PLANNING COMMITTEE MEETING
23 - 25 August 1988
Oxford, U.K.

AGENDA

ATTACHMENTS

ADDITIONAL DOCUMENTS

CEPAC First Full Prospectus (July 1988)

JOIDES MEETING SCHEDULE

Date	Place	Committee/Panel
23-25 Aug	Oxford, UK	PCOM
13-15 Sept	Edinburgh, UK	EXCOM
12-16 Sept	Cornerbrook, Canada	LITHP
24-25 Sept	Tuscany, Italy	FPAP-WG
27-28 Sept	Bavaria, FRG	TEDCOM
3-7 Oct*	Hannover, FRG	TECP
4-6 Oct	Milan, Italy	SOHP
4-6 Oct	Swansea, UK	SSP
17-19 Oct*	Ann Arbor, MI	CEPAC
27-29 Oct	Palisades, NY	WPAC
10-11 Nov	Honolulu, HI	PPSP
28 Nov-2 Dec	Miami, FL	PCOM/Panel Chairmen (Annual Meeting)
2,3,4 MAY 89	OSLO PCOM	
22,23,24 AUG 89	U. W.	

* Tentative meeting (not yet requested or approved)
(Rev. 7/27/88)

ITEM C: NSF REPORT

Budget Outlook

EXCOM had asked NSF to reconsider the ODP budget target figures for FY91 (NSF: $39M; BCOM: $40M) and FY92 (NSF: $40M; BCOM: $42M) to ensure that a constant level of effort for ODP could be maintained.

Bruce Malfait might give an update on this matter.

Membership

No new membership in sight.

However, word has spread that Canada is in a crucial stage (July) of negotiations with Australia to form a consortium. More news might be available by the time of the PCOM meeting. A final okay (assuming an agreement between both countries) is not expected before November 88.

A positive result might inspire the ODP community to revive the request for exploring the potential of a USSR membership.

ITEM E: SCIENCE OPERATOR REPORT

TAMU's report will include planning status for the engineering test leg (Leg 124E). The leg prospectus will be mailed out from TAMU to all PCOM members at the end of July 88. You should have received it in time for this PCOM meeting.

ITEM F: WIRELINE LOGGING SERVICES REPORT

A written report from R.Jarrard is attached (p.53).

ITEM G: NEW PANEL STRUCTURE

At its last meeting PCOM recommended to change the advisory structure to better adapt it to a thematically driven program (details see PCOM minutes p.21).

During the May 88 meeting EXCOM approved PCOM's approach for changes in the advisory structure (see EXCOM summary next page).

In anticipation of this approval, PCOM had set up two-person subcommittees for each affected panel. The subcommittees were supposed to draft mandates for the panels in preparation of the August PCOM meeting:

Panel	Drafting Committee
Diagenesis & Sediment Processes	M.Kastner, A.Taira
Ocean Paleoenvironment & Paleobiology	G.Brass, S.Gartner
Tectonics Panel	D.Cowan, B.Tucholke
Lithosphere Panel	J.Malpas, T.Francis
Shipboard Measurement Panel	M.Langseth, M.Leinen

You will find copies of the draft mandates (which we received !) on p.59. The draft mandates will be discussed at the August PCOM meeting. Other issue for discussion will be:

1. How will DPGs report within the new advisory structure? Should Detailed Planning Groups report directly to PCOM or to the involved Thematic Panels?

2. Selection/nomination of chairpersons for the (new) panels.
   SOHP: Candidates were recommended by SOHP for the chairmen position of the diagenesis and paleoenvironment panels. New members for both panels were also recommended:

<u>Diagenesis and Sediment Processes</u>

Chair: Erwin Suess
Membership: Jim Coleman, Roger Flood, D.J. Piper, Ray Seiver, Dorik Stow, Mike Underwood

<u>Ocean Paleoenvironment and Paleobiology</u>

Chair: Bob Halley, Warren Prell, Bill Ruddiman
Membership: Ed Boyle, Peggy Delany

It is desirable to at least pick the chairmen of the new panels at this PCOM meeting.

PCOM IS ASKED TO:

I) DISCUSS THE DRAFT MANDATES FOR THE PANELS AND BRING THEM INTO FINAL SHAPE;
II) SELECT (AT LEAST) CHAIRPERSONS FOR THE NEW PANELS;
III) DISCUSS AND DECIDE ON THE REPORTING ISSUE WITHIN THE NEW ADVISORY STRUCTURE; (DPGs directly to PCOM or via thematic panels)

ITEM H: SUMMARY OF EXCOM MEETING

On 25-26 May 1988, a joint meeting of EXCOM and the ODP Council was held in Washington, DC. A brief summary of highlights of this meeting appears below:

Long-Range Panning

EXCOM accepted the NSF charge for a post-1993 ODP long-range planning document, which will encompass about 10 years of planning. The plan should:

1) Be founded on a description of current ODP achievements and those expected by 1993; include possible "practical spin-offs" (e.g. technology developments); and identify the COSOD II objectives which have been achieved thus far.
2) Address scientific recommendations/priorities of COSOD II.
3) Address additional (non COSOD II) objectives.
4) Address technical/logistical constraints.
5) Identify priorities, implementation schedule and budget requirements.
6) Indicate earliest significant budget impact in the 1993 time frame.

EXCOM requested that the document also include:

7) An outline of scientific objectives at different levels of effort: a) "steady-state" program; b) program with moderate increase (10%); and c) program with significant increase of about 50% as outlined by COSOD II.
8) After scientific priorities are defined, discuss technologies needed for the program, including the use of alternate platforms.

Changes in Advisory Structure

EXCOM approved, in principle, the changes to the JOIDES advisory structure as recommended by the Panel Review Subcommittee and endorsed by PCOM. EXCOM emphasized the need for the ad hoc DPGs to act as regional as well as thematic planning groups. Regional expertise should be included in the appropriate panels.

ODP Program Plan and Budget

EXCOM approved the FY89 Program Plan and Budget ($ 36M), including the budget allocations as proposed by BCOM. At BCOM's recommendation EXCOM reaffirmed the priority of maintaining the 4% SOE within the budget of ODP for future fiscal years. EXCOM also endorsed BCOM's request for higher budget target figures for FY91 and FY92 (NSF: $39M/$40M; BCOM: $40M/$42M) in order to maintain a constant level of effort for ODP through 1992. Otherwise scientific objectives as outlined in the four-year program plan cannot be achieved.

Lesser Developed Countries in ODP

Although EXCOM was supportive of including 3rd world scientists in ODP activities, a $50K per annum support plan was turned down as the money would be taken out of the science budget. Currently other funding sources are being explored to support this initiative.

ITEM I: LONG-RANGE PLANNING (DOCUMENT)

Status

PCOM is charged with developing a long-range planning document, which will define the shape of ODP in the nineties. The discussion of this issue was started at the last PCOM meeting. A preliminary outline was presented during the last PCOM meeting. Input from EXCOM has subsequently expanded the scope of the outline to include a review of ODP achievements, practical spin-offs and clearly define the trade-offs for different levels of effort (see summary p.5). A revised outline was then forwarded to the thematic panels for input. In late July 88 TECP and SOHP will have met to exclusively discuss long-range planning .

Already earlier in 88 the thematic panels started to develop scientific white papers which will define global thematic priorities - in addition to already existing input provided by COSOD II and COSOD I, and in part as adaption to ODP needs. The panels' (draft) white papers are expected to be available at the August PCOM meeting (LITHP's White Paper is published in the JOIDES Journal, Feb.1988 issue [Vol.XIV, no.1]). The White Papers are scheduled for publication in the Oct.88 JOIDES Journal issue to provide guidance for the scientific community.

Additionally, the thematic panels are asked to advise PCOM where best to address these highest thematic priorities. This information is expected to be available at the August PCOM meeting.

To help get things started we are listing certain 'expertise' of PCOM members, who might help lead the discussion:

TECP liaison:	T.Shipley (July 88 meeting)/ O.Eldholm
SOHP liaison:	N.Pisias (July 88 meeting), G.Brass/U.von Rad
LITHP liaison:	M.Kastner/J.Malpas

COSOD II steering committee: M.Kastner

PCOM watchdogs for the five COSOD II WORKING GROUP(s):

I.	Global Environmental Changes, &	N.Pisias
V.	Evolution and Extinct. of Oceanic Biota	W.Coulbourn, S.Gartner
II.	Mantle-Crust Interactions	J.Malpas
III.	Fluid Circulation and Global Geochem.Budget	M.Kastner, A.Taira
IV.	Stress and Deformation of the Lithosphere	O.Eldholm, M.Langseth

Helpful documents for the discussion:

1. Timetable for Developing the LRP (Draft PCOM Minutes)
2. First Outline of Long-range Planning Document (Draft PCOM Minutes)
3. Revised Outline, sent to Thematic Panels (Telexed to PCOM)
4. EXCOM Guidance for Long-range Planning (see p.5)
5. Thematic Panel Input (white papers etc.)
6. COSOD II (and COSOD I) Reports (copies widely distributed)

ITEM I: Long-range Planning (Document), continued

In preparation of this meeting document 2. and 3. (outlines) have been telemailed and telexed to all PCOM members. This was intended to draw the attention of PCOM members to this major issue for this meeting so that everybody would come prepared.

Nick Pisias, as present PCOM chair, agreed to write the first draft of the long-range plan in Oct/Nov this year - provided the input is reasonably well defined.

PCOM IS ASKED TO:

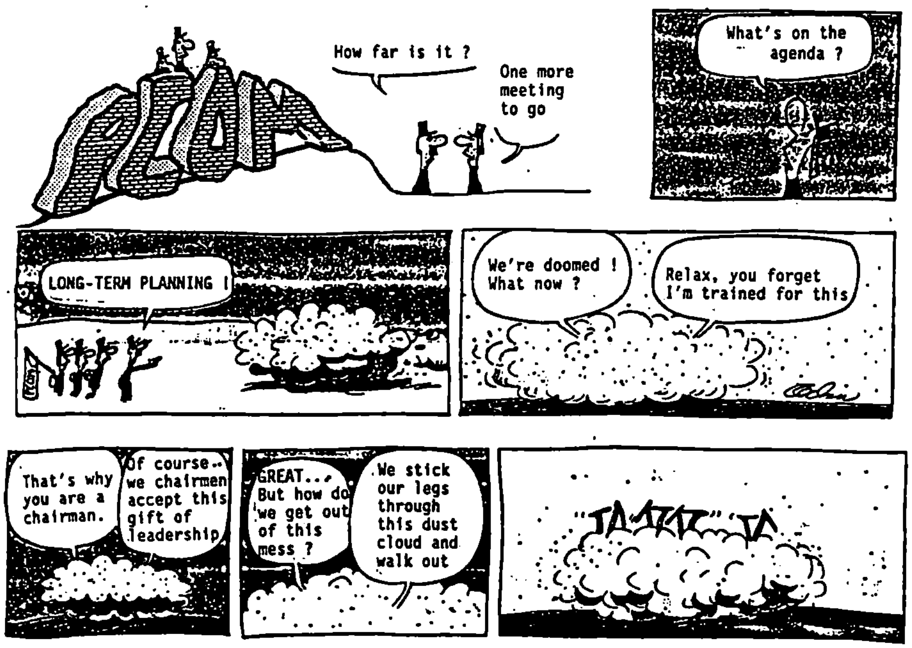
I) DISCUSS THE SCIENTIFIC PRIORITIES FOR THE LONG RANGE PLAN, CONSIDERING THE INPUT FROM COSOD II, THEMATIC PANELS AND OTHER SOURCES.

II) DEVELOP A STRATEGY FOR DEFINING THE TECHNICAL/LOGISTICAL REQUIREMENTS OF THE PROGRAM.

III) ADAPT THE SCIENTIFIC PRIORITIES TO SEVERAL POSSIBLE LEVELS OF EFFORT TO ACHIEVE THESE PRIORITIES, CLEARLY INDICATING THE TRADE-OFFS
a) ca.50% increase, b) ca. 10% increase, c) constant level of effort (inflation-adjusted)

Helpful questions to proceed in this direction are:

1. Is the LRP outline complete as presented?
2. Who could best provide further input - on scientific priorities/scientific achievements/practical spin-offs/logging/technical requirements/engineering requirements/development times/costs?
3. Which PCOM member can act as filter to input?



ITEM J: INDIAN OCEAN

Leg 122 (Exmouth Plateau)

Co-chiefs: U.von Rad (FRG), B.Haq

For various reasons this leg lost several days in drilling time (medical emergency, change of port, breakdown of power supply in labs etc.). Also initial drilling results at site EP10A clearly proved the human nature/origin of geophysicists/seismic stratigraphy.

Sites EP-2A and EP-9E will be traded between legs 122 and 123. Lou Garrison might give an update on the progress of the leg.

Leg 123 (Argo Abyssal Plain)

Co-chiefs: F.Gradstein, J.Ludden (both Canada)
Sites: EP-9E, AAP-1B (with basement penetration as deep as possible)

Questions regarding the accuracy of navigational data for the back-up site AAP-2 have been answered; the site is okay.

Sites EP-2E and EP-9E will be traded between legs 122 and 123. Additional information on the leg will be available at the meeting.

ITEM K: WESTERN PACIFIC PLANNING

Leg 124 (Banda-Celebes-Sulu-[S.China] Seas)

Co-chiefs: E.Silver, K.Hinz (FRG)

Status: Leg was expanded to 60 days. All requested Philippine sites got clearance; however some new alternate sites probably still need clearance; they have been picked very late in this game. Prime sites are BNDA-2, CS-1, SS-3, CR-1 (Cagayan Ridge, Sulu Sea, equivalent to SUL-4; much to the displeasure of one co-chief, this site has been mixed up with site Sulu Sea 4 [SS-4], which addresses a very interesting tectonic problem of active margins in the SE of the Sulu Sea basin). Political concerns will prevent drilling at sites SCS-5 and SCS-9; both are situated in disputed waters.

PPSP: All sites including several alternate sites in the Sulu Sea and S.China Sea got safety approval (with some minor restrictions to avoid certain features displayed in seismics).

ITEM K: Western Pacific Planning, continued

Leg 124E (Engineering Test Leg)

You should have received the leg prospectus from TAMU prior to this meeting.

