from the community through proposals, must be weighed during the next year. In the past these types of decisions were made somewhat arbitrarily, with the scientific community responding to the planned ship track rather than the community and panels providing the scientific justification for drilling specific areas.

The thematic panels in particular must now look at global problems in defining long-range goals. During individual cruises, co-chiefs, science operations and JOIDES sometimes have to gamble on whether conditions warrant a risk of time or resources. With the luxury of four years for devising a unified drilling strategy, we ought to do better than just "roll the dice."

During the next year, JOIDES will be addressing other important issues of long-range planning. The COSOD-II report is now available. How will the recommendations of this conference be incorporated into JOIDES planning? The structure of the JOIDES advisory panels is being reviewed this year and we will see some changes. These changes are intended to provide a more flexible structure and to enhance the ability of the program to address the long-range goals outlined in the COSOD and COSOD-II reports.

Of prime importance to the long-range goals of the drilling program are engineering developments. PCOM has made a significant commitment to improving drilling and logging technologies by including an engineering test leg in the first year of western Pacific drilling. PCOM also recommended that half of the special operations budget for the FY89 Program Plan be devoted to engineering development.

And finally we are faced with budgets. The "ODP Tree" presented by Jean Jarry at the PCOM Annual Meeting illustrates that the fertilizer of this program is continued funding. Achieving the objectives of ODP requires not only the commitment of the scientists and engineers but also the necessary resources. For example, drilling in Prydz Bay on Leg 119 was highly justifiable for scientif

JOIDES RESOLUTION OPERATIONS SCHEDULE

Legs 120 - 129

LEG	AREA	DEPARTS LOCATION	DEPARTS DATE	ARRIVES DESTINATION	ARRIVES DATE	IN PORT
120	Central Kerguelen Plateau	Mauritius	26 February	Freemantle	27 April	27 Apr - 1 May
121	Broken Ridge and N90°E Ridge	Freemantle	2 May	Singapore	24 June	24-28 June
122	Exmouth Plateau	Singapore	29 June	Singapore	28 August	28 Aug - 1 Sept
123	Argo Abyssal Plain and Exmouth Plateau	Singapore	2 September	Darwin	29 October	29 Oct - 2 Nov
- - -	- - -	- - -	- - -	- - -	- - -	- - -
124	Sulu Sea/So.China Sea	Darwin	3 November	Manila	14 December	14-18 December
124E	Engineering Tests	Manila	19 December	Guam	18 Jan 1989	18-22 January
125	Bonins-Marianas	Guam	23 January	Tokyo	20 March	20-24 March
126	Bonins II	Tokyo	25 March	Yokohama	9 May	9-13 May
127	Nankai Trough	Yokohama	14 May	Yokohama	10 July	10-14 July
128	Japan Sea I	Yokohama	15 July	Niigata	4 September	4-8 September
129	Japan Sea II	Niigata	9 September	Nagasaki	20 October ?	--
	Dry Dock	Nagasaki (?)				20 Oct - 2 Nov

NOTE: Ports and dates after Leg 123 are tentative and should be used as estimates only. (Rev 2/15/88)

LEGS 119 & 120: KERGUELEN PLATEAU AND PRYDZ BAY DRILLING

Legs 119 and 120 will complete a latitudinal transect in the Southern Ocean between Kerguelen Island (49°S) and Prydz Bay, Antarctica (67°S). This transect will study the Late Cretaceous to Holocene paleoclimatic history of East Antarctica, the origin and tectonic history of the Kerguelen Plateau, and the Late Mesozoic rifting history of East Antarctica and India. Leg 119 (19 Dec 1987 - 21 Feb 1988) will drill sites on the northern and southern Kerguelen Plateau and on the Prydz Bay continental margin (Figure 1), while Leg 120 (26 Feb - 27 Apr 1988) will drill several sites on the central portion of the Kerguelen Plateau. Ice support will be provided by the MAERSK MASTER, on which geophysical and biological studies will be conducted.

Drilling on the Kerguelen Plateau has both tectonic and paleoceanographic objectives. The Plateau offers the opportunity to make a latitudinal transect between 49°S and 62°S in an area of the Southern Ocean where sediment thicknesses and carbonate preservation are enhanced. This area lies south of the present-day Antarctic Convergence and beneath the main flow of the Antarctic Circumpolar Current, and drilling on the Kerguelen Plateau should document the development and evolution of these two paleoceanographic features, which have a major effect on global climate and surface water circulation. On the other hand, the origin and tectonic development of the Kerguelen Plateau remain obscure despite past geophysical and geological investigations. Reconstructions have debated the continental vs. oceanic origin of the plateau and have utilized bathymetry, seismic reflection, seismic sonobuoy refraction, dredges, piston cores, magnetics, and gravimetry without incorporating deep-sea drilling.

The drilling program on the northern end of the plateau is aimed at the recovery of an expanded section (910 m) of Neogene calcareous and biosiliceous oozes and the northern end of the paleoclimatic transect. A second objective will be to date the reflector at 910 m, which may represent a major middle Cenozoic unconformity signalling the uplift of the Kerguelen Plateau and subsequent rifting between the plateau and Broken Ridge. Drilling on the southern end of the plateau, through about 550 m of sediment and 50 m of basement, is aimed at obtaining an Upper Cretaceous through Cenozoic reference section, determining the nature and age of the basement there, and providing evidence of the rifting and subsidence of the Kerguelen Plateau.

Drilling in Prydz Bay is aimed at understanding Antarctic climatic evolution, both before and during the development of the present continental ice sheet. The present ice drainage basin of the Lambert Glacier is believed to be long-lived because of the structural control of the Lambert Graben (Permian or Early Cretaceous), and Prydz Bay sediments should reflect all stages of Antarctic glaciation and the pre-glacial continental climate. The drilling program in Prydz Bay is designed to step down a series of prograding seismic reflectors with four overlapping holes, each of 500 m depth, in an effort to document the Late Cretaceous to Holocene paleoclimatic history of East Antarctica as well as provide data on the timing of the East Antarctica-India separation in the Early Cretaceous. The history of ice-sheet volume changes will also be investigated.

LEG 119 STATUS REPORT

The following site summaries have been received from Drs. John Barron and Birger Larsen, Co-Chief Scientists aboard the JOIDES RESOLUTION, as Leg 119 nears completion.

<u>Site Summary, Site 736</u>
Latitude: 49° 24.121' S
Longitude: 71° 39.611' E
Water Depth: 631 m

Site 736 (proposed Site KHP-1) is located on the northern part of the Kerguelen-Heard Plateau. A 371 m

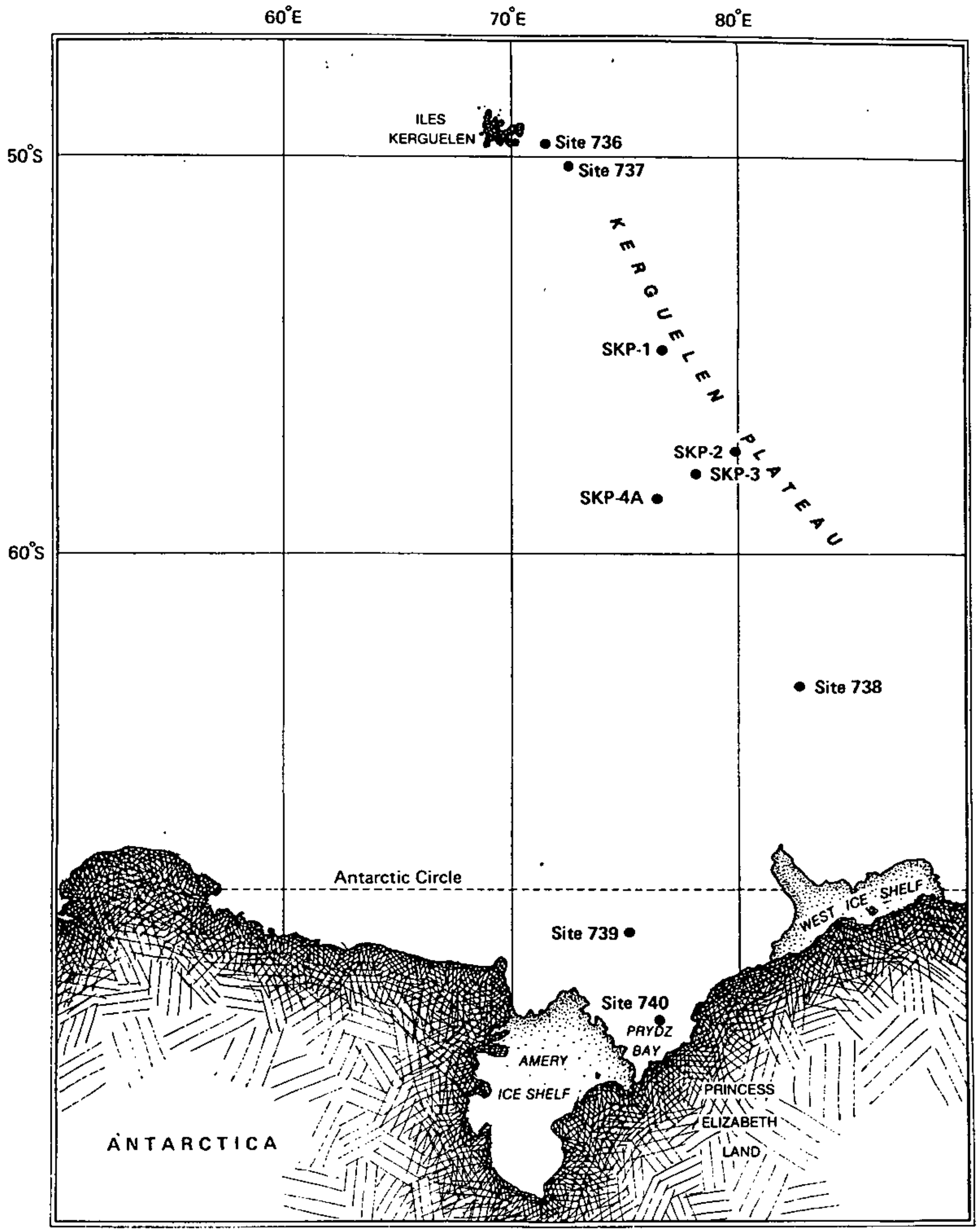

Figure 1. Location of Leg 119 and 120 sites in the Southern Ocean. Kerguelen-Heard Plateau Sites 736, 737, and 738 were drilled during Leg 119, along with Prydz Bay Sites 739 and 740, as of late January, 1988.

thick, continuous section of upper Pliocene and Quaternary diatomaceous ooze with a varying component of volcanic ice-rafted and/or detrital material was cored in three holes at this site.

APC coring commenced on 26 December 1987 in Hole 736A. Except for the interval 119.5-146.4 mbsf, which was cored with the XCB, APC coring was completed in the upper 165.4 m of the sediment column with an average recovery of 94%. Below that level, XCB coring in Hole 736A continued to 242.6 mbsf, where poor recovery and drilling characteristics resulted in the decision to switch to RCB coring in another hole. Hole 736B was a shallow APC site which duplicated coring in the upper 27 m of Hole 736A in order to ensure a more complete recovery of the uppermost Quaternary section. In Hole 736C, RCB coring commenced at 206.9 mbsf and continued to 371 mbsf (29 December), the total depth of the hole. Recovery was variable, ranging from no recovery to full recovery and averaging 47%.

Two lithologic units were recognized at Site 736. The upper 277 m of the section (Unit I) consists of diatomaceous ooze containing occasional pebbles and gravel that appear to be ice-rafted. The age of the base of this unit is approximately 2.8 Ma according to diatom stratigraphy, so it is likely that the base of the unit is tied with the onset of ice rafting in this area. Approximately the same upper unit (0-240 mbsf) is characterized on seismic lines by closely spaced strong reflectors. Regionally, there are considerable channeling and thickness variations associated with the upper unit, and it appears that this may be unit S1 of Munchy and Schlich (1987). Below 277 mbsf, diatomaceous oozes continue (Unit II) without appreciable detrital content to the base of the hole.

Diatoms and radiolarians are consistent in the Site 736 sediments and standard Antarctic zonations can be applied. Coring at the site was terminated in the *Nitzschia interfrigidaria* Zone (diatoms; 3.1-3.88 Ma). Carbonate is sparse and sporadic in its occurrence. Biostratigraphy indicate that the section is complete, with sediment accumulation rates ranging between 50 and 140 m/m.y. Unfortunately, the magnetic signal of the sediments is very weak, and no reversal stratigraphy could be established. No gas was encountered in Site 736 sediments, and total organic content is low.

<u>Site Summary, Site 737</u>
Latitude: 50° 13.660′ S
Longitude: 73° 01.950′ E
Water Depth: 664 m

Site 737 (proposed Site KHP-3) lies on the northern Kerguelen-Heard Plateau about 100 km southeast of Site 736. The 715.5 m thick middle Eocene through lower Pliocene section cored in two holes at Site 737 begins almost exactly (3.4 Ma) where coring was terminated at Site 736, so together the two sites form a valuable reference section for the late Paleogene and Neogene at about 50°S.

Coring commenced on 30 December in Hole 737A with APC coring to 167 mbsf. Core recovery neared 100%, but one core was lost. Below that level, XCB coring continued to 273.2 mbsf with 22% recovery on an average, but four cores were empty. The poor recovery in the lower part of Hole 737A resulted in the decision to switch to rotary drilling and coring (RCB) in another hole. Hole 737B was washed down to 114.5 mbsf, and 2 cores were taken between 114.5 and 133.8 mbsf in order to sample the Miocene/Pliocene boundary, which was lost in Hole 737A. Washing continued to 253.5 mbsf. The remainder of the hole was RCB-cored to a total depth at 715.5 mbsf. The recovery was variable, averaging 62%, most of the recovered cores being only slightly deformed or fractured.

The topmost 1.5 m recovered at Site 737 consists of Quaternary glauconitic lag sand which overlies a 234 m thick sequence of diatom ooze. From 234 to 250 mbsf, increasing amounts of calcareous nannofossils change the sediment to diatom nannofossil ooze extending to 315 mbsf. The diatom and diatom nannofossil oozes seem to comprise a continuous lower Pliocene to upper Miocene section (3.4-8.2 Ma) from 1 to 263 mbsf. A hiatus covering the time from 8.2 to 10 Ma between the upper Miocene and the middle Miocene is indicated at the base of this level. The sedimentation rate was significantly lower for the middle Miocene diatom nannofossil ooze interval from 264 to 315 mbsf, than for the younger section in Holes 737A and 737B.

The oozes are underlain by a 355 m thick sequence of variable bioturbated glauconitic calcareous claystone forming an almost continuous hemi-pelagic and turbidite-redeposited upper Eocene to upper Oligocene section. The top of this sequence is a major hiatus covering the interval from 15 to 23 Ma. It is probable that this hiatus shows up as the important Reflector A of Munschy and Schlich (1987), who propose that it marks the division between pre-rifting and post-rifting sequences on the Kerguelen Plateau. The age of Reflector A is thus clearly younger than the middle Eocene age expected.

The deepest part of Hole 737B from 670 to 715 mbsf consists of clayey pelagic limestone with occasional thin (10 cm thick) chert layers of middle Eocene age. The upper part of this sequence is correlated with a strong seismic reflector, possibly Reflector M of Munschy and Schlich (1987). Minor amounts of volcanic material occur throughout the section cored.

Siliceous microfossils are abundant, well-preserved, and the diatom assemblages highly diversified in the siliceous upper part (middle Miocene to Quaternary) of the sequence. Calcareous nannofossils are abundant through the Eocene-Oligocene lower part of the cored sequence. Below 245 mbsf all core-catcher samples yielded foraminifers, chiefly planktonic. A detailed magnetostratigraphy has been established for the Oligocene interval.

Site Summary, Site 738
Latitude: 62° 42.543′ S
Longitude: 82° 47.245′ E
Water Depth: 2252.5 m

A 490 m thick lower Turonian through Quaternary section overlying 43 m of basaltic breccia and altered basalt was cored at Site 738 (proposed site SKP-6A) on the southern tip of the Kerguelen Plateau. Lithologic units recognized at this site are:

Unit I: (0-18.3 mbsf) Quaternary to uppermost Miocene diatom ooze;
Unit II: (18.3-19.2 mbsf) upper Miocene nannofossil ooze containing a minor percentage of diatoms;
Unit III: (19.2-120.8 mbsf) lower Oligocene to middle Eocene homogeneous nannofossil ooze;
Unit IV: (120.8-254.4 mbsf) middle and lower Eocene nannofossil ooze and chalk containing thin chert layers and concretions;
Unit V: (254.4-418.6 mbsf) lower Eocene to Campanian chalk with chert nodules and fragments, bioturbated in the Cretaceous section;
Unit VI:(418.6-490.0 mbsf) Campanian to lower Turonian silicified limestone, which is partially laminated and contains burrows, along with Unit VII: algal calcarenite containing basalt pebbles; and Unit VIII: (490.0-533.8 mbsf) basaltic breccia and altered basalt.

The sequence documents a series of paleoceanographic and geological changes in the area: (1) Unit VII indicates inner shelf deposition during or before the early Turonian; (2) the Upper Cretaceous chalk, though primarily pelagic, contains indications from trace fossil assemblages, benthic shelly faunas and omission surfaces associated with glauconite, of a seafloor depth shallower than at present; (3) gradual change through the late Miocene and early Pliocene in the pelagic facies, from nannofossil ooze to diatom ooze; (4) deposition of ice-rafted debris of gneissic/granitic Antarctic derivation from the late Miocene to Recent. The sedimentary sequence overlies altered basaltic basement.

Site 738 constitutes an excellent middle Paleocene to Maestrichtian reference section for Southern Ocean calcareous microfossils. Short hiatuses are present only at the Eocene/Oligocene boundary and in the lower upper Eocene; preservation declines in the sediments older than late Maestrichtian. A combination of low-latitude and middle latitude zones can be applied to nannofossil and planktonic foraminiferal assemblages. The Cretaceous-Tertiary boundary appears complete, although the uppermost Cretaceous, immediately below the boundary, was poorly covered. The Cretaceous-Tertiary boundary lies in a 15 cm thick laminated claystone interval that contains 95% micrite particles and few to rare nannofossils. Late Maestrichtian planktonic forimanifers include ornate specimen that are more typical of subtropical transitional regions than cool, temperate ones. Cenozoic benthic foraminiferal assemblages of Site 738 indicate paleodepths near or deeper than at present (2252.5 m). However, the upper Maestrichtian is characterized by species indicative of outer shelf environments. Benthic foraminifers in the older Cretaceous sediments are too sparse to be definitive of paleodepth. Surprisingly, low-latitude diatoms are present in the uppermost Miocene (5.8-6.1 Ma). Ice-rafted debris is restricted to the overlying Pliocene and Quaternary.

The minimum age of the basaltic basement is provided by the overlying Turonian limestone (90 Ma). Basement consists alternately of volcaniclastics and massive, aphyric basalt, moderately to highly fractured and altered. The dull red volcaniclastics, abundance of vesicles, and the lack of typical submarine flows suggest that these basalts were erupted in a shallow-water or subaerial environment.

<u>Site Summary, Site 739</u>
Latitude: 67° 16.570′ S
Longitude: 75° 04.914′ E
Water Depth: 410.3 m

A thick sequence of glacial sediments ranging in age from Quaternary to late Eocene-early Oligocene was drilled on the shelf of Eastern Antarctica in the outer part of Prydz Bay at Site 739. The drillhole is the first attempt to drill through the glacial sequence in Eastern Antarctica, and the first record of early Neogene ice cover on the shelf.

Coring began on 18 January 1988 with two unsuccessful attempts at obtaining more than a few meters of extremely hard surface layers with APC and XCB. A third attempt with rotary drilling eventually penetrated to a depth of 486.8 m. However, overall recovery was only about 35%; in the upper 106 m.

The sequence is remarkably uniform, consisting almost exclusively of more or less pebbly mudstone (diamictite). This succession has been divided into five units. Unit I (0-15 mbsf) consists of normally consolidated diamicton with diatoms of late Pliocene to Quaternary. It is possibly very disturbed by scouring of icebergs. Unit II (15-170 mbsf) is a very hard, compacted diamicton, totally devoid of structures.

Approximately the upper 100 m of this unit makes up the covering sediments, forming the banks of the outer shelf. The lower part, between 100 and 170 mbsf, contains more organic carbon (1-2%) and diatoms indicating an early Pliocene to late Miocene age. Unit III (170-260 mbsf) is comprised of stratified diamictite horizons with diatoms, with the stratification often contorted, suggesting redeposition by mudflows down the paleo-shelf/slope. The unit contains, at 193 mbsf, a mainly gravel-free claystone with up to 30% diatoms of late Eocene-early Oligocene age. Unit IV (260 to 313 mbsf) is massive diamictite with 1-2% $CaCO_3$. Units III and IV comprise the innermost part of a thick prograding sequence, forming the outer part of the Prydz Bay Shelf. Unit V, from 313 mbsf to the bottom of the hole, consists of massive, slightly indurated, but friable diamictite. It is mainly unfossiliferous and as yet undated. The entire succession appears to have been deposited close to the grounding line at the shelf break by an extended Lambert Glacier, mainly as a result of raining out of basal debris from the floating ice front.

The diamictite sediments recovered afford poor biostratigraphic control throughout most of the sequence because of the occurrence of thick intervals barren of microfossils, the absence of zonal marker species, and the sporadic occurrence of reworked species. Diatoms are the most persistent of the recovered fossil groups, enabling recognition of the Quaternary to 17 mbsf, lower Pliocene between 111 and 127 mbsf, Miocene between 142 and 168 mbsf, and upper Eocene to lower Oligocene between 178 and 318 mbsf. A hiatus probably lies between the upper Eocene-lower

Oligocene and the upper Miocene interval. The lowermost age determination of Site 739, at 378 mbsf, is from a nannoplankton species with ranges from middle Eocene to Oligocene.

The physical properties data seem to indicate a thin cover of normally consolidated glacial sediments covering a 300 m thick sequence of overconsolidated sediments bearing evidence of cyclic loading, most likely due to glacial oscillations. This sequence is underlain by glacial sediments that apparently have experienced no history of excess loading.

The result of the glacial activity is a prograding sequence comprising waterlain tills and glaciomarine sediments seaward of the old shelf break, and much thinner lodgement tills forming the banks on the shelf. Site 739 records for the first time a shelf marginal succession dominated for a prolonged period of time by a major glacier complex. This may be typical of the greater part of the glacial sedimentation of the continental shelf of Antarctica and other high latitude shelves.

The main conclusion drawn from the site is that a major glacier complex reached Prydz Bay as early as the late Eocene-early Oligocene, and that the ice front was beyond that of the present day by at least 300 km. This suggests full-scale ice sheet development of East Antarctica in the early Oligocene and possibly earlier. The glacial record extends through lower Oligocene, upper Miocene to lower Pliocene, possibly the upper Pliocene, and Quaternary. No trace of oil or gas was recorded at the site.

Site Summary, Site 740
Latitude: 68° 41.220′ S
Longitude: 76° 43.246′ E
Water Depth: 810.8 m

Site 740 is situated in the inner part of Prydz Bay, East Antarctica. The drilling objective was to date the oldest sequence overlying basement in eastern Prydz Bay, the formation of the Lambert Graben, or separation of the Indian subcontinent from the Antarctic continent. Drilling began on 25 January 1988, in a local mud basin in an 800 m deep erosional trough approximately 30 km from the coast.

The sedimentary succession at Site 740 is incomplete due to poor recovery. It can be divided into three units: Unit I (0-15 mbsf) consists of soft diatom ooze with up to 75% diatoms of late Pliocene to Recent age; Unit II (15-60 mbsf) consists of silty clay with about 1% gravel and coarse sand, containing minor diatoms of late Pliocene to Recent age that are confined to the uppermost part of the unit; Unit III (60-225 mbsf) is gray and reddish sandstone alternating with siltstone and claystone, arranged in pedogenically influenced fining and coarsening-upward sequence. The age of Units II and III is uncertain because of the lack of paleontological data.

The sedimentary succession records major changes of depositional environment. The oldest sediments of Unit III, situated approximately 300 m above the basement, represent a "red bed" type sequence deposited within the proximal reaches of a fluvial depositional system. Climatic conditions at the time were probably warm and characterized by seasonal rainfall. Unit II, which rests unconformably on Unit III, is probably indicative of cold water glaciomarine environments. The overlying diatom ooze represents the present day conditions. No trace of hydrocarbons was detected at the site.

