EXECUTIVE SUMMARY
LITHOSPHERE PANEL MEETING
28-29 July 1986
Corvallis, Oregon

## 1. LEG 109 - THE FUTURE OF YOUNG CRUSTAL DRILLING

The panel discussed the future of drilling in young crustal rocks in light of the experience of Legs 106 and 109. The problems associated with spud-in in areas without significant sediment cover appear to have been largely overcome with the development of the hard rock guidebase and unsupported spud-in techniques. Hole stability remains the major limiting factor for drilling in fresh, highly fractured basaltic rocks. Despite these problems, the scientific value of crustal drilling at mid-ocean ridges remains indisputable. LITHP recommends that TAMU produce a report for PCOM outlining a specific, long-term engineering development plan for improving the feasibility of young, crustal drilling. LITHP strongly endorses continued engineering efforts in this area.

## 2. INDIAN OCEAN DRILLING

a. LITHP reaffirmed its support for the scientific objectives of the SWIR drilling program, but noted a number of technical problems with the present proposal (depth limitations of TV system, problems with the PDCM core retrieval system and the difficulty of unsupported spud-in on plutonic (gabbroic) rocks). Because of these technical limitations the use of the "pogo" drilling technique on SWIR needs to be re-evaluated and alternative sites in relatively shallow water depths on the fracture zone walls should be identified by the site survey team. A hard rock guidebase should be available for use on Leg 111 should difficulties arise with unsupported spud-in.

b. LITHP endorses the deepening of the Argo basin site as a geochemical reference hole for the Sunda Arc system.

## 3. LITHP EVALUATION OF THE WPAC DRILLING PLAN

a. The nine-leg program as it now stands addresses high priority LITHP thematic objectives in the Bonin-1, Bonin-Mariana-2, Japan Sea and Lau Basin legs.

b. LITHP endorses WPACs call for a Lau Basin Working Group to synthesize available data and present a revised drilling proposal.

c. LITHP believes significant penetration into igneous basement (~500 m) is essential at the geochemical reference hole (BONIN Site 8) seaward of the Bonin Trench. This requires a re-entry cone and a multiple bit hole taking about 1/2 leg. Ideally, a second site should be drilled outboard of the Marianas.

d. LITHP urges that all Mariana-Bonin sites be drilled into igneous basement to bit destruction.

## 4. LITHP THEMATIC OBJECTIVES IN THE CEPAC REGION

The panel adopted a list of eight thematic objectives for lithospheric drilling in the central and eastern Pacific.

* Magmatic, tectonic and hydrothermal processes at mid-ocean ridges
* Deeper structure and composition of the oceanic crust and upper mantle
* Lithospheric flexure and rheology
* Intraplate volcanism (atolls, guyots and hotspots)
* Crustal and lithospheric aging
* Mantle heterogeneity
* Global geochemical fluxes

Although LITHP considers all of these important lithospheric objectives that can be addressed by drilling in the central and eastern Pacific, the panel reaffirms its commitment to mid-ocean ridge drilling as its **highest** priority. However, if drilling at mid-ocean ridges is to be scientifically viable it will require:

(1) a substantial, **long-term commitment** from ODP **to develop new engineering techniques** to improve penetration and recovery rates when drilling in young crustal rocks

(2) a **multi-leg, focussed drilling program** on mid-ocean ridges

Without this long-term two-fold commitment it is unlikely that this highest priority lithospheric objective will be achieved in the current drilling program.

## 5. PANEL ROTATION AND MEMBERSHIP

LITHP will rotate off four members between now and the end of 1986:

T. Juteau replaced by F. Albarede (Fr.)
A. Saunders replaced by J. Pierce (U.K.)
G. M. Purdy
M. Leinen

Since L. Cathles will not be joining LITHP, this reduces the panel to 14 members. Based on the rotation schedule approved at the last LITHP meeting we recommend John Mutter (L-DGO) be appointed to the LITHP to replace Purdy. We also suggest Mutter as the SOP Liaison and Malpas as the ARP liaison.

## 6. NEXT MEETING

January 6,7 1987 in London. If possible, a joint meeting with CEPAC.