Leg 125 (Bonins-Marianas)

Co-chiefs: P.Fryer, J.Pearce (UK)

Status: Two sites are planned on Conical Seamount (MAR-3, MAR-3A); furthermore two sites of the Bonin transect will be drilled (BON-6, BON-7). BON-7 is lowest in priority.

A Lamont core has been discovered which had been taken at the top of an ultramafic diapir. It showed variably-sized fragments of ultramafics floating in a soft matrix.

This leg is up for safety review at the PPSP meeting, 10-11 November 88, Hawaii.

Leg 126 (Bonins)

Co-chiefs: B.Taylor, T.Ui (J)

Status: Four sites are planned (BON-1, BON-2, BON-5, BON-5A), completing the Bonin arc transect, which will be started during leg 125.

This leg got two extra days to avoid arrival in Japan during a major holiday.

SSP: Concerns about high heat flow at site BON-1 prove to be right; Japanese measurements indicate variability on a small scale, but also very high values (see attachment p.71); please remember, BON-1 is planned as a ca. 1000m hole.

This leg is up for safety review at the PPSP meeting, 10-11 November 88, Hawaii.

Co-chief B.Taylor has provided PCOM with an update on drilling depths for Leg 126 sites (p.75), including a composite of seismic sections. A more complete set of sections will be available for review at the meeting.

Leg 127 (Japan Sea I)

Co-chiefs: K.Tamaki (J), tba.

Status: Sites J1B, J1D, J1E and J3A are scheduled taking ca. 54 days operational time.

PPSP: See comments under Leg 128.

Leg 128 (Japan Sea II)

Co-chiefs: K.Suyehiro (J), J.Ingle

Status: 30 days of drilling for sites J2A and JS2 are scheduled. Approximately 11 days should be added for logging and downhole experiments.

PPSP: The Japan Sea program underwent a safety preview during the 28-29 PPSP meeting in Corvallis (see minutes p.83). The panel expressed cautious optimism, and no unsurmountable problems were seen. K.Suyehiro received useful advice as to what input is expected at the upcoming full safety review.

FY90 PROGRAMS

Please note: the FY90 schedule must be finalized at the Nov.

annual PCOM mtg!

Leg 129 (Nankai Trough)

Co-chiefs: A.Taira (J), I.Hill (UK)

Status: Two sites are planned, NKT-1 and NKT-2, with a total time estimate of 57 days. At the last PCOM meeting a plan had been suggested by the logging group which would incorporate an extensive logging program into the leg. An alternative plan was in place in case the GEOPROPS tool would be available.

PPSP: The Nankai program was recommended for an early safety review. The safety review (preview) is scheduled for the next PPSP meeting, 10-11 Nov., Hawaii.

DMP: The panel felt that the downhole measurement scenario was becoming very complex. It recommended that a special WG meet separately in order to develop a detailed logging program. (Possibly an add-on day to the next DMP meeting devoted to developing a consistent logging program could help).

ITEM K: Western Pacific Planning, continued

Geochemical Reference Hole program:

Status: Slightly different recommendations from LITHP and TECP;

LITHP: 1 leg during WPAC drilling (FY90) with shallow sites MAR-4, 5, and 6. A second leg during CEPAC drilling, with 1/2 leg devoted to drill A2-2 on anomaly M-18 to at least 200m basement and second half be used either to deepen the site or to drill site JJ-5 in the Jurassic quiet zone.

TECP: A minimum of 4 sites: A2-1 and A2-3 (both on anomaly M-18) will also address M-series drilling, sites JJ-5 and JJ-3 will also address the oldest Pacific crust and oldest recognized magnetic lineation respectively.

There is, however, a problem with site survey data; the more to the north the less the data coverage.

A new proposal has been submitted with fairly good site survey data (306/E Old Pacific History) which still has to undergo review by the thematic panels. It addresses problems of 'Old-Pacific crust', 'M-series drilling' and 'Geochemical Reference holes',. The memo from the LITHP chairman (see p.113) in reference to this proposal points out some questions.

CEPAC: During the recent CEPAC meeting questions were raised as to the present design of the Geochemical Reference program. The probability of achieving useful results, being able to accurately characterize large regions based on any single site, was questioned by the panel.

PCOM IS ASKED TO:

I) RECOGNIZE THAT THE GEOCHEMICAL REFERENCE PROGRAM NEEDS URGENT ACTION IF IT WILL BE CONSIDERED FOR INCLUSION IN FY90 (DEADLINE: ANNUAL PCOM MEETING NOV/DEC 88)

Northeast Australian Margin (NEA)

Status: 12 sites recommended (NEA 1,2,3,4,5,6,8,9A,10A,11,13,14). If these sites do not fit in one leg SOHP recommends to drop sites NEA9A (or NEA10) and NEA13. SOHP is in contact with MVT proponents to get accurate time estimates for possible MVT experiments to be conducted at some of the proposed sites.

Though all necessary site survey data for proposed sites have been acquired processing is not yet completed.

PPSP: This program is scheduled for a safety preview at the PPSP meeting, 10-11 November 88, in Hawaii. Peter Davies, BMR/Canberra has been invited to present this program.

Vanuatu

Status: This 1 leg program consists of six sites, DEZ 1,2,4,5, and IAB-1A, 2A.

Velocity analysis for site DEZ 2 has been completed; the proponents M.Fisher and J.-Y.Collot think they can exclude the presence of hard rock (carbonates). SSP will comment on this issue at its next meeting in early October.

Lau Basin:

Status: A 1 leg program without need of guidebase is presently favored. The following sites are tentatively being considered: LG-2, LG-1 or LG-7, LG-3 and LG-6. Final selection of sites and details of the program will be defined after additional site survey data have been acquired in 1988 (SCS line for transect at 18°40'S is needed).

There is a chance that the DARWIN in June 88 (L.Parson) and the WASHINGTON in January 89 (Hawkins) will take care of the site survey needs.

CEPAC: The panel has completed its first full prospectus. This includes several programs which could be considered for incorporation into the drilling schedule of FY90 in the Western Pacific (for more detail see next agenda item, and CEPAC prospectus).

- Old Pacific
- Ontong Java Transect
- Atolls and Guyots

ITEM L: CENTRAL & EASTERN PACIFIC PLANNING

PCOM

For planning purposes the approximately 18 months timeframe for drilling in the Central and Eastern Pacific is still in place. PCOM now has the first draft of the full CEPAC Prospectus. In general, it includes programs based on the thematic panels' input plus the Bering Sea program. PCOM is asked to review and evaluate the Prospectus, using the same approach as was made for summaries and evaluations of the WPAC Prospectus at the Nikko meeting.

A map of CEPAC's recommended programs appears on the following page.

THEMATIC PANELS

The following is the minimum or core program for CEPAC drilling as forwarded from the 3 thematic panels (unchanged since last PCOM meeting).

LITHP: A core program has been defined covering four themes; drilling this core program will need approximately 6.5 legs.

- Deep Crustal Drilling: Deepen 504B (1.5 legs)
- Magmatic/hydrother.processes at fast spreading sediment free ridge crests: EPR (2 legs)
- Magmatic/hydrother.processes at sedimented ridge crests: JdF/Escanaba (2 legs)
- Young hot spot volcanism: Loihi (1 leg)

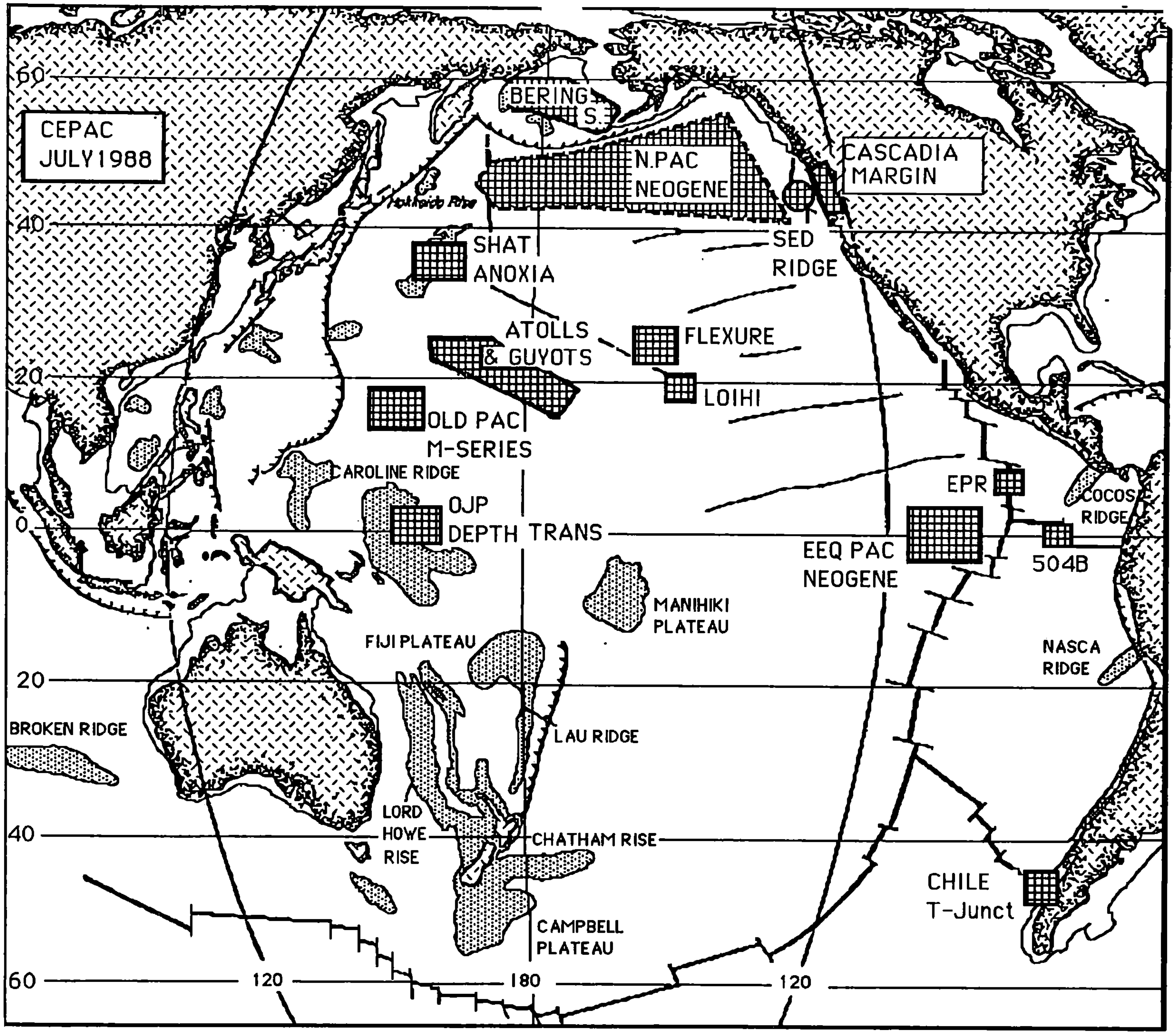
4 hard-rock guidebases will be required for CEPAC drilling (incl. engineering legs).

SOHP: The following is a minimum program for CEPAC drilling covering SOHP's top ranked four themes. Approximately 4.5 legs.

- Neogene paleoceanography: needs <u>at least</u> three transects:
    - a. W-Equatorial transect: proposal 142/E
    - b. E-Equatorial transect: proposal 221/E
    - c. N-Pacific transect: Sites Meiji 1 and 2 (259/E); NW-1, 3 and 4 (199/E); PM-1A (247/E).

- Mesozoic-Paleogene paleoceanography & Sealevel - atolls and guyots: Sites OS-3 (260/D); Allison, Menard and Wilde Guyots (203/E); Sylvania and Harrie Guyots (202/E); Enewetak (202/E).(also SHAT-1 and SHAT-3, see below).

- Anoxic events: Sites SHAT-1 and SHAT-3 (253/E)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TECP: The panel presents its top-ranking five themes for inclusion into a CEPAC drilling phase:

1. M-Series dating (combine with Geochem.Ref.Sites)
2. Lithosphere flexure (Hawaiian moat (3/E) preferred)
3. Ridge-trench interaction (Chile T-junction, 8/E)
4. Pre-70 MA plate motions (combine w.Geochem.Ref.Sites)
5. Deformation in accretionary prisms (Oregon margin)

Loihi Program

PCOM had requested better justification from LITHP for Loihi drilling for consideration in the CEPAC program. A response from the LITHP chairman appears on p.88.

(Note: If Loihi is included, at least two more guidebases (= $$) are needed. SOE money as outlined in the 4-year plan already is pretty much committed !)

CEPAC: During the 18-19 July meeting in Corvallis, the panel was busy developing the CEPAC drilling prospectus. This prospectus covers all high priorities as defined by the thematic panels; it does not yet provide site specific information and does not completely exclude immature programs as the panel felt it should wait with such drastic decisions until its October 88 meeting.

EPR-WG (sedimented ridges): To discuss sedimented ridges the composition of the WG was slightly changed. Chairman: Bob Detrick. The meeting took place at the Pacific Geoscience Centre, 26-28 July 1988; A brief summary of the results will be available at the PCOM meeting.

PCOM members volunteered for CEPAC watchdog assignments. 'Watchdogs' should assist in leading the discussion on particular themes. Watchdog reports, in part prepared for the College Station PCOM meeting, in part for this meeting are attached (see p.95).

PCOM IS ASKED TO:

I) DISCUSS AND EVALUATE THE PROGRAMS PRESENTLY INCLUDED IN THE CEPAC PROSPECTUS.

II) RECOGNIZE THE DISSATISFACTION OF THE PANELS WITH THE TIGHT CEPAC TIME FRAME.

III) DISCUSS AND DEFINE SCIENTIFIC PRIORITIES FOR A CEPAC DRILLING PROGRAM.

IV) -IF APPROPRIATE- RECONSIDER THE PRESENT TIME FRAME FOR CEPAC DRILLING BASED ON SCIENTIFIC PRIORITIES.

ITEM M: DRILLING BEYOND FISCAL YEAR 1992

Following the PCOM Annual Meeting in Miami, Nov/Dec 88, PCOM is expected to provide a scientific plan for the then-upcoming 4 years (FY90-FY93). This scientific outlook clearly goes beyond the presently defined CEPAC program, including several extra months for possible engineering legs, ship maintenance etc. Therefore, in preparation of the annual meeting PCOM should start developing and discussing plans for FY92/FY93.

