

Summary of Principal Recommendations1) Pacific Drilling

## a) Panel recommends:

Leg 111: EPR 10-13°N

Leg 112: 504B

Leg 113: 504B or EPR

Decision of Leg 113 should await results of Leg 111. If 111 is not successful then two legs on 504B would give real chance of sampling Layer 3. If 111 is successful then two legs on EPR would give a good start at Active Hydrothermal Natural Laboratory with added bonus of 500m further penetration into 504B. Either way exciting results are likely.

b) Drilling on EPR 10-13°N should be start of long term 'natural laboratory' to study active hydrothermal processes. Minimum reasonable startup effort is three ~300m deep holes.

c) Huge volume of new data collected on EPR 10-13°N makes considered choice of precise site difficult: recommend formation of working group to solve this.

2) Atlantic Drilling

a) Leg 102: Panel recommends full scale downhole measurements leg carrying out complete suite of downhole experiments at 417 and 395 and deepening 603 to at least 50m into basement. Second choice would be to delete 395 (given it would be picked up on Mark I or Mark II). Third choice would be to delete 395 and possible extra pipe trip on 603 to achieve required basement penetration.

b) Panel recommends French Gorrige Ridge proposal as back up to any eastern Atlantic/Med drilling that may run into clearance problems. Priority is below that of MARK, 504 or EPR however.

A. INTRODUCTION

1. The next meeting of the Panel was tentatively scheduled for November 6 and 7 in either Miami or Lamont.

2. Russ McDuff reported on the last PCOM meeting in Paris:

i) Latest drilling schedule was presented. The panel needs information on Chile Triple Junction plans: Langmuir will get details from Cande in time for our next meeting.

- ii) More effective means of communicating with TAMU engineers to define bare rock drilling specifications is needed. One day meeting with experienced ALVIN divers is required to jointly produce quantitative limits on terrains likely to be encountered and to devise a drilling strategy: (e.g. is real time video from end of drill string simply a necessity?) Suggestion was raised to hold meeting in Hawaii to allow engineers to see volcanic lavas. Purdy will discuss with Honnorez and Garrison and organize something soonest.
  - iii) Many messages were received by Honnorez in Paris urging the replacement of the postponed bare rock drilling leg by a mantle heterogeneity leg (a follow-up to leg 82). There was strong support for this in letters and cables from O'Nions, Schilling, Melson, Frey, Bougault, White, Allegre, Michael. The panel reviewed its discussion at the previous meeting and came to the same conclusion, i.e. as a problem it is an extremely high priority objective that the Panel supports strongly. However, at this time we have not seen a well-defined strategy that will answer some of the key problems and assure progress in this area. Purdy will contact Schilling and encourage him to submit a specific proposal.
3. Three communications were received from members of the community criticizing Lithosphere Panel policy and objectives: all were under misconceptions. A widely held and incorrect view seems to be we wish to carry out focussed drilling in a small number of key areas to the exclusion of all else. This is not true. The Panel contends that the focussed drilling (Natural Laboratory) approach is the best way to attack the magma generation - crustal accretion objective which is our highest priority. However, we have several other high priority aims that will be best served with different approaches, e.g. oceanic plateaus, mantle heterogeneity and crustal evolution. Just because the Panel was clearly unanimously defined the focussed drilling approach to the crustal accretion problem as its first priority in no way lessens its commitment and interest in addressing other fundamental lithosphere objectives.

## B. PACIFIC DRILLING

### 1. 504B:

Becker, Salisbury and Emmerman presented results and status of 504B. The probable benefits of deepening this hole were discussed. Best estimate was that one full leg would result in 500m more penetration if time was set aside (as panel would recommend) for full suite of downhole geophysical experiments. Need for better sample recovery was reaffirmed and Carlson indicated TAMU was well aware of this. Downhole geophysical measurements are a sufficiently important part of this effort that they should be scheduled to take place from the drill ship, and not depend on the uncertain development of an unproven fly-in re-entry system. Best guess from Stephen OSE results is that additional 1000m penetration would be needed to reach gabbro: this would need at least two more legs. This drill site remains our best chance at sampling layer 2/3 boundary, and at measuring geochemical

gradients, physical and magnetic properties and changes in metamorphic grade through a significant portion of the oceanic crust. It remains one of our highest priorities for Pacific Drilling.