JOIDES Lithosphere Panel Meeting
Oregon State University
Corvallis, Oregon
28-29 July 1986

Members Present:

R. Detrick (URI), Chairman
K. Becker (RSMAS)
K. Bostrom (ESF)
J. Delaney (UW)
T. Fujii (Japan)
J. Hawkins (SIO)
T. Juteau (France)
C. Langmuir (L-DGO)
M. Leinen (URI)
M. McNutt (MIT)
N. Peterson (Germany)
M. Purdy (WHOI)
A. Saunders (UK)
J. Sinton (HIG)(29th only)

In Attendance:

A. Adamson (ODP)
R. Batiza (NSF)
B. Bryan (Leg 109 Co-chief)
E. Davis (CEPAC)
B. Duncan (IOP)
S. Howard (ODP)
N. Pisias (PCOM)

Absent: J. Honnorez
J. Malpas
R. McDuff

AGENDA

1. Minutes of Previous Meeting
2. Reports from Liaisons
3. LITHP "White Paper"
4. Leg 109 Report
5. Site 395A, Leg 111 (504B) Plans
6. Leg 115 (SWIR)
7. Co-chief Nominations
8. Pacific Drilling - Objectives and Long-Term Planning

# MINUTES

The meeting began at 8:57 am. Detrick welcomed new panel members K. Becker (RSMAS), K. Bostrom (ESF), and M. McNutt (MIT) along with R. Batiza (Northwestern) who will be officially joining the panel in September. It was also noted that this is the last panel meeting for T. Juteau (to be replaced by Francis Albarede), M. Leinen, M. Purdy and A. Saunders (to be replaced by Julian Pierce). Their service on the panel and work on behalf of the lithospheric community is greatly appreciated.

## 1. MINUTES OF THE PREVIOUS MEETING

The minutes of the last meeting were approved without changes.

## 2. REPORTS FROM LIAISONS

### 2.1 PCOM (N. Pisias)

Pisias reported the results of the May PCOM meeting including the adoption of an Indian Ocean drilling schedule starting with SWIR (Leg 115) and ending with Kerguelen II (Leg 120). The main uncertainty still centers around the Red Sea. The French completed a survey of the Gulf of Suez area in January with Egypt, but the data tapes were confiscated. Saudi Arabia denied permission to the French, British and Germans for other work in the Red Sea. The Bannock deep and drilling of the southernmost young crustal sites in the Red Sea may have to be dropped from the program, even if clearance is obtained for RESOLUTION, because of the lack of site survey information. Lou Garrison and Biju-Deval are in Saudi Arabia now trying to get permission for working in Saudi territorial waters. ODP needs at least six months lead time to arrange ports in the Red Sea.

Other items discussed:

- a motion to PCOM to exclude time for bare-rock drilling at the EPR from the 3-year CEPAC program and identify it as thematic time was defeated. There were objections on PCOM to "special treatment" for bare-rock drilling.

- COSOD II will be held in Strasbourg 6-10 July 1987. The primary purpose will be to address post-1991 drilling objectives. LePichon will chair the steering committee. USSAC will send ~150 U.S. scientists to the meeting; total attendance is expected to be about 300.

- PCOM endorsed PANCHM proposal for joint scheduling of thematic and regional panel meetings, but voted against PANCHM recommendation that thematic liaisons have voting rights on regional panels. LITHP liaisons are Juteau (ARP), Batiza (CEPAC), Hawkins (WPAC), Saunders (SOP) and Langmuir (IOP). Batiza, Hawkins and

Langmuir have agreed to serve, but new liaisons will have to be found for ARP and SOP since Juteau and Saunders are rotating off LITHP.

2.2 NSF/ODP (R. Batiza/A. Adamson)

- ESF joined ODP on June 1; about $5 million in USSAC money will be available next FY for drilling related science (site surveys, syntheses, etc.).

- Audrey Meyer will replace Robb Kidd at ODP

2.3 IOP (B. Duncan)

- IOP strongly supports Intraplate Deformation, 90E Ridge, Broken Ridge, Exmouth Plateau and Argo Abyssal Plain programs as previously scheduled and as a first alternative, if the Red Sea is not drilled, favors an extension of the Argo Abyssal Plain program.