Thematic panels have been asked to provide input for long-range planning for this PCOM meeting. Because of time constraints, all panels' deliberations may not be included in the agenda book. However, at the latest, input will be available at the PCOM meeting.

At the EXCOM meeting 25-27 May 1988, in Washington DC, political pressure was voiced by a European member to go back to the Atlantic Ocean in late 92.

During the Sunriver PCOM meetings in late 87, the idea of having the JOIDES RESOLUTION shuttle between the Atlantic and the Pacific Ocean was introduced. It was seen as a possible solution to unreasonable time constraints for CEPAC drilling (two terms of CEPAC drilling) and the political desire of part of the ODP community to get back to the Atlantic.

PCOM IS ASKED TO:

I) DISCUSS SCIENTIFIC PLANNING FOR FY93 IN PREPARATION OF THE PCOM ANNUAL MEETING IN NOV/DEC 1988.

II) BASE ITS DISCUSSION ON THE THEMATIC PANELS' ADVICE (which will be available at the August meeting)

III) LEAVE POLITICS TO EXCOM.

ITEM N: FLUID PROCESSES IN ACCRETIONARY PRISMS WG

At its last meeting PCOM approved the formation of a working group on fluids in accretionary prisms to establish the criteria for evaluation of proposals addressing this topic. This group will also provide input to TECP for defining long-term objectives.

Graham Westbrook accepted the chair for this WG. In cooperation with Ian Dalziel (TECP) and Nick Pisias the following list of members has been developed:

Graham Westbrook (Birmingham, UK; chair)
Keir Becker (Miami)
Joris Gieskes (Scripps)
Roland von Huene (USGS)
Roy Hyndman (Pacific Geoscience Centre, Canada)
Dan Karig (Cornell)
Xavier Le Pichon (Ecole Normale Superieur, France)
Casey Moore (Univ. Calif. Santa Cruz)
Tom Shipley (UT, Austin)
Erwin Suess (OSU)

Additionally several names are under consideration for a ESF representative.

As a tentative meeting date and place, 24-25 September 1988 in Tuscany, Italy, has been chosen (to follow the NATO advanced research workshop on fluids in accretionary wedges, 19-23 September 1988, Italy).

ITEM O: THIRD-PARTY TOOLS/DEVELOPMENTS

DMP had been charged with revising its first draft of a policy how to handle third party tools. DMP has defined a subcommittee which will redraft the policy and then send it to PCOM for consideration (see DMP minutes p.115). The redrafted policy is expected to be available at the PCOM meeting.

ITEM P: PANEL MEMBERSHIP

A. New Chairpersons

LITHP: Bob Detrick will resign after the September LITHP meeting (see attached letter p.113). He is willing to represent LITHP at the annual meeting; a new chairperson has to be named at this PCOM meeting. Bob's own suggestions are Charles Langmuir or Rodey Batiza.

DSP (Diagenesis & Sediment Processes Panel): A chairman is needed for this new panel.

OPB (Ocean Paleoenvironment & Biological Evolution): Larry Meyer offered to resign as chairman of SOHP...very soon.

SMP (Shipboard Measurement Panel): A chairman is needed for this new panel.

B. Membership Rotation

WPAC: R.Thunell (resigned) — No suggested replacement

ITEM Q: NEXT MEETINGS

The next PCOM meeting was tentatively scheduled for 28 Nov - 2 Dec 1988, in Miami. Garry Brass, as hosting member, will provide some more information on facilities etc.

PCOM might wish to choose a location and tentative meeting date for its April 89' meeting.

ITEM R: MISCELLANEOUS

Shipboard Computers

Scientific parties of several legs have experienced a certain frustration with the shipboard computer onboard JOIDES Resolution. It seems that the system is very well set up to ensure archiving of data, but provides little help for the every day needs of transient scientific parties (see attached correspondence p.147).

At this time no in-depth discussion of this issue by PCOM is appropriate, but PCOM may think about possible instructions to IHP, which will discuss and review the onboard computer situation at its next meeting.

PCOM IS ASKED TO:

I) ENSURE THAT IT PROVIDES THE APPROPRIATE INSTRUCTIONS TO IHP WHICH WILL LOOK INTO THE COMPUTER ISSUE AT ITS NEXT MEETING.

DMP Recommendations

Several DMP recommendations have been made during the last DMP meeting:

9: liaison to 'Shipboard measurement panel' (p.121)
10: diamond coring system and logging (p.123)
11: cost analysis diamond coring holes vs. slimlining logging tools (p.123)
12: German KTB rep be invited to PCOM and EXCOM to give presentation (p.126)
13: Logging at AAP (p.133)
14: WG for Nankai logging (p.134)
15: Logging at Sulu Sea (p.135)

JOIDES Office Rotation

This will be the last PCOM meeting chaired by our worthy colleague Nick Pisias. And at the end of September 88 the JOIDES Office will rotate to HIG, Hawaii. Anticipating a successful August PCOM meeting the staff of the present JOIDES Office - Cherry Moss, Sharmon Stambaugh & Michael Wiedicke - herewith says good bye to all PCOM members.

Next PCOM chairman will be Ralph Moberly; non-US liaison and assistant Laurent D'Ozouville. Both will attend the August PCOM meeting to ensure a smooth transition during the 'changing of guards'.

JOIDES PLANNING COMMITTEE MEETING
19-22 April 1988
College Station, Texas

REVISED DRAFT MINUTES

Members:

N.Pisias (Chairman) - Oregon State University
G.Brass - University of Miami
H.Beiersdorf - BGR, Federal Republic of Germany (for U. von Rad)
J.P.Cadet - France
D.Cowan - University of Washington
W.Coulbourn - Hawaii Institute for Geophysics
O.Eldholm - ESF Consortium
T.Francis - United Kingdom
S.Gartner - Texas A&M University
M.Kastner - Scripps Institution of Oceanography
M.Langseth - Lamont-Doherty Geological Observatory
R.Larson - University of Rhode Island
P.Robinson - Canada (for J.Malpas)
T.Shipley - University of Texas Institute for Geophysics
A.Taira - Ocean Research Institute, Japan
B.Tucholke - Woods Hole Oceanographic Institution

Liaisons:

B.Malfait - National Science Foundation
T.Pyle - Joint Oceanographic Institutions, Inc.
L.Garrison - Science Operator (ODP/TAMU)
R.Jarrard - Wireline Logging Services (ODP/LDGO)

Guests / Observers:

X.Le Pichon (COSOD II Steering Committee Chairman), Ecole Normal Superieure, France
L.D'Ozouville (CCOP/SOPAC, Fiji)
R.Anderson - Borehole Research Group (ODP/LDGO)
E.Kappel - JOI, Inc.
L.Stevens - JOI, Inc.

TAMU Staff:

R.Merrill - Sciences Services
A.Meyer - Science Operations
B.Harding - Engineering and Drilling Operations
M.Storms - Engineering Development
D.Huey - Engineering
S.Howard - Engineering
T.Pettigrew - Engineering

JOIDES Office:

M.Wiedicke
S.Stambaugh

MEETING HANDOUTS

1. WPAC Executive Summary for 11-13 April 1988 meeting (J)
2. Notes on WPAC Logging/Downhole Measurements Program (from DMP/Jarrard)
3. Nankai drilling scenario (from R.Jarrard) (K)
4. Letter from Leg 122 co-chiefs to PCOM Chairman
5. FY88 NSF Budget (B.Malfait) (A)
6. Viewgraphs from JOI, Inc. report (T.Pyle)
7. Arctic Drilling Five-Year Plan for 1989-1994 (from L.Johnson, ONR, through T.Pyle)
8. Shipboard Participation Tally, Legs 101-123 (A.Meyer) (C)
9. Viewgraphs from TAMU Engineering Presentation (Barry and the Engineers) (D)
10. Letter re: proposed S.China Sea Margin program (from D.Hayes through Langseth)
11. Final East Pacific Rise WG Report (E.Davis)
12. Wireline Logging Services Report (R.Jarrard) (E)
13. Operations Times, Legs 122 and 123 (L.Garrison)
14. ODP Operations Schedule (revised 4/25/88 from L.Garrison) (G)
15. Memo from T.Francis on August PCOM meeting arrangements
16. Summary of COSOD II discussions (prepared at meeting) (F)
17. Proposed outline for ODP Long-Range Planning document (prepared during meeting) (M)
18. CEPAC Mesozoic Paleoceanography Objectives (from Brian Tucholke, PCOM watchdog for this CEPAC program)

Tuesday, 19 April 1988

710 INTRODUCTIONS AND WELCOME

N.Pisias, PCOM Chairman, welcomed members and guests. M.Friedman, (Dean of the College of Geosciences at Texas A&M University and meeting host, welcomed PCOM to TAMU and expressed appreciation for PCOM's dedication toward making DSDP and ODP outstanding scientific programs.

The Chairman welcomed PCOM returning retiree, H.Beiersdorf, alternate for U.von Rad. He introduced D.Cowan, new PCOM representative from U.Washington. Pisias welcomed COSOD II Steering Committee Chairman, Xavier Le Pichon and introduced Laurent D'Ozouville, the non-U.S.liaison for the University of Hawaii JOIDES Office rotation beginning October, 1988. Pisias also introduced Lee Stevens, new clearance specialist based at JOI, Inc.

L.Garrison introduced TAMU/ODP staff members: P.Rabinowitz, B.Harding, R.Merrill and A.Meyer. Pisias sent regrets from Leg 117 Co-chief, Warren Prell, and announced that Leg 119 and 120 co-chiefs would report at the next meeting.

711 ADOPTION OF THE AGENDA

Pisias said that the agenda item "Short-Range Planning" would be rearranged to reflect the planning impact of extending Leg 120 for four days. B.Tucholke asked if Proposal 300/B (Return to SWIR) would be discussed in detail. As TECP and LITHP did not endorse the present proposal, no specific agenda item for PCOM review was added.

PCOM Consensus:

PCOM approves the agenda for the 19-22 April 1988 meeting.

712 APPROVAL OF PREVIOUS MINUTES

PCOM Motion:

PCOM adopts the minutes of the 30 November - 4 December Annual meeting of the Planning Committee.

Vote: 16 for; 0 against, 0 abstain

713 NSF REPORT

FY88 Budget Update and FY89 Projections

B.Malfait reported for the National Science Foundation (written report attached as Appendix A). Malfait presented an update on the FY88 budget which was approved by Congress shortly after PCOM's December meeting (Appendix A.1). The U.S. deficit has impacted NSF increases; basic science is being supported, but funding for several major initiatives as well as academic fleet upgrades is being delayed. ODP received a 2.2% increase for FY88 ($.6M); the requested increase was 4.3% of the FY87 budget ($1.3M). For FY89, ODP has requested a steady-state level of funding ($1.4M or 4.6% increase, Appendix A.2).

FY 89-92 Program Plan and Long-Range Planning

Details on the 4-year ODP program plan, currently being prepared by JOI, PCOM and the subcontractors, are shown in Appendix A.3. This plan will be presented to the U.S. Science Board in August.

Malfait provided PCOM with details for a long-range planning document which will be the blueprint for post-1993 ODP activities (Appendix A.4). This document, prepared by PCOM/EXCOM, must be ready for NSF review by early 1989; it will be used to negotiate new MOUs and evaluate funding levels.

714 JOI, INC REPORT

Program Plan Status

T.Pyle opened the report for JOI Inc with an update on the FY89-92 Program Plan. The final draft is scheduled to be completed by 1 May, with NSF Panel Review, EXCOM review (25-27 May meeting) and National Science Board review to follow. Pyle noted that for future program plans, PCOM should be more involved in writing up sections of the plan which highlight ODP scientific achievements.

Pyle presented a budget summary for FY89-92, comparing BCOM's recommendations (breakdowns and totals listed in Appendix B.1) with NSF targets. An increase in international partner contributions was budgeted for FY90. BCOM recommendations exceed NSF targets in FY 91 and 92.

He reviewed the Special Operating Expenses (SOE) for FY89. BCOM had recommended that some of the 4% special operations budget be applied to anticipated overruns in the standard operating budget for FY89. PCOM input on approximately $335K of uncommitted SOE for FY89 is needed (Appendix B.2) PCOM advice on SOE expenditures is needed for FY90-92 (Appendix B.2) Development of the mining-type diamond coring system (DCS) and hard-rock guidebases for the EPR drilling consumes much of the SOE in these years.

PCOM Discussion

It was noted that the projected budgets would not cover engineering objectives outlined at COSOD II. G.Brass pointed out that ODP has had to demonstrate a "lean" program in order to justify substantial increases to NSF; BCOM's requests are still greater than NSF targets if planned scientific objectives are to be achieved. PCOM discussed potential loss of non-U.S. partners if significant technology developments are not pursued.

PCOM budget recommendations for uncommitted Special Operations Budget were discussed after presentations by the subcontractors and results appear below (Minute 717).

Other JOI Issues

T.Pyle discussed several other issues for PCOM consideration, including:

* Potential problem with DCS incompatibility with ODP logging tools (will require slimming of Schlumberger tools)
* Cost alternatives to Part A publications (suggested by the PEC and currently under review by the Information Handling Panel)
* Shipboard computing capacity and requirements for processing the new formation microscanner (FMS) data

Highlights of recent JOI, Inc activity included:

* ODP Policy Manual will be presented to EXCOM in May.
* Favorable TAMU administrative cost review by Trowbridge committee appointed by JOI Board of Governors.
* Lesser Developed Countries initiative (Indian scientist participation

on Leg 116 and visiting Saudi scientist at Lamont Borehole Research Group) and recent hire of Lee Stevens, clearance specialist, who will assist JOI and TAMU on clearance and LDC participation.

* Second Performance Evaluation Committee (PEC) review. [Site visits completed; draft report by late June. Comments by the PEC have focussed on tightening up the JOIDES advisory structure and the fact that ODP publications are regional rather than thematic in nature.]

715 SCIENCE OPERATOR'S REPORT

Leg 118

P.Robinson, Leg 118 co-chief, provided an overview of the scientific and operations results from the Southwest Indian Ridge/Atlantis II Fracture Zone drilling.

He discussed site survey operations and spud-in attempts as well as the HRGB deployment (2-day operation) at a shallow site (Hole 735B) on the wall of the fracture zone. In 17 days of drilling, 500 meters of massive Layer 3-type gabbros were penetrated, with average recovery of 87%. The logs from Hole 735B will be important for "groundtruthing" ODP logs to cores.