REFERENCES

Munschy, M., and Schlich, R., 1987. Structure and evolution of the Kerguelen-Heard Plateau (Indian Ocean) deduced from seismic stratigraphy. Mar.Geol., 76:131-152.

LEG 118: FRACTURE ZONE DRILLING ON THE SOUTHWEST INDIAN RIDGE

The aim of Leg 118 was to drill one or more holes in the Atlantis II Fracture Zone of the Southwest Indian Ridge (see Figure 1 for site locations). The primary goal was to drill a deep (500+ m) hole in exposed upper mantle peridotite on a median ridge of the fracture zone with the aid of a hardrock guidebase, and to conduct a major geophysical logging and downhole measurements program. Since a deep hole at this site was not achievable due to difficult drilling conditions, other locations on the walls and floor of the fracture zone were attempted. The guidebase was set successfully on a shallow platform on the east rim of the transform at Site 735B.

The following site summaries are based on reports received from Drs. Paul Robinson and Richard von Herzen, Co-Chief Scientists aboard JOIDES RESOLUTION, Leg 118, during the period 23 October to 14 December 1987. The Preliminary Report from Leg 118, which provides further details of results and drilling operations, is available from ODP/TAMU Publications (see ODP Bibliography this issue). The Logging Reports and Engineering/Operations reports from Leg 118 also appear in this issue of the JOIDES Journal.

Site Summary, Site 732

Latitude:	Holes A-C	32°32.81′ S
	Holes D-F	32°32.85′ S
Longitude:	Holes A-C	57°03.29′ E
	Holes D-F	57°02.70′ E
Water Depth:	4807-4885.5 m	

Site 732 (proposed site SWIR I) is located on a median tectonic ridge that bisects the northern half of the N-S trending Atlantis II Transform in the Indian Ocean (Figure 1). Dredge hauls from the wall of this ridge recovered mainly serpentinized peridotite, suggesting that the feature is a mantle diapir. The principal scientific objectives for drilling this site were to (1) determine the nature and vertical variability of rock in the median ridge, (2) investigate the deformation of mantle rocks on the floor of the transform, (3) determine the thermal structure of the mantle section and assess the extent of hydrothermal alteration, and (4) determine the physical properties, magnetism and seismic velocities of mantle rock. A deep reentry hole using the barerock guidebase was planned at this site.

After a TV/sonar survey to locate a site for a test spud-in, six test holes were drilled in two locations at Site 732; the deepest penetration was 24 mbsf in Hole 732C. Each hole penetrated 2 to 8 meters of soft material overlying a harder unit. The ridge appears to be capped by a poorly sorted gravel or conglomerate interlayered with sand and sandstone and overlain by a thin pelagic cover. Clasts from the gravels are similar in size and composition to those recovered from gravels on the floor of the transform during the pre-cruise site survey.

Unstable hole conditions made it impossible to reach basement at this site. Consequently, the site was abandoned and the ship moved to proposed site SWIR II on the west wall of the transform.

Site Summary, Site 733

Hole 733A: 33°05.25′S, 56°58.65′E
Hole 733B: 33°05.30′S, 56°58.65′E
Holes 733C & 733D:
33°04.89′S, 56°59.31′E
Water Depths: 4479-5208 m

Peridotite was dredged from the Site 733 area during the pre-cruise site survey and several small benches suitable for guidebase deployment were located during the TV survey. Four holes were drilled at two locations, one on a sedimented bench and another in a small, sediment-filled trough. The deepest hole (733D) penetrated to 23.5 mbsf. Because basement was not reached in these holes and drilling conditions were not promising, Site 734 was selected for a test spud-in.

Site Summary, Site 734

Holes 734A-E: 32°06.82′ S, 57°07.79′ E
Holes 734F-G: 32°06.93′ S, 57°08.12′ E
Water depth: 3417.5-3735.2 m

Site 734 is located on the east wall of the Atlantis II Transform and a deep hole into upper mantle peridotite was again the objective. Seven holes were drilled at this site but significant penetration was achieved only in Holes 734B and 734G (47.5 mbsf and 31.0 mbsf, respectively). A total of 7.8 m of sediment containing various clasts of igneous and metamorphic rock was recovered, chiefly from Holes 734B, 734D and 734G. None of the recovered core can be unequivocally interpreted as basement but the abundance of ultramafic clasts and fragments suggests that such material is present beneath the rubble and talus. For those holes at which spud-in was successful, the drilling conditions were poor. The site was not suitable for deployment of the guidebase and the JOIDES RESOLUTION moved to Site 735.

<u>Site Summary, Site 735</u>
Hole 735A: 32°43.30'S, 57°16.30'E
Hole 735B: 32°43.42'S, 57°15.97'E
Hole 735C: 32°43.44'S, 57°15.95'E
Water Depth: 720.0-742.9 m

Site 735 is located on a shallow platform in about 700 m of water on the east rim of the Atlantis II transform. This platform, about 5 km long in a north-south direction and 2 km wide, is one of a series of uplifted blocks that are connected by saddles to form a long, linear ridge parallel to the Atlantis II Transform.

The platform at Site 735 has a flat surface, suggesting that it is a wave-cut feature. Its position in the magnetic anomaly pattern on the east transform wall suggests a crustal age of about 12 Ma. A TV/sonar survey of the seafloor revealed basement outcrops lightly mantled with sediment.

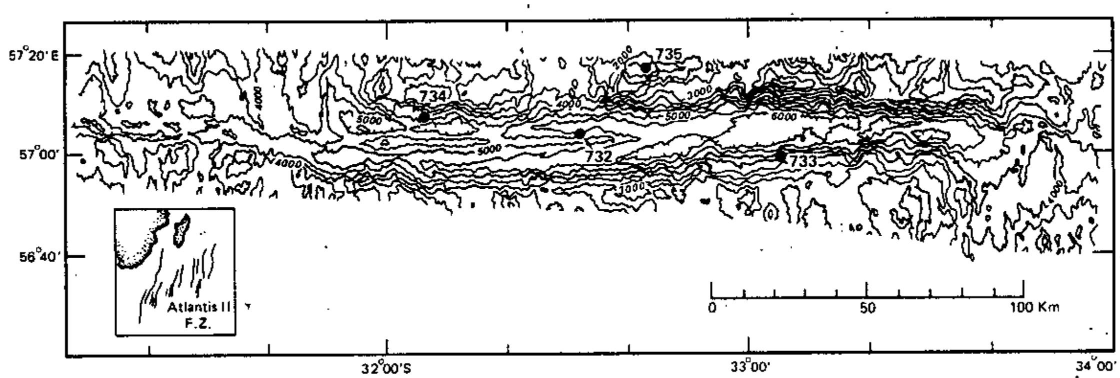

Figure 1. Location of the Atlantis II Fracture Zone of the Southwest Indian Ridge (inset). Bathymetry of the median ridge with sites drilled during Leg 118 are shown. The hard-rock guidebase was successfully deployed at Site 735B, located on a shallow platform on the east rim of the transform.

An unsupported test spud-in, using the coring motor, recovered 0.1 m of gabbro from Hole 735A. The hardrock guidebase was then deployed and drilling commenced in Hole 735B. The coring motor was used to start the hole and to drill to a depth of 60 m. A standard rotary coring system was then used to drill to 500 mbsf. A newly developed Navidrill was used to cut a further 0.7 m. The entire 500.7 m deep hole was drilled in 17 days, resulting in an average rate of penetration of 30 m/day.

A total of 435 m of olivine gabbro, olivine-bearing gabbro, two-pyroxene gabbro, Fe-Ti oxide gabbro, troctolite, and microgabbro with rare basalt and trondjhemite was recovered from Hole 735B for an average recovery of 87%. These rocks have undergone varying degrees of plastic and brittle deformation and many have well developed foliations. Six major lithostratigraphic units are recognized in the sequence based primarily on igneous mineralogy, mineral compositions, and degree and style of deformation.

LITHOSTRATIGRAPHIC UNITS

Unit I is a 39.5 m thick sequence of foliated metagabbro with porphyroclastic to mylonitic textures. Rock types include poorly foliated metagabbro, porphyroclastic metagabbro, mylonite, gneissic metagabbro and augen gneissic metagabbro. Igneous textures have been completely destroyed and the rocks now consist chiefly of neoblasts of plagioclase, clinopyroxene, and amphibole. The protolith was probably a two-pyroxene gabbronorite or olivine gabbronorite. There are a few Fe-Ti oxide-rich layers.

Unit II consists of 140.5 m of olivine and olivine-bearing gabbro. The upper contact is drawn at the first appearance of clearly igneous textures and the lower boundary is a rapid transition to gabbro with more orthopyroxene and more sodic plagioclase. Most of the rocks are mesocumulates. Alternating bands of olivine-rich and olivine-poor gabbro reflect rare modal layering. Chemically, these gabbros are fairly primitive. Interlayered Fe-Ti oxide-bearing gabbros are present, as are a few pyroxene-rich layers. Some mylonitic and porphyroclastic intervals are present, particularly in the upper part of the unit.

Unit III is a 44 m thick sequence of olivine gabbro with intervals of Fe-Ti oxide gabbro. These gabbros are similar to those of Unit II but have significantly more evolved compositions. The upper contact is gradational and is defined mineralogically, but also coincides with a change in chemical composition. A well-developed igneous lamination is steeply dipping in the upper part of the unit but flattens with depth. Mylonitic and foliated zones are common and the lower contact of Unit III is marked by a 60 cm thick zone of mylonite.

Unit IV is made up of 48 m of Fe-Ti oxide-rich gabbro. The upper contact is gradational into Unit III and the lower boundary is marked by a 3 m thick layer of mylonite. These gabbros have more abundant opaque minerals (10% or more) and less olivine than those of Unit III; iron oxide contents are as high as 30 wt% and TiO_2 contents, 9 wt%. A felsic intrusion breccia with trondjhemite veins occurs at two levels in the unit.

Unit V consists of 102.5 m of relatively uniform olivine gabbro characterized by a scarcity of Fe-Ti oxides and low calcium pyroxene. Most of the gabbros are mesocumulates and some exhibit primary grain size layering. They are mineralogically and chemically similar to those of Unit II. Thin troctolite layers and several plagioclase-rich zones are evident. Zones of brecciation are common and these contain felsic veins with epidote and albite.

Unit VI is a 126 m thick interval of olivine-rich gabbro with frequent layers of troctolite. The gabbros are similar to those of Unit V but are more olivine-rich. The troctolite and troctolitic gabbros are interlayered with the olivine gabbros and they are interpreted as being small dikes or intrusive layers. These are the most mafic rocks encountered in Hole 735B. A few coarse-grained Fe-Ti oxide gabbros are also present. Unit VI ... frequent inter...

characterized by mylonitic to porphyroclastic textures.

None of the contacts between units is clearly magmatic. The contact between Units I and II and that between Units IV and V are clearly tectonic. Veins and fractures generally dip 40^0 to 90^0 with a strong peak at 60^0 to 65^0. The mean dip of both veins and foliation decreases downward in the hole suggesting that deformation took place along listric normal faults which flatten downward.

ALTERATION/PHYSICAL PROPERTIES

The rocks from Hole 735B have been subjected to varying degrees of metamorphism and alteration. An early stage of dynamothermal metamorphism produced highly foliated porphyroclastic, gneissic, and mylonitic textures. This high temperature event was followed by brecciation and static alteration associated with brittle deformation. The static alteration was controlled by permeability and is manifested by numerous veins, from 0.5 mm to 2 cm wide, filled largely with hornblende and sodic plagioclase. Clinozoisite, epidote, and minor prehnite occur in the lower parts of the core. A few silicic veins containing diopside, hornblende, sphene, clinozoisite, and albite are also present. In undeformed gabbros, static alteration resulted in development of coronas of hornblende, tremolite, talc, clinozoisite, magnetite, chlorite, sphene, epidote and phlogopite(?) around the primary igneous minerals. A late stage of oxidative alteration is reflected in carbonate-hematite-smectite pseudomorphs of olivine and orthopyroxene.

Paleomagnetic intensities are variable, generally in the range of other oceanic gabbros but up to 2.5 emu/cm^3 in some of the Fe-Ti oxide gabbros. Magnetic susceptibilities average about 100 x 10^{-6} cgs. Again, the highest values are in the Fe-Ti oxide gabbros. Natural remanent inclinations are all steep and about equally divided between normal and reverse. Stable inclinations are reversed and average $65^0 \pm 15^0$.

Compressional wave seismic velocities in the gabbros are in the range of 6.5 to 7.0 km/s. Physical properties measurements show seismic anisotropy up to 10% particularly in some of the foliated rocks. The MCS experiment indicated that in situ seismic velocity increases somewhat (5-10%) with depth over the hole. Grain (matrix) densities averaged about 2.9 g/cm^3 over the hole from logs.

The laterolog showed variations of electrical resistivity of four orders of magnitude downhole (approximately 4 to 40K ohm-m). The most prominent low resistivity zone occurs throughout Unit IV, and is likely the effect of the high mineral conductivity of the Fe-Ti oxides. Smaller scale variations (few m) in the units below may reflect the same conductivity mechanisms.

Four magnetometer sondes were run in the hole. Large and similar variations in the fields were measured in the hole, especially in the Fe-Ti oxide-rich zone where the fields are up to 50% greater and more variable. Susceptibility is also more variable in this zone.

A borehole packer experiment indicated low fluid permeability below about 272 mbsf, with higher values (by several orders of magnitude) above this level. The temperature log shows a very low or even negative gradient in the hole, further suggesting the effects of sea water advection even with low porosity.

More comprehensive studies of the rock samples recovered and the data obtained should better define the origin, tectonics, and physical state of this unique section of material believed to represent the lower oceanic crust.

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LEG 117: OMAN MARGIN/NEOGENE PACKAGE

The two major scientific objectives addressed during Leg 117 of the Ocean Drilling Program are the evolution of the Indian Ocean summer monsoon and the history and origin of Owen Ridge as it relates to the evolution of the southeast Oman continental margin.

The following site summaries are excerpted from reports of Drs. Warren Prell and Nobuaki Niitsuma, Co-Chief Scientists aboard JOIDES RESOLUTION, Leg 117, during the period 24 August to 18 October, 1987. The complete Leg 117 Preliminary Report is available (see ODP Bibliography this issue). The ODP Engineering and Logging Reports from Leg 117 also appear in this issue of the JOIDES Journal.

MID-INDUS FAN SITE

Site Summary, Site 720
Latitude: 16°07.80′ N
Longitude: 60°44.62′ E
Water Depth: 4048 m

Site 720 (proposed site IN-1) is located on the westernmost part of the mid Indus Fan, the dominant physiographic feature of the Arabian Sea. Initiation of Indus Fan deposition is thought to have begun in Oligocene-early Miocene time when the Indian and Asian plates collided and caused major uplift of the Himalayas.

Sediment thickness at Site 720 is >2000 m. The site lies near magnetic anomaly 25, which indicates a Paleocene basement age of about 60 Ma. The site is 5 km east of a meandering channel that is 1.5 km wide, 50 m deep, and has a levee elevation of 30 m above the surrounding seafloor. The location of Site 720 was selected to avoid channel deposits, thereby maximizing the opportunity to collect a relatively continuous depositional record that can be related to uplift and sea level changes.

The principal objectives of Site 720 were: (1) to recover a continuous late Neogene section of fine-grained overbank deposits from the mid fan region of the western Indus Fan; (2) to identify the depositional facies, their composition, and accumulation rates for comparison to other Indus Fan and Bengal Fan (Leg 116) sites; and (3) to interpret the depositional history of the Indus Fan sediments in terms of uplift of the source region (Himalayas), changes in sea level, changes in climate, circulation, and weathering processes.

Maximum depth of penetration at Site 720 was 414.3 mbsf. The stratigraphic section recovered ranges from basal Pleistocene to Holocene and has been divided into two major lithologic units. Unit I (0.0-17.22 mbsf) is composed of nannofossil and foraminifer-bearing nannofossil ooze that is characteristic of pelagic deposition. Unit II (17.22-414.3 mbsf) is composed of a wide range of lithologies, including interbedded silty clays, silts, silty sands, sands, and occasional nannofossil oozes; this unit is characteristic of turbiditic deposition. The fan sediments contain relatively high concentrations (average of about 0.4%) of organic carbon that is mostly derived from terrestrial sources. They are also characterized by complete sulfate reduction below 50 mbsf, which is largely a function of rapid sedimentation. Traces of dolomite occur throughout the sequence and are thought to reflect both detrital sources and in situ precipitation.

Biostratigraphic and magnetostratigraphic data from the pelagic intervals indicate sedimentation rates of about 500 m/m.y. for the Pleistocene turbidite sequence and about 30 m/m.y. for the pelagic intervals. The transition from predominantly turbiditic to pelagic deposition is estimated to occur at about 0.6 Ma. During the Pleistocene, the rates of turbidite deposition are generally related to changes in sea level, with higher rates observed during low sea level stands. However, the depositional record of pelagic Unit I does not contain turbidites that are associated with the sea level changes known to have occurred during that interval. The temporary lack of terrigenous influx to the site is probably related to the distributary channel switching away from the site rather than to a general decrease in turbidite deposition on the Indus Fan. The very high rates of Pleistocene turbidite deposition (more than twice the rates found by Leg 116 on the distal Bengal Fan) are consistent with rapid uplift and erosion in the Indus source area, but the lack of a longer record prevents any observations concerning longer term relations between the rates of uplift and sedimentation on the Indus Fan at Site 720.

OWEN RIDGE SITES 721, 722 AND 731

Sites 721 (proposed site OR-1), 722 (OR-2) and 731 (OR-4) are located in the western Arabian Sea on the Owen Ridge, an asymmetric, northeast-southwest-trending feature (Figure 1). The main scientific objective for drilling these sites was to recover a continuous late Neogene section of pelagic sediments from the crest of the Owen Ridge. An additional objective at Site 731 was to penetrate and possibly recover a thick sequence of turbiditic sediments in order to reconstruct the tectonic history of Owen Ridge and the adjacent Owen Basin. These sediments were expected to yield records of long-term (10^5 to 10^6 yr) and short-term (10^4 to 10^5 yr, i.e., corresponding to Milankovitch frequencies) variations in the biotic, sedimentologic and chemical response of the depositional system to changes in the monsoonal circulation system.

The high-resolution biotic and geologic records of monsoonal upwelling from these sites will be used to test hypotheses on orbital (by changes in solar radiation) and orographic (by uplift of mountains) forcing of monsoon intensity through Neogene time. Because monsoonal circulation drives the seasonal coastal upwelling off Arabia, sediment properties will further be used to identify the initiation and variability in strength of monsoonal upwelling in the Arabian Sea. Once age and character of the sediments has been established, reconstruction of the carbonate budget and uplift history of the Owen Ridge is possible.

Site Summary, Site 721

Latitude: 16°40.636′ N
Longitude: 59°51.779′ E
Water Depth: 1944.8 m

Site 721 (Figure 1) consisted of three holes, with maximum depth to 424.2 mbsf, and with excellent recovery. The section ranges from early Miocene to late Pleistocene and has been divided into four major lithologic units.

Unit I (0.0-261.2 mbsf) consists exclusively of alternating light and dark layers of foraminifer-bearing to foraminifer-nannofossil ooze, and nannofossil ooze of late Pleistocene to mid-late Miocene age. Sedimentation rates are about 50 m/m.y. except in the late Miocene-early Pliocene when rates decreased to about 20 m/m.y. Radiolarian and foraminiferal upwelling assemblages appear in the mid-late Miocene and predominate in this interval. The sediments of this unit reveal strong cyclicity that is indicated by changes in color, bulk densities, carbonate content, and particularly well by magnetic susceptibility on whole-round cores. Preliminary analysis of over 20,000 magnetic susceptibility measurements in all three holes reveal cycles with wavelengths of about 1 m. According to a preliminary age model, this periodicity corresponds to about 25 k.y., which is near the periodicity of Milankovitch precession cycles. This cyclicity is likely to reflect both changes in the productivity and preservation of planktonic organisms and changes in the input of eolian material. The data clearly indicate that the monsoonal upwelling system was active in the late Miocene.

Unit II (261.6-311.4 mbsf) is composed of foraminifer-nannofossil chalk and ooze that grades downsection to siliceous nannofossil chalk and ooze of late Miocene age. Biogenic opal is an abundant component, but both diatoms and radiolarians are of tropical affinities. Due to the lack of middle Miocene strata at Site 721, the age of the onset of monsoon upwelling within the middle Miocene cannot be established at Site 721.

Nannofossil chalk of early-middle Miocene age comprises lithologic Unit

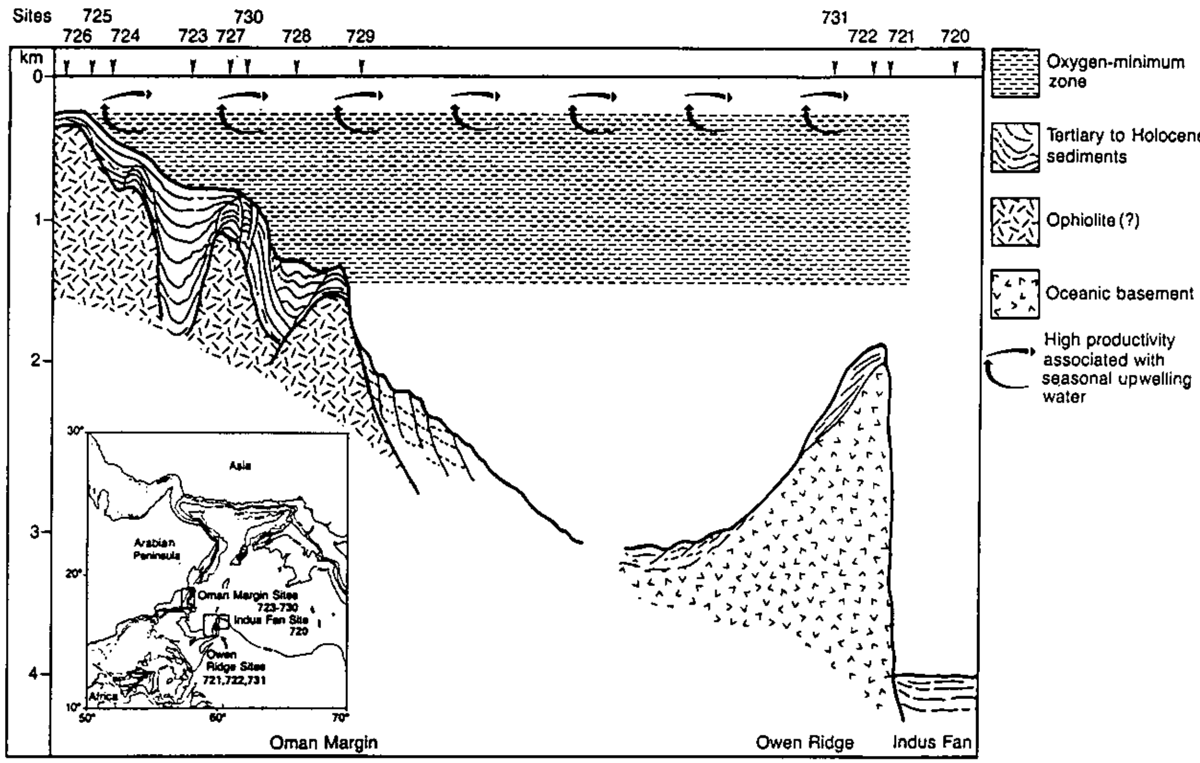

Figure 1. Location of sites drilled during Leg 117 in the NW Indian Ocean (inset). The sites are arranged in depth transects across the Owen Ridge and the Oman continental margin. Note the depths of Sites 723-730, which correspond to the depth of the pronounced oxygen-minimum zone in mid-water.

III (311.4-340.7 mbsf). Silica preservation is poor in the carbonate-rich chalks (80-90% $CaCO_3$). A hiatus (from Zone NN9 to NN5) at the top on Unit III (311 mbsf) correlates with a prominent seismic reflector indicating that as much as 150 m of the middle Miocene section may be missing.

The basal lithologic Unit IV (340.7-424.2 mbsf) is characterized by turbiditic intercalations and contrasts with the dominantly pelagic facies of the overlying units. Clay-bearing nannofossil chalk grades down-section into calcareous silty clay and clayey siltstone of early Miocene age. Preservation of planktonic calcareous and opaline tests is poor and benthic foraminifers that are usually restricted to the upper and middle bathyal depths are absent. The increasingly pelagic sequence is related to the uplift of the Owen Ridge in that coarse-grained lower Miocene turbidite sequences were deposited prior to uplift.

