LITHOSPHERE PANEL MEETING

10-11 April 1986
University of Washington, Seattle

EXECUTIVE SUMMARY

(1) **LEG 109 MAR/KFZ**

(a) LITHP considers logging of DSDP 395A a primary scientific objective of Leg 109, not just a backup program. We recommend 395 be logged regardless of the progress made in drilling Site 648.

(2) **LEG 111**

(a) LITHP expresses great disappointment that one of the highest priority COSOD objectives, drilling a hydrothermal system on the EPR, will not be carried out on Leg 111 and will thus be delayed until at least the early 1990s.

(b) We recommend 504B be drilled on Leg 111 regardless of the progress made at Site 648 on Leg 109.

(c) If drilling at 504B must be terminated early, LITHP recommends a back-up program of shallow crustal drill holes around 504B and feasibility testing of unsupported bare-rock spud-in on the nearby Galapagos Spreading Center.

(3) **INDIAN OCEAN**

(a) LITHP recommends an entire leg be devoted to drilling on the SWIR. Proponents of drilling on SWIR (Dick, Natland, Stephen, Von Herzen) are encouraged to prepare a revised drilling proposal for discussion at the next LITHP meeting.

(b) LITHP again endorses drilling on 90E Ridge and recommend that holes on the Kerguelen Plateau be drilled down and into basement.

(c) Although LITHP strongly supports drilling in the Red Sea, if this area cannot be drilled for political reasons, we recommend the drillship leave the Indian Ocean early for the Western Pacific.

(4) **WESTERN PACIFIC**

(a) The major thematic problems LITHP would like to see addressed in the Western Pacific are:

1) Geochemical evolution of back-arc basin crust.
2) History of arc magmatism.
3) Forearc basement composition and vertical tectonics.
4) Geochemical mass balances at convergent margins.
5) Ophiolite comparison.

- these problems must be addressed at more than one arc-trench system.

(b) A minimum of five legs are required to meet lithospheric objectives in the Western Pacific: 2 legs in the Mariana/ Bonins (forearc), 1 leg in both the Lau Basin and Japan Sea (back-arc basins, marginal seas) and 1 leg devoted to drilling reference holes into basement seaward of the Mariana and Izu-Bonin trenches (geochemical mass balance).

(5) **CENTRAL/EASTERN PACIFIC**

(a) LITHP interests in the Central/Eastern Pacific include:

1) Magmatic processes and their temporal and spatial variation at mid-ocean ridges.
2) Hydrothermal processes at both sedimented and sediment-free and mid-ocean ridges.
3) Deeper structure of the oceanic crust including pillow lava-dike and layer 2/3 boundaries.
4) Mid-plate volcanism seamount formation and plate flexure.
5) Origin of oceanic plateaus.
6) Origin of Jurassic Quiet Zone and vertical distribution of magnetization in oceanic crust.
7) Mantle heterogeneity.

- these thematic interests have not been prioritized and until that is done it is premature to construct detailed drilling scenarios for this area.

(b) Some LITHP objectives in the Central and Eastern Pacific (e.g., ridge crest drilling) will require a substantial commitment of drilling time including multiple legs to the same area if they are to be adequately addressed. ODP planning by arbitrary, regional time blocks before drilling priorities and requirements have been established undermines our ability to meet these COSOD objectives.

(c) A joint LITHP/CEPAC working group of 5-6 people should be established to carefully consider drilling strategies, locales, and technological requirements for rise axis/hydrothermal drilling in the eastern Pacific.

(6) **PANEL MEMBERSHIP**

(a) Appoint Keir Becker who can also act as liaison to DMP.

(b) Appoint Rodey Batiza to replace Ken Macdonald and Marcia McNutt or Tony Watts to replace John Sclater.

(c) Need ore petrologist - suggest Larry Cathles.

(7) **MISCELLANEOUS**

(a) LITHP is preparing a "White Paper" describing its broad thematic interests and the role drilling can play in answering specific scientific questions.

(b) Next LITHP meeting tentatively scheduled for July 29, 30th in Corvallis (alternative site Woods Hole).

Minutes

The meeting began at 8:45 a.m. in the Marine Science Building at the University of Washington. Present were: C. Auroux (ODP), R. Buffler (NSF), J. Delaney, R. Detrick (Chairman), J. Hawkins, C. Langmuir, M. Leinen, J. Malpas, R. McDuff (PCOM), N. Petersen, M. Purdy, A. Saunders. LITHP members not present were: T. Fujii, T. Juteau, K. Macdonald, and J. Sinton.