Robinson commented on the need for excellent camera surveys for future hardrock drilling, as SSP has recommended. He commended the TAMU engineering staff on their contributions to the success of the leg. He added that fracture zones represent potentially productive sites for achieving long-term goals of deep crustal penetration.

Leg 119 and 120 Updates

L.Garrison provided updates of the Kerguelen Plateau/Prydz Bay drilling, and discussed the impact of weather and safety issues on these legs. Leg 120 in particular has experienced heavy sea conditions. Due to a medical emergency, the JOIDES RESOLUTION made a 17-day transit and portcall to Fremantle during Leg 120. The Leg has been extended four days to 1 May in order to accommodate drilling at SKP3C and SKP2D. The extension of time to Leg 120 impacts future leg scheduling.

Cherts and limestones at SKP3D (Site 750) slowed drilling times, as did weather conditions. Chert at SKP3C was less massive and penetration with constant weight on bit was no trouble, but wash out of sediment interlayers caused drilling problems. Although basement objectives were affected by the loss of time to Leg 120, basalt was penetrated at Holes 747C and 750B.

Garrison explained the decision to release the MAERSK MASTER when it was no longer needed for ice support on Leg 119. The contract was extended as far as possible. The higher than anticipated fuel costs were recovered by reprogramming funds and the support boat was available for as long as needed. No safety problems were posed for the remaining time on Leg 119 without ice support. A.Meyer briefly reported on the third party plankton tow studies on the MASTER.

T.Francis asked whether scientific objectives for the leg were achieved considering that the Cretaceous section was not recovered. Pisias responded that the recovered Oligocene section showed signs of compaction, possible evidence of load from extensive ice sheets. These results, in conjunction with the drilling on Legs 113 and 114, are significant in that the E.Antarctic ice sheet may have developed earlier than previously reported (early Oligocene?).

ODP Operations Superintendent, Lamar Hayes, suffered massive heart failure and died during Leg 120. The Planning Committee expressed its sympathy to Lamar's family and friends with the following motion, written by Roger Larson, and seconded and unanimously affirmed by the Planning Committee:

PCOM Motion:

The JOIDES Planning Committee acknowledges the debt and gratitude that the scientific ocean drilling community owes to ODP Operations Superintendent, Lamar Hayes, who died at sea aboard the JOIDES RESOLUTION on March 27, 1988. Lamar first joined the Deep Sea Drilling Project in August, 1970, and sailed with many of us on Glomar Challenger between Legs 18 and 35, and more recently on the JOIDES RESOLUTION.

From his earliest days with DSDP, Lamar served as a leader, teacher, mediator and father to those around him. For those of us who do science at sea in what is often a hostile and unforgiving environment, the presence of even one of these personages for advice and console is a rare and welcome sight. These memories of Lamar form the basis of our gratitude. The debt we owe him is to continue our conduct of the Ocean Drilling Program in a manner befitting of that memory. Whether grappling with complex planning decisions in committee or with a difficult and remote site at sea, we should seek to bring to bear all of the technical and scientific expertise, coupled with the sensitivity and good humor, that Lamar always brought to the job.

Staffing of ODP Cruises

A.Meyer reported on staffing of upcoming ODP cruises and presented a tally of participation by member country for Legs 101-123 (Appendix C). M.Kastner pointed out that with the nomination of Patricia Fryer for Leg 125, the percentage of women ODP co-chiefs was raised to 3%. L.Garrison added that both women co-chiefs are from the U.S.

A.Meyer discussed staffing for Leg 124E, which is expected to have a scientific advisory party of 4-6 members. ODP is looking for scientists with prior shipboard experience (especially with ODP) to describe core, physical properties, and core deformation and to work with the engineering staff on 124E.

ODP Science Services Report

PUBLICATIONS

R.Merrill reported for TAMU with updates on publication target dates and the Part B editorial review boards (with external reviewers confirmed through Leg 115). Post-Leg 106 Part B publication schedules reflect the PCOM-approved changes to production. Part A volumes as of Leg 111 will include the approved volume citation.

COMPUTER FACILITIES

Merrill discussed the requests by shipboard scientists for improved computing capabilities, and TAMU has written a proposal to JOI, Inc for the addition of a MicroVAX 3000 onboard the RESOLUTION at an estimated cost of $151K. (The additional computing capability will interface with the planned additional processing for the Formation Microscanner requested by LDGO). DEC Pro350s onboard will be, for the most part, replaced by IBM compatibles at the next portcall.

"GERIATRIC CORE STUDY"

Merrill reported on the TAMU study of ODP cores to study the integrity of physical properties and faunas over time and to see the effects of ODP storage methods. Approximately 10% of a core from Leg 124E will be dedicated to this study.

ODP Engineering Report

B.Harding reported for the TAMU Engineering Group, with assistance from TAMU engineers assigned to specific engineering projects.

ENGINEERING TEST LEG 124E: STATUS REPORT

B.Harding and M.Storms gave an update on plans for Leg 124E; a prospectus of the leg will be available to PCOM before its August meeting. The summary of highest priority tests (Appendix D.1) estimated that a total of 35 days are required. (The current ship operations schedule calls for a 30 day leg.)

Shallow water testing of the diamond coring system (DCS), estimated at approximately two weeks, is a top priority in response to the timetable of engineering needs for the program (Appendix D.2). XCB testing is scheduled in side-by-side test holes in order to evaluate performance under various drilling parameters. A dedicated hole for testing of downhole measurements is planned.

TAMU has planned a 3.5 day deepwater test (25-30K ft WD) to test coring systems, conduct drillpipe bending tests and test deep water positioning capabilities. PCOM discussions of these plans emphasized that evaluation of chert drilling capabilities would be a high priority.

R.Anderson discussed plans for testing logging and downhole measurement tools on 124E. The following 7 days of testing have been recommended by DMP:

- Wireline packer (2 days)
- Wireline heave compensator (1 day)
- Formation Microscanner (1 day)
- GST through-wiring (1 day)
  (necessary to reduce standard runs from 3 to 2)
- Geoprops probe (0.5 days, assuming test of Navidrill)
- ODP rotatable packer (1.5 days)
- Side entry sub (circulating while logging)

Harding reviewed alternate tests proposed for 124E, if time permits or if primary tests are not achievable (Appendix D.3).
Testing of the Kevlar sandline presumes the purchase of this equipment (about $100K), which PCOM felt was not a high priority purchase at this time.

Harding reviewed anticipated costs for Leg 124E (Appendix D.4), with the major cost ($600K) for rental of the diamond coring system (although the possibility of off-loading the equipment early may cut rental costs). Funding for the leg (Appendix D.4) assumes that $300K of the FY89 Special Operating Expenses will be available.

TAMU Engineering Staff presented development updates on major engineering priorities: the prototype diamond coring system (S.Howard), Navidrill Core Barrel and improved XCB (D.Huey), pressure core sampler and Vibracore (T.Pettigrew).

Items of concern to PCOM during these presentations were:

* At present the engineers have estimated the capability for the DCS drilling is 5500m water depth. This satisfies targets for drilling on the East Pacific Rise, but will not satisfy long-term crustal penetration objectives.

* The redesigned Navidrill has successfully drilled laboratory mock-ups of soft/hard interbedded materials, with various types of diamond-impregnated piloted bits. If results from Leg 121 are not promising, the Navidrill may not be ready for Leg 124E.

* The plans for the Pressure Core Sampler call for completion of a Phase I design by Leg 124. Some PCOM members were concerned that samples will not be accessed under in situ conditions and fluids will be contaminated if sampled with a tool at this phase of design. A commitment to full Phase II design (access to core under pressure) is necessary for a useful tool for in situ sampling. PCOM and TAMU agreed that Phase I will refer to an engineering milestone and Phase II would represent a scientifically viable tool.

At the conclusion of the engineering presentation, N.Pisias thanked the engineering staff for their responsive reports. PCOM further discussed Leg

124E on 20 April. PCOM supported the deep-water tests, but thought interbedded chert drilling the higher priority. R.Larson proposed Leg 124E drilling in the vicinity of the westernmost Marianas basin, where chert lithologies were known from Leg 60 drilling.

PCOM Motion:

The TAMU Engineering Group will include adequate time in Leg 124E for testing soft formation recovery capabilities in a deep water, interbedded chert sequence by reoccupying DSDP Site 452A in 4872m of water in the westernmost Mariana Basin at 17° 40.17'N, 148° 37.75'E, or at an equivalent adjacent site. (Motion, Larson, second Brass)

Vote: 16 for, 0 against, 0 abstain

PCOM did not exclude the deepwater test with this motion, but further clarified priorities and time assigned to 124E with the following motion:

PCOM Motion:

For Leg 124E, 35 days of operation time will be scheduled. The interbedded chert drilling tests are of higher priority, than the deep water operations test. (Motion, Kastner, second Larson)

Vote: 16 for, 0 against, 0 abstain

PCOM Consensus:

PCOM welcomes the initiative shown by the TAMU Engineering Group on the mining-type diamond coring system and supports this potentially important development for ODP.

DEVELOPMENT ENGINEERING PROJECT SCHEDULE

M.Storms presented the engineering schedule through FY90 (Appendix D.2) and the 'generic technology requirements' schedule (Appendix D.5), the results of advanced engineering planning since the Oregon PCOM meeting. Storms asked that the PCOM Chairman filter any changes to the schedule, which calls for testing of equipment before critical scientific need (Navidrill testing prior to WPAC programs, e.g.).

Because of other program needs, continued work on high temperature drilling has focussed on preliminary steam flash studies. TAMU will monitor land-based drilling programs (Sandia Valles caldera drilling and Los Alamos projects) and asked for temperature parameters for possible drill sites (Juan de Fuca Ridge e.g) to continue development work for high temperature drilling. The TAMU engineers will consult the EPR Working Group report for descriptions of anticipated drilling conditions. M.Kastner, as LITHP liaison, agreed to summarize information for TAMU. M.Langseth added that high heat flow values have recently been measured on a Japanese survey near BON-1, and high T drilling may impact the WPAC program.

20 April 1988

716 WIRELINE LOGGING SERVICES REPORT

Leg 118 Results

R.Jarrard reported for the LDGO Borehole Research Group and a written report is attached (Appendix E). Jarrard reviewed results of Leg 118 logging, discussing the contribution of logging to the science on the leg and the ability of calibrating the logs to the well-recovered core from Leg 118. The initial review of the logs do not show evidence of repetition of section. Although PCOM scheduled 8 days for logging on Hole 735B, it was completed in only 6. The geophysical logs indicated crustal velocities near Moho values (7 km/sec) and the vertical seismic profile experiment show a major reflector about 500m beneath the bottom of the hole.

Evaluation of ODP logs/Review of Specialty Tools

Jarrard discussed evaluations of logging success through Leg 119. Substantial decreases in holes lost to bridging problems have occurred since Leg 111 (90% of planned logging completed) but stuck XCBs have been responsible for lost holes in recent legs (see figure, Appendix E). Jarrard reported that an increase in tool failures on first runs on recent legs has not encouraged co-chiefs to send down back up tools.

Jarrard reviewed the deployment schedule for logging/downhole specialty tools through tentative Leg 135 (see figure Appendix E). Jarrard was disappointed that the BHTV has been deployed only at SWIR during the Indian Ocean campaign, and said that stress measurements from Leg 121 with the BHTV would be valuable for continuing the DMP recommendations for a world stress map. The FMS should help fulfil stress measurement objectives when it is on line for WPAC.

Improvement of ODP Logging Programs

In order to more fully exploit the scientific value of ODP logs, the JOIDES shipboard logger may be asked to help with cruise and post-cruise processing for future legs. Acquisition of user software is scheduled for later this year to speed up processing. Jarrard asked for increased awareness of logging objectives at pre-cruise meetings; increased awareness from operations superintendents that three logging strings are standard; and possible increase of logging through pipe. LDGO and JOI will address tool breakdown with Schlumberger.

Specific action items suggested to PCOM from the logging group were:

1) Should every XCB hole with greater than 750m of penetration have standard logs run in two stages? [With deeper drilling, the XCB is pushed to the limit and circulation deteriorates. LDGO would like to ensure that at least the top 750m are logged before the hole is deepened and possibly lost.]

2) Should logging plans include 10% contingency time?

Discussion:

Harding said that good results from tests of the lockable flapper valve indicate that two-stage logging will be possible after final Leg 121 testing. P.Robinson, as a recent co-chief, supported adequate time for logging and good faith efforts by co-chiefs to stick to the logging plan. L.Garrison said that the contingency time scheduled at PCOM's request for ODP legs includes contingency time for logging. PCOM agreed that realistic time estimates for logging would be more advisable than scheduling contingency time.

PCOM Consensus:

For holes planned deeper than 750m, TAMU and LDGO will schedule time for two-stage logging. Logging at 750m will ensure logs for that interval. PCOM asks for a review of this procedure by LDGO and TAMU in 6-8 months.

717 PCOM FY89 BUDGET RECOMMENDATIONS

In the JOI, Inc presentation, T.Pyle asked PCOM for recommendations for approximately $335K of uncommitted Special Operations Expenses for FY89 for the priority projects listed below:

* Rental of the diamond coring system from TONTO for Leg 124E ($300K)
* Rental and engineering time for percussive drilling (Vibracore) system ($85K)
* Hardware enhancement to shipboard VAX for FMS processing ($45K)

R.Anderson noted that the upgrade for the shipboard VAX (MicroVax 3000) will not handle the array processors needed for the FMS. B.Harding said that engineering feasibility for the Vibracore system would continue under present budget funds, but without additional funding, no equipment rental or testing would be possible.

PCOM Motion:

Uncommitted special operating expenses for FY89 ($335 total) will be devoted to diamond coring system development for Leg 124E ($290K) and to a VAX enhancement for processing the formation microscanner data ($45K). (Motion, Brass, second Francis)

Vote: 16 for, 0 against, 0 abstain

718 COSOD II AND LONG-RANGE PLANNING

Chairman N.Pisias opened the discussion on long-range planning and outlined the procedure to begin at this meeting:

1) An introduction on COSOD II by X.Le Pichon, Steering Committee Chairman.

2) An open discussion of the COSOD II Working Groups led by the assigned PCOM watchdogs.