Site 721 provides an excellent record of the monsoonal upwelling in the late Miocene and Plio-Pleistocene. In addition, this sequence should provide insights into the history of monsoon-related eolian sedimentation and the rate of uplift of the Owen Ridge.

<u>Site Summary, Site 722</u>
Latitude: 16°37.312′ N
Longitude: 59°47.755′ E
Water Depth: 2034 m

The section penetrated at Site 722, like at Site 721, ranges from early Miocene to late Pleistocene in age. Two holes were drilled to a total depth of 565.6 mbsf. The section has been divided into four major lithologic units.

Unit I (0.0-232.6 mbsf) consists of a section of foraminiferal-bearing to foraminifer-nannofossil ooze like that at Site 721. The sediments of this unit again reveal strong cyclicity. Preliminary analysis of magnetic susceptibility data shows that correlations can be made both between holes (at Site 722) and between sites (722 and 721) with a precision approaching 10 cm. The magnetic susceptibility data exhibit a complex variability that is made up of periodicities estimated by power spectra analysis, to be near all of the Milankovitch frequencies.

Preliminary XRD and chemical analyses show that high susceptibility values are correlated with increased quartz and dolomite, low total carbonate content, and darker colored sediment. This association of characteristics indicates that changes in the input of eolian material causes the variations in susceptibility. Sedimentation rates are similar to those in lithologic Unit I at Site 721. These data clearly indicate that the monsoonal upwelling system has been active since the late Miocene.

Unit II (232.6-343.4 mbsf) is composed of foraminifer-bearing, radiolarian-bearing, diatomaceous, and diatomaceous-marly nannofossil chalks of late Miocene age. Biogenic opal is an abundant component, unlike Unit I. Dewatering structures were noted near the base of lithologic Unit II.

Unit III (343.4-411.1 mbsf) is primarily composed of early to middle Miocene white nannofossil chalk. Silica preservation is poor in the carbonate-rich chalks but increases rapidly, along with upwelling faunas of planktonic foraminifers, in the uppermost part of the middle Miocene. The middle Miocene interval missing from Site 721 (from zone NN9 to NN5) is present in Site 722. Thus the onset of silica preservation and upwelling faunas may be traced to the latest middle Miocene.

Unit IV (411.1-565.1 mbsf) is similar to the early Miocene sequences seen in Unit IV at Site 721.

Site 722 complements the record of late middle Miocene to Plio-Pleistocene monsoonal upwelling from Site 721.

<u>Site Summary, Site 731</u>
Latitude: 16°28.229′ N
Longitude: 59°42.149′ E
Water Depth: 2366 m

The main scientific objective for drilling Site 731 was to recover a continuous Neogene section of pelagic sediments from the crest of the Owen Ridge. The site consisted of three holes; Hole 731C was penetrated to 994.2 mbsf until coring was suspended in turbiditic sediments of Miocene age. The section penetrated at Site 731 is equivalent to those at Site 721 and 722.

Sediments range from early Miocene (?) and possibly Oligocene (NP 25) to late Pleistocene in age and are divided into four major lithologic units. As at Sites 721 and 722, the sediments in Unit I exhibit strong cyclicity. A transition zone between Units III and IV is found between 320.1 and 359.5 mbsf, which may designate the time when the ridge was uplifted above the lysocline (as indicated by deteriorating preservation of planktonic calcareous and opaline tests in Unit IV and the upsection abundance of benthic foraminifers in Unit III), and above the influence of turbidites. The trend from turbiditic to increasingly pelagic deposition is related to the uplift of the Owen Ridge.

Hole 731C was logged under good conditions with two tool combinations. Log quality is excellent and will provide insight into lithologic changes in the long and sparsely recovered turbiditic Unit IV.

OMAN MARGIN SITES

The Oman Margin sites (723, 724, 725, 726, 727, 728, 729 and 730) form a transect on the continental margin near Oman. The transect brackets water depths ranging from 300 m to 1500 m that corresponds to the vertical extent of a pronounced mid-water oxygen minimum zone (OMZ) (Figure 1). The sites were located so as to recover sediments from the slope basins formed by narrow half-grabens on what is presumed to be ophiolitic basement.

Two of the sites (726 and 729) were targeted to drill pre-Neogene sediments on basement rocks on horst structures. Eolian components and biogenetic material produced in association with coastal upwelling are deposited in the slope basins at high rates (40-200 m/m.y.). The sediments were expected to record changes in sedimentation and oceanographic/atmospheric circulation in considerable detail because of the impeded benthic activity where the OMZ intersects the slope. The objective of drilling in the basins was to sample these continuous and expanded sections of upper Miocene to Recent sediments.

<u>Site Summary, Site 723</u>
Latitude: 18°03.079' N
Longitude: 57°86.561' E
Water Depth: 808 m

Three holes were drilled at Site 723; Hole 723A reached a total depth of 432.3 mbsf. Hole 723B was successfully logged through the bit with the lockable flapper valve. The three logging tool combinations obtained excellent results.

The section penetrated at Site 723 ranges from latest Pliocene (NN18) to the Pleistocene and possibly Holocene. Age control was achieved mainly from calcareous nannoplankton and paleomagnetic horizons. Only one lithologic unit was recognized at Site 723. The unit comprises three interbedded sedimentary facies.

Facies 1, which constitutes more than 99% of the section at Site 723, is green to olive green foraminifer-bearing marly nannofossil ooze and calcareous clayey silt. Faunal and floral indicator species show that monsoonal upwelling was persistent throughout the time of deposition, even though variability in water temperature and nutrient composition may have modified the assemblages. The sedimentation rate is consistently high (around 200 m/m.y.) and the section appears to have been continuously deposited. Both magnetic susceptibility and downhole logs show cyclic variability that may reflect climate-related changes in the depositional system dominated by upwelling and eolian input.

Facies 2, cemented dolomite beds and stringers that contain foraminifer molds and tests, preserves soft-sediment burrowing and primary laminations. Dolomites were recovered in the cores at five depths below 260 mbsf, where beds range from 30 cm to 1 cm in thickness and are occasionally laminated. Colors range from pale green to olive green. Additional layers of this sediment were missed during coring but were recognized in downhole logs.

Facies 3 is a laminated facies and was rarely observed in beds exceeding a few centimeters in thickness. The beds are composed of parallel laminae which individually are 0.1 mm to 1 mm thick. Light-colored laminae are accumulations of nannofossils or diatoms and dark-colored layers are organic-rich clayey silt. The monospecific assemblages of nannofossils and diatoms in the light laminae suggest that they were produced during blooms of relatively short duration (<1 year) and that bioturbation was inhibited, possibly due to complete oxygen depletion in the deeper water column. Facies 3 occurs in close association with Facies 2.

Chemical compositions of interstitial waters and gas support the notion that diagenetic cementation of dolomites is related to an unusual hydrological regime in the subsurface of the slope basin penetrated at Site 723. Alkalinity reached a maximum of >100 mmol/L at total depth, which resulted in severe degassing and core expansion, while chlorinity decreased by 30 mmol/L. The reason for the unusually high and persistent increase in alkalinity and for dolomite precipitation below 260 mbsf is a concomitant increase in sulfate below the zone of sulfate depletion. Profiles of sulfate, chloride, and calcium as well as magnesium are attributed to advective flow of fresh water that dissolved gypsum/anhydrite from an evaporitic source.

Site Summary, Site 724
Latitude: 18°27.713′ N
Longitude: 57°47.147′ E
Water Depth: 593 m

Site 724 was located on the seaward flank of a slope basin that had been drilled previously at Site 723 (Figure 1). Biogenic material produced by coastal upwelling and eolian components are deposited here at lower rates than in the southern part of the basin near Site 723. Three holes were drilled at Site 724 to total penetration depth of 257.7 mbsf.

The section penetrated at Site 724 ranges in age from latest early Pliocene to the Holocene. The magnetostratigraphy for Site 724 was surprisingly good, with the Brunhes/Matuyama and Matuyama/Gauss boundaries identified at 60 mbsf and 180 mbsf, respectively. Only one lithologic unit was recognized at Site 724. This unit is composed of green to olive green calcareous clayey silt high in organic carbon. No dolomite layers were found at this site. Faunal and floral indicator species show that monsoonal upwelling was persistent throughout the time of deposition. Pronounced spikes of cold-water nannoplankton and of radiolarians occur in the uppermost Pliocene. The occurrence of shallow-water benthic foraminifers in the middle Pliocene indicate that the basin may have subsided several hundred meters during the Plio-Pleistocene. The sedimentation rate at Site 724 is 80 m/m.y. (less than half the rate at Site 723) and the section appears to have been continuously deposited.

Site Summary, Site 725
Latitude: 18°29.200′ N
Longitude: 57°42.030′ E
Water Depth: 311 m

Site 725 is located near the shelf-slope transition, on the landward flank of a slope basin which had been drilled at Sites 723 and 724. Biogenic material produced by coastal upwelling, eolian components, and clastic material from the neighboring wide shelf are deposited here at lower rates than in the center of the basin. The intention of Site 725 was to trace the fluctuations in the upper boundary of the OMZ through time and to evaluate these fluctuations with regard to changes in the monsoon and in eustatic sea level.

Three holes were drilled at Site 725 to total depth of 162.8 mbsf at Hole 725C. The section penetrated at Site 725 ranges from the Holocene to the lower Pleistocene and has been subdivided into three lithologic units.

Unit I (0-121 mbsf) comprises forminifer-rich calcitic sandy silt to calcitic marly calcareous ooze, calcitic marly nannofossil ooze, and nannofossil-rich sand, silt, and clay. It is considered to be a hemipelagic facies dominated by input of detrital calcite and biogenic sediments from coastal upwelling. Organic carbon is relatively low (<2%).

Unit II (121-145.4 mbsf) is composed of diatomaceous clayey silt and diatomaceous mud intercalated with calcitic marly nannofossil ooze and calcitic sand, silt, and clay. Diatom-rich beds form laminae on a sub-centimeter scale and are dominated by frustules of two diatom species. The unit is believed to indicate sub-oxic depositional conditions. Organic carbon content increases steadily towards the bottom of the hole and averages 2% in Unit II.

Unit III (145.4-162.8 mbsf) is similar to Unit I and is composed of nannofossil-rich calcitic sand, silt, and clay and calcitic marly nannofossil ooze. All units were found to contain less than 2% authigenic dolomite and traces of apatite and fish scales. The organic carbon content of Unit III averages 3%. The sedimentation rate of the section recovered at Site 725 is constant at about 120 m/m.y.

Chemical compositions of interstitial waters and gas do not show a subsurface source of sulfate inferred at Site 723 and Site 724, and diagenetic reactions are less obvious in the relatively organic-lean sediments at this site. Even though dolomite was encountered in trace amounts throughout the cores, the extent of dolomitization was low.

Site Summary, Site 726
Latitude: 17°48.945′ N
Longitude: 57°22.200′ E
Water Depth: 331 m

Site 726 (target site OM-5) is located landward of the slope basin on what was assumed to be a pre-Neogene basement of ophiolitic composition (Figure 1). The main target of Site 726 was to identify the nature and age of lithologies overlying the basement and to recover the hemipelagic sediments that were deposited on the margin since at least the middle Miocene.

One hole was drilled at Site 726 to a total depth of 186.3 mbsf. The section has been divided into two lithologic units, separated by a pronounced hiatus spanning the time from the Eocene to the late Miocene; the units differ considerably in lithologic character.

Unit I (0.0-131.1 mbsf) is divided into two subunits. Subunit Ia, which contains sediments similar to those found at other sites, i.e phosphorite-bearing nannofossil-rich calcitic silty clay to clayey silt. Subunit Ib is similar to Subunit Ia, but lag deposits of sand-sized foraminifers, phosphoritic grains, fish teeth, and bones are commonly intercalated in the hemipelagic sequence.

Unit II was only sparsely recovered from 131.1 mbsf to total depth, and consists of nummulite and oncolite limestone of Eocene age which was found to be variably cemented by dolomite and calcite. The shallow-water sediments appear to correspond to limestone occurrences described from the Arabian peninsula and the ophiolite complex of Masirah, where similar sediments unconformably overlie ophiolitic basement. The base of the recovered section may be slightly silicified.

Paleontological investigation revealed two major hiatuses. The first separates Pleistocene from middle Pliocene hemipelagic sediments, while the second corresponds to the transition from Eocene limestone to upper Miocene biogenic and eolian upwelling deposits.

Poor recovery in the variably indurated and lithified limestone and dolostone precluded continuous interstitial water sampling and impeded sampling for interstitial gas.

Site Summary, Site 727
Latitude: 17°46.096′ N
Longitude: 57°35.216′ E
Water Depth: 914 m

The positions of Sites 727 (proposed site OM-6) and 723 correspond to the central depth of the pronounced OMZ that impinges on the continental margin underneath a zone of high biogenic productivity. Site 727 was located in the southern part of a slope basin formed by a narrow half-graben in the basement assumed to be ophiolitic. Biogenic material produced by coastal upwelling and eolian components are deposited here at high rates. The intention of Site 727 was to complement the continuous and expanded sections of upper Neogene to

Recent sediments previously recovered at Site 723, to trace the imprint of the oxygen minimum zone through time, and to investigate diagenetic sedimentary processes.

Two holes were drilled at Site 727 to total depth of 182.4 mbsf at Hole 727A. The section penetrated at Site 727 ranges from uppermost Pliocene (NN18) to Holocene. Age control was achieved mainly from calcareous nannoplankton and paleomagnetic horizons. Only one lithologic unit was recognized at Site 727. The unit comprises homogeneous green to olive green foraminifer-bearing marly nannofossil ooze and calcareous clayey silt. Faunal and floral indicator species show that monsoonal upwelling was persistent throughout the time of deposition, even though variability in water temperature and nutrient composition may have modified the assemblages. The sedimentation rate at Site 727 is relatively constant at around 100 m/m.y., and the section appears to have been continuously deposited. Magnetic susceptibility shows downhole variability that can be correlated to other sites on the margin, and may reflect climate-related changes in the depositional system dominated by upwelling and eolian input.

<u>Site Summary, Site 728</u>
Latitude: 17°40.700′ N
Longitude: 59°49.553′ E
Water Depth: 1427.8 m

The position of Site 728 (proposed site OM-8) corresponds to the depth where the lower, ill-defined part of the pronounced mid-water OMZ intersects the Oman continental margin (Figure 1). The first objective at Site 728 was to recover a sedimentary section deposited near the lower boundary of the OMZ. A second objective of drilling at Site 728, in conjunction with drilling at Sites 726, 727, and 729, was to investigate the tectonic movements of adjacent ophiolite blocks by coring the sediments in the two half-graben basins between three of these blocks.

Two holes were drilled at Site 728. Hole 728A was logged successfully with two tool combinations after drilling to a total depth of 346.4 mbsf with an unprecedented recovery of 99%.

One lithologic unit was recognized in the section cored at Site 728, which encompassed sediment deposited since the late Miocene. Unit I was subdivided into three subunits. Subunit IA (0.0-10 mbsf) is composed of Holocene to upper Pleistocene foraminifer ooze to marly calcareous ooze with common bivalve and gastropod debris. Subunit IB (10-320 mbsf) is of late Pleistocene to latest Miocene age, and is made up of marly nannofossil ooze grading into chalk at about 200 mbsf. Siliceous microfossils are preserved, but comprise less than 10% of the sedimentary components. Subunit IC (320-349.5 mbsf) is composed again of nannofossil chalks and marly nannofossil chalks, which are interbedded with diatomaceous nannofossil chalks of distinctly different colors. The age of this subunit is late Miocene.

The most gratifying finding at Site 728 is the presence of siliceous microfossils (radiolarians and diatoms) throughout much of the recovered section. Nannofossil floras are low in diversity, but well-preserved. Foraminifers are very abundant, with a very high ratio of planktonic to benthic foraminifers, which decreases from 99 to 10, below 170 mbsf. Apparently, the site was located in less than 350 m water depth during the early Pliocene and subsided at a fast rate to the present water depth.

A zone of high organic carbon concentrations was encountered at 80 to 110 mbsf. This zone coincides with maxima in alkalinity and uranium concentrations from logs, as well as with the depletion of interstitial sulfate.

<u>Site Summary, Site 729</u>
Latitude: 17°38.715′ N
Longitude: 57°57.221′ E
Water Depth: 1398.8 m

Site 729 (proposed site OM-10) is located at a water depth of 1400 m on the Oman Margin (Figure 1). This site differs from the other seven drilled on the margin in that it is located on a basement block of presumed ophiolitic origin. The objective of Site 729 was to recover the oldest sediments on one of the blocks and to correlate them with acoustically similar rocks overlying the other horst structures. A second objective was to penetrate to the underlying basement to verify the nature and possibly the age of the underlying obducted oceanic crust.

One hole was drilled in rotary coring mode at Site 729. After initially good recovery, only fragments of Miocene (?) shallow-water limestone were recovered in nine successive cores. Hole conditions deteriorated rapidly, and Hole 729A was abandoned without reaching basement.

The sediments recovered at Site 729 were subdivided into two lithologic units. Unit I (0.0-26.3 mbsf) consists of a Pleistocene marly foraminifer nannofossil ooze. Unit II, (very sparsely recovered from 26.3 to 109.1 mbsf) is believed to be composed of oncolite-bearing nummulitic shallow-water limestones of Miocene (?) age.

Site Summary, Site 730
Latitude: 17°43.885′ N
Longitude: 57°41.519′ E
Water Depth: 1065.8 m

Similar to Sites 723 and 727, Site 730 is located near the bottom of the pronounced OMZ which impinges on the margin (Figure 1). Site 730 is positioned to the east of a ridge that is presumably ophiolitic basement and separates the upper and lower sedimentary basins. Sediments of the upper basin, previously drilled only 6 km to the west at Site 727, onlap eastward onto the ridge and are thinned and tilted by tectonic movement of the ridge. East of the basement ridge, seismic reflection profiles reveal a prominent unconformity that truncates eastward-dipping beds. The JOIDES RESOLUTION moved upsection on the dipping reflectors (eastward) and cored through the unconformity to recover older strata at Site 730 than those previously cored at Site 727. The age of sediments and hiatuses, and the evolution of the sediment facies, were expected to be useful in reconstructing the subsidence, as well as the erosional and tectonic history of the slope basins and the prominent basement ridges.

One hole was drilled at Site 730 in APC and XCB coring mode. Hole 730A reached a total depth of 403.9 mbsf and recovered 80% of the section cored. The hole had to be abandoned because of a parted core barrel.

The sediments at Site 730 range from the Holocene to the late early Miocene in age and have been divided into three lithologic units. Unit I consists of marly nannofossil ooze to a sub-bottom depth of 36.8 mbsf. No siliceous fossils occur in this unit. A major hiatus spanning nannofossil zones NN21 to NN10 was found which separated lithologically similar sediments of Pleistocene and late Miocene age. The rate of sedimentation in the interval above the hiatus was established as 40 m/m.y.

Unit II consists of marly nannofossil ooze and diatomaceous silty clay that are middle Miocene in age. Diatom frustules and radiolarians are abundant in Unit II down to 191.2 mbsf, where they begin to decrease in abundance and completely disappear by the early middle Miocene.

Unit III is dominated by foraminifer nannofossil chalks and constitutes the remainder of the section recovered at Site 730. The oldest sediment is late early Miocene (NN4) in age. Unit III is distinguished by the abundance of slump beds 10-200 cm thick, and by the occurrence of recumbent folds and high-angle faults marked by offsets of bioturbation traces and color laminations. Throughout the recovered section, the occurrence of siliceous microfossils coincides with poor preservation of planktonic and benthic foraminifers, which are progressively recrystallized with depth.

Chemical compositions of interstitial waters and gas show no indication of a sub-bottom supply of sulfate, and diagenetic reactions appear to be dominated by carbonate cementation and methanogenesis. The lithologic contrast between Units II and III is clearly paralleled by a drop in the abundance and preservation state of the organic matter, which declines from values above 2% in lithologic Unit II to values less than 1% in Unit III, balanced by a significant increase in carbonate minerals that account for up to 95% of the constituents in some lower Miocene samples.

ODP ENGINEERING/OPERATIONS: LEGS 117 AND 118

LEG 117

During the sixty-day Leg 117 in the Arabian Sea, 25 holes were cored at 12 sites. Approximately 75% of all coring was accomplished with the XCB system. The 4367 meters of core that was recovered established a new coring record for recovery during a single leg. A new XCB bit seal was tested and successfully used on all holes except one, and the results were encouraging. Five holes were successfully logged. Of these five holes, two were logged through the recently developed lockable float valve. A new wireline crimping tool that is used in conjunction with a Kinley wireline cutter was deployed for the first time and was credited for recovering a set of logging tools after a logging tool bow spring became stuck in the core bit.

The operating water depth ranged from 323 meters to a maximum of 4045 meters, with penetrations below the mud line ranging from a mudline core to a maximum depth of 994 meters.

LEG 118

Three weeks were spent in the Atlantis II transform on the Southwest Indian Ridge conducting exploratory coring operations. Holes were drilled on the sides and bottom of a canyon in 3000-5000 meters of water. All of the holes were spudded using newly developed drilling hardware and techniques, with little or no bottom-hole assembly support and stabilization. Though core recovery was low, considerable information was obtained about the drilling characteristics and formation types at the drill sites. This information was used to identify and eliminate many of the drill sites because of the presence of rubble in the sediments overlying basement. The chances of setting a reentry structure (reentry cone/guidebase) on a site where a >200-meter scientific objective could be reached during the time allocated were enhanced significantly using the unsupported exploratory coring/drilling techniques.

After selecting a drill site (Site 735) and drilling an exploratory hole on a shallow platform on the east rim of the transform in 731 meters of water, a guidebase was deployed in less than 48 hours. Hole 735B was spudded with an unsupported bottom-hole assembly. The 9-1/2" positive displacement coring motors were used to establish the hole. After coring 39 meters of hole with the coring motors, the hole itself provided enough bottom-hole assembly support to allow use of the conventional rotary coring system.

During an 18 day drilling period, 500 meters of gabbro was cored in Hole 735B. A total of 434 meters of core was recovered, for an average recovery rate of 87%. The gabbro formation was massive in nature with zones that had undergone mylonitization, making the rock very difficult to drill.

The considerable time spent conducting unsupported exploratory coring operations allowed extensive field testing to be conducted on the coring motors. Running the guidebase, extensive core bit testing in Hole 735B and the successful deployment of the Navidrill resulted in a significant increase in knowledge and experience of hard-rock drilling. ODP will use the results of the hardware tested on Leg 118 as key building blocks for future development of crustal coring systems designed to drill and core fractured hard-rock formations.

JOIDES LITHOSPHERE PANEL WHITE PAPER ON GLOBAL THEMATIC PRIORITIES

PREFACE

This White Paper was prepared by the JOIDES Lithosphere Panel in order to identify specific problems related to origin and evolution of the oceanic lithosphere which can be addressed by ocean drilling, and to develop recommendations on the drilling strategies and technical development required to carry out this drilling.

The report is organized under six principal headings based on the evolution of oceanic crust:

1) Magmatic processes in young ocean basins
2) Magmatic and hydrothermal processes at ocean ridges
3) Structure of the oceanic crust and its variation with age
4) Intraplate volcanism
5) Magmatism at convergent margins
6) Temporal and spatial variation of magma sources in the mantle

In each section the basic scientific questions are identified, the potential contributions from crustal drilling are summarized, and specific recommendations are presented on drilling strategies and priorities. We conclude this report with a summary of our panel's global short-term and long-term lithospheric drilling priorities.

This report was prepared prior to COSOD II, and lithospheric drilling priorities will need to be re-evaluated in light of the recommendations contained in that report, as well as continuing development of new crustal drilling technology.

1.0 MAGMATIC PROCESSES IN YOUNG OCEAN BASINS

The transition from a continental to oceanic rift and the initiation of sea floor spreading is a fundamental geotectonic problem which is still poorly understood. Seismic surveying over a large number of margins and drilling of sequences of dipping reflectors off Norway suggest that at some margins volcanism may be much more important than previously recognized. Among the questions that must be addressed are:

* What is the petrological and geochemical nature of the upper mantle beneath an embryonic oceanic rift?
* What is the nature of the earliest "oceanic" crust emplaced in a continental rift?
* What controls the development of thick volcanic sequences at some margins, but not at others?
* What is the geometry of the initial emplacement of oceanic crust?
* How does the composition of the ocean crust evolve in space and time during the initial few million years of sea floor spreading?