## 2. Drilling on an Active Hydrothermal Vent Area

This Panel places its highest priority on starting a focussed drilling program to study active hydrothermal processes at the earliest opportunity and specifically before the drilling ship goes south to the Weddell Sea.

- i. Delaney reviewed the major components of hydrothermal systems stressing both the three dimensionality and time-variable nature of the problem. Models of such systems are wildly unconstrained at this time: there exists a clear need for good basic measurements of permeabilities, flow rates and thermal gradients. An important required parameter that drilling will not provide is magma chamber size and shape.
- ii. MacDonald reviewed possible sites suitable for the focussed study of active hydrothermal processes. Criteria for site evaluation were availability of site survey data; magnetic latitude and clarity of anomaly pattern; spreading rate; simplicity of tectonic fabric and crustal generation processes; hydrothermal activity; logistics (proximity to port, clearance). It quickly became clear that the East Pacific Rise at 10-13°N most effectively satisfied these criteria. This region has been the subject of 3 U.S., 3 French and 2 German SEABEAM cruises, one SEAMARC cruise, 3 ALVIN and 3 CYANA cruises, 3 ANGUS, one Deep Tow and 2 RAIE, both French and U.S. hydrothermal studies, ROSE, RISE and multichannel seismic expeditions, gravity and 3-D magnetic studies. However, it needs more multichannel coverage for definition of magma chamber geometry and more off axis geophysical coverage in general.
- iii. To make optimum selection of specific site for 'Active Hydrothermal Processes Natural Laboratory' all this data needs to be assimilated quickly. Rather than a formal synthesis (probably take too long), Panel recommends formation of working group consisting primarily of those who have collected the data in this region. Possible names are:

Orcutt or Detrick or Mutter  
Langmuir or Bryan or Batiza  
Bougault  
Francheteau or Baecker  
Mottl or Edmond  
MacDonald or Fox or Ryan  
Delaney or Boulegue

The charge to this group would be to formulate a recommendation to the Lithosphere Panel on the basis of all available data for the optimum site location on the EPR between 10-13°N.

iv. The Panel addressed the question of drilling strategy and attempted to define the minimum useful drilling effort. Our preliminary conclusion was that a useful start would be provided by three holes each nominal 300m depth separated by 'half a hydrothermal wavelength' (nominal 2-5 km), two to be located along axis and one off axis. This drilling will need bare rock spud in capability, ability to penetrate rubble zones, improved sample recovery in unconsolidated sections and ability to withstand high temperatures (limits unspecified). Sidewall coring and remote downhole geochemical analyses were discussed as partial solutions to poor recovery problems, but it was agreed first priority should be with improving conventional sample recovery techniques. The development of remote downhole geochemical analysis methods is an important but complex issue that we request the Downhole Measurements Panel to investigate and to monitor, and report back to our Panel in a timely manner. The first priority in water chemistry studies is collection downhole, both of small volume pressurized samples and multiple sampling of larger unpressurized volumes at several depths. A concerted effort to understand the contamination problem is needed before these water chemistry studies can in any way achieve their potential. Russ McDuff undertook to canvas Elderfield, Mottl, Gieskes, Bender, Sayles and Boulegue to obtain consensus opinion on specifications for a useful downhole water chemistry analysis capability. The measurements made down these holes (as part of the drilling program) are an absolutely essential part of the program: the minimum suite of downhole data required for this drilling to approach its full potential is: Standard Logging; Temperature; Flow; Packer; Large Scale Resistivity; Magnetometer; Downhole Seismic; Geochemical (to be specified). Detailed descriptions of all these measurements await further review and discussion. Much interest was expressed in regional stress estimations from borehole televiewer or four arm caliper measurements of hole deformation. Saunders briefly reviewed a U.K. Lithosphere Panel meeting and particularly mentioned Whitmarsh's experiment measuring the several day long relaxation of anelastic strain in drill cores: this would need oriented cores.