3) Prioritize/adopt COSOD II recommendations and other input (COSOD I, JOIDES panels) into a series of options reflecting:

   i) increasing funding levels
   ii) order of engineering development as a function of funds
   iii) decision points: what happens if a technological development is too costly or unfeasible?

4) Identify the level which is essential for a scientifically exciting ODP program beyond 1993.

INTRODUCTION BY XAVIER LE PICHON

Le Pichon thanked PCOM for the invitation to attend the meeting and for PCOM and JOI's input to COSOD II. His impressions from COSOD II included:

* The twenty years of success of ocean drilling, based on sound management and extension to the international community, may be jeopardized without evidence of continued progress.
* Need to involve Lesser Developed Countries in ODP - how to include the scientific contributions of countries not able to join ODP.
* Need to open the program to new scientific constituencies such as global seismic networks and global change programs.
* Need for new technologies as stated in the COSOD II chapter on technology.
* Need to make ODP an experiment-oriented program.

Le Pichon advocated setting up short-lived working groups to design drilling experiments and have more outside review of them. He recommended that before 1992, ODP should develop a technology outline, possibly funded by a separate budget, and identify one experiment (EPR, e.g) that demonstrates that the program is moving into a new mode.

<u>Discussion</u>:

PCOM discussed the strengths of the program versus merely providing a scientific facility. Balancing an experimentally-driven program with opening it to new constituencies may pose special problems. G.Brass pointed out that ODP already has a major role in NSF global change programs, and that coordinating with global seismic networks is impossible without a downhole seismometer.

T.Francis said that even without major advances in technology after 1992, ocean drilling will continue. Losing even one member country over this issue, however, would constitute a financial crisis for ODP. P.Robinson said that there is broad support for ODP in Canada, but did not advise "diluting" the program by tacking on other programs.

PCOM also discussed the perception by the scientific community that ODP is still in reconnaissance mode, without the driving force of testing the plate tectonics theory that DSDP enjoyed. H.Beiersdorf added that paleoceanography and global climate change, disciplines "created" by DSDP, are exciting results of ODP. D.Cowan said that an exciting result of COSOD II is global themes that integrate fluid studies, composition of the mantle, hydrothermal systems etc.into projects that will bring together earth scientists from many disciplines.

PCOM briefly discussed potential new sources of funding for ODP such as more industry involvement. ODP engineering developments have commercial drilling potential, but sections of the existing MOUs regarding patent rights would need modification.

REVIEW OF COSOD II WORKING GROUP THEMES

Assigned PCOM watchdogs gave overviews of the five COSOD II Working Groups. The watchdogs were:

COSOD II Working Groups(s)	PCOM Watchdogs
I. Global Environmental Changes, &	N.Pisias
V. Evolution and Extinction of Oceanic Biota	W.Coulbourn, S.Gartner
II. Mantle-Crust Interactions	Robinson (Canada), R.Larson
III. Fluid Circ.and Global Geochem.Budget	M.Kastner, A.Taira
IV. Stress and Deformation of the Lith.	O.Eldholm, M.Langseth

COSOD II AND LONG-RANGE PLANNING

PCOM discussions on the importance and impact of COSOD II were summarized and the outline circulated for PCOM review at the meeting (Appendix F). This outline will serve as a basis for further integration of COSOD II objectives into long-range planning documents.

PCOM acknowledged the leadership of X.Le Pichon in organizing COSOD II and ESF's role in coordinating the conference and final report with the following:

PCOM Motion:

> The JOIDES Planning Committee expressed its thanks to those responsible for the success of the Second Conference on Scientific Ocean Drilling and, in particular, for the energetic leadership of Xavier Le Pichon, its Chairman. We are also very grateful to the European Science Foundation for the publication of the report. The Planning Committee, in constructing its long-range plans, will rely on the guidance and advice so ably presented in the COSOD II report. (Motion, Brass, second Kastner)

Vote: 16 for, 0 against, 0 abstain

21 April 1988

719 SHORT-TERM PLANNING

PCOM had previously been informed by the Science Operator that the 4-day extension of the Leg 120 would impact scheduling. Options for reassigning leg time included: taking 2 days each from Legs 122 and 123, and extending Leg 124 to 56 days to avoid disruptive Christmas season portcalls. PCOM decided to review the science programs on Legs 122 and 123 in detail to study the impacts of recent safety reviews before automatically extending Leg 124.

LEG 122 PLANNING

Leg 122 (Exmouth Plateau):
Co-chiefs: U.von Rad (FRG), B.Haq
Sites: EP-7, EP-10A, EP-12, EP-2A; [if EP-12 is not advisable the priority is: EP-7, EP-10A, EP2A, EP-6]

Pisias reviewed the PPSP safety decisions effecting Leg 122 and 123 and site priorities for Leg 122 as previously defined by PCOM (see above). Sites EP-6, EP-7F, and EP-12 were rejected; Sites EP-2A and EP-11B were approved. Site EP-9F was approved to 1300m; Sites EP-9E and EP-10A were approved with certain restrictions. PPSP again reviewed the program and suggested drilling holes near existing industry wells where hydrocarbon potentials are known. The current program does not address the syn-rift basement objectives planned at EP-12. SOHP has indicated that the program, even with the loss of Jurassic sediments penetration, is still scientifically viable.

L.Garrison reviewed the drilling times for the leg (Appendix G) and relocation of the sites. Pisias reviewed the relocation of EP-12 and noted that Leg 122 has safety impact on Leg 123 as EP-9 drilling is contingent on safely drilling EP-10 on this leg. PCOM discussed the merit of drilling where industry logs are available at the twin sites; ODP drilling would provide continuous core of similar sections, however. Robinson asked that the co-chiefs' preference for drilling EP-7 and EP-12 over EP-2A be considered. Ample contingency time and enough time for EP-10 drilling were PCOM priorities in these discussions.

PCOM Motion:

In view of the PPSP safely review, Leg 122 drilling at the Exmouth Plateau will include, in priority order, Sites EP-10A, EP-2A and either EP-7 or EP-12, depending on co-chief option. Operational time for the leg is set at 38.5 days, 14 days of transit and 2 days contingency time, for a total leg length of 55 days. (Motion, Brass, second Larson)

Vote: 16 for, 0 against, 0 abstain

(Note: The ODP operations schedule, updates 4/25/88 and attached as Appendix H indicates a total of 56 days at sea for Leg 122.)

LEG 123

Leg 123 (Argo Abyssal Plain):
Co-chiefs: F.Gradstein, J.Ludden (both Canada)
Sites: (EP-9E), AAP-1B

Pisias reviewed a letter from Leg 123 co-chiefs. circulated at this meeting, which requests minimum penetration of 200m at Site AAP1B and outlines the logging priorities for the leg. Time estimates for the leg are listed in Appendix G.

Robinson urged deeper penetration at AAP1B (500m) and asked for additional time for the leg to achieve this objective. Brass, as SOHP liaison said that SOHP has long advocated this site as a deep stratigraphic test hole, and that VSP experiments at the hole are essential. Jarrard said that the Leg 123 shipboard party includes D.Buffler, who can process VSP data; Jarrard estimated that one extra day would be needed for the experiment. He also recommended substituting the standard susceptibility tool with the French magnetic susceptibility tool on the leg, as it can be used in both sediments and basement.

PCOM Consensus:

> Leg 123, with a total of 60 days, will include at VSP experiment at Site AAP1B. PCOM accepts the use of the French magnetic susceptibility tool on the leg. PCOM restates the priority that AAP1B will be drilled to as deep a level in the oceanic crust as possible.

PCOM rejected the request of the co-chiefs for a 200m minimum penetration with the above consensus.

(Note: See Appendix H for new departure and arrival dates for Leg 123.)

720 JOIDES PANEL STRUCTURE

At the last PCOM meeting, the subcommittee to evaluate the present panel structure met and prepared initial recommendations, which were briefly introduced to PCOM by T.Francis. The subcommittee consisted of: T.Francis, M.Langseth, A.Taira. M.Leinen (written comments only), and R.Heath (EXCOM). N.Pisias sat in on the initial meeting of the subcommittee.

M.Langseth presented the conclusions of the panel and overheads of their recommendations are attached as Appendix I.

Discussion:

PCOM discussions on the recommended changes to the advisory structure focussed on:

* Splitting SOHP into two panels: how to ensure that fluid circulation, now a LITHP hydrothermal circulation theme, is handled in the new structure.

* The need for a hierarchical structure where input from the Detailed

Planning Groups (DPGs) goes through the thematic panels and not directly to PCOM. Some members thought the "path" of information should be clearly stated in the mandate of each DPG and thematic working group.

* The current East Pacific Rise Working Group is a good model for how the thematic subgroups should operate as it provided needed expertise and flexibility to a priority drilling program.

* The role of proponents on DPGs must be balanced with other outside expertise to avoid conflict of interest.

M.Langseth pointed out that the key to a thematically-driven program is long-range planning, which will be primarily the responsibility of the thematic panels and of PCOM. Francis added that proposals are not unsolicited as long as long-term plans are identified to the community. Pisias said that the thematic panels are being asked to provide PCOM with an outline of long-range themes and a map of where best on the globe to drill these problems. LITHP has updated its "White Paper" and the other thematic panels will soon respond. [Note: The thematic panels have been asked to hold special meetings or to circulate position papers to all members before the August PCOM meeting, so that PCOM has thematic input for the long-range planning document.]

PCOM Motion:

PCOM accepts the recommendations for the JOIDES Advisory Structure as forwarded by the Panel Structure Subcommittee and summarized by subcommittee member, M.Langseth, to be used as a framework for the JOIDES panel structure. (Motion Robinson, second Eldholm)

Vote: 16 for, 0 against, 0 abstain

Subsequent discussion by PCOM centered on life-time of and mechanism for setting up the DPGs, proposal review processes, and how panels like CEPAC and SOHP will operate during the transitional phase of the current panel structure. Appointing members of the new "split" SOHP panels [(1) Ocean Paleoenvironment and Biological Evolution, and (2) Diagenesis and Sediment Processes] and new Shipboard Measurements Panel was also a concern. B.Tucholke suggested that the SOHP Chairman be consulted on membership.

M.Langseth said that DPGs should be set up once drilling targets are a component of the long-range ODP plan. He said that CEPAC should operate through the transitional phase and the DPGs should be set up once ODP plans beyond the Pacific are known. PCOM discussed how drilling prospectuses would be written without regional panels. Although the exact reporting structure and mandates for DPGs were not defined, PCOM agreed that their plans would be evaluated by the thematic panels.

PCOM Motion (amended):

At the August meeting, PCOM will discuss drafts of the mandates of the JOIDES Advisory Structure. The Chairman of PCOM will appoint two-person committees for reviewing the four proposed thematic panels and the new shipboard measurements panel. (Motion as amended: Brass, second Kastner)

Vote: 16 for, 0 against, 0 abstain

The following PCOM members were assigned to review and draft mandates responsive to the proposed JOIDES structure:

Panel	PCOM Drafting Committee
Sediment Processes and Diagenesis	M.Kastner, A.Taira
Ocean Paleoenvironment/Biology	G.Brass., S.Gartner
Tectonics Panel	D.Cowan, B.Tucholke
Lithosphere Panel	J.Malpas, T.Francis
Shipboard Measurements Panel	M.Langseth, M.Leinen

[Note: Leinen and Malpas, who will represent URI and Canada respectively at the August meeting, were nominated by PCOM members for their expertise to cover the assigned panels.]

Pisias also recommended that the liaison structure for PPSP be improved. Specifically, exchange between PPSP and SSP should be early enough in a program so that late safety reviews such as the one for Exmouth Plateau are not repeated for potentially risky drilling areas such as the NE Australia Margin and Japan Sea.

Finally, in response to some of the panels, PCOM discussed possible lengths of time for members to serve on JOIDES panels and committees. Most members agreed that three years was a compromise for "learning curve" and "new blood." PCOM also discussed panel "no-shows." H.Beiersdorf recommended that two unexplained absences should be cause to dismiss a panel member.

721 WESTERN PACIFIC PLANNING

PCOM referred to the Executive Summary of the recent WPAC meeting (Appendix J) for drilling objectives and times for the Western Pacific program. A leg-by-leg review followed.

LEG 124 (SE ASIA BASINS)

(Banda-Sulu-Celebes-S.China Seas):
Co-chiefs: E.Silver, K.Hinz (FRG)

Status: Approximately 41 days operational time assigned. Not all six sites can be addressed in a first leg. PCOM therefore developed the following two options depending on availability of clearances:

- Option 1: Sites BNDA-1, BNDA-2, SCS-5;
- Option 2: Sites CS-1, SUL-5, SCS-5;

Pisias opened the discussion of Leg 124 with a status review . A recent SCS analog survey did not image basement at BNDA-1. L.Garrison said that TAMU is generally optimistic that clearances will be granted for the Celebes, Sulu and S.China Sea sites, but Indonesian clearance for Banda looks doubtful. L.Stevens mentioned that SCS-5 lies in waters claimed by both China and Vietnam.

G.Brass, PCOM watchdog for the leg, reviewed the microplate tectonics objectives. The original drilling plan of the leg was to sample several of the basins, especially the magnetically anomalous "zipper" opening in the S.China Sea. The Sulu Sea is a potential anoxic basin site. D.Cowan mentioned that drilling only two basins would diminish the tectonic objectives of the leg. Pisias presented the option of extending the leg in order to achieve the priority basement drilling at BNDA-2 or other basement site if Banda clearances are not forthcoming. [Note: TAMU deadline for clearance has been set for 3 June.]

L.Garrison reviewed logistics for the leg, for which 39 days were available after scheduling Legs 121 - 123. TAMU would like to avoid a disruptive Christmas port call on Leg 124, if possible. He mentioned potential safety problems at the Sulu site.

PCOM discussed the objectives of the Celebes Sea site (CS-1) and schemes for drilling which would allow basement recovery (RCB/XCB, wash down, then rotary core, e.g). The time extension would primary ensure that basement objectives are achieved.