- IOP would like to resupply at the end of Leg 119 at Kerguelen using a second ship instead of at Reunion. PCOM endorsed Reunion because of the additional costs of resupply at Kerguelen (at least $0.5 million), but this means losing 14 days of prime drilling time.

- IOP and SOHP to form a working group to iron out differences between panels on Kerguelen drilling.

- IOP endorses SSP request for near-bottom 3.5 kHz pinger on SWIR site survey. IOP also requests a bottom camera for identifying rubble.

- Neogene site survey work done. British will survey Makran in Nov-Dec. Insufficient site survey information for Somali Deep Hole.

2.4 WPAC (M. Leinen)

- WPAC has revised their first drilling prospectus and re-prioritized the various proposed drilling legs. The Bonin-1, Bonin-Mariana-2 and Japan Sea Legs, all strongly endorsed by LITHP, are high on WPACs priority list and, in general, LITHP is satisfied with WPAC recommendations. However, two points of concern were raised:

**Lau Basin:** Lau Basin drilling, another high-priority LITHP objective, has slipped in the WPAC rankings apparently because of confusion over different interpretations of Lau Basin tectonics and geochemistry. LITHP endorses WPACs call for a Lau Basin Working Group to synthesize the available data and present a revised proposal. Jim Hawkins, of LITHP, will serve on the working group.

**Geochemical Reference Holes:** At its last meeting LITHP strongly endorsed the drilling of geochemical reference holes seaward of the Mariana and Bonin trenches to address two problems of

global significance: (1) the bulk composition of sediment and altered basement being recirculated into the mantle and (2) the temporal variations in the composition of the igneous crust. The revised WPAC prospectus calls for one site (BONIN Site 8) immediately outboard of the other Bonin drill holes to be drilled though the sediments to bit destruction. LITHP believes significant penetration into igneous basement is essential at the geochemical reference holes. We propose a re-entry cone and a multiple bit hole with substantial basement penetration. This objective should not be an appendage to the Bonin proposal, but merits devotion of at least half a leg. LITHP also believes a second site should be drilled outboard of the Marianas. Thus an entire leg or parts of two legs (e.g. 1/2 of the Zenisu Ridge leg) should be devoted to this objective. A proposal outlining in more detail the scientific rationale behind the geochemical reference holes and more information on specific sites will be submitted to ODP and WPAC by C. Langmuir and M. Leinen prior to the next WPAC meeting.

- LITHP urges that all Mariana-Bonin sites be drilled into igneous basement to bit destruction.

2.5 CEPAC (E. Davis)

- CEPAC is in a state of flux with a new panel chairman yet to be appointed (D. Rea is going to NSF) and a number of new members.

- CEPAC carried out another straw vote on their most favored drilling packages, recognizing that proposals are still coming in and guiding criteria from thematic panels are still being received. The results were:

| Rank | Drilling Package |
|---|---|
| 1 | EPR 13°N fast spreading (3 legs) |
| 1 | Ontong Java Plateau |
| 1 | North Pacific reconstructions |
| 2 | Atolls and guyots |
| 2 | Northeast Pacific convergence |
| 2 | Juan de Fuca sedimented ridge |
| 3 | North Pacific paleo-envir-climate |
| 4 | Bering Sea paleo-envir-tectonics |
| 4 | Equatorial Pacific paleocean-envir |
| 6 | Crustal flexure-Hawaiian moat |
| 5 | Old Pacific crust and sediments |
| 5 | Gulf of California |
| 5 | Northeast Pacific (INPAC) paleocean |
| 5 | Aleutian convergence |
| 6 | Chile triple junction |
| 7 | Costa Rica convergence |
| 7 | California margin |
| 7 | Gulf of Alaska sediment and tectonics |

- this straw vote indicated at least 14 drilling packages are favored for further consideration. Since EPR requires 3 legs, the total number of legs identified is 16 or 2.7 years of drilling in the CEPAC region.

- LITHP requests a joint meeting with CEPAC in early January (6 and 7) in London or at the following meeting in late spring (May ?).

3. LITHP "WHITE PAPER"

John Malpas is in self-imposed exile in Cyprus awaiting the contributions of various LITHP members to the "White Paper" outlined at our last meeting. The chairman pleaded with the panel members to send their contributions to Malpas and Detrick ASAP. A draft of the "White Paper" will be put together in September and circulated by mail to panel members in October for comment.