The second group of important downhole measurements are those to be made continuously over a period of years: these include strain, flow and temperature, and earthquake monitoring. Remote chemical analyses and detailed geodetic measurements were also considered important.

v. Drilling Priorities in the Pacific: As the minimum reasonable start at the Active Hydrothermal Natural Laboratory is judged to be 3 ~300m holes then two legs will be required for this. If only three Pacific legs are available then Lithosphere Panel recommends following scenario:

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Leg 113: 504B or EPR

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Panel was painfully aware of its ignorance concerning objectives of proposed Chile Triple Junction leg.

### C. ATLANTIC DRILLING

1. Leg 102: Salisbury presented various options and scenarios and these along with their priorities were discussed at length. An important conclusion was that the Lithosphere Panel supports deepening Site 603 (ENA3) providing time is taken (i.e. extra pipe trip if needed) to obtain >50m of basement. This would constitute first substantial sample of Jurassic crust in Atlantic, sampling the seafloor spreading process soon after its beginning, and perhaps providing one more data point for the mantle heterogeneity story.

Site 395: Because logging on Leg 78B was such a failure it is important to return to this site to carry out full suite of experiments identical to these in 504B to allow the two to be contrasted: The suite presented by Salisbury was:

- Schlumberger logs (obviously),
- Large scale resistivity,
- Magnetometer (Johnson plus BRG 3 component),
- Multichannel sonic log
- HPC
- HPC heatflow à la Dick Von Herzen
- Packer
- Televiwer - four arm caliper
- Deep water sampling
- VSP

Excluding VSP, time estimate for this on site was 5.5 days. Because of topography problems Purdy doubted OSE at this site was worthwhile but VSP was potentially very useful.

Concerns with uncertainties with respect to being able to re-enter 418 caused discussions to focus on 417D. Operations recommended by Salisbury at 417D were:

- Schlumberger log
- Large scale resistivity
- Magnetometer
- Multichannel sonic
- Packer
- Televiwers - four arm caliper
- Water sampling
- VSP and OSE.

If two days are allowed for fishing the bottom hole assembly then about 11 days are required for this (including 3-4 days for VSP + OSE).

A combination of this work with that at 395 would provide excellent comparison of identical datasets in young and old Atlantic crust.

First preference of Lithosphere Panel would be an extra long leg (~60 days) to allow a minimum 50m basalt penetration at 603, and full suite of experiments as listed by Salisbury at 417 and 395. This would take optimum advantage of having drill ship staffed by downholers and the otherwise long deadhead transatlantic run to Galicia.

Second preference (other than trimming a few days off downhole experiments) would be to delete 395 work and include it as part of MARK I or MARK II.

Third preference would be to also delete basalt penetration (est. 4-5 days) at 603. This last option, of course, would leave our Panel with only the 417 experiments. These are judged the highest priority for this leg because it seems extremely likely that we shall be able to get to 395 either on MARK I, MARK II or simply on passage from NW Africa to Barbados N. Thus, if we can get 417 now it would provide us with the important combination of full downhole geophysics on young and old Atlantic and young Pacific (i.e. 395, 417 and 504B). It is the comparison of these datasets that could be the most exciting result. Lithosphere Panel recommendations for co-chiefs on Leg 102 are Salisbury, Becker, Von Herzen, Tim Francis, Roy Hyndman.

2. MARK I Site Survey: The JOI funded site survey has been contracted to a team consisting of Detrick and Fox (URI), Mayer (Dalhousie), Karson (WHOI), Kastens and Ryan (LDGO). It was judged timely to provide further guidance to the Site Survey Team with regard to MARK drilling objectives.