PCOM Motion:

Leg 124 will be extended to 60 days, in order to reach the prime objective of drilling basement in the SE Asia basins region. Primary basement sites are in the Celebes Sea (CS-1 or equivalent), Sulu Sea (Site SS-1 or equivalent) and Banda Sea (BNDA-2 or equivalent). (Motion Tucholke, second Shipley)

Vote: 8 for, 4 opposed, 4 abstain

Discussion:

Before voting, PCOM discussed additional targets for the leg if time permits. SCS-9 could be drilled as well as a SOHP-recommended additional site in the Sulu Sea, although the present SS-1 (formerly Sulu Site 5A) was a compromise site accepted by SOHP. Langseth mentioned that having two basins for comparison in the region would be extremely important. The additional time could be used for additional paleoceanographic objectives and downhole programs such as stress measurements.

Pisias noted that at WPAC's recent meeting, drilling times were calculated to be much longer, and the entire program expanded whereas the original drilling times (APC) for a 41-day program seemed reasonable (See Appendix J).

PCOM discussed the consequences of extending the leg, specifically thematic input from SOHP on Sulu site priorities. Brass suggested APC/XCP coring at Sulu 4 and then XCB coring, which would achieve high priority objectives if BNDA-2 clearance does not come through. TAMU will continue to ask for clearances on the S.China Sea 10 and 11 sites as back up.

PCOM Consensus:

Priority order for Leg 124 contingency sites is SULU-4 and SCS 10-11.

The new departure and arrival dates for Leg 124 are listed in Appendix H.

LEG 125

Leg 125 (Bonins & Mariana Diapirs):
Co-chiefs: P.Fryer, J.Pearce (UK)

Status: Two sites are planned on Conical Seamount (MAR-3, MAR-3A); two sites of the Bonin transect will be drilled (BON-6, BON-7). BON-7 is lowest in priority.

N.Pisias gave an update on the program. New drilling time estimates may not leave enough time in the current 56-day program to complete BON-6 (see Appendix J), the last site scheduled.

PCOM agreed to leave 21 operational days for BON-6 (drilling, logging and re-entry) to ensure its completion. Dates and ports for Leg 125 are listed in Appendix H.

LEG 126

Leg 126 (Bonin Transect):
Co-chiefs: B.Taylor, T.Ui (J)

Status: Four sites are planned (BON-1, BON-2, BON-5, BON-5A), completing the Bonin arc transect, begun on Leg 125.

PCOM discussed possible high temperatures at BON-1, and the increased drilling times estimated for BON-1 and BON-2 (see Appendix J). 57.4 days are needed but only 54 scheduled. New MCS data show a possible basement reflector (sill?) at BON-2 which may have to be drilled to reach the sediments.

PCOM Consensus:

> Leg 126 (Bonin Transect) will remain a 56 day leg. The co-chiefs are asked to justify the drilling depths for all sites. PCOM flags the need for heat flow measurements at BON-1 (anticipated from an upcoming Japanese heat flow survey) and notes the possibility of changing drilling plans there if necessary.

M.Langseth agreed to monitor information from the Japanese survey.

LEG 127

Leg 127 (Japan Sea I):
Co-chiefs: K.Tamaki (J), tba.

Status: Sites J1B, J1D, J1E and J3A are scheduled for ca. 54 operational days.

PCOM agreed to rearrange the WPAC drilling schedule and put Nankai drilling (formerly scheduled for Leg 127) later in the program. Weather windows for the Japan Sea programs are not affected and more time will improve the potential for engineering success and optimal weather window for Nankai.

N.Pisias reviewed the current program for Leg 127. There is strong potential for a safety problem at J1D and no satisfactory back-up site. WPAC recommends moving J3A to an alternate site in a simpler tectonic setting (See Appendix J).

PCOM forwarded the following names for the second co-chief to the Science Operator:

> Paul Baker (Duke), Gerhardt Einsele, Jim Ingle, Carolyn Isaacs (USGS), Hugh Jenkyns (Oxford), Kerry Kelts, Judy McKenzie, Joe Morley, Kenneth Pisciotto (San Francisco), and Hans Schrader

An early safety review by PPSP is recommended for this leg. New dates for Leg 128 are listed in Appendix H.

LEG 128

Leg 128 (Japan Sea II):
Co-chiefs: K.Suyehiro (J), tba.

Status: 30 days of drilling for sites J2A and JS2 are scheduled.

Pisias reviewed the status of Leg 128 (above). The drilling plan recommended by WPAC calls for a return to Site J-1b drilled during Leg 127 to deploy a downhole seismometer. The updated logging program for the leg is listed in Appendix J. A.Taira mentioned that the schedule for the downhole tools for this leg will not be impacted by the earlier departure date.

The new schedule for Leg 128 is shown in Appendix H. PCOM forwarded the following names to TAMU for consideration for the remaining co-chief slot:

> Paul Baker (Duke), Steve Calvert (UBC), Gerhardt Einsele, Jim Ingle, Carolyn Isaacs (USGS), Hugh Jenkyns (Oxford), Kerry Kelts, Judy McKenzie, Joe Morley, Kenneth Pisciotto (San Francisco), Alastair Robertson (Edinburgh) and Hans Schrader

LEG 129

Leg 129 (Nankai):
Co-chiefs: A.Taira (J), I.Hill (UK)

Status: Two sites are planned (NKT-1 and NKT-2) for a total estimated time of 57 days. An extensive geotechnical program at Nankai has been separated from this leg to be done at a later time if downhole tools are ready (Nankai Geotechnical leg).

Pisias reviewed the status of Leg 129. R.Jarrard has devised a scenario for Leg 129 downhole programs which is not dependent on the GEOPROPS probe availability (Appendix K). Jarrard explained that testing the probe early in the leg (and running only one-half of the possible measurements) as well as logging fresh holes were the main concerns. The logging program and times recommended by WPAC (Appendix J) are compatible with plans outlined in Appendix K. 20 days of logging are recommended at NKT-1 and NKT-2.

PCOM recognized that incorporation of the GEOPROPS probe into the Nankai leg would alleviate the need for a special Nankai Geotechnical leg. L.Garrison remarked that TAMU drilling times did not include contingency time for possible unstable hole conditions at NKT-2 or use of drill-in casing.

PCOM Consensus:

The Leg 129 Nankai program is extended to a full 60 days. TAMU Engineering is asked for input regarding possible unstable drilling conditions. DMP is asked to comment on the drilling strategy as it affects logging.

T.Shipley urged an early safety review of this program at the July PPSP meeting as gas hydrates may be a problem.

A.Taira reviewed the planned Japanese downhole temperature and OBS experiments for NKT-2. A Japanese engineer is coordinating with ODP engineers on the tool design.

The new dates for Leg 129 are listed in Appendix H.

FY90 PROGRAM IN THE WESTERN PACIFIC

Additional Nankai Programs (e.g geotechnical, hydrogeology)

T.Shipley, TECP liaison, reported that TECP reviewed the current proposals for additional Nankai programs at its last meeting and is not overly enthused at this stage. G.Brass, SOHP liaison, said the panel wants to see how this drilling is preferable to the proposed Cascadia Margin accretionary prism sites for fluid studies. Shipley said that TECP did not view that the existing hydrogeological proposal is an integrated experiment. Shipley added that seamount subduction in the area may affect system equilibria in the Nankai region.

Pisias noted that CEPAC has recommended a working group to study accretionary prism drilling and hydrogeology as they have similar questions about the Cascadia programs. Sufficient expertise in this area does not exist in the current panel structure.

PCOM Consensus:

Additional Nankai programs (e.g. geotechnical and hydrogeological studies) are to be further reviewed by SOHP and TECP. The fluids and accretionary prism problems are not adequately addressed by the available proposals.

This input is to be returned to panels and proponents in order to develop an improved proposal.

PCOM Consensus:

A working group on accretionary prisms will be established by the August PCOM meeting, with membership to be drawn from suggestions from and members of JOIDES panels.

Geochemical Reference Sites

Pisias said that the thematic panels were asked to discuss other scientific objectives that could be addressed by sites that also address objectives of geochemical reference holes. Several regions have been proposed (see map in Appendix L). G.Brass reviewed the many problems SOHP sees with the concept (heterogeneity, need for complete section in a single hole, fluid interactions, regional variation in sedimentation, etc.). SOHP continues to recommend old Jurassic crust sites with the geochemical reference sites a secondary priority.

M.Kastner reported that LITHP has changed its original recommendation of BON-8 as a reference site and now recommend a two stage strategy: shallow sites MAR-4, 5 and 6 in the FY90 WPAC program and a deep hole (A2-2) in M-18 crust, to be drilled during the CEPAC program.

Shipley reported that TECP (P.Vogt) has proposed four sites for the CEPAC program for this theme , but would agree with LITHP's approach and sites.

R.Larson recommended drilling sites in the JJ3 region on M-38 crust (see map in Appendix L) as this would yield first-order plate reconstruction data. Site surveys in this region are lacking, however.

P.Robinson remarked that LITHP has clearly identified geochemical reference sites as a important first step to understand the nature of subducting crust, but that other objectives should be addressed with this drilling, if possible. Brass pointed out that with massive alteration in old crust, drilling to 500m would merely scratch the surface. Drilling in cherts in these regions was also of concern to PCOM members.

Pisias summed up the discussions with the observation that the proposed geochemical reference sites clearly impact WPAC and CEPAC drilling schedules. The thematic panels are converging on the Marianas sites, but site survey data is lacking. If significant basement penetration is required, then these programs may face serious reappraisal, possibly moving them later in drilling program when new technology may improve sediment and crustal recovery.

PCOM Consensus:

LITHP will be asked to review the Mariana sites (MAR-4, 5 and 6) for geochemical reference site objectives and evaluate their importance if basement cannot be achieved. Should this program await assurance of drilling and recovery capability in the chert sequences known to be present in this area? SSP will be asked to identify where site surveys will be needed.

South China Sea Margin:

At its last meeting, PCOM asked TECP to reevaluate this program in light of the new survey data. Shipley reported that TECP reviewed the program, and though favorable to the concept of drilling in this back arc setting, did not endorse the proposal, as the plate kinematics and extensional tectonics are not well constrained in it.

Brass reported that SOHP is interested in the region for comparison to the NE Australia margin, but were pessimistic about dating the siliciclastic sediments.

PCOM Consensus:

> Due to the lack of JOIDES thematic panel support, the South China Sea Margin program is no longer scheduled for the Western Pacific drilling program.

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ADDITIONAL WESTERN PACIFIC PROGRAMS

Pisias reviewed the medium-range Western Pacific program. The NE Australia Margin program is unchanged, although early SSP review is urged. The Vanuatu program may require a spud-in test. The Lau program is unchanged since PCOM's last review. Pisias said that PPSP will be asked to assign "watchdogs" for WPAC programs.

L.Garrison reviewed scheduling of the medium-range WPAC program, which currently ends in mid-July 1990, and is a 9-leg program, excluding the geochemical reference sites and a proposed second engineering leg.

722 CENTRAL AND EASTERN PACIFIC PLANNING

N.Pisias called upon the PCOM thematic panel liaisons to report on CEPAC thematic programs designated at the last PCOM meeting.

LITHP OBJECTIVES IN CEPAC

M.Kastner reported on LITHP's response. The panel reviewed its highest-priorities for CEPAC drilling and came up with the following core program, which requires about 6.5 legs.

1.5	legs	Deepening 504B
2	legs	EPR
2	legs	Juan de Fuca/Escanaba
1	leg	Young hot spot volcanism (Loihi, Marquesas etc.)

Kastner said that LITHP would like a working group similar to the EPR-WG, to review sedimented ridge-crest drilling (Juan de Fuca, Gorda Ridge). LITHP has suggested a one-half leg engineering effort at 504B to condition the hole and test recovery there before further drilling is recommended.

PCOM discussed the results of the EPR-WG. Pisias said that with some change in membership and a new Chairman (current chairman, E.Davis, is a proponent), the same group could review the sedimented ridge drilling strategies.

Pisias said he would instruct CEPAC to include the following priority LITHP themes in their prospectus: EPR, 504B and sedimented ridge crest drilling. PCOM discussed the hot spot drilling in detail but wondered if the problems addressed by the Loihi drilling could be solved through dredging and land-based studies on Hawaii. LITHP was asked to respond specifically to this concern. LITHP will also be asked to reevaluate atoll/guyot drilling to see if some Loihi objectives might be achieved by other atoll drilling. The possibility of hotspot drilling as a back-up to an unsuccessful redrilling of 504B was also discussed by PCOM.

Pisias remarked on the challenge to long-range planning posed by assigning legs contingent upon engineering results. Enough time must be assigned, for example, between EPR efforts, to fully evaluate the results. This will impact any regionally based drilling programs.

SOHP OBJECTIVES IN CEPAC

G.Brass, SOHP liaison, reported on SOHP's four priority themes for CEPAC:

Neogene paleoceanography: needs at least three transects:

a. W-Equatorial transect: proposal 142/E
b. E-Equatorial transect: proposal 221/E
c. N-Pacific transect: Sites Meiji 1 and 2 (259/E); NW-1, 3 and 4 (199/E); PM-1A (247/E).

Mesozoic-Paleogene paleoceanography & sealevel - atolls and guyots:
Sites OS-3 (260/D); Allison, Menard and Wilde Guyots (203/E); Sylvania and Harrie Guyots (202/E); Enewetak (202/E). (also SHAT-1 and SHAT-3, see below).

Anoxic events: Sites SHAT-1 and SHAT-3 (253/E)

Brass remarked that not much paleoceanographic data exist from the Central and Eastern Pacific Ocean and all transects would be valuable. He said that black shales and anoxic events are important problems, although Hess Rise might give better recovery than the proposed Shatsky Rise. Larson added that if soft sediment/chert recovery is improved, Shatsky is the preferred site.

The PCOM watchdogs for the Neogene paleoceanographic transects reported on these programs. (N.Pisias, a proponent, was absent from this discussion; G.Brass served as PCOM Chairman pro tem.)

S.Gartner reviewed the paleoclimate objectives in the high productivity equatorial transects. He said that about 90% of the proposed programs would be required to achieve the lateral variability needed for the paleocurrent parameters. He remarked that DSDP cores that complete the transects may have degraded and may not be usable for these high resolution studies, however. H.Beiersdorf added that these studies fit well as components of global climate studies, especially the recent ODP paleoclimate legs.

Brass reported on the northern Pacific transect program, which combines sites from many proposals into about one leg in order to get sites with good fossil preservation. Gartner added that SOHP needs to provide better site information for this proposal. Brass reiterated the need for LITHP to re-evaluate guyot drilling as part of global sea level studies if SOHP recommendations for this drilling are accepted by PCOM.