4. SCIENTIFIC RESULTS (Bryan/Juteau)

Bill Bryan summarized the scientific results from drilling at Site 648B on Leg 109. The hole was advanced from 33.3 m to 50.5 m sub-bottom, a total increase in depth of 17.2 m. Core recovery was approximately 2.17 m, for a total recovery rate of 12.7%. Much of the time spent in the hole was devoted to attempts to stabilize the hole with cement and in redrilling fill. Six drilling days were lost fishing bottom hole assemblies. The additional penetration extended the lithologic sequence recognized by Leg 106. Fresh pillow basalts overlay a fine-grained to glassy dark basalt >1 m thick at about 34 m below the seafloor. Beneath this layer is a distinctive, moderately vesicular basalt 1-2 m thick with partly filled "segregation vesicles" and numerous miarolitic cavities. Below this gas-enriched zone the basalt becomes massive and more coarsely crystalline and plagioclase crystals increase in size and abundance downward. This sequence can reasonably be interpreted as a single cooling unit, very likely the upper part of a lava lake ponded within the small volcanic cone of Serocki Volcano. The vesicular interval may result from rising gas being trapped beneath the quenched surface of the lava lake, while the more massive lower interval may represent the interior of the lava pond.

Although Leg 109 was unsuccessful in an attempt to spud into plutonic gabbros exposed on a topographic high just southwest of the Kane RTI (Site 669), at Site 670 almost 100 m of serpentinized peridotite were drilled beneath 6-8 m of sediment in the western portion of the rift valley between Sites 648 and 649. Hole 670A was spudded using an unsupported positive displacement coring motor (PDCM). After coring from 3625 to 3660.7 m, the PDCM drilling assembly was retrieved and the hole was re-entered using a rotary coring system. This remarkable re-entry (the hole was a crater 4x8 ft) took less than 15 minutes using the TV system and the ship's dynamic positioning system. Recovery rates ranged from 1-17%, with an average of 7-8%. Thierry Juteau described four different units of serpentinited harzburgite identified in the hole. Generally the

degree of serpentinization decreases downward in the section and the rocks are strongly foliated along a horizontal plane suggesting the peridotite may have been emplaced and serpentinized in place. The geologic setting of this serpentinite body, almost at the axis of the median valley, defies conventional notions of oceanic crustal stratigraphy and the crustal accretion process.

The Leg 109 co-chiefs made a number of observations relevant to future bare-rock, crustal drilling: (1) spud-in is not a problem, except in very massive rock like gabbro, (2) unsupported spud-in is possible without a guidebase, (3) re-entry without a guidebase is possible with the real-time video system, (4) smaller, lighter and cheaper guidebases and re-entry cones are feasible, (5) the ship has a surveying capability that can allow the precise positioning of drill sites relative to seafloor geological features, but the camera system has a depth limit of 20,000' (~6000 m), (6) available drilling jar designs are not well-suited for work when they don't have lateral support, (7) the core retrieval system of the PDCM needs to be redesigned and (8) although the total penetration and recovery rates obtained on Leg 109 are less than hoped for, valuable scientific results were obtained and ODP should be encouraged to improve crustal drilling techniques so that future bare-rock drilling can be carried out.

### 4.2 ENGINEERING REPORT (S. Howard)

Steve Howard, the Drilling Superintendent on Leg 109, presented an overview of drilling operations at Site 648 and described some short-term and long-term development options for future hard rock drilling efforts (see Appendix I).

Hole stability remains the major limiting factor in drilling in fresh, highly fractioned basaltic rocks. Penetration rates of up to 2 m/hr were obtained with the 9-7/8" core bits, but sloughing of rubble into the hole limited total penetration to 17 m despite aggregate drilling of over 165 m of basalt, basaltic rubble and cement during the leg. Cementing was somewhat effective at improving hole stability, but mud sweeping operations were of marginal success at removing cuttings. Improvements made in bit protection based on Leg 106 increased the bit life of the 9-7/8" coring bits from less than 6 hrs to almost 10 hrs. However, the Leg 109 results indicate that a major redesign of the drilling jars and the PDCM will be needed.