The primary objective of MARK is to sample a clearly defined transform bounded ridge segment. Specifically we would like total SEABEAM coverage over a segment extending from south of the possible small offset transform at approximately latitude 22°42'N to 25 km north of the Kane-median valley intersection. We need full SEABEAM coverage of the intersection area (including OCP proposed sites 1 through 4) as back up to MARK I and II. Full coverage of the ridge to the south should, as a minimum, include the peaks of the crestal mountains (i.e. nominal 35 n.m. wide swath centered on center of median valley). As much coverage as possible of the complete transform section of Kane west to the intersection with the northern ridge segment is needed. We hope to see preliminary shipboard plots at our November meeting at which time we should be able to offer more detailed guidance for the January SEAMARC I leg.

3. Gorringer Ridge: Thierry Juteau reviewed the French proposal to drill Gorringer ridge. The panel was particularly intrigued by this opportunity to achieve substantial penetration into Layer 3 (with the site on the south flank of Ormonde [Mevel's Site 1]) and to drill

through the observed contact between mantle derived serpentinites and gabbros in the saddle between Ormande and Gettysburg (Mevel's Site 2). The primary criticisms are the anomalous nature of Gorringe and lack of knowledge of tectonic setting in which the crust and mantle which would be sampled were formed. Nevertheless, the Panel recommends this drilling as a back-up in the E. Atlantic in case of, for example, clearance problems in the Med or at Galicia. It is a well defined problem with good existing site surveys. Its priority, however, does not exceed that of MARK, EPR or 504B.

#### D. INDIAN OCEAN DRILLING

1. Recent Indian Ocean Workshop: Langmuir brought seven formal proposals from this workshop which are to be distributed to members of our Panel for detailed investigation and review in time for our November meeting at which prioritization will be attempted. A panel member will act as a proponent of each of the proposals as follows.

<u>P.I.</u>	<u>Panel Proponent</u>
1. Brocher	Purdy
2. Bonatti and Ross	Juteau or Emmerman?
3. Natland	Saunders
4. Duncan	Juteau
5. Duncan	Juteau
6. Dick	Hawkins
7. Langmuir	Langmuir and Sinton

2. Kerguelen: The processes of formation and evolution of oceanic plateaus are a high Lithosphere Panel priority. Purdy will contact Kennett and Curray to get all existing drilling plans in this region and pass this on to Juteau who undertook to formulate by our November meeting a preliminary straw-man drilling plan to most effectively achieve Lithosphere Panel objectives.

#### E. WESTERN PACIFIC DRILLING

1. Purdy expressed strong desire to choose site of focussed drilling efforts to study back arc spreading processes in the W. Pacific at the earliest opportunity. In this way, the necessary planning and data collection could, for a change, be done in a timely and organized manner. The question was posed 'Given we have time what is the best process by which to involve the wider community in choosing the site of such a focussed effort?!
2. The panel was pleased to hear of Jim Hawkins existing intention of organize a workshop to address drilling in W. Pacific arcs.
3. The idea was discussed of using COSOD II as a forum for several specific workshops of the type needed to address questions like that posed in (1) above.

F. PCOM DECISIONS

In discussing suitable adjectives to use to describe the various levels of certainty of PCOM decisions (as in, for example, 'cast in concrete', or conversely perhaps 'soft as clay') the panel determined the universally most appropriate word given the recent vacillations would be 'thixotropic'!



Attendees

G.M. Purdy  
K. Bostrom  
J. Delaney  
R. Emmermann  
J. Hawkins  
T. Juteau  
C. Langmuir  
M. Leinen  
K. MacDonald  
R. McDuff  
A. Saunders  
J. Sinton

Visitors:

R. Carlson  
M. Salisbury  
K. Becker

Absent:

J. Sclater  
M. Ozima  
P. Robinson