Brass reiterated his concerns voiced during the COSOD II discussions, that more emphasis be placed on Mesozoic paleoclimate objectives, as the climate dynamics varied considerably from the Cenozoic ones (See Appendix F).

Pisias returned as Chairman and requested instructions from PCOM for the CEPAC prospectus. CEPAC will be asked to develop all SOHP themes with additional input from LITHP on guyot drilling.

TECP OBJECTIVES IN CEPAC

T.Shipley, TECP liaison reviewed TECP's priority programs in the CEPAC region.

1. M-Series dating (combined with Geochem.Ref.Sites?)
2. Lithosphere flexure (Hawaiian moat preferred; also LITH topic)
3. Ridge-trench interaction (Chile T junction)
4. Pre-70 MA plate motions (combined with Geochem.Ref.Sites?)
5. Deformation in accretionary prisms (Oregon margin of highest immediate interest)

Shipley said that further definition of accretionary prism drilling would depend on the Nankai results. Coulbourn, the PCOM watchdog for the lithosphere flexure program, reported that biostratigraphic resolution was still a problem. Also location of the transect may have to be changed after review of the recent GLORIA cruise in the area. Comparing this program with Marquesas drilling (an alternate site for this program), Coulbourn said that dating may be better there, but MSC coverage, now lacking, is essential.

O.Eldholm, watchdog for the Chile Triple Junction program said that the new survey data must be reviewed by the proponents soon.
With regards to the TECP pre-70 MA plate motion priority, Larson mentioned that core orientation problems will have to be addressed. Garrison responded that TAMU engineers are aware of possibilities for oriented core, but no engineers are currently assigned to this task. Larson said that the JJ sites (see map in Appendix L) would be important ones for the pre-70 MA studies.

Because TECP has not ranked their priority programs, PCOM was not as clear on instructions to CEPAC for tectonics themes. PCOM recognized that TECP themes such as M-series dating and pre-70 MA plate motion overlap with other thematic programs (e.g. geochemical reference sites).

<u>PCOM Consensus</u>:

CEPAC is instructed to continue developing the major themes identified by TECP for the prospectus. Multiple drilling objectives with other thematic programs should be recognized. TECP is instructed to contact proponents for better site definition for their priority programs.

723 LONG-RANGE PLANNING

PCOM discussed long-range planning throughout the meeting and consolidated their recommendations in an outline for the NSF long-range planning document (Appendix M).

A major concern was how to interpret and incorporate the COSOD II technology development budget recommendations into a realistic framework for the next four years and beyond. M.Kastner suggested that the following guidelines be forwarded to EXCOM:

PCOM Motion:

The following two drilling programs, which address the main scientific objectives proposed by COSOD II, to be reached over the next decade, should be presented to EXCOM:

1) Looking forward beyond 1992, to achieve the COSOD II objectives, the ideal flexible program will require a 50% increase in the level of effort, to begin in 1993.

2) The minimum acceptable, although less flexible program, will require a 10% increase in the level of effort.

(Motion Kastner, second Taira)

Vote: 14 for, 1 against, 1 abstain

Discussion:

Before voting, PCOM discussed the worst case scenario: budget cuts. B.Malfait pointed out that a steady-state program requires budget increases for the same level of effort due to inflation. PCOM agreed that to implement the full COSOD II program (multiple drilling platforms, ultradeep drilling, etc.), then Option 1 in the above motion would be a reasonable cost estimate.

Pisias explained that in the long-range planning outline (Appendix M) he was trying to overcome what he viewed as a shortcoming of the COSOD II document: It did not provide an overview of priorities which circumvented the boundaries defined by the COSOD II working groups. After 1992, and hopefully successful drilling at the East Pacific Rise, availability of a new drilling technology may impact all long-range planning. The updated position papers from the thematic panels and COSOD I will figure into these plans. PCOM agreed that the long-range program plan should focus on science, not budget constraints.

PCOM discussed the special meetings of the thematic panels for addressing long-range planning, and the importance of identifying and putting their "White Papers" themes on maps, i.e. identifying best places to drill priority themes.

PCOM Consensus:

PCOM endorsed the suggestions by the Panel Structure Review Subcommittee, as presented by M.Langseth at the April 1988 PCOM meeting, as guidance to PCOM and the thematic panels on planning science responsive to COSOD II.

M.Langseth asked that the thematic panels in particular respond to those global programs such as stress, climate and fluids and hydrothermal circulation identified in COSOD II and how WPAC and CEPAC drilling will contribute to their understanding. S.Gartner pointed out that under the new panel structure, there will be four thematic panels. Pisias said that the current SOHP panel will be asked to address the areas to be covered by the new panels. M.Langseth paraphrased a R.Anderson remark that "the worst criticism of ODP is that it is an energetic application of a methodology in a timely manner." He asked that ODP focus away from applying a tool, the drillship, and focus on completing thematic objectives.

Pisias remarked that the PEC review had focused on flexibility in the program. He said that PCOM's decision to allow extra time for Leg 124 for basement drilling was a good example of that flexibility. Despite flexibility, PCOM must make a statement on the direction of ODP beyond the Pacific no later than the December PCOM meeting this year. The rational way to approach this is through long-range plans from the thematic panels.

PCOM Consensus:

With regards to long-range planning for ODP: exciting science, as identified by the thematic panels, is the vector which points the ship.

PCOM discussed the suggestion by the Panel Review Subcommittee to "publish widely" the ODP long-range drilling plans. B.Tucholke wondered if a "request for proposals" for drilling at EPR should be circulated to the community. Pisias responded that the LITHP White Paper, published in the JOIDES Journal, identified slow-spreading centers as a priority drilling target, as did COSOD I. The scientific community should be encouraged to submit proposals responsive to major themes.

T.Francis, coordinator of the technology development chapter in the COSOD II document, asked that the idea of a permanent support vessel for on-station drilling not be abandoned so readily, as his figures (based on Legs 101-114) showed it could be cost effective. H.Beiersdorf supported this and suggested that a small working group investigate the continued use of support vessels.

723 OTHER PCOM ACTION ITEMS

SAMPLE REQUESTS

G.Brass reported that SOHP would like clarification from TAMU on a recent sample request denial. R.Merrill has responded that this request was made while the "one-year" rule was still in effect for those materials, not because a TAMU scientists was working on the problem, as reported by SOHP.

ODP ARCTIC DRILLING

T.Pyle and G.Brass have been asked to participate in an upcoming Arctic drilling symposium in Canada and have asked for PCOM's perspective for their presentations. An Arctic drilling plan for 1989-1994 from L.Johnson (ONR) was circulated, but not reviewed, at this meeting. PCOM (at least Olav Eldholm) expressed its continued interest in Arctic drilling and Tom was left in the cold on this matter.

THIRD PARTY TOOL DEVELOPMENTS

PCOM has requested that DMP monitor the development of third-party tools, which are of interest to ODP or are planned to be deployed in ODP. M.Langseth, DMP liaison reviewed DMP's response.

DMP recognized two types of tools:(a) instruments under development, such as GEOPROPS and (b) mature tools (such as HPC temperature probe, USGS susceptibility tool). DMP also recognized the difference between tools under development which will eventually become standard ODP tools, and those from individual investigators for "one-time" use on the JOIDES RESOLUTION.

DMP drafted a detailed plan on how ODP should approach the question of third-party tools in ODP for PCOM review. As an immediate step each DMP member agreed to collate a list of known third-party tool developments in his country. Science operator and logging contractor also will prepare a list of planned or proposed deployment of third-party tools in future legs.

Langseth reviewed the problematic areas in the document such as land-testing of third-party tools, provisions for spare parts for non-ODP tools, etc. He said that the DMP document needs to more fully separate the types of tools and recommendations for their use. R.Jarrard added that DMP's document principally addressed those tools which are intended for routine ODP use. Langseth said that DMP should be PCOM's watchdog for downhole tools outside of ODP development.

PCOM Consensus

> PCOM commends DMP on its first effort to develop a policy on third-party downhole tools for ODP. PCOM suggests that the document more clearly differentiate the catagories of tools under development (single investigator developments, e.g.) and outline approaches for each of these cases.

PCOM affirmed the need for acceptance testing by ODP to ensure that downhole tools can be deployed safely. Last minute requests by PIs to put tools on a cruise are not acceptable. M.Langseth suggested that a TAMU staff scientist be identified to monitor third-party tool developments and interact more with DMP.

OTHER DMP RECOMMENDATIONS

In fulfillment of his role of DMP liaison, M.Langseth forwarded additional DMP recommendations:

* For the first run of the formation microscanner, a dedicated scientist should be identified (Jarrard says its in the plan.)
* DMP 88/2 :ODP/TAMU should develop display capabilities to automate barrel sheets so that logging data can be integrated with the core descriptions.
* DMP 88/4: For Leg 121, holes NNER-9, NNER-10, 90ER-2, DMP recommended BHTV deployment in basement and over limited section in sediment in sediment as long as the data remain useful.
* DMP 88/8: DMP requests that TAMU respond to "processing bottlenecks" aboard the RESOLUTION. PCOM asks DMP to be more specific, and see if the planned processing upgrades for the FMS will address this issue.

JOIDES PANEL MEMBERSHIP

PCOM Consensus:

With regards to panel rotations for SOHP, PCOM recommends that the current membership be retained until this thematic panel is split. SOHP may request that guests attend meetings, if necessary, to supplement present panel expertise.

Other panel rotations considered were:

	Rotating Off	Suggested Replacement
LITHP:	J.Malpas (C)	J.Franklin (C)
	N.Peterson (FRG)	J.Erzinger (FRG)
TEDCOM:	J.Jarry (F)	J.Bonasse-Gahot (F)
	J.Kasahara (J)	H.Fujimoto (J)
	[J.Lowe will be replaced by W.Cotten]	
	Ch.Sparks (F) recommended as new TEDCOM chairman	
CEPAC:	U.von Stackelberg (FRG)	H.Beiersdorf (FRG)
	H.Jenkyns (UK)	P.Floyd (UK)

H.Beiersdorf noted that with the rotation of Peterson, LITHP no longer has a paleomagnetist. It was suggested that LITHP consider a paleomagnetist for its next panel rotation.

PCOM endorsed TEDCOM's selection of Charles Sparks as new Chairman.

WPAC: Jim Eade (SOPAC) will be invited to replace J.Recy as WPAC member-at large. If he cannot serve, J.Daniel (ORSTROM) will be invited.

NEW PCOM LIAISON ROTATIONS

LITHP: Malpas will replace P.Robinson
DMP: D.Cowan will replace R.McDuff and help out M.Langseth
CEPAC: M.Leinen was volunteered to replace R.Larson

<u>PCOM Consensus:</u>

PCOM thanks its departing colleagues, R.Larson and P.Robinson, (and in his absence, R.McDuff) for their outstanding service to ODP as PCOM representatives for their institutions and countries.

Robinson expressed his thanks and his hopes that the long-range planning will be fruitful. Larson said, "You can take this job and shove it, I ain't workin' here no more!"

There being no further business to consider, the meeting was adjourned at 1:30 PM.

JOIDES PCOM MEETING
19-22 April 1988

LIST OF APPENDIXES *

No	Document Description
A.1	FY 1988 NSF Budget (B.Malfait/NSF)
A.2	FY 1989 NSF Budget
A.3	FY 89 Budget and FY 90-92 Plan
A.4	NSF Long Range Planning of ODP Outline
B.1	FY89-92 Budget Summary (T.Pyle/JOI). Table PP-7 in FY89 Program Plan
B.2	JOI Report FY89-92 Program Plan: Engineering and Technology Highlights.
C	Shipboard Participant Tally, Legs 101 - 123 (TAMU/ODP)
D.1	Summary of Priority Tests for Leg 124E (TAMU/ODP)
D.2	Development Engineering Project Schedule (TAMU/ODP)
D.3	Summary of Alternate Tests for Leg 124E (TAMU/ODP)
D.4	Leg 124E - Costs and Sources of Funds (TAMU/ODP)
D.5	Chart of Development Engineering 'Generic' Technology Requirements (TAMU/ODP)
E	Wireline Logging Services Report and Schedule of Introduction of Logging Tools (L-DGO)
F	Summary of COSOD II Discussion - written at PCOM meeting 19-22 April 1988
G	Drilling Estimates of Legs 122 and 123 (April 7, 1988)
H	ODP Operations Schedule (Revised 4/25/88)
I	Overheads summarizing results from JOIDES Advisory Panel Subcommittee (from M.Langseth, Subcommittee member)
J	Western Pacific Regional Panel meeting, 11-13 April 1988, Executive Summary
K	Nankai Program Logging Scenario (from R.Jarrard, as presented at the WPAC meeting)
L	Map of recommended Geochemical Reference Hole Sites (from JOIDES Office)
M	Long Range Planning Outline - written at PCOM Meeting, 19-23 April 1988

* Attached to draft minutes of meeting

Changes in Logging for Upcoming Legs

<u>123</u> (Argo/Exmouth):

1) drilling strategy at AAP-1B changed to XCB A hole, case that interval in rotary B hole; requires 1.3 extra days for logging.
2) PCOM had added 4 days for VSP(1 day) and extra basement penetration, but change of ports absorbs 3 of those days.
3) DMP and 123 Operations Superintendant request that AAP-1B be completed before Exmouth site.
4) planned logging on track, including staffing of needed expertise in hydrofrac, VSP, and susceptibility.
5) stress-related experiments are also on ODP test of techniques: stress direction from televiewer breakouts and tube-wave anisotropy; stress magnitude from hydrofrac, breakout morphology, and core expansion.

<u>124</u> (SE Asia Basins):

1) drilling strategy changes to XCB A hole, case that interval in rotary B hole; requires 2 extra days for logging.
2) WPAC had dropped DMP-recommended televiewer stress because of time constraints; cochiefs strongly favor televiewer.
3) CMP recommendation to log shallow SUL-4 (if drilled); cochiefs think unlikely that time will permit drilling it.

<u>124</u> (Engineering Test)

1) most logging experiments on track.
2) probably add a brief test of ability to get logging tools down a mining/coring hole; DMP recommendation that the mining/coring system be designed with logging compatibility.
3) FMS test dubious, too soon.
4) Japanese request for 2 days to test deployment system for Nankai temperature string; 1/2 day feasible in present plan.