1.1 Contributions from Drilling

The abundant terrigenous sediment supply at developing oceanic rifts quickly buries the volcanic products of early rifting under thick accumulations of sediment and leads to extensive sill injection within the sedimentary section. Drilling thus offers the only way of sampling this crust. Drilling can also provide a vertical stratigraphic record in the syn-rift sediments providing important constraints on the age of rifting and the uplift and subsidence history during the splitting process. Full sampling of the sequence of volcanism by drilling will also provide critical information on the geochemical evolution of magmatism during the rifting process, and by inference, provide important constraints on the thermal and compositional evolution of the underlying mantle.

1.2 Drilling Strategy & Priorities

Two different drilling strategies can be employed: The first is to drill in young rifts like the Red Sea or Gulf of California. Both areas were drilled during DSDP with considerable success. A second approach is to drill relict rifts preserved in passive continental margins such as those bordering the Atlantic or off Australia. In many cases, the thick accumulations of post-rift sediments along these margins make this approach impractical. But in other sediment-starved areas, it is feasible to drill into rift-related volcanics as was successfully demonstrated on Leg 104. Additional basement drilling should be an important objective of future passive margin drilling efforts.

2.0 MAGMATIC AND HYDROTHERMAL PROCESSES AT OCEAN RIDGES

Sixty percent of the Earth's surface is created at ocean ridges, as magmas generated within the mantle are cooled to form the oceanic crust. Increasingly detailed geological and geophysical investigations of spreading centers over the past two decades, and field mapping and drilling of a few well-preserved ophiolite complexes, have lead to a basic conceptual model for the complex and interrelated magmatic, tectonic and hydrothermal processes involved in the formation of oceanic crust. However, many important questions remain, some of which can only be addressed by drilling.

2.1 Magmatic Processes at Ocean Ridges

The magmatic system at ocean ridges can be viewed as having four basic components: (1) the production and segregation of melt in the upper mantle, (2) the ascent of this melt to crustal depths, (3) the temporary storage of the magma in a crustal reservoir, and (4) the eruption and crystallization of the magmas forming oceanic crust. All four processes are still poorly understood. The most important questions which must be answered to better understand this system are the following:

* What is the horizontal and vertical extent of the zone of melt production in the upper mantle? What is the extent of partial melting and how does it vary temporally and spatially? What is the expression of variations in source composition on the chemistry of the erupting basalts?

* How is magma transported from a presumed wide zone of melt generation to a narrow magma chamber? To what extent does the melt interact with the surrounding mantle? Over what time and space scales are crustal magma reservoirs supplied?

* What are the shape and dimensions of crustal magma chambers? Are they large and steady-state or small and ephemeral? Do they act as "open" or "closed" systems? Can ocean crust form without a crustal magma chamber?

* What are the characteristic length and time scales of ridge crest magmatism? Does a single, tectonically defined spreading center cell act as a single magmatic unit or is it segmented on a much finer scale?

* What controls the apparent episodicity of the sea floor spreading process? How does it vary as a function of spreading rate? Tectonic setting?

2.1.1. Contributions from Drilling

The answers to these basic questions will require a multi-disciplinary approach involving detailed geologic mapping and sampling, geophysical experiments and, ultimately, long-term monitoring of selected sites along the ocean ridge system. Drilling at spreading centers can make four unique contributions to ocean ridge studies:

First, drilling can sample deeper crustal levels in a "normal" tectonic setting.

Second, drilling can provide a vertical stratigraphy of lavas that is currently the best method of investigating temporal variations in magmatic activity at a single location on a time scale shorter than that required to construct layer 2 (10^4-10^5 yrs).

Third, drilling can "ground-truth" geological horizons such as the pillow/dike or dike/gabbro boundaries that can then be mapped much more widely and cost-effectively using geophysical techniques.

Fourth, drill holes can be used for borehole logging, downhole physical properties experiments and long-term geophysical monitoring with instruments such as short and long period seismometers, strainmeters, and magnetometers.

2.1.2 Drilling Strategy & Priorities

Our highest priority is for a single, deep (>500 m), zero-age hole at both a fast (>5-6 cm/yr) and slow (<2 cm/yr) spreading ridge with at least two shallower holes located in an "L" pattern along and across-strike at both ridges. The holes should be positioned close enough to permit cross-hole tomography and other geophysical experiments. Ideally the site at the fast spreading ridge should be located where a crustal magma chamber has been clearly identified geophysically; at the slow spreading ridge the site should be located as far as possible from a fracture zone. Once these holes have been established a series of intermediate depth (100-500 m) holes should be drilled along-strike toward transforms or other ridge axis discontinuities to assess their affect on crustal accretion processes. Drilling of near-axis seamounts can also provide important information on the formation, transportation and composition of melts generated in the upper mantle beneath mid-ocean ridges (see "Seamounts").

2.2 Hydrothermal Processes at Mid-Ocean Ridges

Three kinds of submarine hydrothermal systems have been identified. The most spectacular are the high temperature (350°C), black smoker systems found at sediment-free ridge crests such as the East Pacific Rise and Mid-Atlantic Ridge, associated with sulfide deposition. The second is associated with sediment-buried ridge crests like Escanaba Trough, northern Juan de Fuca or Gulf of California. Here the system is modified by the relative impermeability of the sediments, and chemical reactions between the hydrothermal fluids and the sediments. The third kind of system is the low temperature type (10-20°C) which is associated with oxide deposits and which may account for a large fraction of the total heat loss from ocean ridges.

A basic understanding of submarine systems requires answers to the following questions:

* What is the size, shape, depth, temperature, and time-dependent behavior of the heat source?

* What are the spatial and temporal variations in permeability and composition of the host rocks?

* What are the time/space variations in physical properties and composition of the circulating fluids?

* What are the feedback loops linking the evolution of these principal components?

2.2.1 Contributions from Drilling

Studies of fossil hydrothermal systems preserved in ophiolites have provided valuable insight into the subsurface geometry and composition of submarine hydrothermal systems. One important objective of drilling must be to test the hypothesis that these systems are a useful analogue of the active hydrothermal systems at ocean ridges. However, even if this hypothesis is valid, there are many aspects of hydrothermal systems which cannot be determined from an extinct system, such as variations in permeability and porosity of the host rocks, physical properties and composition of circulating fluid, and dynamics of the water-hot rock interface. Drilling is the only available tool for constraining many of these parameters in an active submarine hydrothermal system. In particular:

* Drilling provides the only technique for penetrating the deeper levels of an active hydrothermal system.

* Drilling can determine in-situ physical properties in the host rock (porosity, permeability, temperature, etc.) and sample hydrothermal and porewater fluids.

* Drill holes can be used for long-term monitoring of hydrothermal activity.

* Drilling off-axis can provide a record of the time-integrated alteration history of the oceanic crust.

2.2.2. Drilling Strategy & Priorities

The primary, long-term goal of a ridge crest drilling program should be the establishment of a deep penetration (>1000 m), high-temperature reference hole in an active ridge crest hydrothermal system. The target should be the penetration of the boundary between a vigorous hydrothermal system and an identifiable heat source (or at least the magma chamber reflection). The physical and chemical properties, the thickness and dynamic behavior of this boundary are completely unknown, yet they control the style and vigor of heat and mass transport within the magma chamber as well as that of the surrounding hydrothermal system.

Another goal of a hydrothermal drilling program should be to examine along-axis and across-axis variations within a single ridge segment. Along-strike variations include at least two scales of investigation, the segment scale (tens of kilometers), and the scale of individual on-axis hydrothermal circulation cells (size uncertain, but probably of the order of 0.5 to 4.0 km). Ideally, these shallower holes (100-500 m) would sample both the discharge and recharge zones of the circulation cell. The cross-axis holes would investigate the aging of the hydrothermal system and their spacing would ideally reflect the size of ridge flank hydrothermal cells determined from detailed heat flow investigations prior to drilling.

A third goal of a long-term hydrothermal drilling program should be to investigate the fundamental differences between hydrothermal systems at sedimented and sediment-free spreading centers. The presence of a relatively impermeable sediment layer strongly moderates heat loss from the system and has a profound chemical effect on fluid compositions. These systems may be a modern analogue of the large, sediment-hosted massive sulfide deposits frequently found on land.

Finally, any serious approach to drilling seafloor hydrothermal systems must take into account the positioning of drill holes and arrays of drill holes to optimize post-drilling experiments. For example, seismic and electromagnetic tomography from boreholes, together with multichannel seismic imaging of the roof of the magma chamber, promise to provide important physical constraints on key components of submarine hydrothermal systems.

3.0 STRUCTURE OF OCEANIC CRUST AND ITS VARIATION WITH AGE

The geologic structure and physical properties of oceanic crust are still known largely by inference from ophiolites or indirectly from geophysical experiments. The general structure of the oceanic crust inferred from these studies consists of a 1 km thick extrusive basaltic carapace that grades into a 1 km thick complex of sheeted dikes characterized by pervasive greenschist and amphibole facies alteration. In this model the sheeted dikes are underlain by a 3-5 km thick plutonic section consisting at shallow levels of isotropic gabbro, and at deeper levels by cumulate gabbros that grade downward into cumulate ultramafics.

The deepest crustal drill hole (Hole 504B) has sampled only the uppermost 1288 m of this section, bottoming in the sheeted dikes of seismic layer 2C. We thus lack direct information from more than 80% of the oceanic crust. A major objective of ODP lithospheric drilling should be to sample the remaining part of seismic layer 2, the layer 2/3 boundary, and at least the upper portion of seismic layer 3.

3.1 Contributions from Drilling

Deep crustal drilling will provide a critical test of the ophiolite model of oceanic crust. Drilling at 504B has confirmed part of the ophiolite hypothesis in the presence of the sheeted dike unit. However, correlation of oceanic seismic layer 3 with the thick plutonic section in ophiolites has yet to be verified by drilling. Important questions remain as to the tectonic setting in which ophiolites formed and the degree to which they are a good structural analogue of normal oceanic crust. Recent detailed chemical and mineralogical studies of ophiolite complexes have demonstrated that many classic ophiolites are more closely related to an arc-marginal basin setting than to a typical mid-ocean ridge. Only drilling can verify this question.

We still have few constraints on how the composition and physical properties of the oceanic crust vary with age or whether there have been significant temporal variations in the crust accreted at ocean ridges. As ocean crust is transported away from spreading centers, it is thought to undergo chemical changes, first by rapid high temperature hydrothermal processes, then by slow interaction with pore waters, often through a significant sediment blanket and possibly over tens of millions of years. The full extent of both the high and low temperature alteration can only be studied in old ocean crust, and only by drilling since old crust is covered by sediment.

3.2 Drilling Strategy & Priorities

Our highest priority is to obtain at least one crustal hole that penetrates below the layer 2/3 boundary into layer 3. Right now 504B is the deepest existing hole in oceanic crust and appears to offer the best chance of achieving this objective in the next ten years. However, the slow rate of penetration on Leg 111 suggests that we may be approaching the limits of deep crustal drilling with present technology. The high thermal gradients in the young crust at Hole 504B also amplify the temperature problems associated with drilling to deep crustal levels. We support efforts to re-occupy and deepen 504B, but if this is not technically feasible, then drilling should concentrate on deepening other existing crustal holes (e.g., DSDP 418A) located on older crust into layer 3.

The attenuated crustal section present at oceanic fracture zones, especially those along slow spreading ridges, may offer a window into the lower crust and upper mantle. The spectacular success in drilling at Hole 735B on the Southwest Indian Ridge indicates that even with existing drilling technology high penetration and recovery rates are possible in gabbroic and other lower crustal rocks. Fracture zone drilling, albeit in an unusual tectonic setting, may offer the best opportunity in the next 5-7 years of sampling the lower oceanic crust and crust-mantle boundary. The magmatic, metamorphic and hydrothermal processes within fractures zones are also interesting in their own right. Drilling in oceanic fracture zones should thus be an important component of any long-term lithospheric drilling program.

Another high priority is to obtain several relatively deep holes in older, sedimented parts of the ocean basins in order to investigate temporal and spatial variations in structure and geochemistry of the oceanic crust. This drilling is well within the present technical capabilities of ODP and will provide unique information on the composition and alteration history of old oceanic crust that can be obtained in no other way.

4.0 INTRAPLATE VOLCANISM

Intraplate volcanism is the second most common type of volcanic activity occurring in the ocean basins. It takes many forms including small near-axis seamounts, linear volcanic chains, aseismic ridges, oceanic plateaus and thick intrusive complexes. In the following discussion we focus on four specific problems: (1) formation of seamounts near mid-ocean ridges, (2) linear volcanic chains and geochemical evolution of mid-plate hotspots, (3) the effect of mid-plate volcanism on lithospheric properties, (4) the origin of oceanic plateaus and the great mid-Cretaceous volcanic event.

4.1 Seamounts Near Mid-Ocean Ridges

Recent high-resolution bathymetric surveys along ocean ridges have revealed the frequent presence of small seamounts at or near spreading centers. Geochemically and petrologically these seamounts are magmatic products of the ridge crest system, although the chemical composition of the seamount lavas often differ from those of the surrounding seafloor. Hydrothermal activity at near-axis seamounts may also provide an interesting contrast with ridge crest activity due primarily to the higher elevation (lower pressure) of the upper portions of the upflow zone. Of particular interest is the enhanced likelihood of 2-phase separation (boiling) with related effects on seamount sulfide deposits (e.g. higher precious metal contents).

4.1.1 Contributions from Drilling

Only by drilling can a vertical stratigraphy of lava flows be obtained for investigating temporal variations in magmatism. For example, drilling seamounts at various distances from spreading centers may provide information on the rates of magma supply and how they have varied through time. Drilling on a small (<500-1000 m high) seamount could also provide unique constraints on its internal magma plumbing system as well as "ground-truthing" geophysical models for still controversial problems such as the origin of seamount magnetism.

4.1.2 Drilling Strategies & Priorities

Studies of near-axis seamounts are a logical complement to investigations of magmatic and hydrothermal processes at nearby spreading centers. Thus any drilling of near-axis seamounts should be part of a larger program of geological and geophysical investigations of the adjacent spreading center. Potential drilling targets are Axial Volcano on the Juan de Fuca Ridge, Mic, Mok and Sasha on the East Pacific Rise south of the Clipperton Transform and the seamounts near the 12°54'N OSC on the East Pacific Rise.

The principal objective should be establishment of a single deep hole (>500 m) on the volcano summit. A summit hole is likely to provide the best opportunity of obtaining a simple and complete stratigraphic succession from a single volcanic vent. A summit hole could also provide samples of lava lakes (caldera), cone-sheet intrusive feeders and shallow, sub-caldera plutonics, as well as investigate seamount hydrothermal systems.

4.2 Linear Volcanic Chains and Geochemical Evolution of Hotspots

Hotspot volcanism, and the linear volcanic chains often associated with them, are of considerable lithospheric interest both for the constraints they provide on plate kinematics and absolute plate motions, and as a means of investigating the composition and geochemical evolution of the mantle. Important questions still exist concerning the extent to which many island chains and aseismic ridges (eg. the Marquesas and Society islands, Louisville Ridge) can be related to fixed hotspots, the nature of the magma sources forming them, and the timing of activity along the chains.

Another aspect of hotspot volcanism of considerable interest is the early evolution of hotspot magmas. The traditional view of Hawaiian hotspot volcanism was that a long tholeiitic phase of activity constructed the volcanos and was followed by a short capping phase of alkalic activity. Work on Loihi seamount has indicated there may also be an early alkalic phase of volcanism that has been attributed to mixing of the primitive hotspot magmas with remelted lithosphere during their ascent to the surface. However, this interpretation is based entirely on rocks recovered in dredges or by submersibles. We still do not have good stratigraphic control on the relationship between the alkalic and tholeiitic basalts forming Loihi, and fundamental questions still exist regarding the source composition, degree of partial melting, fractionation history and lithospheric contamination during the early evolution of hotspot magmas.

4.2.1 Contributions from Drilling

Drilling linear island chains can provide three key pieces of information to address these problems:

* First, by drilling older linear island chains and aseismic ridges and dating either the basement rocks or the overlying sediments it will be possible to determine the timing of volcanic activity along the chains and thus determine both the azimuth and rates of absolute plate motions.

* Second, drilling will provide a unique set of stratigraphically controlled basement samples that will provide a window into the composition and heterogeneity of the upper mantle from which these magmas were derived.

* Third, by drilling a young, incipient hot spot volcano it will be possible to study the still, largely unknown, early eruptive products of hot spot volcanism in a continuous, stratigraphic section.

4.2.2 Drilling Strategies & Priorities

Studies of hot spot volcanism have played a pivotal role in current models of mantle chemistry, dynamics and evolution. One obvious target for drilling is, of course, Loihi. It is already well-studied and mapped, it is logistically convenient to Hawaii for permanent instrumentation, and is in relatively shallow water (ca.1000 m). However, other targets such as Mehetia and Teahitia in the Society Islands may be suitable as well.

Sampling of basement at hot spot related island chains and aseismic ridges is also important. Often holes are drilled on these shallow features for paleoceanographic and tectonic objectives and it is essential that these holes be extended, whenever possible, into basement at least until bit destruction.

4.3 Mid-Plate Volcanism & Lithospheric Flexure

Mid-plate volcanism represents a thermal perturbation to the cooling lithosphere that can be exploited as a natural laboratory to study the thermomechanical properties of the lithosphere. Most mid-plate volcanos are surrounded by broad regions of anomalously shallow seafloor called swells. Most of the characteristics of swells (height, geoid anomaly, subsidence history, heat flow) can be explained by the reheating of the mid- to lower lithosphere. However, there is no consensus as to the mechanism by which the heat is added to the lithosphere, the role played by the volcanos themselves in raising temperatures, or the dynamic contribution of the upwelling asthenosphere in producing swells.

The sedimentary sequences preserved in the flexural moats of hotspot volcanos are a sensitive measure of the thermal history of the swell that can be used to address these problems. The stratigraphy of the moat sediments is largely controlled by the effective elastic thickness of the plate supporting the volcanic loads. Multichannel seismic profiling in the flexural moat flanking the island of Oahu has imaged onlap and offlap sequences consistent with variations in the effective elastic thickness of the lithosphere with time. However, without dates for the sedimentary horizons it is not possible to determine the time interval between volcano formation and the onset of plate weakening, or even definitively tie the offlap pattern to the process of heat transfer within the swell.

4.3.1 Contributions from Drilling

Drilling in the flexural moats of hot spot volcanos is the best method of dating the sedimentary horizons observed on reflection profiles and thus quantifying the subsidence rates at various times during the development of the moat. With this information it should be possible to determine the elastic response of the plate to the volcanic load and assess the relative importance of lithospheric reheating and other factors, such as the formation of a deep crustal sill complex, on this response. Drilling in flexural moats will also provide two other important kinds of information on hot spot volcanos. The compositional variations of the ash flows and volcaniclastic debris deposited in the moat can reveal the stratigraphy of the adjacent volcanos to depths not accessible by drilling the volcano itself. The variation in sediment supply to the moat can also be used to infer erosion and subsidence rates for the adjacent islands and may provide information on sea level fluctuations.

4.3.2 Drilling Strategies & Priorities

Models of the thermal and mechanical evolution of the lithosphere are at the point where distinct hypotheses exist that can be tested only by drilling. The kind of drilling required, which involves penetration of 100 m to several hundred meters through the volcaniclastic sediments in the flexural moat, is clearly within the present technical capabilities of ODP. The main uncertainty is how well the stratigraphic horizons observed in reflection profiles can be dated either paleontologically or by other means (e.g., magnetostratigraphy). One possible target is the Hawaiian moat where good reflection data already exist, but fossil preservation may be poor. Another possible location is the Marquesas Islands where proximity to the equator increases the likelihood of datable fossils in the moat, but more site survey work would be needed. The main objectives of a drilling program of this kind (several holes across and along the moat) could easily be accomplished in a single leg.

4.4 Oceanic Plateaus & Mid-Cretaceous Volcanism

Despite their huge size and distinctive morphology, the vast oceanic plateaus such a Hess Rise, Shatsky Rise, Manihiki Plateau, Ontong-Java Plateau and Kerguelen Plateau remain among the least understood features in the ocean basins. Geophysically, these plateaus are characterized by 20-30 km thick crust more typical of continental areas than the ocean basins, leading some investigators to propose that they are continental fragments. Others have argued that they have an over-thickened oceanic crustal section formed by excess volcanism associated with a ridge-centered hot spot (the Iceland analogy) or a ridge-ridge-ridge triple junction. Still others have speculated that the plateaus may represent voluminous volcanic outpourings associated with meteoric impacts. Data on the age, chemical composition and structure of basement rocks of plateaus are required to resolve this controversy and advance our understanding of how and why these plateaus form.

Many of the plateaus in the western Pacific appear to have formed in the mid-Cretaceous during a period spanning perhaps 30 my of remarkably intense mid-plate volcanism. In addition to these plateaus, this event appears to have formed several major guyot chains and at least one major deep sea intrusive event in the Nauru Basin. Diverse magmatic products were erupted during his period, and there were complex episodes of uplift and subsidence in different parts of the region whose timing and significance are still poorly understood. The volume of volcanism indicates a major disturbance of the normal thermal and convective pattern in the mantle which, perhaps coincidentally, overlaps with the long Cretaceous period of normal magnetic polarity. An important goal of crustal drilling in this area should be a systematic investigation of the composition, subsidence history, and temporal relationships between the various plateaus, island chains and basins in this area.

4.4.1 Contributions from Drilling

Generally, plateau crust is buried under as much as 1.5 km of sediment, hence drilling is in most cases the only method of recovering samples of basement rock for petrological and geochemical studies. Samples obtained by drilling are also usually less altered than dredged rocks and have unambiguous stratigraphic control. Paleontological evidence from the sediments deposited on plateaus will provide important constraints on the age of these features and their long-term subsidence history. Drilling into volcanic basement at atolls and guyots, aseismic ridges and in mid-plate intrusive complexes will provide similar information on the origin of these features.

4.4.2 Drilling Strategies & Priorities

Drilling is the only method of unambiguously determining the age and composition (oceanic vs. continental) of oceanic plateaus. Penetration of Cretaceous cherts may pose a problem on some plateaus. Potential targets include Kerguelen Plateau in the Indian Ocean and Ontong-Java and Manihiki plateaus in the western Pacific. Holes drilled on these shallow plateaus will have important paleoceanographic and tectonic objectives as well. However, it is important to emphasize that achieving the basement objectives at these sites will require more than penetrating a few meters in "basement", since intrsive sills may mask true basement and such limited penetration will yield no information on the temporal variability or stratigraphic relationships in the basement rocks. A relatively deep (100-500 m), re-entry hole should be drilled on each plateau with several shallower (<100 m) single bit holes to sample spatial variability in basement structure and composition in different parts of a single plateau.

5.0 INTRAOCEANIC CONVERGENT MARGINS

Intraoceanic convergent margins are comprised of three principal tectonic components: (1) forearc, (2) volcanic arc, (3) backarc basin. In order to understand these margins as a system, we need answers to the following fundamental questions:

* What are the relative contributions from volcanism, intrusive activity, accretion and tectonic erosion in the evolution of arc and forearc regions?

* What roles do serpentine diapirism and block faulting play in forearc tectonism?

* What is the temporal and spatial variability of magma types in arc-forearc regions? How are magmatism and tectonism interrelated?

* What initiates backarc basin development? How does the geochemistry of backarc basin crust vary during the history of the basin?

* What are the nature of hydrothermal systems in arc-forearc-backarc regions? How do they compare with ocean ridge hydrothermal systems?

* What are the relative roles of mantle, subducted sediments and oceanic crust in the sources for magmas in the forearc-arc-backarc regions?

The answers to these questions are of fundamental importance to our understanding of how intraoceanic convergent margins form and evolve, and what sort of chemical communication exists between crust and mantle. These problems must be attacked by a combined program of geological mapping (Sea Beam, Sea MARC), geophysical surveys (MCS), dredging and submersible studies, as well as a carefully designed and focussed drilling program.

5.1 Contributions from Drilling

Drilling can make a number of important contributions to studies of intraoceanic convergent margins:

* Drilling can provide vertical stratigraphic records for deciphering the uplift/subsidence history of both the forearc and backarc regions.

* Drilling can provide a nearly complete tephrachronological record useful for deciphering time-dependent relations among forearc, arc and backarc processes. This kind of information is essential in order to investigate temporal variations in arc magmatism or the relationship between tectonism and magmatism in the early development of backarc basins.