The panel discussed the future of drilling in young crustal rocks in light of the experience of Legs 106 and 109. It is clear that significant engineering development will be required if this type of drilling is to be scientifically feasible. Among the short and long-term options discussed were:

- emphasis on drilling smaller bore holes. Significant improvements were noted when the hole size was reduced from 12-1/4" to 9-7/8" and reducing the hole size further should improve hole conditions. A further reduction in hole size will necessitate

developing special size drill bits, drill collars and casing not in the suite of tools currently utilized by ODP.

- use of high-speed diamond bits powered by downhole motors/turbines. The roller-cone bits currently used by ODP are not well-suited for drilling and coring crustal rocks. The 3.75 in. diameter Navidrill coring system currently under development at TAMU may be the kind of system required.

- side-wall coring techniques to improve the representativeness of the recovered material.

- drill-in casing to improve hole stability.

- redesigned drilling jars suitable for use without lateral support.

- redesigned PDCM coring system.

- smaller, lighter and cheaper guidebases.

- improved cementing and mud-sweeping techniques.

The panel noted that most of the engineering development described above is a long-term effort (2-5 years) that will require a significant commitment of resources by ODP. However, given the high scientific priority the lithospheric community places on young crustal drilling such a commitment is, in our opinion, justified. The long-lead time before such drilling will be attempted in the central and eastern Pacific provides a unique opportunity to develop this new technology. It may be feasible to test new hard-rock drilling techniques on land in similar geologic settings in Iceland or Hawaii before use at sea.

- The LITHP recommends that TAMU put together a report summarizing the results of Legs 106 and 109 and outlining a specific, long-term engineering development plan for improving the feasibility of young, crustal drilling. The report will be prepared with the assistance of LITHP and Leg 106/109 co-chiefs and will be submitted to PCOM by early December.

5. SITE 395A, LEG 111 (504B)

Kier Becker next reviewed the results of logging at Hole 395A. The nine-day logging program at this site was extremely successful and together with logging done at 418A on Leg 102 completes a suite of three logged deep crustal holes (504B, 395A and 418A) that represents a major accomplishment of the new drilling program. The logs run at 395A include the Schlumberger GST-ACT-NGT neutron activation log, German magnetometer (vertical field only), Schlumberger LSS-DIL-SFL (sonic and resistivity), German magnetic susceptibility, L-DGO multichannel sonic, Japanese magnetometer, large-scale resistivity, and Schlumberger LDT-CNT-NGT (lithodensity plus inclinometer). In addition, packer experiments were

successfully set at 396 and 536 m, for bulk permeability measurements over the lowermost 210 and 80 m of open hole. A preliminary interpretation of the logging data indicates that Hole 395A was drilled through the highly porous, permeable low-velocity pillows of seismic Layer 2A, before penetrating the gradational boundary between Layers 2A and 2B. Permeabilities in the upper 500 m of 395A are greater than the permeability in the uppermost 200 m of 504B.

The plans for Leg 111 were also discussed. The leg has three major objectives: (1) deepening 504B, (2) logging 504B and (3) carrying out a 5 day program of APC and XCB coring to basement to obtain biostratigraphic and paleoceanographic information and study processes of diagenetic alteration. Thirty days will be devoted to drilling at 504B and the expected additional penetration is about 500 m. A 9-10 day logging program will follow with the full suite of logging tools and a 2-day VSP experiment. The back-up program is a series of single bit holes to study heat flow variability around 504B (Mottl proposal).

6. LEG 115 (SWIR)

The panel discussed the Dick et al. revised proposal (86/388) for drilling on the Southwest Indian Ridge. LITHP reaffirmed its strong support for the scientific objectives of the SWIR drilling program, but noted a number of technical problems with the present proposal.

- the TV system is limited to depths of less than 20,000 ft (~6000 m) and many of the proposed sites (SWIR 1a to 1j; SWIR 2, SWIR 4) are in water depths of 6000 m or greater. Since the TV system is essential to current drilling operations shallower sites must be selected.