1. REPORTS

1.1 PCOM

Russ McDuff reviewed the January PCOM meeting in La Jolla where PCOM discussed the panel structure and proposed that COSOD-II be held in 1987. The stated purpose of COSOD-II is to review the geological objectives of ODP and the requirements for future technical development. J. Orcutt is organizing a conference steering committee. PCOM decided against a major change in the JOIDES panel structure at this time, but felt inter-panel communication needed to be improved and duplication of effort between regional and thematic panels eliminated. To improve communication, PCOM endorsed the idea of an annual panel chairmen's meeting (PANCHM), the first to be held in Corvallis, April 3-4.

Purdy expressed dismay that his statement to PCOM that "none of the primary lithospheric objectives will be achieved in the foreseeable future if planning priorities remain unchanged" elicited no response. He also expressed concern that the PCOM minutes do not reflect these comments or his recommendations regarding logging 395, EPR, or SWIR drilling.

Indian Ocean drilling is still in a state of flux due to lack of site surveys and political problems. PCOM asks that we consider alternative drilling plans including early departure from the Indian Ocean. PCOM endorsed drilling 504B on Leg 111 over EPR, but considered the possibility of returning to 648 if drilling on Leg 109 is very successful.

1.2 PANCHM Meeting

Detrick reported that he was stranded in Denver by a Spring snowstorm and missed the first PANCHM meeting. Minutes of that meeting indicate the PANCHM agreed with PCOM that thematic panels should identify important global themes while regional panels concentrate on proposal review and construction of a drilling schedule. Four other problems identified were (1) PCOM's unresponsiveness in acting on requests for changes or additions in panel membership; (2) major topics such as geochemistry and tectonic evolution of ocean basins are poorly represented by present panel structure; (3) flow of paper, especially minutes and supporting documents around the advisory

system; and (4) concern about publicizing ODP in the broader community of Earth scientists.

Detrick will communicate LITHP perspective on these and other issues to D. Rea by letter for inclusion in PANCHM report.

1.3 NSF

Buffler reported that ESF will join the program effective 1 June 86. This should improve the USSAC funding picture. Dick's SWIR site survey will be funded; scheduled for later this year on CONRAD. Other work in the Indian Ocean either funded by ODP or split funded with MG&G include Weissel's proposals on intraplate deformation and Broken Ridge, and Curray's work on Northern 90E Ridge. Sclater proposal on southern 90E Ridge pending. Bonatti Red Sea proposal declined along with MacKenzie's Broken Ridge seismic proposal. June 1st deadline for 1987 site survey work in Pacific.

2. LEG 109

LITHP expressed concern that logging of 395 was still considered a back-up program for drilling at 648. LITHP has **repeatedly** recommended that logging 395 is of much greater scientific merit than a few more meters of penetration at 648 and it should be an integral component of Leg 109. The term "substantial progress" in the PCOM recommendations regarding Leg 109 is ambiguous and could result in no logging of 395. LITHP recommends 395 be logged **regardless** of the progress at 648.

A policy for hard rock description developed by Leg 106 scientists was submitted to LITHP for approval. C. Langmuir and J. Hawkins will review.

3. LEG 111

LITHP members expressed their great disappointment that the EPR will not be drilled on Leg 111 and that this drilling will be postponed to 1990 at the earliest. The panel still believes the need to gain technical and engineering expertise with a second bare-rock guidebase deployment and hydrothermal drilling outweigh the short term scientific benefits of drilling 504B. The possibility of reprogramming Leg 111 to the MARK area to continue deepening 648 was considered by LITHP to be completely unrealistic given the logistics involved in advance planning and staffing. Scientifically, LITHP favors 504B or EPR over a third leg on the MAR.

4. INDIAN OCEAN

LITHP was pleased to hear that the SWIR site survey will be funded and that the PCOM recommended at its last meeting that an entire leg be devoted to SWIR. An alternative proposal to drill the CIR without a site survey submitted by Natland and Fischer was therefore shelved. There appears to be some confusion regarding drilling plans for SWIR since several generations of proposals exist. The panel urges the proponents of SWIR drilling (Dick/Natland/Stephens/Von Herzen) to prepare a brief prospectus on SWIR before the next PCOM meeting.