* Drilling into forearc diapirs and their flanking sediments may be the best way to study their formation and tectonic history. Drilling these features should provide constraints on the timing of their emplacement and the emplacement mechanism, as well as the extent of fluid circulation through the outer forearc and the chemistry of the fluids.

* Drilling provides the only access to igneous basement beneath large portions of the forearc, arc and backarc that are covered by sediments. Drilling also provides the only way of sampling the early magmatic products of back-arc basin rifting and testing models for the geochemical evolution of back-arc basin magmatism.

* Drilling in backarc basins, as at ocean ridges, can provide unique constraints on processes of crustal constructive and hydrothermal activity at backarc basin spreading centers.

* Drilling can establish the composition of the sediment and basaltic crust being subducted in order to assess their role in arc magmatism.

5.2 Drilling Strategies & Priorities

The various problems of lithospheric interest outlined above at intra-oceanic convergent margins require both a spatial perspective, to investigate the different components of the system (forearc-arc-backarc), and a temporal perspective to compare convergent margins in different stages of evolution (mature vs immature). Our panel thus favors a "transect" drilling strategy involving multiple holes extending from the backarc spreading center (where zero-age drilling could be carried out) across the arc and forearc to the undisturbed plate about to be consumed. Ideally, margins in different stages of development should be drilled. The highest priority objective should be to investigate the evolutionary development of each component of the convergent margin system and the interplay between tectonic and petrologic variables. Drilling should be concentrated in areas where the subaerial geology and overall geologic history are well-characterized (Indonesia, western Melanesia, Vanuatu, Tonga-Kermadec, Fiji, Mariana, Izu-Bonin, Japan, S. Sandwich-Scotia, Aleutian, Antilles). The emphasis in these transects should be on intermediate to deep basement holes (>100-500 m) in order to adequately sample the predicted vertical variability in areas representing initial stages of back-arc basin development, and the deeper portions of the arcs and forearcs.

A second key component of lithospheric drilling in convergent margins should be drilling reference holes into basement on the subducting plate in order to access its role in arc magmatism. Two approaches can be taken. First, areas can be studied where the composition of the subducting crust varies substantially to determine if there are corresponding changes in the arc volcanics. Second, areas with substantial chemical variations along the arc can be investigated to determine whether there are corresponding variations in the subducting crust. Both approaches can be accomplished only through drilling and substantial progress can be made with current drilling technology. A series of holes are required paralleling the volcanic arc on the subducting plate. Some of these can be single bit holes (provided the chert penetration problem is solved), although a few should be deep (>500 m) reentry holes to insure a representative vertical section through a substantial part of layer 2 is obtained. Potential locations for these studies include the Bonin, Mariana, Aleutian, and Antilles arcs.

6.0 MANTLE HETEROGENEITY

The spatial and temporal distribution of heterogeneities in the mantle, and their relative scales, are closely linked with the problem of deciphering the dynamic or convective state of the mantle and mixing conditions that may exist between different zones of the Earth's interior. Some particularly important questions are:

* What have been the variations in mantle temperature and degree of partial melting temporally and spatially?

* Is convection mantle-wide or limited to different zones such as the upper and lower mantle? If the latter case prevails, how much exchange has taken place by entrainment between the two systems?

* What is the source of so-called mantle plumes and how do they interact with the overlying plates or upper mantle?

* How do mantle plumes affect magmatism at mid-ocean ridges? What is the role of fracture zones in this process?

These questions also pertain, of course, to understanding how the earth has outgassed, how mantle differentiation has taken place and how the ocean, the atmosphere, and the continental crust have grown and evolved through geologic time.

Many of these questions can be addressed through studies of the geochemical and isotopic composition of lavas erupted along ocean ridges, at island arcs and in backarc basins, at oceanic islands and along hotspot chains. Radiogenic isotope ratios (Pb, Nd, Sr, He, etc.) and related information on time integrated parent/daughter element ratios are particularly useful in identifying different mantle reservoirs, their mean ages, any mixing that may have taken place, and whether crustal recycling into the mantle is an important process. There are global correlations among basalt chemistry, axial depth and crustal thickness which are quantitatively consistent with long wavelength temperature variations in the mantle. These correlations include basalts from hot spots, cold spots, backarc basins and normal ocean ridges. Recovering basalt from older crust can thus also provide important information about temporal and spatial variations in mantle temperature and degree of partial melting.

6.1 Contributions from Drilling

Drilling can make two unique contributions. First, drilling can provide a continuous, high resolution record of the history of magmatic activity at one location on a time scale shorter than that of the construction of layer 2 (10^5 to 10^6 years). This good stratigraphic control permits studies of short-term variations in mantle chemistry and temperature at a single location. Second, drilling provides the only method of sampling older, sedimented crust providing constraints on the temporal variability over times scales of 10^6-10^8 years and spatial scales of up to 104 km.

6.2 Drilling Strategy & Priorities

These fundamental questions concerning temporal and spatial variations in mantle chemistry and temperature can be addressed by drilling holes with 100 m or more of basement penetration on crust of various ages in different ocean basins.

Several different drilling strategies can be employed. Grid sampling using scales relevant to the particular problem, such as carried out during DSDP Leg 82 in the N. Atlantic around the Azores, is one approach. Another strategy is to drill transects of shallow holes (<100 m) along a spreading flow line. Sampling of basement at seamounts, aseismic ridges and oceanic plateaus is another approach. Finally, the geochemical reference holes discussed in the previous section will also be valuable in constraining variations in the chemistry of the ocean crust through time. It will ultimately be the accumulation of data from all of these approaches, together with continued dredging and drilling at ocean ridges, that will provide the critical information needed to understand the thermal and chemical evolution of the upper mantle.

SUMMARY

Table 1 summarizes the ten highest priority, global lithospheric drilling objectives. Also included is information on the number and depth of holes, technical and drilling time requirements, and possible drilling locations based on the strategies and priorities discussed below.

The two highest, long-term lithospheric drilling priorities are: (1) deep crustal drilling into oceanic layer 3, and (2) establishing a suite of drill holes to investigate magmatic and hydrothermal processes at mid-ocean ridges. However, neither of these drilling objectives are technically feasible at the present time and both will require a long-term engineering development effort to improve crustal drilling technology. We have therefore also identified in Table 1 other shorter-term, technically feasible lithospheric drilling objectives that address important, mature scientific questions (eg. flexural moat drilling, drilling old oceanic crust, convergent margin drilling including geochemical reference holes). We believe a hybrid drilling strategy that includes these short-term objectives and that is also coupled with a parallel engineering development effort to achieve our longer-term goals is the most productive approach to lithospheric drilling within ODP.

Achieving the highest priority lithospheric drilling objectives identified in this report will require a dual commitment to both improve crustal drilling technology and devote substantial amounts of drilling time, including multiple legs at a single

Table 1. Summary of High Priority Lithospheric Drilling Objectives+

Drilling Objective	# Holes	Crustal Drilling Depth (m)	Advanced Crustal Drilling Technology	Legs	Example Locations
Young oceanic rifts	Multi	<100 - >500	High temp. drilling (for some holes)	1-2	Red Sea, Gulf of Calif.
Drilling at fast and slow spreading ridges*	2-6	2 >500 4 1-500	Bare-rock, young crust, high temp.	-6?	MAR, EPR, Juan de Fuca
Drilling a sedimented ridge crest, hydrothermal system	>3	>500	High temp. drilling	1-2	Juan de Fuca, Escanaba Trough, Gulf of Calif.
Deep crustal hole into layer 3*	1	>2000	Deep crustal drilling	>2?	DSDP 504B,418A
Fracture zone drilling	Multi	<100 - >500	Bare-rock, young crust (for some holes)	1-2	Kane, Oceanographer, AII, Vema
Near-axis seamounts; hotspot drilling	Multi	<100 - >500	Bare-rock, young crust (for some holes)	>2	EPR, Loihi, 90E Ridge, Mid-Pacific Mts.
Flexural moat drilling	Multi	none	none	1	Hawaii, Marquesas
Oceanic plateau drilling	Multi	6100	none	2	Kerguelen, Ontong-Java, Shatsky
Drilling old oceanic crust	Multi	<100 - >500	none	-3	Atlantic, Pacific or Indian Ocean
Intraoceanic convergent margin transects (2) (incl. reference holes)	Multi	<100 - >500	none (except at backarc spreading centers)	3-6	Izu-Bonin, Tonga, Kermadic, Aleutian, Antilles

+Listed in order presented in text.
*New crustal drilling technology required to achieve this objective.

site, to lithospheric drilling. The engineering development effort must begin now and must be continued over at least the next 5-7 years. We believe an expenditure on the order of 5% of the annual drilling budget ($2.0 million/yr) is the minimum level of resources that should be devoted to this development effort. Coupled with this engineering effort there must also be a change in the way long-term planning is carried out within ODP so that drilling can focus on a smaller number of thematic problems, like those identified in this report.

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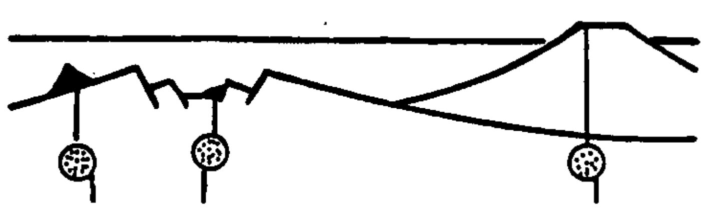


WIRELINE SERVICES CONTRACTOR REPORT

The Leg 117 report below was prepared by Rich Jarrard, Lamont logging representative on Leg 117. Dave Goldberg, Lamont logging representative on Leg 118, prepared the Leg 118 report. For further information, contact the Borehole Research Group, Lamont-Doherty Geological Observatory, Palisades, NY 10964.

LEG 117: FORMATION PROPERTIES LOGS AID PALEOCLIMATE STUDIES

ODP Leg 117 focussed on the Neogene paleoclimatic history of the Arabian Sea (see Science Operator Report this issue). Downhole logging addressed the objectives of this leg by providing continuous records of variations in formation properties and by linking the information from cores to regional seismic data. In a total of 5.5 days of logging, over 2500 m from 5 sites were logged. "Standard" Schlumberger logs were run in each of the three drilled provinces: Indus Fan (Site 720), Owen Ridge (Sites 722 and 731), and Oman Margin (Sites 723 and 728).

Indus Fan Site

Indus Fan Site 720 penetrated 414 m of Pleistocene turbidites with rare pelagic interbeds. Though comparison of core to logs indicates a core recovery of only 10% in the turbidites, the combination of downhole logs and regional seismic stratigraphy provides a valuable picture of deep-sea fan processes. Changes in bottom current activity, sometimes associated with sudden changes in submarine channel location, cause distinctive changes in both seismic sequences and log responses. A synthetic seismogram for Site 720 indicates that nearly every seismic sequence boundary corresponds to a depth at which turbidite deposition is temporarily interrupted; pelagic sediments are deposited instead. Within each seismic sequence, the logs indicate a distinctive pattern of bed thicknesses and of upward fining or coarsening.

Owen Ridge Sites

Owen Ridge Sites 722 and 731 penetrated a 320-400 m thick cap of Neogene calcareous sediments, overlying terrigenous turbidites. Downhole logs were obtained in the open hole interval 71.4-555.5 mbsf at 565.6 m deep Hole 722B, and from the seafloor to 979 mbsf at 994 m deep Hole 731C. At Site 731, downhole logs provided a continuous record through uncored intervals of the turbidites. Calcareous units were expected beneath the turbidites. However, no calcareous units were encountered in the spot cores, and a calcium log demonstrated that no calcareous units are present. At both Sites 722 and 731, turbidite log responses indicate an alternation between very silty and very clay-rich beds; the clay-rich beds are dominant in the youngest turbidites and silt-rich beds predominate below 800 mbsf. The turbidite cores and logs contain a record of complex mineralogical variations associated with changing climates and source regions.

Oman Margin Sites

On Oman Margin, logging provided high-resolution records of margin deposition at two sites: 727 m of Pleistocene sediments at Site 723 and 342 m of Plio-Pleistocene sediments at Site 728. Site 723 exhibited a variety of remarkable diagenetic effects. Interstitial water samples showed very low chlorinities, and the chlorinity indicator log provides continuous measurements between the discrete core measurements. Many dense dolomite beds are found in cores and more are evident in the logs. These dolomite beds do not create seismic reflectors, because they are thin and laterally discontinuous. A synthetic seismogram from sonic and density logs shows that the seismic reflectors are caused by larger-scale porosity variations.

Cyclicity in Leg 117 Logs

In most sedimentary environments, clay content controls porosity and other elastic properties (e.g. velocity, density). In many Leg 117 sites, logs show that diatom abundance is more important than clay content in controlling elastic properties and thereby creating seismic reflectors. For example, a pronounced 2 m cyclicity in logs from Site 728 is probably due to rhythmic variations in diatom content. This cyclicity may be caused by the 19-23,000 year period of the earth's precession, reflecting an orbital control on monsoonal upwelling. In contrast, logs from Site 723 indicate that uranium is very highly correlated with porosity-sensitive logs. Furthermore, core analyses of organic carbon percentage are well correlated with the uranium log. Thus Site 723 exhibits a nearly unique situation: the percentage of organic matter is so high that it controls porosity and creates seismic reflectors. The uranium log here provides a continuous, high-resolution record of variations in organic matter, independent of the vagaries of core recovery.

LEG 118: LOG RESPONSES SENSITIVE TO CORE MINERALOGY

Investigation of petrologic and physical properties of lower crust and upper mantle rocks near a ridge-transform plate boundary were prime objectives of Leg 118 drilling (see Science Operator Report this issue). Preliminary results of an extensive suite of logging and downhole measurements acquired in Hole 735B reveal the first in situ results from oceanic crustal layer 3 where nearly continuous recovered core is available for comparison. This unique opportunity enables logging data to be correlated with detailed studies of alteration and deformation in olivine and altered gabbros from a fracture zone.

Hole 735B Logs

Four curves from independent Schlumberger logs illustrate the dramatic sensitivity of log response to mineralogy (Figure 1). Low-porosity, silica-rich olivine gabbro found over most of the interval is shown also to have very high electrical resistivity, measuring from 4000 to 40,000 ohm-m. High concentrations of Fe-Ti oxides in magnetite and ilmenite in a distinct interval is evidenced by a decrease in silica concentration, an increase in photoelectric factor response (P) to the large atomic weight of titanium, and a sharp drop in electrical resistivity by 3 to 4 orders of magnitude due to the high conductivity of the oxides. Owing to the nearly constant measured porosity and borehole size throughout the interval, small scale variations in resistivity and P in the upper 100 m of the hole can be associated with compositional changes in altered gabbro. Similar variation in the lower 100 m interval corresponds to the most mafic olivine gabbros having interlayered intrusions of oxide-rich gabbro.

Other successfully recorded logs in Hole 735B delineate changes in bulk physical properties which were not observed by shipboard core analyses. The negative vertical component of the magnetometer log illustrates an in situ magnetic field reversal, which was not apparent in the laboratory data. The largest variation in magnetic field occurs in the oxide-rich gabbro; measured magnetic susceptibility increases by a factor of 3 or 4. Drill stem packer tests were also conducted and measured high flow rates above the oxide-rich gabbro interval which indicate considerable fracture permeability. Low sonic log amplitudes and a negative temperature log gradient also suggest that fracturing and fluid flow are present, and an acoustic borehole televiewer shows evidence for fracturing in the upper interval of the hole. Wellbore breakouts in the televiewer record suggest that local compressive stresses are concurrent with the prevailing N-S direction of ridge spreading.

In summary, the downhole experiments provide unique hydraulic and geophysical data as well as a tie to mineralogical changes in the core. The understanding of crustal circulation patterns and alteration processes is a critical step in deciphering the tectonic evolution of fracture zones; the logging results in Hole 735B clearly add to our present limited knowledge of these features.

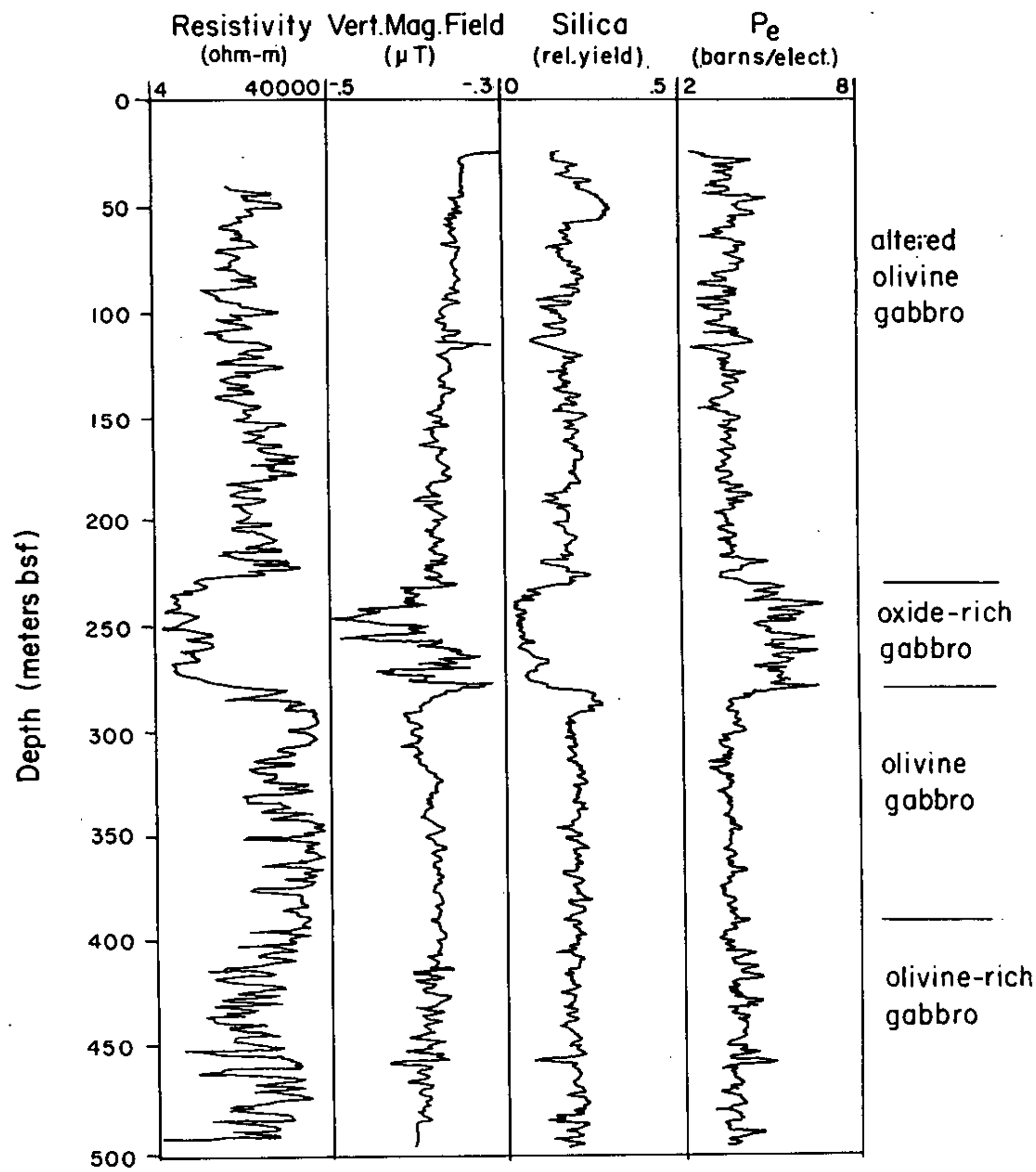


Figure 1. Selected logs in Hole 735B in the Atlantis II fracture zone of the SW Indian Ridge. The oxide-rich gabbros correlate to low electrical resistivity, variable magnetic field (reverse polarity), low silica content, and high photo-electric factor (P) which indicates a high concentration of conductive titanium oxide.

ODP SITE SURVEY DATABANK REPORT

The JOIDES/ODP Site Survey Databank received the following data between September, 1987 and January, 1988. For additional information on the ODP Site Survey Databank, please contact Carl Brenner at Lamont-Doherty Geological Observatory, Palisades, NY 10964.

- From D.Speed (UCSC): Selected seismic profiles documenting proposed Eastern Sunda Forearc and Banda-Sulu drillsites.

- From R.Schlich (IPG, France): Processed multichannel seismic profiles, with velocity information, from MARION DUFRESNE Cruise 47, documenting proposed Central and Southern Kerguelen Plateau drillsites SKP-1, SKP-2, SKP-4A, SKP-6A, and SKP-8. Also, profiles of bathymetry, gravity and magnetics for all MD-47 lines.

- From M.Coffin (BMR, Australia): Selected sections of multichannel seismic line 22 from RIG SEISMIC Cruise 47, documenting proposed alternate drillsite SKP-4B.

- From K.Lighty (ODP/TAMU): Digital tape of navigation merged with underway geophysical values for JOIDES RESOLUTION Leg 110, along with microfilm of seismic profiles, bathymetry and magnetics.

- From U.von Stackelberg (BGR, Germany): Cruise report from R/V SONNE Cruise 48, Lau Basin area.

- From K.Lighty (ODP/TAMU): Magnetic tapes of underway geophysics, merged with navigation, and microfilm of seismic profiles and magnetic data, ODP Legs 109 and 111.

- From B.Taylor (HIG): Two digital tapes of navigation merged with underway geophysics for FRED MOORE site survey of the Bonin area and other selected cruises in the region.

- From H.Kudrass (BGR, Germany): Heat flow and core description report for SONNE site survey cruise, Sulu Sea area.

- From K.Hinz (BGR, Germany): Multichannel seismic profiles, with corresponding navigation, documenting proposed drillsites in the Sulu and Celebes Sea areas.

- From C.Rangin (UPMC, France): CEPM multichannel seismic lines 16A and 17 documenting proposed Sulu Sea drillsites.

- From P.Williamson (BMR, Australia): Additional processed RIG SEISMIC multichannel seismic profiles documenting several of the proposed Exmouth Plateau/Argo Abyssal Plain drillsites.

- From J.Recy (ORSTROM, New Caledonia): Selected single channel seismic profiles in the Banda Sea area, with corresponding navigation.

PLANNING COMMITTEE REPORT

The Annual Planning Committee Meeting was held from 30 November - 4 December 1987, in Sunriver, Oregon. Highlights of the meeting appear below.

LONG-RANGE PLANNING

Planning Committee recommendations formulated at this meeting formed the basis of a four-year program plan which was required for the FY89 ODP Program Plan. In addition, PCOM began discussions on the long-range impact of COSOD II in order to prepare a long-range document for NSF. This report will be due before the JOIDES Executive Committee meets in May, 1988. Because most PCOM members had not yet received the final COSOD II document, detailed discussions are planned for the April, 1988 PCOM meeting. Another report on long-range planning will be necessary for the National Science Board review for NSF in August, 1988.

ODP ENGINEERING REQUIREMENTS

Mike Storms, ODP/TAMU Engineering, presented a special report on current projects and future requirements for upcoming ODP legs. TAMU has proposed dedicated engineering legs, increased land testing, and expanded liaison with JOIDES panels as ways to ensure that priority projects are accomplished on schedule. PCOM actions relating to engineering included:

* Establishing an engineering monitoring group, consisting of one U.S. and one non-U.S. PCOM member to act as the first line of liaison among PCOM, the advisory panels, TAMU engineers and the Borehole Research Group.

* Encouraging panels to hold at least one meeting per year in College Station to improve engineering liaison.

* Support of an engineering test leg to follow the Leg 124 (Banda-Sulu S.China Sea) program, consisting of 30 days ship time.

The engineering test leg has been endorsed by several JOIDES panels and, if inserted after Leg 124, solves some logistics and transit time problems. TAMU engineers will submit a proposal for the engineering leg (Leg 124E) for review at the April, 1988 PCOM meeting. Systems identified for testing by TAMU for Leg 124E include: mining coring system, Navidrill, pressurized core sampler, XCB, and the positive displacement motors.

The JOIDES Office, PCOM engineering monitoring group, and ODP/TAMU engineers have formulated a schedule for engineering development needs for Western Pacific programs to be included in the FY89 Program Plan and the four-year program plan (Table 1).

ODP LOGGING PROGRAM

PCOM approved the acquisition and slim-lining of the Schlumberger formation microscanner. Acceptance of the DMP and Borehole Research Group's recommendation to purchase this tool (a high resolution dipmeter) postpones the purchase of a yet unproven third wireline packer. Total cost of the tool is $160K, divided between FY88 and FY89.