- the PDCM core retrieval system needs to be completely redesigned. The 7 to 10 pogo holes proposed for SWIR 1 are thus probably not practical with the present coring motor system. An alternative is to use a conventional rotary core mounted below a drilling motor, but this precludes wire-line core retrieval. Holes drilled 10-20 m into basement below 9 m of sediment will require a minimum of 2-3 pipe trips with this system at 36-48 hrs/trip plus drilling time, severely limiting the number of such holes that can be drilled.

- Leg 109 demonstrated that drilling conditions in altered peridotites can be quite favorable (Site 670), but spudding into plutonic rocks (gabbros) beneath a thin cover of basaltic rubble may not be feasible without a guidebase (Site 669).

- rubble, which is expected to be ubiquitous in the fracture zone, is potentially a major drilling problem.

Based on this discussion LITHP makes the following recommendations:

1. Because of technical limitations the use of the "pogo" drilling technique on SWIR needs to be re-evaluated.

2. Serpentinized peridotite is the most drillable target in the fracture zone environment and site survey information (Sea Beam, bottom camera, dredge results) will be critical in locating potential outcrops relatively free of surficial rubble.

3. Potential drilling sites (e.g., SWIR 3) in relatively shallow water depths on the fracture zone walls and outside the fracture zone valley need to be identified in the site survey because of camera depth limitations and to minimize pipe trip time.

4. The hard rock guidebase should be available for use on Leg 115 should difficulties arise with unsupported spud in.

The panel discussed the possibility of postponing SWIR drilling to a later date in the Indian Ocean drilling program, but it was unclear whether this was either logistically feasible or would buy enough time to allow significant new engineering development. The panel concluded that at this point, the most effective means of improving the likelihood of a successful SWIR drilling leg is a well-designed and executed site survey. The panel will invite H. Dick to present the site survey results at the next LITHP meeting in January.

7. CO-CHIEF NOMINATIONS

Table 1 lists LITHP Co-chief Scientist nominations for the relevant Indian Ocean legs.

**Table 1**
LITHP Nominations for Indian Ocean Legs Co-Chief Scientists

| Leg | U.S. | Non-U.S. |
|---|---|---|
| 115 SWIR | R. von Herzen; H. Dick | J. Cann (U.K.); R. Hyndman (Canada); A. Nicolas (Fr.); P. Robinson (Canada), M. Salisbury (Canada) |
| 116 Red Sea | E. Bonatti; M. Steckler; J. Cochran | H. Backer (Ger.); P. Guennoc (Fr.); G. Pautot (Fr.); U. von Rad (Ger.); R. Whitmarsh (U.K.) |
| 121 Broken Ridge<br>90E S<br>Intraplate<br>122 90E N | J. Curray; R. Duncan; J. Sclater | J. Peirce (Canada); R. Whitmarsh (U.K.) |

## 8. PACIFIC DRILLING - OBJECTIVES AND LONG-TERM PLANNING

At the request of PCOM, the LITHP discussed its long-term thematic objectives in the central and eastern Pacific. This discussion began with presentations by Rodey Batiza on the results of the Seamount Drilling Workshop held at L-DGO in June and a presentation by Earl Davis on recent geological and geophysical investigations of the northern Juan de Fuca Ridge.

After extensive discussion the panel developed a list of eight thematic objectives for lithosphere drilling in the central and eastern Pacific (Table 2). The scientific rationale for each of these themes will be included in the LITHP White Paper. The list is similar to one developed at the last panel meeting and is not fundamentally different from the lithospheric objectives outlined in the original COSOD document.

Although LITHP considers all of these important lithospheric objectives that can be addressed by drilling in the central and eastern Pacific, the panel reaffirms its commitment to mid-ocean ridge drilling as its **highest** priority. However, to achieve this objective it will require:

(1) a substantial, **long-term commitment** from ODP **to develop new engineering techniques** to improve penetration and recovery rates when drilling in young crustal rocks.

(2) a **multi-leg, focussed drilling effort** on mid-ocean ridges.

Without this kind of long-term, two-fold commitment, it is unlikely that this highest priority lithospheric objective will be achieved in the current drilling program

## 9. PANEL MEMBERSHIP AND ROTATION

Larry Cathles has declined an invitation to join LITHP and G.M. Purdy and M. Leinen are rotating off the panel effective the end of 1986. This reduces LITHP membership to 14. Based on the rotation schedule approved at the last LITHP meeting we request that John Mutter (L-DGO) be appointed to the panel prior to our next meeting.