There is apparently still some concern about drilling in the Red Sea and whether or not operational permits will be granted. If the Red Sea cannot be drilled, LITHP recommends the drillship leave early for the western Pacific. LITHP endorses 90E Ridge drilling again and urges that any drilling on Kerguelen continue down to and into basement.

5. WESTERN PACIFIC

5.1 General Discussion

Jim Hawkins presented an excellent overview of the major scientific problems at western Pacific arc-trench-backarc basin systems. These include (1) geochemical evolution of back-arc basin crust and hydrothermal processes, (2) the history of arc magmatism, and (3) the nature of igneous basement in forearcs and their vertical tectonic history. He emphasized the importance of looking at more than one arc-trench system and focussing on the important processes, rather than concentrating on a single geographic transect.

Of particular interest in back-arc basins is the temporal and spatial relationship of MORB, back-arc basin and island arc basalts. In the Lau Basin the arc to back-arc and back-arc to MORB transitions in the evolution of this basin have been mapped out in a general way by dredging. The merits of dredging vs. drilling in addressing this problem were extensively discussed by the panel as well as different drilling strategies (a single reentry hole vs. a large number of limited penetration pogo holes). The consensus was that drilling is an effective tool for defining the early opening history of back-arc basins and the basement composition at the margins of the basin. It is also essential in getting at the vertical stratigraphy of igneous activity. Extensive pre-drilling dredging and Sea Beam surveying will be useful in choosing specific drilling targets. The Lau Basin is an attractive target because of the extensive survey work already completed there. The Bonin Basin and possibly the Coriolos Trough are interesting as examples of the early stages of back-arc basin spreading. Sediment ponds of sufficient thickness exist close to the center of the Lau Basin so that bare-rock drilling will not be required.

Several important problems were identified in the forearc region that can only be attacked by drilling. These include the nature of igneous basement, the vertical tectonics of the forearc region, and the history of arc magmatism. Another attractive drilling objective is the large diapiric structures identified in both the Bonin and Mariana forearcs. Both the Bonin and Mariana forearcs offer important drilling targets and because of the variability in structure and tectonic history, LITHP strongly recommends both be drilled.

Another aspect of drilling at convergent margins championed by Charlie Langmuir is the establishment of reference holes on the incoming plate which include as complete recovery as possible of the entire sedimentary section and substantial penetration into basaltic basement (>100 m). Knowledge of the composition of subducted crust is critical for models of arc petrogenesis and for a general understanding of mantle and crustal evolution. For example, there are substantial chemical differences between recent lavas erupted in the Mariana and Izu-Bonin arcs that may be related to differences in the chemical composition of the sediments and crust being subducted. A reference hole seaward of each arc-trench system studied will provide the constraints needed to begin to examine this geochemical mass balance. LITHP strongly endorses this aspect of drilling at convergent margins.

5.2 Specific Recommendations

Margaret Leinen reviewed the 6, 9, and 12 leg scenarios developed at the last meeting of the WPAC panel. The thematic interests mentioned above are well-represented in their proposed program. LITHP also strongly endorses drilling in the Lau Basin, in the Mariana-Bonin forearc and in the Japan Sea. Drilling in the Coriolos Trough of the Vanuatu (New Hebrides) arc may also be of interest to LITHP as an example of early back-arc basin development, but more information is needed on the geochemistry of the lavas from this basin and their similarity with the Bonin Trough. LITHP does not highly rate Sulu-Banda, South China Sea, or Nankai Trough drilling.

LITHP believes a **minimum** of 2 legs is required in the Mariana-Bonin areas to achieve lithospheric objectives. In the 6-leg WPAC scenario we thus favor a second Mariana-Bonin leg over Sulu-Banda. A leg (or parts of 2 legs) is required to drill reference holes seaward of the Izu-Bonin and Mariana trenches (a proposal for this drilling will be submitted by Langmuir et al. in the very near future). LITHP rates this effort very highly, above Nankai Trough/South China Sea or Japan Sea in the WPAC 6-leg scenario. Finally, at least 1 leg should be dedicated to the Lau Basin.

In summary, a minimum of 5 legs is required to meet lithosphere objectives in the western Pacific. They are (in order of priority):

Mariana-Bonin	2 legs
Lau Basin	1 leg
Reference Drill Holes	1 leg
Japan Sea	1 leg

- if a sixth leg is available LITHP favors Vanuatu (Coriolos Trough).