WESTERN PACIFIC PLANNING

At the August PCOM meeting, the first nine programs from the WPAC Third Prospectus were evaluated and sent back to the thematic and regional panels for further definition. [See the October, 1987 issue of the JOIDES Journal, Vol. XIII, No.3.]. At this meeting, PCOM used the panel recommendations to formulate a drilling plan for FY89. Plans for the remaining Western Pacific drilling (through FY90) were also evaluated.

<u>Leg 124: Banda-Celebes-Sulu-S.China Sea</u>

PCOM had instructed WPAC to revise this leg in order to better address basement objectives. PCOM also asked WPAC to consider the addition of a Celebes Sea site. In response, WPAC ranked sites SCS-5, SCS-9, SULU-5, CS-1 and BANDA 1 and 2 equally as they all addressed unique problems. This six-hole program was estimated at 65

Table 1. Engineering Priority Time Lines for Western Pacific Drilling

Leg Number (tentative)	FY 1989						FY 1990					?
	124 Banda	125 Bonin-Mariana	126 Bonins	127 Nankai	128 Japan Sea I & II	129 Japan Sea I & II	130 Ref. Hole	131 Geotech	132 S.China Sea	133 NEA Margin	134 Vanuatu	135 Lau Basin
A. Young Crustal Rock Drilling												X
B. High Temp Drilling & Logging												0
C. Bare Rock Bases												0*
D. Recovery in Alternating Hard/Soft Sequences							X		0	0		
E. Coarse Grain Unconsolidated Sediments	X	0	0	X	0	0		X	0	0	0	0
F. In Situ Pore Pressure/Permeability				X				X				
G. In Situ Physical Properties								X				
H. Pressure Core Barrel	0	0		X	X	0	0	0	0	0		
I. Deep Stable Holes [1000-3000 m]**	X		0	X		X		X	X		0	

X = legs where development is essential.
0 = legs where development would greatly add to the scientific results.
* if engineering test is to be done in this basin.
** This definition refers to drilling depth of >1000m sediments. Note that this definition of deep stable hole is not identical with SOHP's long-term desire to get "Deep stratigraphic test" sites of 2-3 km drilling depth.

operational days, without transit, and therefore, represents more than a leg of drilling. In addition, the Banda sites face potential survey and clearance problems.

The following options are in effect for the Leg 124 program, depending on clearance status:

Option 1: A leg consisting of BANDA 1 and 2, and SCS-5 (alternate), as described in the WPAC prospectus, with 41.5 operational days allotted.

Option 2: If no clearances from Indonesia for Banda are obtained, a program consisting of CS-1, SULU-5, and possibly SCS-5 (alternate) is proposed, for a total of 41.5 operational days.

Clearances for all six sites will be pursued concurrently.

Leg 124E: Engineering Test Leg

As mentioned earlier in this report, an engineering test leg is scheduled for FY89. Sites near the Marianas Trough are prime testing areas for this leg since crustal drilling and massive cherts (east of the Marianas Trench) will be encountered there.

Leg 125: Bonins-Marianas

The Leg 125 program will consist of drilling sites MAR-3 (flank of the Conical Seamount), a new MAR-3A site (top of seamount), BON-6 and BON-7. As recommended by the thematic panels, BON-7 is the lowest priority site.

Leg 126: Bonins

PCOM recommends that the program outlined in the WPAC Third Prospectus (consisting of sites BON-1, BON-2, BON-5 and BON-5A), and estimated at 56 days operations time, be drilled for Leg 126. An updated downhole measurements program, to be provided by DMP, will be reviewed at the April, 1988 PCOM meeting.

Leg 127: Nankai Trough

The Nankai Trough program will consist of drilling sites NKT-1 and NKT-2, as outlined in the Third WPAC prospectus, for a total leg time of 57 days.

Legs 128 and 129: Japan Sea I and II

The WPAC Prospectus outlined sites J1B, J1D, J1E and J3A for Leg 128, and no changes were made by PCOM; 54 days operational time was alloted. The inclusion of the engineering leg has slightly improved the weather window for this leg, now scheduled to begin in mid-July, 1989. A proposal to place a long-term seismic monitoring experiment at J1B has been endorsed.

PCOM endorses the program of 30 days drilling at Sites J-2A and JS-2, as outlined by WPAC, and recommends adding approximately 11 days for downhole experiments (oblique seismic and deploying the Japanese seismometer, if available.) WPAC and DMP are to provide further definition for the downhole measurements program.

Recommended FY90 Drilling Program

The scientific objectives for the proposed FY90 drilling program in the Western Pacific are described in this issue (p. 47). PCOM actions and recommendations on the program include the following:

* PCOM charged the Downhole Measurements Panel with providing detailed information on the proposed GEOPROPS tool for the Nankai Geotechnical program. Scheduling of this program is dependent on a successful test of the tool.

* PCOM has asked LITHP to devise a geochemical reference site program, which will include a "generic" BON8 site.

* The Sunda program, a collision-processes leg, was dropped from the drilling schedule due to site survey problems and low thematic ranking. In its place, PCOM tentatively scheduled a South China Sea Margin program, pending review of the proposal by the Tectonics Panel.

* In light of the new geophysical data, PCOM recommends a one-leg program on the Northeast Australia Margin. SOHP priorities for the leg should be coordinated with WPAC logistics consideraitons. A one-leg program should be available for PCOM review at the April meeting.

* PCOM approved a one-leg, collision process program for Vanuatu, consisting of sites DEZ 1, 2, 3, 4, and 5 and IAB 1A and 2A.

* A Lau Basin science program, which requires no bare-rock guide base, is accepted for a single leg of drilling in the second half of the Western Pacific Program. The drilling plan includes several back-arc sites and a forearc site.

See the JOIDES RESOLUTION Operations Schedule in this issue (p. 3) for current dates and port calls through Leg 129.

CENTRAL AND EASTERN PACIFIC PLANNING

PCOM reviewed the status of the current CEPAC Prospectus outline, in which the six top priority programs of the thematic panels were presented (Table 2). Issues which arose during these discussions included:

* How to plan an 18-month program in the Central & Eastern Pacific, considering the time allotted for extended East Pacific Rise drilling.

* Whether the total time spent in the Pacific is postponing Atlantic drilling, and how to generate thematic interest in the Atlantic without a definite "return date".

* The possible impact of a change in panel structure to long-range planning for ODP.

* How to balance thematic programs for the Central & Eastern Pacific considering that some lithosphere objectives are best suited for the area, and tectonics objectives were heavily represented in the Western Pacific program.

PCOM agreed to draw up a plan for approximately 18 months of drilling in the central and eastern Pacific and send it back to the thematic panels for justification, with the understanding that the program could be expanded if important themes emerge.

PCOM defined a tentative CEPAC program using the highest priority themes of the three thematic panels (Table 3). PCOM watchdogs were assigned to these themes for a more detailed discussion

Table 2. Top Thematic Priorities for Central & Eastern Pacific Drilling

Lithosphere Panel

1. Structure of the Lower Oceanic Crust
2. Magmatic & Hydrothermal Processes at Sediment-free Ridge Crests
3. Magmatic & Hydrothermal Processes at Sedimented Ridge Crests
4. Early Magmatic Evolution of Hot-Spot Volcanism
5. Crustal Structure and Magmatic Evolution of Oceanic Plateaus
6. Composition & Magnetization of Old Pacific Crust

Sediments & Ocean History Panel

1. Neogene Paleoenvironment (high-resolution history)
2. Mesozoic-Paleogene Paleoceanography (high and low latitudes)
3. Atolls & Guyots (sea level and subsidence history)
4. Anoxic Events (Cretaceous)
5. Old Pacific Crust (the Cretaceous open ocean)
6. Metallogenesis & Diagenesis
7. Fans & Sedimentary Processes

Tectonics Panel*

M-Series Dating/Calibration of Anomalies in Old Oceanic Crust
Flexure of Oceanic Lithosphere
Ridge-Trench Interaction
Pre-70 MA Absolute Plate Motion
Deformation in Accretionary Prisms

* Not in order of priority

at the April, 1988 PCOM meeting. Watchdog assignments were made on a thematic basis, and are not limited to specific proposals, although particularly relevant proposals for watchdog review were identified.

PCOM discussed LITHP's request for a working group devoted to East Pacific Rise drilling as a synthesis proposal is needed for this high priority program. Formation of an East Pacific Rise Working Group was approved by PCOM. [Note: EPR-WG members of are listed in the JOIDES Directory.]

JOIDES ADVISORY PANEL STRUCTURE

A subcommittee to evaluate the JOIDES Advisory Panel Structure, consisting of T.Francis, A.Taira, M.Langseth and R.Heath (EXCOM), met twice during the meeting. In discussing the panel structure, the subcommittee considered the problem of maintaining the present representation of all member nations. A written report from the subcommittee will be reviewed at the April, 1988, PCOM meeting. T.Francis gave preliminary results of the discussions, including:

* The number of panel meetings should not increase in the future.

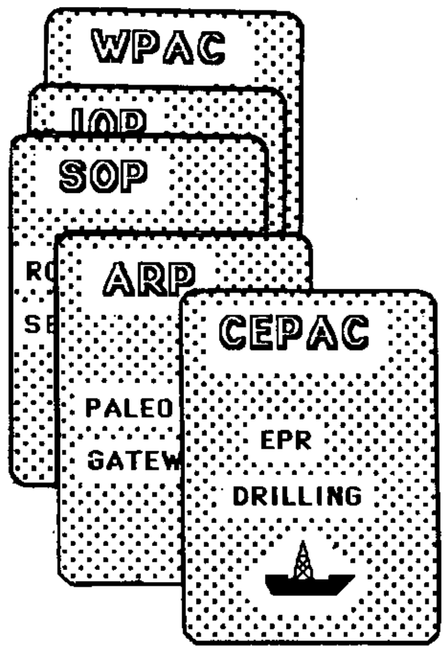
* As it is important that ODP be thematically driven, a number of models for restructuring thematic panels were discussed. An increase in the number of thematic panels may be necessary, with a possibility, for example, of splitting SOHP into two panels--paleoceanography/bioenvironment and diagenesis/sedimentary processes.

* Regional panels should be phased out and somehow incorporated into short-lived, detailed planning groups appointed by PCOM. These groups would carry out the primary roles of regional panels, i.e., to synthesize highly ranked drilling proposals into an operational drilling schedule.

* Thematic panels would oversee thematic subgroups.

* A new technical service panel, an on-board data analysis panel, is suggested. This panel would assist SOHP on geochemistry matters and also deal with physical properties.

The next meeting of the Planning Committee is scheduled for 19-22 April, 1988, in College Station, Texas. The agenda will include follow up discussion on the JOIDES Advisory Panel Structure, COSOD II, and further CEPAC planning.



PROGRAM	RELEVANT PROPOSALS
Lithosphere Panel	
* Structure of lower oceanic crust (about 1.5 leg)	286/E Deepening of 504B
* Magmatic and hydrothermal processes/sed-free ridgecrests (2 legs)	76/E East Pacific Rise at 13°N
* Magmatic and hydrothermal processes/sedimented ridgecrests (1 leg)	232/E Juan de Fuca 224/E and 284/E Escanaba Trough
Sediments & Ocean History Panel	
* Neogene paleoenvironment (1 leg)	221/E Equatorial Pacific 142/E Ontong-Java Plateau transect
* Mesozoic paleoceanography/ atolls and guyots (1+ leg)	202/E Drowned Marshalls Guyots
* Anoxic events (1 leg)	253/E Shatsky Rise
Tectonics Panel	
* Ridge-trench processes (1 leg)	8/E Chile Triple-junction
* Lithosphere Flexure (1 leg)	3/E Hawaii flexural moat
All Panels	
* M-series dating/reference holes	285/E Jr quiet zone 287/E M-series drilling

Table 3. Tentative Central & Eastern Pacific Program

PRELIMINARY WESTERN PACIFIC SCIENCE PLAN

In the last JOIDES Journal (Vol. XIII, No. 3, Oct. 1987) a tentative drilling schedule for the Western Pacific was presented. Below is an update to the science plan, based on the results of the Annual PCOM Meeting held in December, 1987. Current information on drilling sites for the Western Pacific program is listed in Table 1.

BANDA-CELEBES-SULU-SOUTH CHINA SEA BASINS

These marginal basins are nested between a series of arcs, trenches and microcontinental terranes. Because of the complexity of this transect, the program has been expanded to include the following: Two sites in sub-basins of the Banda Sea (BNDA1, BNDA2), one site in the Celebes Sea (CS1), one site in the Sulu Sea (SUL5), and two possible sites in the South China Sea Basin (SCS5, SCS9). For logistical reasons, this program has been divided into two shorter legs, the first scheduled as Leg 124, with a possible second leg to follow in FY90.

BONINS-MARIANAS

Plans for the transect across the Bonin arc system have not changed. To investigate ultramafic diapirs in the outer forearc, two holes will be drilled at Conical Seamount in the Marianas (MAR3, MAR3A). Site BON8 on the seaward side of the trench will not be drilled during this two-leg program, but this or a similar site is being considered for a geochemical reference site (see below) .

The FY90 program presented below was outlined at the Annual PCOM meeting. Table 2 lists information on tentative drill sites.

GEOCHEMICAL REFERENCE HOLE(S) - BONIN AND MARIANA ARCS

A principal unknown in the understanding of the geochemistry of volcanic arc magmas is what material is derived from the subducting sediments and crustal rocks. Extensive geochemical studies of arc rocks in the Bonin and Mariana Arcs make this region an ideal place to test the hypothesis that chemical anomalies in the down-going slab and associated sediments are reflected in the chemistry of the arc. The drilling program will consist of a series of holes to sample the sediment and oceanic basement on the seaward side of the Bonin and Mariana Trench.

JOIDES Panels advocate the positioning of one site seaward of the Bonins so that the age of magnetic sequences found in the western Pacific ('M-Series drilling') can be determined, as well as the nature and age of very old Pacific crust. Off the Marianas, drilling will sample the oceanic basement, overlying sediment sections, and also seamounts, which are common in this area, but virtually absent in the Bonin subduction system.

In addition, the drilling of these sites completes the transect of the Bonin and Mariana systems begun during DSDP drilling, and will include the oceanic portion of the trench region.

NANKAI GEOTECHNICAL

Critical to our understanding of the processes of deformation in accretionary prisms is the need to better measure the physical state of the sediments being deformed. A significant part of the Nankai Trough drilling (Leg 127) is measurement of physical properties of the sediments in the Nankai Trough. A major limitation of physical properties measurements made on ODP material, however, is the state of preservation of drilled sediment samples. To improve our ability to measure physical state of sequences requires the development of instrumentation for in situ sampling. The Nankai Geotechnical program is designed to take advantage of such tools, and if they are available, a site in the toe of the Nankai accretionary prism will be drilled. Downhole geotechnical measurements, under in-situ conditions, will be supplemented by pore pressure, temperature, in-situ

Table 1. FY89 Western Pacific Drilling Sites

SITES	LOCATION	WATER DEPTH	DRILL DEPTH	BASE-MENT	MAIN OBJECTIVE & COMMENTS
Leg 124:	Banda-Celebes-Sulu-SCS Basin (2 or 3 sites)				
BNDA1	6.0oS/128.0oE	4600	>800	20	Stratigraphy, age & basin origin
BNDA2	4.9°S/124.9°E	4800	>800	20	Stratigraphy, age & basin origin
CS1	4.7°N/123.5°E	4900	750	50	Stratigraphy, age & basin origin
SUL5	8.8°N/121.6°E	4600	1060	50	Basin origin, paleoceanographic objectives
SCS5*	12.5°N/114.5°E	4350	750	50	Timing of opening of SW part of basin, age of crust
SCS9	16.2°N/117.9°E	4200	>500	20	Calibrate magn.anomaly-pattern (site at magn.anomaly 6)
Leg 126:	Marianas and Bonin Diapirs				
MAR3	19°30′N/146°41′E	4200	700	yes	Timing and emplacement of serpentine diapir (flank)
MAR3A	19°30′N/146°41′E	3200	700	700	Fabric & hydrogeology of serpentine diapir (summit)
BON6	31°54′N/141°06′E	2850	1100	~150	Deformation & translation history [outer arc site]
BON7	30°58′N/141°48′E	4650	500	yes	Ultramafic diapir at outer forearc seamount (?)
Leg 127:	Bonins				
BON1	30°55′N/139°53′E	2270	900	50	History of rifting arc, nature of rift and arc basement
BON2	30°55′N/140°00′E	1100	700	200	Extent and chemistry of hydrothermal circulation
BON5A	32°26′N/140°47′E	2700	950	--	Uplift & subsidence history, forearc [forearc site]
BON5B	32°23′N/140°48′E	3400	950	50	Stratigraphy, nature of igneous basement [forearc site]
Leg 128:	Nankai Trough				
NKT1	32°58′N/134°58′E	4803	900	--	Reference hole
NKT2	32°32′N/134°56′E	4730	1300	--	Hole through decollement; in-situ geotech. measurements
Leg 129:	Japan Sea I				
J1B	40°14′N/138°15′E	2780	800	100	Nature and age of basement of basins
J1D	44°00′N/138°49′E	3170	380	30	Style of multiple rifting
J1E	38°37′N/134°33′E	2890	880	50	
J3A	43°51′N/139°09′E	2040	730	30	Timing of convergence and obduction of oceanic crust
Leg 130:	Japan Sea II				
J2A	39°14′N/133°51′E	2050	1390	20	Metallogeny on failed back-arc rift, style of rifting
JS2	37°05′N/134°45′E	998	600	--	Paleoceanography (anoxic-suboxic-oxic history)

* Tentative site location
Note: Details may change with ongoing planning

stress measurements and pore fluid sampling.

The success of this program fully depends on the availability of new tools which are currently under development. If it becomes apparent that these tools will not be available in time, this one-leg program will be removed from the schedule.

SOUTH-CHINA SEA MARGIN

The northern margin of the South China Sea offers a well-constrained setting in which to document the tectonic, depositional, and paleoceanographic development of a young "Atlantic-type" marginal basin. It is well suited for studying models of continental margin evolution because: (1) It is old enough to have been affected by the complex, initial extension processes and tectonic conditions; (2) It is young enough to (a) still exhibit observable differences in its subsidence and associated thermal history as predicted by crustal extension models, and (b) most likely provide the high-resolution stratigraphic framework necessary to determine the tectonic history; and (3) It provides an opportunity to study ties between eustacy and tectonism in a relatively simple setting.

Four sites, arranged in a transect across the continental margin and the transition to the oceanic basin, are proposed. Newly acquired geophysical data have greatly improved this program; it is tentatively scheduled as one leg, pending a review by the Tectonics Panel.

NORTHEAST AUSTRALIAN MARGIN (NEA MARGIN)

The NEA Margin (including Queensland Trough/Queensland Plateau) is an excellent example of a mixed carbonate/siliciclastic province in a passive margin setting, thought to be controlled principally by climate and relative sea level. A great variety of objectives has been identified for drilling in this area, including: (1) Sea level control on sedimentation, (2) Comparison of margin and plateau sequences to separate global sea level effects from tectonic subsidence, (3) Changes in paleoclimate related to plate position and its effects on sedimentation, (4) Diagenesis of mixed carbonate/siliciclastic and pure carbonate sequences under an ocean regime different from the Caribbean and Indian Oceans.

Comparing the drilling results from relatively young passive margins in different settings (S.China Sea, NE Australia) will greatly enhance post-drilling synthesis of passive margin studies.

Though the final sites have not yet been determined a one-leg, E-W transect across the NE Australian margin, Queensland Trough and adjacent Queensland Plateau will be the prime focus. At some of the sites, conditions associated with the deposition of hydrothermally-derived sulfides will be investigated. The passive margin setting at the NEA Margin may be analogous to an environment which produced Mississippi-Valley-Type ore deposits.

VANUATU

The program concentrates on collisional processes. The New Hebrides (Vanuatu) Arc underwent a reversal in arc polarity during the late Miocene. Since then, the Australia-India plate has been underthrusting the arc from the west at a rate of at least 10 cm/yr. The subduction process is complicated by E-trending aseismic ridges (e.g. D'Entrecasteaux Ridge) on the Australia-India plate entering the subduction zone. This configuration is linked to deformation of the forearc, rapid uplift of the arc and also effects intra-arc basin formation. The principal objectives of this one-leg program are to study the processes involved in arc-ridge collision, subduction reversal, and the formation of intra-arc basins. Drilling a complete transect across the collision zone of D'Entrecasteaux Ridge - volcanic arc (Sites DEZ1 - DEZ5), and intra-arc basins (Sites IAB1 and 2 in the Aoba Basin), is planned.

LAU BASIN

The Lau Basin is an actively spreading mature back-arc basin which started opening about 3-5 Ma ago. N-MORB-type

Table 2. Tentative FY90 Western Pacific Drilling Sites

SITES	LOCATION	WATER DEPTH	DRILL DEPTH	BASE-MENT	MAIN OBJECTIVE & COMMENTS
Geochemical Reference Holes					
Sites to be picked		ca.5500	6-900	yes	Sample geochem.charact.components of subducted plate
South China Sea Margin					
SCS1	18°58'N/118°11'E	3750	1670	20	{ Excellent prepared example to test models for passive SCS2
SCS2	19°29'N/117°54'E	3410	1020	20	{ margin development: Relationship between rifting/
SCS3	19°57'N/117°40'E	2750	1220	20	{ drifting, subsidence/uplift, sedimentation/seismic
SCS4	20°47'N/117°30'E	750	1000	--	{ sequences, thermal history/hydrocarb.maturation
Northeast Australian Margin*					
NEA1	16°38'S/146°18'E	218	500		Paleoshelf deposits, toe of slope carb.detritus
NEA2	16°38'S/146°18'E	285	800		Paleoshelf margin for sedim.history & slope deposition
NEA3	16°37'S/146°19'E	412	300		{ Toe-of-slope to basin transition & older
NEA4	16°26'S/146°14'E	956	450		{ Queensland Trough sediments
NEA5	16°37'S/146°44'E	1620	900		Basin reference site, paleoceanography & basin history
NEA9	17°52'S/150°07'E	400	300		{ Subsidence history of Queensland Plateau
NEA10	17°55'S/150°15'E	487	250		{ and periplatform cycles
NEA12	18°44'S/149°59'E	915	1000		Older Tertiary sequence for complete basin fill history
Vanuatu					
DEZ-1	15°20'S/166°16'E	2500	300	100	{ Transect across D'Entrecasteaux Ridge / arc collision
DEZ-2	15°19'S/166°21'E	2130	1000	100	{ zone, with reference site (1), lowermost accr.wedge
DEZ-3	15°20'S/166°30'E	500	800		{ site (2), uplifted frontal-arc horst (?)(3)
DEZ-4	15°57'S/166°47'E	900	1000	}	Guyot-arc: Nature of imbricated arc rocks
DEZ-5	16°01'S/166°40'E	1100	750	50 }	collision zone: Guyot sequence
IAB-1A	14°47'S/167°35'E	3075	1000		{ Dating of major unconformity,
IAB-2A	14°38'S/167°55'E	2600			{ relationship to collision
or -2B	14°50'S/167°55'E	2400	1000		{ and influence on chemistry of volcanism
Lau Basin					
LG1	18°45'S/176°45'W	2400	220	120	{ Relationships between magmatism, tectonics &
LG2	18°45'S/177°45'W	2600	350	50	{ hydrothermal metal accumulation; backarc basin
LG7	18°45'S/177°10'W	2400	200	50	{ formation; (arc volcanism, distal sites)
LG3	22°10'S/175°42'W	740	500	--	Arc rifting, arc volcanism (proximal site),
LG6	22°00'S/174°30'W	4500	550	50	Basement & tect. history of forearc, volcanism (distal)

* All sites tentative; emphasis will be put on an E-W transect.

basalt forms within the center of the basin at an intermediate spreading rate (5-6 cm/yr). Accumulation rates of thermally-derived elements in the overlying sediments are as high as those near the East Pacific Rise. In contrast, the basin's western margin is underlain by older basalts which have compositions closer to those of island arcs.

The basin is well-documented, and therefore, fundamental processes of crustal generation can be studied in detail. These processes include: (1) Changes in the composition of both basement basalts and overlying sediments during the opening of the backarc basin and the relationship of each to the basin's tectonic history; (2) The time-transgressive character of the basin's opening and its and vertical tectonic history of the adjacent arc; and (3) The geochemically distinctive and widespread volcanism which forms the basement of oceanic island arcs.