## 10. NEXT MEETING

January 6 and 7 in London (hosed by Andy Saunders and Julian Pierce) to coincide with the Geological Society's conference on Magmatism in the Ocean Basins to be held in Leicester, 8-10 January. If possible, LITHP requests a joint meeting with CEPAC.

The LITHP meeting adjourned at 1645 on 29 July.

**Table 2**

LITHP Thematic Objectives in the Central and Eastern Pacific[1]

| Theme | Locations |
|---|---|
| * Magmatic, tectonic and hydrothermal processes at MOR | EPR (incl. near-axis seamounts)<br>Juan de Fuca/Gorda, Gulf of California |
| * Deeper structure and composition of oceanic crust and upper mantle | 504B<br>Fast spreading crust (e.g. 597C)<br>FZ, Nova-Canton Trough |
| * Lithospheric flexure and rheology | Hawaiian moat, Marquesas swell |
| * Intraplate volcanism - magmatism, tectonic history | Atolls and Guyots (e.g. Mid-Pacs)<br>Hot spot volcanos (e.g. Loihi, Teahitia) |
| * Crustal structure and origin of oceanic plateaus | Ontong-Java |
| * Crustal and lithospheric aging<br>* Mantle heterogeneity<br>* Global geochemical fluxes | Leg 82 type transects; drilling into basement wherever feasible |

[1]Drilling at mid-ocean ridges is the highest priority LITHP objective in the CEPAC region. The remaining objectives are all important, in many cases interrelated, and have not been prioritized.

# APPENDIX I

## FUTURE CONSIDERATIONS FOR HARD ROCK DRILLING

### GUIDE BASE

Prior to building anymore guide bases, the second guide base should be deployed. More operational and engineering data is needed on the existing guide base systems prior to making any significant modifications.

### DRILLING - CORING YOUNG FRACTURED ROCK

Emphasis must be placed on drilling smaller bore holes. Significant improvements were noted when the hole size was reduced from 12-1/4" to 9-7/8" in diameter. It can be expected that reducing the hole size further would result in continued improvement in hole conditions. A further reduction in hole size however will necessitate developing special size drill bits, drill collars, and casing not in the suite of tools currently utilized by the Ocean Drilling Program (1-2 years).

The utilization of the guide base has proven to be an effective means of spudding a hole in on hard rock with only minimal support for the bottom-hole assembly. The drilling techniques used to date have provided reasonable penetration rates (1-2 meters/hour). The most limiting factor in drilling young fractured basalt formations is the lack of hole stability. Emphasis needs to be placed on a means of addressing the unstable hole conditions early on.

#### Current Options - Short Term Development

- Reduce hole sizes - minimize hole disturbance.
- Pump cement plugs on selected bit runs.
- Selection of drill sites - select more stable. bare rock formations to drill. May defeat science objectives?

#### Future Options - Long Term Development

- Core small holes with high speed diamond bits powered by downhole motors/turbines. The 3.750 diameter Navidrill coring system is currently under development. A one to two year development period is estimated.

- Because of budget restrictions will be put on hold. Next year.

### HOLE CLEANING TECHNIQUES

A means of removing course drill cuttings and rubble from the hole needs to be developed. This may possibly be accomplished by modifying the geometry of the guide base and reentry cone to maintain adequate flow rates to expel the cuttings more efficiently to the sea floor.

## PENETRATION RATES

Utilizing existing roller cone core bit technology penetration rates of two meters/hour have been realized to date. A penetration rate of two meters/hour is considered reasonable in fractured basalt formations.

In order to improve penetration rates in drilling and coring fractured basalts, again smaller hole sizes and the utilization of high speed diamond bits should be explored.

## RECOVERY RATES

Recovery rate coring fracture basalt has varied between an average of 8 to 15 percent on Leg 106 and 109. The major cause of poor core recovery may be attributed to jamming of the core barrel with rubble.

The majority of the hard rock coring was done with the proven rotary coring system. Core recovery is expected to remain poor (8-15 percent) when drilling highly unstable formations regardless of the coring system.

Improvements in core recovery may be realized by selecting drilling techniques that will minimize hole disturbance.