6. CENTRAL/EASTERN PACIFIC

The panel did not have time for extensive discussions of lithospheric interests in the central and eastern Pacific. Based on a brief discussion the following problems were identified (in no particular order):

(1) Magmatic processes and their temporal and spatial variation at mid-ocean ridges.
(2) Hydrothermal processes at both sedimented and sediment-free mid-ocean ridges.
(3) Deeper structure of the oceanic crust including the pillow lava-dike and layer 2/3 boundary.
(4) Mid-plate volcanism, seamount formation, plate flexure.
(5) Origin of oceanic plateaus.
(6) Origin of Jurassic-Quiet Zone and vertical distribution of magnetism in oceanic crust.
(7) Mantle heterogeneity.

Some lithospheric objectives in the central and eastern Pacific (e.g. ridge crest drilling, hydrothermal processes) will require a substantial commitment of drilling time including multiple legs in the same area. It is unlikely we will be able to attack all the problems listed above and a careful prioritization of these objectives will be necessary before detailed drilling scenarios for the central and eastern Pacific can be realistically constructed. LITHP plans to begin this process at its next meeting in July. It is important that sufficient time is allowed in the planning process for these thematic objectives to be fully developed.

Both CEPAC and LITHP have a strong interest in drilling at spreading centers in the eastern Pacific. We propose that a joint LITHP/CEPAC working group of 5-6 people be established to carefully consider drilling strategies, locales, and technological requirements for rise axis/hydrothermal drilling.

7. LITHP WHITE PAPER

Following on a suggestion may by Andy Saunders at the last LITHP meeting, a significant amount of time was spent by the panel discussing a LITHP White Paper. This report has two principal objectives (1) to describe the broad thematic interests of the LITHP and (2) to describe the role drilling can play in answering specific scientific questions of lithospheric interest. After much discussion it was finally decided to prepare a short (10-15 page) preliminary report identifying the major problems of lithospheric interest and including for each problem:

- a brief outline of the problem
- simple cartoons illustrating the discussion
- a brief summary of what is known (or expected)
- how the problem can be attacked by drilling (or drilling in concert with other techniques)

The panel agreed on the following content for the report: (names in parentheses indicate author):

1. Oceanic Spreading Centers
   a. Evolution in time and space of magmatic processes at MOR (Saunders, Langmuir)
   b. Deeper structure of oceanic crust including pillow lava-dike and layer 2/3 boundary; magnetism of oceanic crust (Purdy, Petersen)
   c. Hydrothermal processes at MOR (Delaney)
2. Aging of the Lithosphere
   a. Mid-plate volcanism including seamounts, plateaus, etc., (Sinton)
   b. Low temperature alteration of oceanic crust and age-dependent variation in physical properties (Stuadigel)
3. Convergent Margins
   a. Geochemical evolution of back-arc basin crust and history of arc magmatism (Hawkins)
   b. Forarc basement structure and tectonics (Hawkins)
4. Geochemical mass balances (Langmuir)
5. Mantle heterogeneity (Schilling)
6. Ophiolite model (Malpas)

- problems 4, 5, and 6 are global in nature and can only be addressed by understanding the geological processes involved in 1, 2, and 3.

John Malpas agreed to assemble this document provided each individual sends him their section before May 12th.

8. PANEL MEMBERSHIP

The panel approved the following rotation schedule for LITHP membership

4/86 Marcia McNutt (MIT) or Tony Watts (L-DGO) to replace John Sclater

9/86 Rodey Batiza (Northwestern) to replace Ken Macdonald

9/86 Julian Pierce (U.K.) to replace Andy Saunders

1/87 John Mutter (L-DGO) re replace Mike Purdy

6/87 Jim Gill or Bob Stern to replace Margaret Leinen

6/87 Jill Karsten (UW) to replace John Sinton

6/88 Hawkins, Langmuir, Hawkins replaced

6/89 Detrick institutionalized

- in addition the panel reiterates its desire to have Keir Becker appointed to the panel (also to act as a liaison to DMP). The panel also recognized the need for the appointment of an ore petrologist, e.g. Larry Cathles (EXXON).

9. FUTURE MEETINGS

The next meeting of LITHP is scheduled for July 29 and 30 in Corvallis, OR (back-up site is Woods Hole). The following meeting is tentatively scheduled for January 6, 7, 1987 in the U.K. to occur in conjunction with the conference on Magmatism in the Ocean Basins January 8, 9, and 10.

The LITHP meeting was adjourned at about 4:00 p.m. on April 11th.