Presently two drilling transects are being considered for one leg of drilling: (1) A transect of three sites at about 19°S just west of the assumed spreading center in order to examine the petrological evolution and the relationship between magmatism, tectonics and hydrothermal accumulations (Sites LG2, LG7, LG1); and (2) Two sites at about 22°S (one at the arc proper and one forearc site) in order to examine tectonic history of arc and forearc and relationship to volcanism. Currently no bare-rock sites are being considered.

REPORT OF ANNUAL PANEL CHAIRMEN'S MEETING

The Annual Panel Chairmen's Meeting was held on 29 November, 1987, in conjunction with the Annual Planning Committee meeting, at Sunriver, Oregon. The group focussed on JOIDES advisory panel structure, but also covered long-term planning, engineering developments, and Part B publications.

D.Cowan (Tectonics Panel) chaired the meeting and presented the results at the joint session with the Planning Committee. Highlights of Cowan's report and the meeting appear below.

JOIDES PANEL ADVISORY STRUCTURE

The Panel Chairmen's concerns on prospective changes to the advisory structure included the following:

* Does enough regional and thematic expertise exist on the panels to address global themes?

* Should major thematic panels be subdivided?

* What is the lifetime of a regional panel?

* How can panels handle the number of proposals in the system? Should deadlines for submission be established?

The Chairmen have recommended the following modifications to the panel advisory structure:

* The number and character of the present thematic panels should be retained.

* Thematic panels can form advisory bodies for specific tasks; these would report to the panels.

* Regional panels synthesize thematic priorities, mature proposals and logistical constraints into drilling prospectuses.

* Regional panels have a finite lifetime.

* Thematic panels should reflect a global distribution of regional expertise.

During the Chairmen's meeting, the dual role of the Downhole Measurement Panel (DMP) as a service and science development panel was discussed. It was noted that with its interest in global stress mapping and other themes, DMP has become thematic in scope. The consensus of the Chairmen was that, although DMP serves largely as a service panel, DMP also considers and promotes the science of downhole measurement.

Foremost of the Chairmen's concerns are the plans for the drillship after the program in the Pacific has been completed. Cowan said that COSOD II, workshops, thematic panels, and advisory groups will play a role in these plans, which must be advertised to the community as soon as possible.

ENGINEERING DEVELOPMENTS

J.Jarry (Technology and Engineering Development Committee) presented short- and long-term engineering requirements for ODP. The Panel Chairmen reaffirmed that drilling and recovery in young or fractured basement, and in alternating hard/soft sediments, are still top engineering priorities. TAMU's engineering timelines for the mining coring system, pressure core system, Navidrill and other developments were reviewed. There was a consensus among the Chairmen that it would be beneficial for TAMU liaisons to panel meetings to be engineers rather than staff scientists. The Chairmen also discussed the need for increased spending on long-term developments if COSOD II objectives are to be addressed.

ODP PUBLICATIONS

T.Moore (Information Handling Panel) reviewed recent changes to ODP Part B Publications. He explained the new editorial review board (the two leg co-chief scientists, the leg ODP staff scientist, an external scientist, and a TAMU/ODP editor) which will oversee future Part B Volumes. The Chairmen emphasized the co-chiefs' responsibility for insuring the quality of Part B volumes.

Each of the Panel Chairmen presented his panel's scientific agendas and priorities at the Annual Planning Committee meeting which followed on 30 November, 1987. Their input was especially important in formulating the FY89 Program Plan, which required a projection of the next four years of ODP drilling. The Chairmen's recommendations on panel structure were forwarded to the JOIDES Advisory Panel Subcommittee, which met during this meeting, for review (see PCOM report for details).

NEW JOIDES PANEL CHAIRMEN

The following people were recommended and have accepted the post of Panel Chairman to these panels:

- Central & Eastern Pacific Regional Panel -

Dr. David K. Rea
Department of Geological Sciences
University of Michigan
Ann Arbor, MI 48109
(313) 936-0521

- Site Survey Panel -

Dr. Gregory S. Mountain
Lamont-Doherty Geological Observatory
Palisades, NY 10964
(914) 359-2900 x541

- Tectonics Panel -

Dr. Ian W.D. Dalziel
Institute for Geophysics
University of Texas at Austin
8701 Mopac Boulevard
Austin, TX 78759-8345
(512) 471-0431

EXECUTIVE COMMITTEE REPORT

The last meeting of the JOIDES Executive Committee was held from 5-7 October 1987 in Nikko, Japan.

ODP PUBLICATIONS POLICY

EXCOM discussed the revised publications policy and the effects it will have on ODP Proceedings volumes. EXCOM reviewed the proposed establishment of an editorial board to review the contents of the ODP Proceedings, Volume B in order to address the issue of peer review. The publications policy developed by the Information Handling Panel in August, 1987 was endorsed.

REVIEW OF PANEL STRUCTURE

N.Pisias reported that it is the general feeling of PCOM that the advisory panel structure is in need of review and possible modification. PCOM has approached this process by appointing a subcommittee to consider changes in the panel structure. The goal of the subcommittee is to insure that ODP is indeed "thematically driven" and that the thematic panels adequately represent the diverse problems to be addressed by ocean drilling. It is PCOM's intent that the final COSOD II report be used as a tool in re-evaluating the panel structure.

For the short term, PCOM has addressed the problem of a more thematically driven program by specifying how prospectuses should be generated, and by adjusting the roles of thematic and regional panels in their evaluation of proposals. Proposals will now be evaluated and ranked by thematic panels, then forwarded to regional panels for their evaluation. Regional panels will write prospectuses which include the programs identified and prioritized by the thematic panels, and PCOM will use the regional prospectuses to formulate a final drilling program.

EXCOM endorsed PCOM's revised proposal review process, with the addition that regional panels should provide input on possible geographic alternatives which might better address problems defined by forwarded proposals. EXCOM also endorsed PCOM's establishment of a subcommittee to review the JOIDES Advisory Structure.

COSOD II

It was reported that preparation of the final COSOD II document was underway and that it will be based on the edited "White Papers" presented in Strasbourg. The final document will include major scientific objectives, required technologies to achieve them and strategies for drilling.

It was recognized that the COSOD-II document will have a significant impact on the direction of ODP, but it is not yet apparent how its content will be incorporated into the JOIDES planning structure. The JOIDES planning structure must establish a timetable for reviewing, evaluating and incorporating COSOD II results. A strawman timetable for JOIDES analysis of COSOD-II results was considered.

[NOTE: The COSOD II final report is now available. Please see the JOIDES/ODP Bulletin Board, p. 56 for details.]

THIRD WORLD PARTICIPATION

Several members expressed their wish to provide support within the program to encourage third world participation in ODP. It was agreed that EXCOM must pay closer attention to this issue and should develop a concrete plan for dealing with developing countries, and that involving developing countries is a very important issue and deserves more attention.

EXCOM appointed J.Baker, H.Duerbaum and J.Stel as members of a subcommittee to develop long-term options for increasing participation of developing countries in drilling activities. The subcommittee will report at the next EXCOM meeting.

The Executive Committee will meet next from May 25-27, 1988 in Washington, DC.

PROPOSALS RECEIVED BY THE JOIDES OFFICE

1 October, 1987 - 31 January, 1988

Ref. No.	Date Rec'd.	Title	Investigator(s)	Inst.	Site Survey Avail. Data	Site Survey Future Need	Panel Reference	PCOM Ref.	Remarks
				WESTERN PACIFIC OCEAN					
294/D	10/28/87	Petrology & geochemistry of basement rocks in the the Aoba intra-arc basin	J.Shervais	U.South Carolina	--	Yes	TECP 11/87 LITHP 11/87 WPAC 11/87		related to 25/D, 187/D, 190/D
295/D	12/7/87	Hydrogeology & structural evolution of the Nankai accretionary complex	J.Gieskes, et al.	Scripps ORI Japan Leeds, UK	Yes		TECP 12/87 SOHP 12/87 WPAC 12/87		related to 50/D, 178/D, 298/F
				SOUTHERN OCEAN					
273/C	10/8/87	Candidate drillsite S-Kerguelen Plateau	M.Coffin, et al.	BMR, Australia	Yes		SOHP 11/87 TECP 11/87 LITHP 11/87 SOP 11/87		Addendum SKP-4B,
296/C	12/7/87	Ross Sea, Antarctica	A.Cooper, et al.	USGS V.U./NZ Ohio State BGR/F.R.G.	Yes		TECP 12/87 SOHP 12/87 LITHP 12/87 SOP 12/87		Strongly related to 244/C
297/C	12/29/87	Pacific Margin of the Antarctic peninsula	P.Barker, et al.	British Antarctic Survey	Yes	Yes	TECP 12/87 SOHP 12/87 SOP 12/87		(preliminary)
				GENERAL AND INSTRUMENTAL					
298/F	21/1/88	Acquiring vertical seismic profiles in Nankai Trough ODP sites	G.Moore	U.Tulsa			DMP 1/88 TECP 1/88 SOHP 1/88 LITHP 1/88 WPAC 1/88		directly related to 50/D, 178/D and 295/D

JOIDES/ODP BULLETIN BOARD

COSOD II FINAL REPORT AVAILABLE

The Report of the Second Conference on Scientific Ocean Drilling (COSOD II) is now available. The prime objective of the Conference, held 6-8 July 1987 in Strasbourg, was to make recommendations for future scientific and technological objectives for the Ocean Drilling Program. COSOD II participants will receive their copies directly from the European Science Foundation, the meeting host. Additional copies can be ordered from the following offices:

Canada

Ms.Louisa Horne
Canadian ODP Committee
Dalhousie University
Halifax, Nova Scotia B3H 3J5

Federal Republic of Germany

Dr.Hans J.Duerbaum
Bundesanstalt fur Geowissenschaften und Rohstoffe
Postfach 510153
D-3000 Hannover 51

France

Mme.Martine Cheminee
Universite Pierre et Marie Curie
4 Place Jussieu (Tour 26)
F-75230 Paris Cedex 05

Japan

Dr.Takahisa Nemoto
Tokyo University
Ocean Research Institute
1-15-1 Minamidai
Nakano-ku
Tokyo 164

USSR

Dr.Nikita A.Bogdanov
Institute of the Lithosphere
Staromonetny per., 22
Moscow 109180

United Kingdom

Dr.James C.Briden
National Environmental Research Council
Polaris House
North Star Avenue
Swindon SN2 1EU

USA and Latin America

Ms. Robin Smith
Joint Oceanographic Institutions, Inc.
1755 Massachusetts Ave., NW
Suite 800
Washington, DC 20036

All Other Countries

Dr.G.Bernard Munsch
European Science Foundation
1 Quai Lezay-Marnesia
F-67000 Strasbourg, France

NEW POLICY FOR SUBMISSION OF ODP PROPOSALS

Please note that the guidelines for submission of proposals to the Ocean Drilling Program require proponents to submit six copies of a proposal to the JOIDES Office. The JOIDES Office will no longer be able to process proposals unless the correct number of copies is received. Also, it is advised that the number of fold-outs be kept to a minimum as they seriously complicate duplication and distribution of the proposal. If fold-outs can be reduced to standard sized pages, it will greatly expedite the distribution of a proposal to the panels.

JOIDES MEETING SCHEDULE

Date	Place	Committee/Panel
4-5 February	Houston	TEDCOM
10-12 February	College Station	EPR-WG
29 Feb - 1 Mar	Washington, DC	BCOM
2-4 March	Honolulu	LITHP
7-9 March	Houston	SOHP
9-10 March	London	PPSP
15-17 March	Palisades	SSP
15-18 March	Corvallis	TECP
23-25 March	Menlo Park	CEPAC
24-25 March	College Station	Annual Co-Chief Scientists' Meeting
11-13 April	Hannover	WPAC
19-22 April	College Station	PCOM
25-27 May	Washington, DC	EXCOM/ODP Council
23-25 August	Oxford	PCOM
14-16 September	Edinburgh	EXCOM
28 Nov - 2 Dec	Miami	PCOM/Panel Chairmen (Annual Meeting)

* Tentative meeting (not yet formally requested/approved)
(rev. 2/15/88)

ODP/TAMU PANEL LIAISONS

Downhole Measurements Panel - SUZANNE O'CONNELL
Information Handling Panel - RUSS MERRILL
Pollution Prevention & Safety Panel - LOU GARRISON
Site Survey Panel - AUDREY MEYER
Technology & Engineering Development Committee - BARRY HARDING

JOI/USSAC FELLOWSHIP

Joint Oceanographic Institutions, Inc., in cooperation with the U.S. Science Advisory Committee, is continuing to support its new Ocean Drilling Graduate Fellowship Program in the fiscal year 1988. The fellowship will provide an opportunity for scientists of unusual promise and ability who are in residence at a U.S. institution to conduct research compatible with that of the ODP. The award for a doctoral candidate is $18,000, to be used for stipend, tuition, benefits, research costs and incidental travel, if any. Applications are reviewed three times per year in January, May and September. Applications for upcoming legs should be submitted to JOI according to the following schedule:

Leg*	Application Deadline
126 (Bonin II)	1 May 1988
127 (Nankai Trough)	1 May 1988
128 (Japan Sea I)	1 September 1988
129 (Japan Sea II)	1 September 1988
Shorebased work	1 January 1989

* Tentative schedule based on discussions at the August Planning Committee meeting.

An application packet, with instructions and information on upcoming cruises is available from: JOI/USSAC Ocean Drilling Program Fellowship, JOI, Inc., 1755 Massachusetts Ave., NW, Suite 800, Washington, DC 20036.

JOI/USSAC GRADUATE FELLOWS ANNOUNCED

The Joint Oceanographic Institutions/US Science Advisory Committee (JOI/USSAC) is pleased to announce the JOI/USSAC Ocean Drilling Graduate Fellows:

Steve Clemens, Brown University (Leg 117 participant): "Neogene Variability of Monsoon Winds as Recorded in the Eolian Component of Arabian Sea Sediments".

Jeffrey Corrigan, University of Texas at Austin (Leg 116 participant): "Thermal History of the Indian Ocean Intraplate Deformation Zone".

John Firth, Florida State University: "Biometric Analysis of Oligocene Calcareous Nannofossils".

David Lea, Massachusetts Institute of Technology: "Foraminiferal Cadmium and Barium Records in the Upper Pliocene".

Vincent Salters, Massachusetts Institute of Technology (Leg 120 participant): "Investigation of the Trace Element and Isotope Variability of Igneous Rocks from the Kerguelen Plateau".

John Tarduno, Stanford University: "Paleomagnetic Investigation of Pacific Ocean Rises".

James Zachos, University of Rhode Island (Leg 120 participant): "Late Cretaceous and Paleogene Variations in Climate and Productivity in the Southern Indian Ocean".

With the award comes a stipend of $18,000 to be used for student stipend, tuition and benefits, research costs, and incidental travel, if any.

WORKSHOP ON MEDITERRANEAN DRILLING SCHEDULED

During the next CIESM Meeting in Athens (October, 1988), an Ocean Drilling Program Workshop on Scientific Drilling Initiatives in the Mediterranean Sea is scheduled. The goals of the meeting will be to:

* Synthesize global problems concerning the origin, evolution, structure, sedimentation, and paleoceanography of the Mediterranean Basins;
* Stress how scientific drilling can address these problems;
* Develop and strongly support a coherent drilling strategy in the Mediterranean Sea; and
* Integrate drilling objectives to other marine and onshore programs before 1992.

The workshop will be organized in general plenary sessions and in subgroup sessions on specific topics. Written participation (probably in the form of extended abstracts or drilling proposals) will be published within the CIESM Report.

For further information on the workshop, please contact:

Dr.Jean Mascle, Laboratoire de Geodynamique Sous-Marine, B.P. 48, 06230, Villefranche-sur-Mer, France. Tel: (33) 93-01-75-80.

Dr.James Austin, Jr., Institute for Geophysics, University of Texas at Austin, 8701 Mopac Boulevard, Austin, Texas 78759-8345 U.S.A. Tel: (512) 471-0450

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JOI/USSAC WORKSHOP ON DOWNHOLE SEISMOMETERS

A workshop on broad-band downhole seismometers in the deep ocean will be held 26-28 April, 1988 at Woods Hole Oceanographic Institution, Woods Hole, Massachusetts. The focus of the workshop will be to:

* Review the scientific justification for establishing a network of broad-band downhole ocean floor seismic monitoring stations.
* Review state-of-the-art instrumentation and engineering to monitor global seismic activity in the deep ocean. Issues ranging from sensor design, data telemetry, the Ocean Drilling Program and wireline re-entry of deep ocean boreholes will be discussed.
* Plan specific, short-term pilot projects and devise specifications for a global ocean-floor network.

The workshop conveners are:

A.M.Dziewonski, Department of Earth and Planetary Sciences, Harvard University, 24 Oxford Street, Cambridge, MA 02138; Tel:(617) 495-2510, and

G.M.Purdy, Department of Geology and Geophysics, Woods Hole Oceanographic Institution, Woods Hole, MA 02543; Tel:(617) 548-1400, Ext 2826.

Workshop sponsors are the Joint Oceanographic Institutions, Inc. and the U.S.Science Advisory Committee. Applications are invited from potential workshop participants. Funds from JOI/USSAC for travel and subsistence are available for U.S.participants on the basis of eligibility and need. Applications for participation and funding must be received by 8 April 1988 and addressed to G.M.Purdy at WHOI.

WORKSHOP REPORTS AVAILABLE

Recent reports of JOI-USSAC sponsored workshops are now available at JOI, Inc. These reports are:

Scientific Seamount Drilling (Preliminary Report) Drs. Tony Watts and Rodey Batiza, conveners

Measurements of Physical Properties and Mechanical State in the Ocean Drilling Program, Drs. Daniel Karig and Matthew Salisbury, conveners

Wellbore Sampling, Mr. Barry Harding and Dr. Richard Traeger, conveners

For copies of these reports write to: JOI/USSAC WORKSHOP REPORT, JOI, Inc., 1755 Massachusetts Ave. NW, Suite 800, Washington, DC 20036.

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JOI/USSAC NEWSLETTER

If you are interested in receiving the JOI/USSAC Newsletter, which will begin publication in March, 1988 please contact the Editor, Robin Smith, Joint Oceanographic Institutions, 1755 Mass. Ave. NW, Suite 800, Washington, DC 20036. The Newsletter will contain information on workshops, fellowships, site survey augmentation, and information on upcoming events concerning the US ocean drilling scientist. There is no cost for the newsletter.

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ODP PHOTOGRAPHIC COLLECTION AVAILABLE

The Ocean Drilling Program announces the availability of the entire color photographic collection of core beginning with DSDP Leg 1, Core 1 through ODP Leg 120. The collection consists of over 25,000 photographs. The collection will be available in two viewing formats: 35mm slides or 8 in video disc. Delivery of orders will begin in June of 1988.

The cost of the collection is dependent upon the format chosen. The 35 mm slide set will cost approximately $4,500 plus postage. The slides will be boxed, consecutively numbered, and come with an index to the collection.

The video disc will cost approximately $12.75 plus postage. Video discs will be packaged with an index. A video disc player with random access capabilities and a video monitor are required to use the video disc. An example of the player is the Sony disc player #20002-2.

If you are interested and/or have questions, please contact:

John Beck
Ocean Drilling Program
1000 Discovery Drive
College Station, TX 77840
Telephone: (409) 845-1183

JOIDES JOURNAL DIRECTORY

Due to increased publication and mailing costs, the JOIDES Journal is now limited to 90 pages per issue. Approximately one-third of these pages are devoted to the JOIDES Directory. Because the primary function of the Journal is to advise the community on upcoming cruises and longer term ODP developments, the JOIDES Office will publish the full directory only once per year.

Beginning with Volume XIV, the JOIDES Journal will carry a full directory listing in the February issue since many panel members rotate after the Annual Planning Committee meeting. New panel and committee members, address changes, etc., will be included in the June and October issues. These will be listed in a format for easy updating of the Directory Issue. As always, the JOIDES Journal staff appreciates your help in keeping the Directory listings as up to date as possible.

DRILLING BULLETIN BOARD

The DRILLING Bulletin Board is a great way to advertise your meetings, catch up on the activities of the JOIDES RESOLUTION, or to send a general message to the Ocean Drilling and Continental Drilling Programs. The DRILLING Bulletin Board is available on Omnet's ScienceNet electronic mail system. If you are on the Omnet system, it's as easy as typing "compose" and then "To:Drilling". If you have any questions please contact E.Kappel by telemail or (202) 232-3900 by telephone.

ODP PROMOTIONAL MATERIALS

A new portable ODP display is available for use at meetings and conventions. The display folds into two compact cylinders and may be put on board a plane as luggage or shipped. For more information and scheduling, contact Robin Smith, JOI, Inc., 1755 Massachusetts Ave., NW, Washington, DC 20036, Telephone: (202) 232-3900.

A new 24 page, 8 1/2" x 11" full-color booklet on the Ocean Drilling Program is now available from Joint Oceanographic Institutions. Write to ODP Booklet, JOI, Inc., 1755 Massachusetts Ave. NW, Suite 800, Washington, DC 20036.

The Science Operator brochure for the Ocean Drilling Program has been updated. This edition features a color photo of the JOIDES RESOLUTION when she was in the Panama Canal. The section on research has been updated and includes a summary of cruises in the South Atlantic. Copies may be ordered from Karen Riedel, Ocean Drilling Program, 1000 Discovery Drive, College Station, TX 77840 USA.

JOI, Inc. has a pamphlet available entitled "Impact of Ocean Drilling on the Earth Sciences" written by William Hay. The pamphlet is an informative overview of Ocean Drilling and could be quite useful for public relations, education, or just as an information piece for your marine science program. If you are interested, please contact Robin Smith at the JOI Office.

JOIDES JOURNAL MAILING LIST

Joint Oceanographic Institutions (JOI), Inc. has been handling distribution of the JOIDES Journal. Please notify JOI of any changes or additions to the mailing list, or if you have not received your copy of the Journal please contact: Robin Smith, JOI, Inc., 1755 Massachusetts Ave., NW, Suite 800, Washington, DC 20036, Telephone: (202) 232-3900, Telex: 257828/BAKE UR, Telemail: R.Smith.JOI

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REQUEST FOR NOTICES

The editorial staff of the JOIDES Journal encourages members of the scientific community to submit news items for publication in the JOIDES Journal. We would welcome updates on: upcoming meetings, workshops and symposia; availability of relevant publications and workshop reports; or any other items of interest to the ODP community.

The Journal is published in February, June and October of each year; notices should be received no later than one month before press time to ensure their publication. Please send items to:

JOIDES Journal, c/o JOIDES Office, College of Oceanography, Oregon State University, Corvallis, OR 97331 USA, Telemail: JOIDES.OSU

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BITNET COMMUNICATIONS NETWORK

BITNET is a world-wide communication network. It enables one to send mail and files to a user on a remote Computer System. Currently, there are approximately 2000 nodes on this network.

In order to send mail or files to a remote user, one must know the "USERNAME" and "NODENAME" of the target user. The NODENAME of the computer systems at the Ocean Drilling Program (ODP) is "TAMODP". The username for any ODP user or all ODP users can be acquired from the System Manager at ODP. If you do not know the username of the person at ODP that you desire to send to, an account has been set up for this purpose Username "SYSTEM", nodename "TAMODP". When sending to this address, please indicate who the message is for.

If you are a first time user of the Bitnet, it is advised to check with your System Manager for the details of the usage of the network. The format of the command to initiate a BITNET file transfer will probably vary from installation to installation.

If you need assistance or have questions concerning the SYSTEM account,or to obtain a list of the ODP user account names, please feel free to contact the System Manager Moses Sun at (409)845-9298 or Wanda Johnson at (409)845-7918.

DSDP AND ODP DATA AVAILABLE

ODP Data Available

The ODP databases currently available include all the DSDP computerized data files (Legs 1-96), the geological and geophysical data collected by ODP from Legs 101-112, and all core photos taken by DSDP and ODP (Legs 1-112). The table below lists and briefly describes the data available.

Most data collected by ODP are available as paper and microfilm copies of the original paper forms collected aboard JOIDES RESOLUTION. Underway geophysical data are on 35 mm continuous roll microfilm. All other data are on 16 mm microfilm.

All DSDP data and most of the ODP data are contained in a computerized database (contact the ODP Data Librarian to find out what ODP data are available electronically). These data can be searched on almost any specified criteria related to the database. All data files can be cross-referenced so that a data request can include information from more than one data file. For example, a customized search could be done to locate all samples (from DSDP and ODP Legs) taken in the Indian Ocean with $CaCO_3$ greater than 55% and a composition including greater than 10% quartz.

Computerized data are currently available on hard-copy printouts, on magnetic tape, or through the BITNET network.

Photos of the cores and seismic lines collected by ODP and DSDP are also available. Seismic lines, whole core and closeup core photos are available in black and white 8 x 10 prints. Whole core color 35 mm slides are also available.

The following can also be requested: (1) ODP Data Announcements, which contain information about the ODP database; (2) Data File Documents, which contain information about specific ODP data files; (3) ODP Technical Note #9, "Deep Sea Drilling Project Data File Documents", which includes all the DSDP data file documents. To obtain data or additional information, please contact:

Kathe Lighty, Data Librarian
Ocean Drilling Program
1000 Discovery Drive
College Station, Texas 77840 U.S.A.
Phone: (409) 845-8495 or 845-2673
Telex: 792779 ODP TAMU
Easylink Number: 62760290
BITNET Number: %DATABASE@TAMODP
Omnet Number: Ocean.Drilling.TAMU

Small requests can be answered quickly and free of charge. If a charge must be made to recover expenses, an invoice will be sent and must be paid before the request is processed.

Data Available from National Geophysical Data Center (NGDC)

DSDP data files can be provided by NGDC in their entirety on magnetic tape according to user specifications. NGDC is also able to provide researchers with a full range of correlative marine geological and geophysical data from other sources. NGDC will provide a complimentary inventory of all data available on request. Inventory searches are custom tailored to each user's needs (i.e., geographic area, parameter measured, etc.).

Information from the DSDP Site Summary file is fully searchable and distributable in PC-compatible form on floppy diskette, as well as in the form of computer listings and graphics, and magnetic tape. NGDC is working on making all of the DSDP data files fully searchable and available in PC-compatible form. Digital DSDP geophysical data are fully searchable and available on magnetic tape.

AVAILABLE DATA

Data Available	Data Source	Description	Comments
1. LITHOLOGIC and STRATIGRAPHIC DATA			
Visual Core Descriptions –Sediment/sedimentary rock	Shipboard data	Information about core color, sedimentary structures, disturbance, large minerals and fossils, etc.	
–Igneous/metamorphic rock	Shipboard data	Information about lithology, texture, structure, mineralogy, alteration, etc.	
Smear slide descriptions	Shipboard data	Nature and abundance of sedimentary components.	
Thin section descriptions	Shipboard data	Petrographic descriptions of igneous and metamorphic rock. Includes information on mineralogy, texture, alteration, vesicles, etc.	
Paleontology	*Initial Reports, Proceedings*	Abundance, preservation and location for 26 fossil groups. The "dictionary" consists of more than 12,000 fossil names.	
Screen	Processed data	Computer-generated lithologic classifications. Basic composition data, average density, and age of layer.	
2. PHYSICAL PROPERTIES			
G.R.A.P.E. (gamma ray attenuation porosity evaluator)	Shipboard data	Continuous whole-core density measurements.	
Grain size	Shore laboratory	Sand-silt-clay content of a sample.	Legs 1–79 only
Index properties: bulk and grain density, water content, and porosity	Shipboard data	Gravimetric and volumetric measurements from a known volume of sediment.	
Liquid and plastic limits	Shipboard data	Atterberg limits of sediment samples.	
Shear-strength measurements	Shipboard data	Sediment shear-strength measurements using motorized and Torvane instruments.	
Thermal conductivity	Shipboard data	Thermal conductivity measurements of sediments using a thermal probe.	
Velocity measurements	Shipboard data	Compressional and shear-wave velocity measurements.	
Downhole measurements –Heatflow	Shipboard data	*In-situ* formation temperature measurements.	
–Pressure	Shipboard data	*In-situ* formation and hydrostatic pressure.	
3. SEDIMENT CHEMICAL ANALYSES			
Carbon-carbonate	Shipboard data, shore laboratory	Percent by weight of the total carbon, organic carbon, and carbonate content of a sample.	Hydrogen percents for Legs 101, 103, 104, 106–108; nitrogen percents for Legs 101, 103, 104, 107, 108.
Interstitial water chemistry	Shipboard data, shore laboratory	Quantitative ion, pH, salinity, and alkalinity analyses of interstitial water.	
Gas chromatography	Shipboard data	Hydrocarbon levels in core gases.	
Rock evaluation	Shipboard data	Hydrocarbon content of a sample.	
4. IGNEOUS/METAMORPHIC CHEMICAL ANALYSES			
Major element analyses	Shipboard data, shore laboratory	Major element chemical analyses of igneous, metamorphic, and some sedimentary rocks composed of volcanic material.	
Minor element analyses	Shipboard data, shore laboratory	Minor element chemical analyses of igneous, metamorphic, and some sedimentary rocks composed of volcanic material.	

AVAILABLE DATA (Continued)

Data Available	Data Source	Description	Comments
5. X-RAY MINERALOGY			
X-ray mineralogy	Shore laboratory	X-ray diffraction.	Legs 1–37 only
6. PALEOMAGNETICS			
Paleomagnetics	Shipboard data, shore laboratory	Declination, inclination, and intensity of magnetization for discrete samples and continuous whole core. Includes NRM and alternating field demagnetization.	
Susceptibility	Shipboard data	Discrete sample and continuous whole-core measurements.	
7. UNDERWAY GEOPHYSICS			
Bathymetry	Shipboard data	Analog records of water-depth profile.	Available on 35 mm continuous microfilm
Magnetics	Shipboard data	Analog records and digital data.	Available on 35 mm continuous microfilm
Navigation	Shipboard data	Satellite fixes and course and speed changes that have been run through a navigation smoothing program, edited on the basis of reasonable ship and drift velocities, and later merged with the depth and magnetic data.	Available in MGD77 exchange format.
Seismics	Shipboard data	Analog records of sub-bottom profiles and unprocessed signal on magnetic tape.	Available on 35 mm continuous microfilm
8. SPECIAL REFERENCE FILES			
Leg, site, hole summaries	Shipboard data, initial core descriptions	Information on general leg, site, and hole characteristics (i.e. cruise objectives, location, water depth, sediment nature, drilling statistics).	
DSDP Guide to Core Material	*Initial Reports*, prime data files	Summary data for each core: depth of core, general paleontology, sediment type and structures, carbonate, grain size, x-ray, etc.	Legs 1–85 only
AGEPROFILE	*Initial Reports*, hole summaries	Definition of age layers downhole.	
COREDEPTH	Shipboard summaries	Depth of each core. Allows determination of precise depth (in m) of a particular sample.	
9. AIDS TO RESEARCH			
ODASI	A file of ODP-affiliated scientists and institutions. Can be cross-referenced and is searchable.		
Keyword Index	A computer-searchable bibliography of DSDP- and ODP-related papers and studies in progress.		
Sample Records	Inventory of all shipboard samples taken.		
Site Location Map	DSDP and ODP site positions on a world map of ocean topography.		
Thin Section Inventory	Inventory of all shipboard thin sections taken.		

In addition to the DSDP data files (see table below), NGDC can also provide analog geological and geophysical information from DSDP on microfilm. Two summary publications are available: (1) "Sedimentology, Physical Properties, and Geochemistry in the Initial Reports of the Deep Sea Drilling Project volumes 1-44: An Overview", Report MGG-1; (2) "Lithologic Data from Pacific Ocean Deep Sea Drilling Project Cores", Report MGG-4.

Data requests may be made by telephone or by letter. Costs for services are as follows: $90 per magnetic tape, $30 per floppy diskette, $20 per reel of microfilm, $12.50-12.80 per copy of Report MGG-1. $10 per copy of report MGG-4. Costs for computer listings and custom graphics vary. Prepayment is required by check or money order (drawn on a U.S. bank), or by charge to Mastercard, VISA, or American Express. A $10 surcharge is added to all shipments ($20 for foreign shipments), and a $15 fee is added to all rush orders. Shipping and handling is included in the prices quoted.

Data Announcements describing each DSDP data set in detail are available at no charge on request. For additional information on data availability, costs, ordering, etc., please contact:

Marine Geology & Geophysics Division
National Geophysical Data Center
NOAA E/GC 3 Dept. 334
325 Broadway
Boulder, CO 80303
303-497-6338 (FTS 320-6338)

For technical details, call 303-497-6339 (FTS 320-6339) or write to the address above.

SAMPLE DISTRIBUTION

The materials from ODP Leg 112 are now available for sampling by the general scientific community. The twelve-month moratorium on cruise related sample distribution is completed for Ocean Drilling Program Legs 101-112. Scientists who request samples from these cruises (after February 1988) are no longer required to contribute to the ODP Proceedings.

Preliminary sample record inventories for ODP Legs 101-118 are now in searchable database structures. The DSDP sample investigations database has been uploaded, keyboarding of the ODP sample requests are in progress. This database contains records of all sample requests, the purpose for which the samples were used and the institute where the samples were sent. At present, the most efficient way to access this database is to request a search by contacting the Curator.

During 1987, the East Coast Repository sent samples to investigators on an average of 8 weeks after receipt of a request at ODP. The Gulf Coast Repository sent samples to investigators on an average of 9 weeks after receipt of a request at ODP.

Investigators requiring information about the distribution of samples and/or desiring samples, or who want information about the sample investigation or sample records database, should address their requests to:

The Curator, Ocean Drilling Program, 1000 Discovery Drive, College Station, Texas 77840, Telephone: (409) 845-4819

BIBLIOGRAPHY OF THE OCEAN DRILLING PROGRAM

The following publications are available from the ODP Subcontractors. Information from Texas A&M University is available from ODP, 1000 Discovery Drive, College Station, Texas 77840. Information from the Lamont-Doherty Geological Observatory can be obtained from R.Anderson or R.Jarrard at the Borehole Research Group, LDGO, Palisades, N.Y. 10964.

TEXAS A&M UNIVERSITY

1. Proceedings of the Ocean Drilling Program, Part A (Initial Reports)

Volumes 101/102 (combined) Dec 86
Volume 103 published Apr 87
Volume 104 published July 87
Volume 105 published Aug 87
Voume 107 published Oct 87
Volume 108 published Jan 88
Volumes 106/109/111 (combined) Feb 88

2. Technical Notes

#1 Preliminary time estimates for coring operations (Rev. Edition Dec 86)
#2 Operational and laboratory capabilities of JOIDES RESOLUTION (June 85)
#3 Shipboard scientist's handbook (rev. July 87)
#4 Five papers on the Ocean Drilling Program from "OCEANS '85" (May 86)
#5 Water Chemistry Procedures aboard JOIDES RESOLUTION (Sep 86)
#6 Organic Geochemistry aboard JOIDES RESOLUTION - An Assay (Sep 86)
#7 Shipboard Organic Geochemistry on JOIDES RESOLUTION (Sep 86)
#8 Shipboard sedimentologists' handbook (Feb 88)
#9 Deep Sea Drilling Project data file documents (Jan 88)

3. Scientific Prospectuses

#0 (Mar 86) Leg 100
#11 (July 86) Leg 111
#12 (Aug 86) Leg 112
#13 (Oct 86) Leg 113
#14 (Feb 87) Leg 114
#15 (May 87) Leg 115
#16 (May 87) Leg 116
#17 (June 87) Leg 117
#18 (June 87) Leg 118
#19 (Sep 87) Leg 119
#20 (Oct 87) Leg 120
#21 (Mar 88) Leg 121

4. Preliminary Reports

#0 (May 86) Leg 100
#10 (Sep 86) Leg 110
#12 (Feb 87) Leg 112
#13 (May 87) Leg 113
#14 (June 87) Leg 114
#15 (Sep 87) Leg 115
#16 (Sep 87) Leg 116
#17 (Nov 87) Leg 117
#18 (Feb 88) Leg 118

5. Other Items Available

- Ocean Drilling Program (in English, French, Spanish or German)
- Onboard JOIDES RESOLUTION
- ODP Sample Distribution Policy
- Instructions for Contributors to Proceedings of the Ocean Drilling Program (new edition available Feb 88)
- ODP Engineering and Drilling Operations

LAMONT-DOHERTY GEOLOGICAL OBSERVATORY

Wireline Logging Manual (2nd Edition, Dec 86)

DIRECTORY OF JOIDES COMMITTEES, PANELS AND WORKING GROUPS

EXCUTIVE COMMITTEE (EXCOM)

Caldwell, Dr. Douglas R., Chairman
College of Oceanography, Oregon State University, Corvallis, OR 97331 Tel: (503) 754-4763, Tx: 258707/JOID UR, Telemail: JOIDES.OSU [Alt: Dr. Lawrence F. Small]

Biju-Duval, Dr. Bernard,
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Mayer, L.*	SOHP	(902)424-2503	01921863/DALUNIVLIB HFX
McLerran, A.	TEDCOM	(619)481-0482	not available
McNutt, M.*	LITHP	(617)253-7304	921473/MIT CAM
Merrell, W.*	EXCOM	(409)740-4403	not available
Merrill, R.*	ODP/TAMU	(409)845-2673	792779/ODP TAMU
Mevel, C.	LITHP	(33)43-36-25-25	200145/UPMC SIX F
Meyer, A.*	ODP/TAMU	(409)845-2197	792779/ODP TAMU
Meyer, H.	SSP	(511)6433128	0923730/BGR HA D
Meyers, P.	SOHP	(313)764-0597	8102236056/U OF M AA
Michot, J.	ODPC	(32)(2)649-00-30	23069/B
Millheim, K.	TEDCOM	(918)660-3381	284255/CDFTU UR
Moberly, R.*	EXCOM	(808)948-8765	7238285/HIGCM HR
Moore, G.*	WPAC	(918)592-6000x3090	7400459/GMTU UC
Moore, T.	IHP	(713)973-3054	9108813649/USEPR TEX HOU
Moss, C.*	JOIDES	(503)754-2600	258707/JOID UR
Mottl, M.*	EPR-WG	(808)948-7006	7238285/HIGCM HR
Mountain, G.*	SSP	(914)359-2900x541	7105762653/LAMONTGEO
Moussat, E.	IHP	(33)98-22-40-40	940627/OCEAN F
Mudie, P.	SOP	(902)426-8720	01931552/BIO DRT
Munsch, B.	ODPC	(33)88-35-30-63	890440/ESF F
Mutter, J.*	LITHP	(914)359-2900x525	258294/MCSP UR
Natland, J.*	WPAC	(619)534-3538	9103371271/UCWWD SIO SDG
Nemoto, T.*	EXCOM,ODPC	(81)(3)376-1251	25607/ORIUT J
Nicholich, R.	PPSP	(39)(40)568-201	460014/I
Nickless, E.	NERC	(44)793-40101	444293/ENVRE G
Nobes, P.	DMP	(519)885-1211	not available
Normark, W.	SOHP	(415)856-7045	171449/PCS USGS MNPK
Nowak, J.	IHP	(49)511-643-2815	922739/GFIZ D
NSF (ODP)*		(202)357-9849	257653/NFSO UR
O'Connell, S.*	DMP	(409)845-0507	792779/ODP TAMU
ODP/TAMU*		(409)845-2673	792779/ODP TAMU
ODP Databank*	LDGO	(914)359-2900x542	7105762653/LAMONTGEO
Okada, Hakuyu*	CEPAC	(81)542-37-1111	25607/ORIUT J
Okada, Hisatake*	ARP	(81)236-31-1421x2588	25607/ORIUT J
Olhoeft, G.	DMP	(303)236-1302	9109370740/GSA FTS LKWD
Orcutt, J.*	LITHP	(619)534-2887	9103371271/UCWWD SIO SDG
Ottosson, M-O.	EXCOM,ODPC	(46)(8)15-15-80	13599/RESCOUN S
Pascal, G.	DMP	(33)98-46-25-21	940627/OCEAN F
Paxton, A.	TEDCOM	(44)224-574555	739721/BRTOIL G
Pearce, J.	LITHP	(44)632-328511	53654/UNINEW G
Pereira, C.	SOP	(709)737-4382	0164101/MEMORIAL SNF
Perfit, M.	LITHP	(904)392-2128	not available
Peirce, J.***	SSP	(403)296-5809	03821524/PETROCANRS CGY
Peveraro, R.	DMP	(44)41-226-5555	777633/BRTOIL G
Piccardo, G.	LITHP	(39)(10)51-81-84	
Pisias, N.*	PCOM	(503)754-2600	258707/JOID UR
			258682/PISI UR
Porter, R.	DMP	(206)543-6515	9104740096/UW UI
Pozzi, J-P.	DMP	(33)43-29-12-25	202601/NORMSUP F
Prell, W.*	IOP	(401)863-3221	952095/BRNTLXCTR PVD
Premoli-Silva, I.	SOHP	(39)(2)29-28-13	320484/
Price, R.	ODPC	(613)995-3065	0533117/EMAR OTT
Pyle, T.*	JOI	(202)232-3900	257828/BAKE UR

Rabinowitz, P.*	ODP/TAMU	(409)845-2673	792779/ODP TAMU
Raleigh, B.*	EXCOM	(914)359-2900x345	7105762653/LAMONTGEO
Rangin, C.	WPAC	(33)43-36-25-25x5257	200145/UPMC SIX F
Rea, D.	CEPAC	(313)936-0521	not available
Renard, V.	SSP	(33)98-22-40-40	940627/OCEAN F
Riddihough, R.	TECP	(613)995-4482	not available
Riedel, K.*	ODP/TAMU	(409)845-2673	792779/ODP TAMU
Rischmueller, H.	TEDCOM	(49)511-654-2669	923730/BGR HA D
Roberts, D.	PPSP	(44)1-920-8474	888811/BPLDNA G G
Robertson, A.	TECP	(44)31-667-1081	727442/UNIVED G
Roure, F.	TECP	(33)47-52-68-13	203050/IFP A F
Rucker, D.*	JOI	(202)232-3900	257828/BAKE UR
Saito, T.*	SOHP	(81)236-31-1421x2585	25607/ORIUT J
Sancetta, C.*	CEPAC	(914)359-2900x412	7105762653/LAMONTGEO
Sarg, R.	SOHP	(713)966-6005	9108813649/USEPRTX HOU
Sartori, R.	SSP	(39)(51)22-54-44	511350/I
Saunders, J.	IHP	(41)(61)25-82-82	not available
Sawyer, D.*	ARP	(512)451-4238	9108741380/UTIG AUS
Schaaf, A.	SOHP	(33)98-03-16-94x328	941439/SEGALEN F
Schilling, J.	EXCOM	(401)792-6102	257580/KNAU UR
Schlanger, S.	CEPAC	(312)491-5097	not available
Schlich, R.	IOP	(33)88-41-63-65	890518/IPGS F
Schrader, H.	CEPAC	(47)(5)21-35-00	42877/UBBRB N
Schuh, F.	TEDCOM	(214)380-0203	794784/ARCO PLNO
Scott, S.	WPAC	(416)978-5424	0623887/GEOLOGY TOR
Scrutton, R.	IOP	(44)31-667-1081	727442/UNIVED G
Segawa, J.	IOP	(81)3-376-1251x259	25607/ORIUT J
Sengor, A.	CEPAC,ODPC	(90)(1)433-100	23706/ITU TR
Serocki, S.*	ODP/TAMU	(409)845-6135	792779/ODP TAMU
Shackleton, N.*	SOHP	(44)223-334871	81240/CAMSPL G
Shipley, T.*	PCOM	(512)471-0430	9108741380/UTIG AUS
Sibuet, J-C.	ARP	(33)98-22-42-33	940627/OCEAN F
Sliter, W.	CEPAC	(415)853-8300	171449/PCS USGS MNPK
Small, L.	EXCOM	(503)754-4763	5105960682/OSU COVS
Smith, R.*	JOI	(202)232-3900	257828/BAKE UR
Smythe, D.	ARP	(44)31-667-1000	727343/SEISED G
Sondergeld, C.	DMP	(918)660-3917	200654/AMOCO UR
Sparks, C.	TEDCOM	(33)47-52-63-95	203050/IFP A F
Speed, R.	ARP	(312)492-3238	not available
Srivastava, S.*	TECP	(902)426-3148	01931552/BIO DRT
Stambaugh, S.*	JOIDES	(503)754-2600	258707/JOID UR
Stanton, P.	TEDCOM	(713)940-3793	9108815579/USEPRTX HOU
Steele, J.*	EXCOM	(617)548-1400x2500	951679/OCEANIST WOOH
Stein, R.	SOHP	(49)641-702-8365	482956/GRIWOTY UNIGI D
Steingrimsson, B.	DMP		
Stel, J.	EXCOM,ODPC	(31)20-22-29-02x125	16064/NRZ NL
Stephen, R.*	DMP,EPR-WG	(617)548-1400x2583	951679/OCEANIST WOOH
Storms, M.*	ODP/TAMU	(409)845-2101	792779/ODP TAMU
Summerhayes, C.	SOHP	(44)9327-762672	296041/BPSUNA G
Sutherland, A.*	NSF	(202)357-9849	257653/NSFO UR
Suyehiro, K.*	SSP	(81)472-51-1111	25607/ORIUT J
Svendsen, W.	TEDCOM	(612)331-1331	210685/LYHQ UR
Taira, A.*	PCOM	(81)(3)376-1251x256	25607/ORIUT J
Tamaki, K.*	SSP	(81)3-376-1251	25607/ORIUT J
Taylor, B.*	WPAC	(33)43-36-25-25x5257	200145/UPMC SIX F
Thierstein, H.	PCOM	(41)1-256-3666	53178/ETH BI CH
Thunnell, R.	WPAC	(803)777-7593	not available
Traeger, R.	DMP	(505)844-2155	9109891600/SANDIA LABS
Tucholke, B.*	PCOM	(617)548-1400x2494	951679/OCEANIST WOOH

Van Lieshout, R.	ODPC	(31)(2159)457-37	890440/ESF F
Veis, G.	ODPC	(30)(1)777-36-13	215032/SATGEO GR
Villinger, H.*	DMP	(49)471-483-1215	238695/POLAR D
Vincent, E.	IOP	(33)43-36-25-25x5162	200145/UPMC SIX F
Vogt, P.	TECP	(202)767-2024	897437/NRL LIMA WSH
von Rad, U.	PCOM	(49)511-643-2785	923730/BGR HA D
von Stackelberg, U.	CEPAC	(49)(511)643-2790	923730/BGR HA D
Vorren, T.	SOHP	(47)(83)70011	64251/UBIBG N
Vrellis, G.	TEDCOM	(30)(1)80-69-314	219415/DEP GR
Watts, T.*	TECP	(914)359-2900x533	7105762653/LAMONTGEO
Wefer, G.	SOHP	(49)421-218-3389	245811/UNI D
Weigel, W.	SSP	(49)40-4123-2981	214732/UNI HH D
Westbrook, G.	TECP	(44)21-472-1301	338938/SPAPHY G
Westgaard, L.	ODPC	(47)2-15-70-12	not available
White, R.	IOP	(44)223-333-400	817297/ASTRON G
Whitmarsh, R.*	ARP	(44)42879-4141	858833/OCEANS G
Wiedicke, M.*	JOIDES	(503)754-2600	258707/JOID UR
Wilkins, R.*	DMP	(808)948-6513	7238285/HIGCM HR
Winterer, E.*	PCOM	(619)534-2360	9103371271/UCWWD SIO SDG
Wise, S.	SOP	(904)644-5860	5106000494/FSU OCEAN
Wortel, R.	TECP	(31)(30)53-50-74	40704/VMLRU NL
Worthington, P.	DMP	(44)9327-63263	296041/BPSUNA G
Zeigler, P.	PPSP	(31)(70)773-203	36000/NL
Zierenberg, R.	EPR-WG	(415)329-5437	171449/PCS USGS MNPK

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Comments and suggestions concerning the content of this or future issues of the JOIDES Journal should be directed to the editorial staff: Sharmon Stambaugh, editor, Cherry Moss, associate editor, and Michael Wiedicke, editorial advisor, c/o JOIDES Planning Office, College of Oceanography, Oregon State University, Corvallis, OR 97331.

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Special Issue No. 2: Initial Site Prospectus, Supplement One, April 1978 (Vol. III)

Special Issue No. 3: Initial Site Prospectus, Supplement Two, June 1980 (Vol. VI)

Special Issue No. 4: Guide to the Ocean Drilling Program, September 1985, (Vol. XI)

Special Issue No. 4: Guide to the Ocean Drilling Program, Supplement One, June 1986 (Vol. XI)

Special Issue No. 5: Guidelines for Pollution Prevention and Safety, March 1986 (Vol. XII)

Core from Leg 118, Hole 735B. Leg 118 drilling reached a record 500.7 mbsf into gabbro. This section of core, recovered at about 480 mbsf, shows amphibole veins perpendicular to foliation in a well-foliated to augen gneissic gabbro.