<u>125</u> (Bonmar):

1) no change, wireline packer on track

<u>126</u> (Bonin):

1) no change, FMS (Formation microscanner) on track.
2) no plans for high-temperature logging capability at Bon-1 (except 124E test of cooling hole with sidewall entry sub).

<u>127</u> & <u>128</u> (Japan Sea I and II):

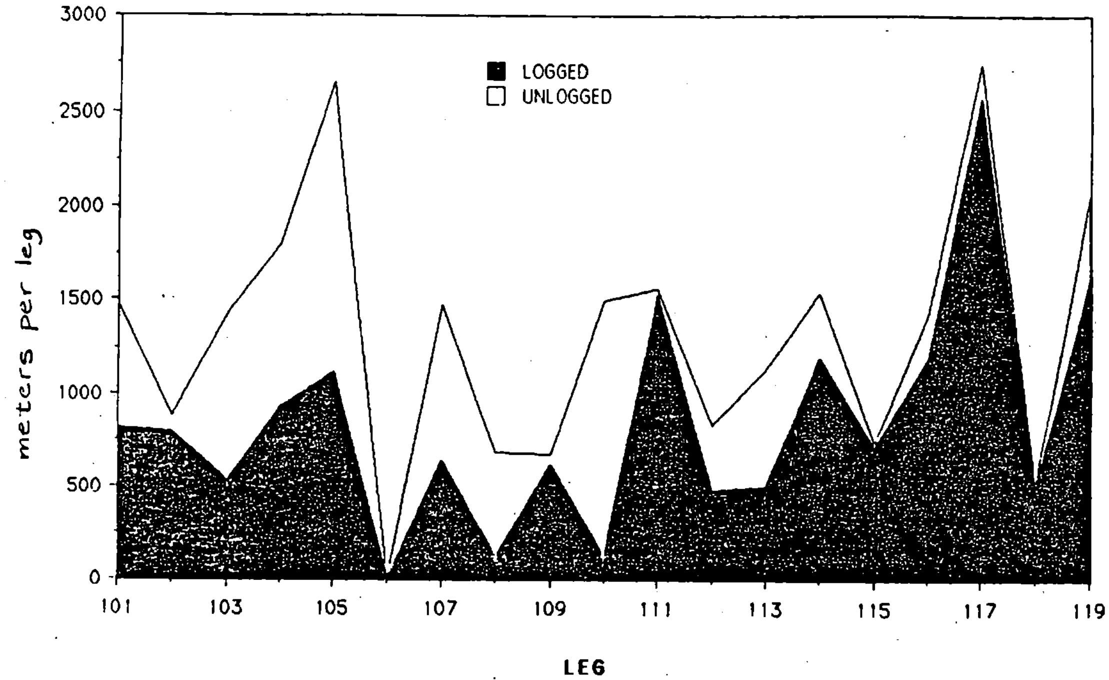
1) most logging plans on track.
2) some uncertainty about which leg to put J1b VSP and packer in,

to minimize costs and maximize shipboard expertise.

129 (Nankai):

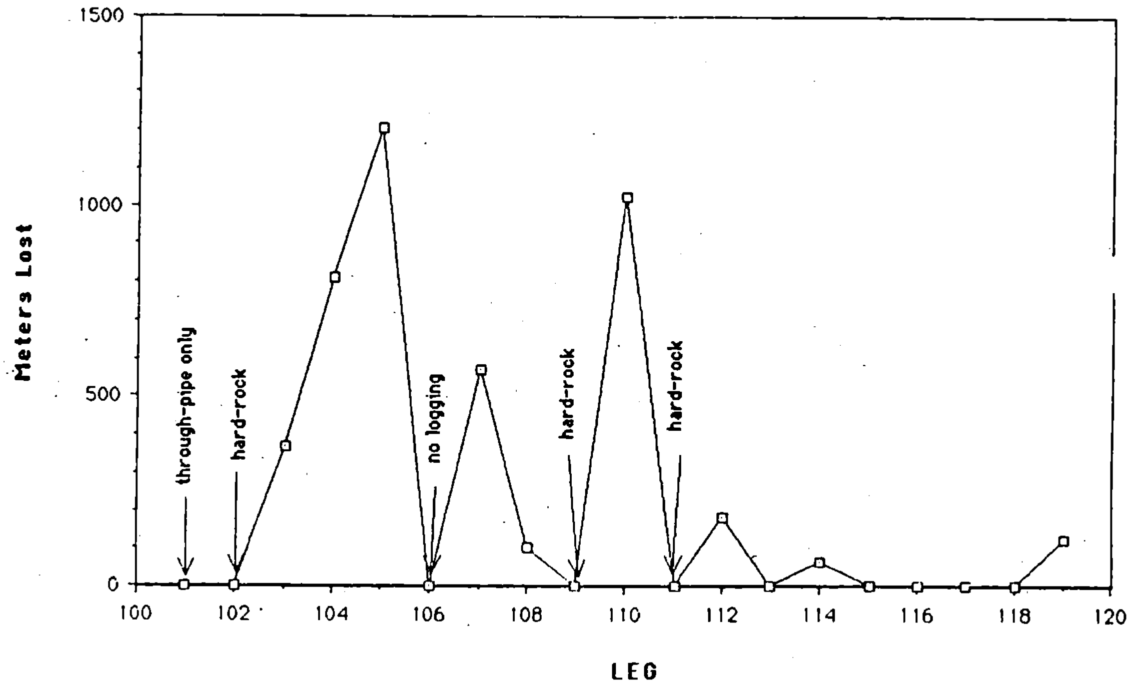
1) PCOM had asked DMP for a logging operations plan; DMP response was that a combined drilling/logging operations plan is warranted, requiring a 1-1.5 day meeting; DMP requested a working group for this.
2) major debate on whether one leg is sufficient for drilling and logging of NKT-1 and NKT-2; no analysis done of implications of drilling/logging delays on scientific returns.
3) DMP response to proposal for temperature string deployments, DMP continues to endorse experiment, but recommends extra hole and conditioning of scheduled reentry hole instead of proposed dedicated hole.
4) DMP response to proposal for VSP and offset seismic experiment: DMP continues to endorse both.
5) geopropo probe: PCOM postponement of Nankai leg makes tool development before leg feasible; development proposal pending; proponent thinks Jarrard strawman has too few geopropo measurements; DMP recommended running lateral stress tool for soft sediments.
6) known deficiencies in Jarrard strawman (Appendix K of April PCOM minutes): safety panel will not approve washing NKT-2 before coring; temperature string requires reentry cone.

LOGGING SUCCESS RATE
Evaluation of Legs 101-119 & Extrapolation to Future
(presented at April 1988 PCOM Meeting)

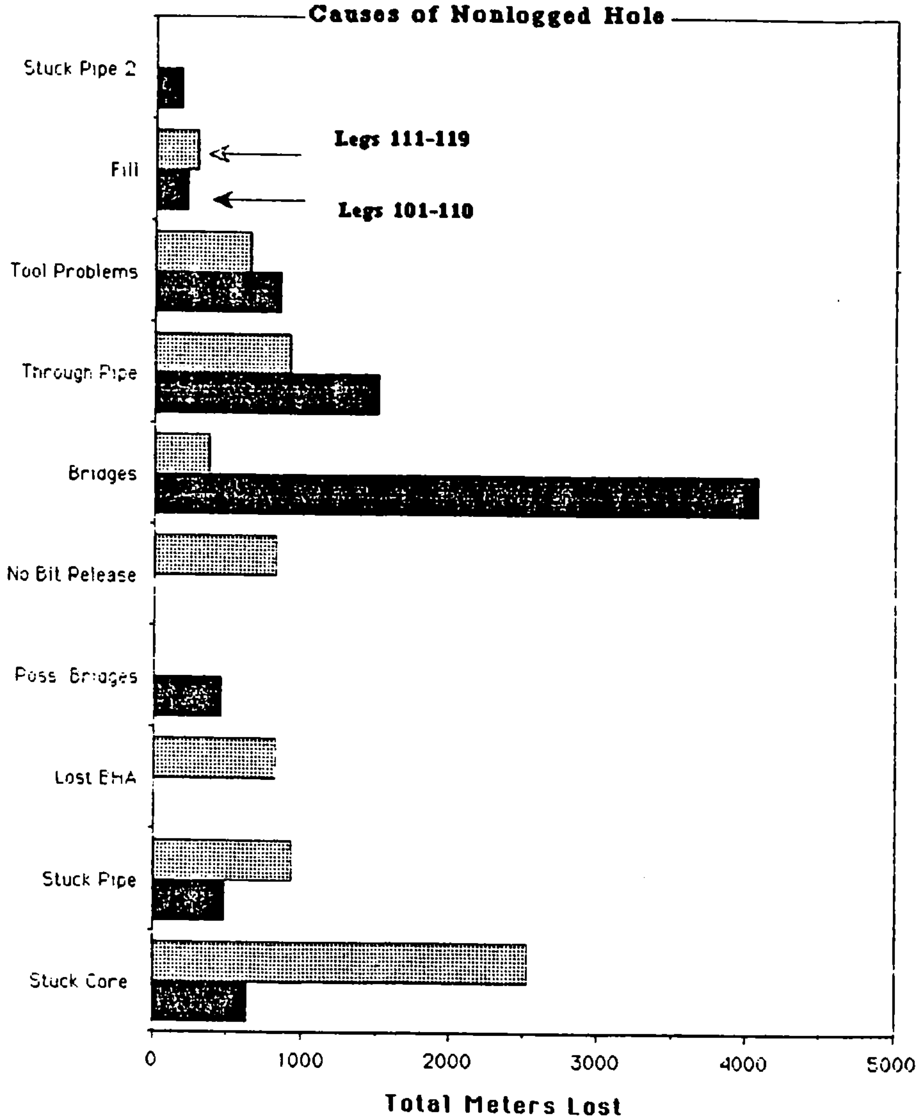


The upper line in this figure shows the total number of meters available to log per leg (the sum of the penetration depths of all holes with logging). The solid fill shows the actual total meters of hole logged (logging the same interval with more than one tool string does not affect this). In the first 10 ODP legs, only about 50% of available hole was logged. In the next nine legs, this percentage increased to about 90%.

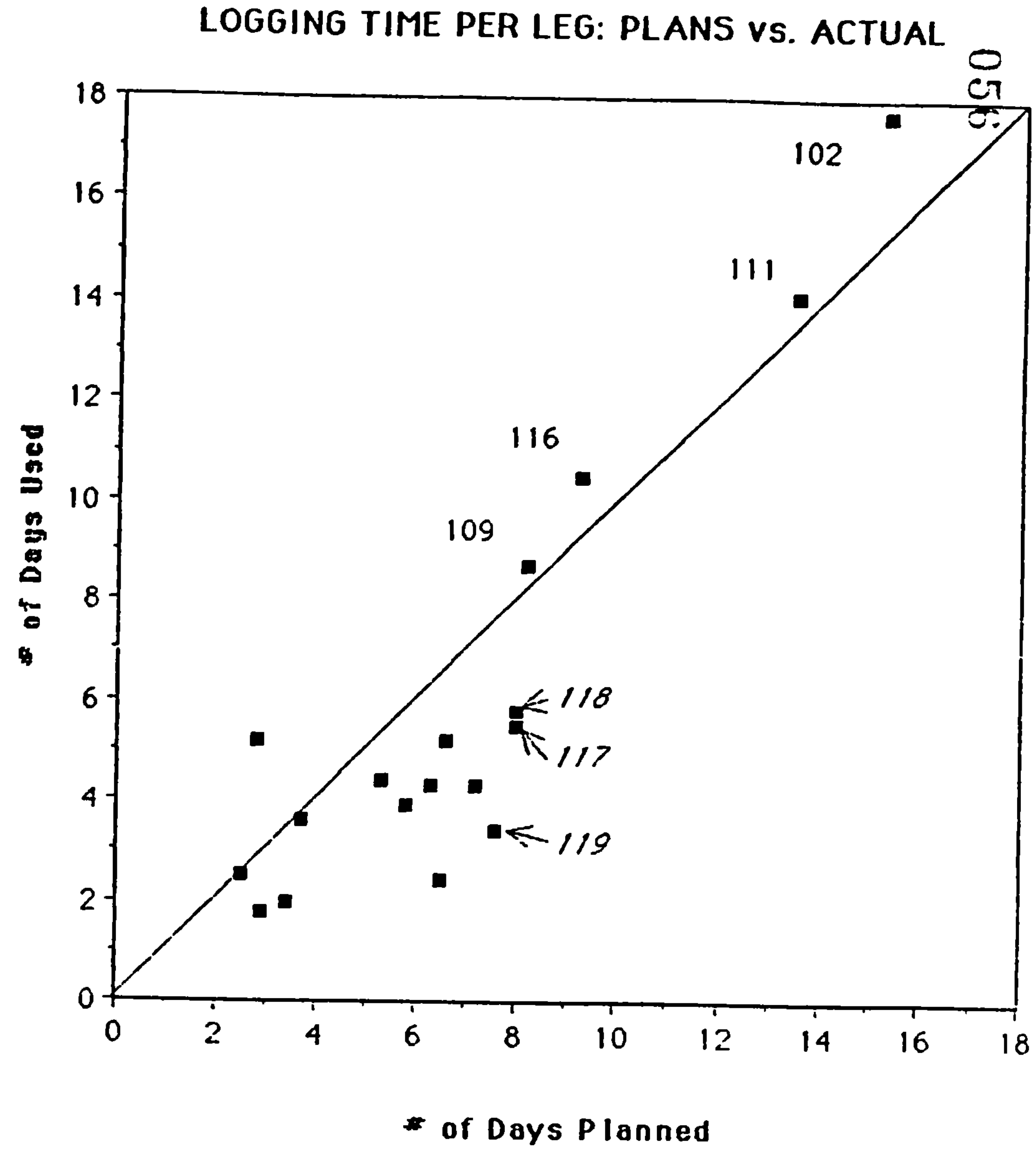
THE BRIDGE PROBLEM



Bridges have been the main reason that hole available for logging was not logged. A change from freshwater to salt muds is primarily responsible for the improved results since Leg 110. The sidewall entry sub, our second line of defense, has not yet been used in a hole to bypass bridges, although the bridge problem still may recur.

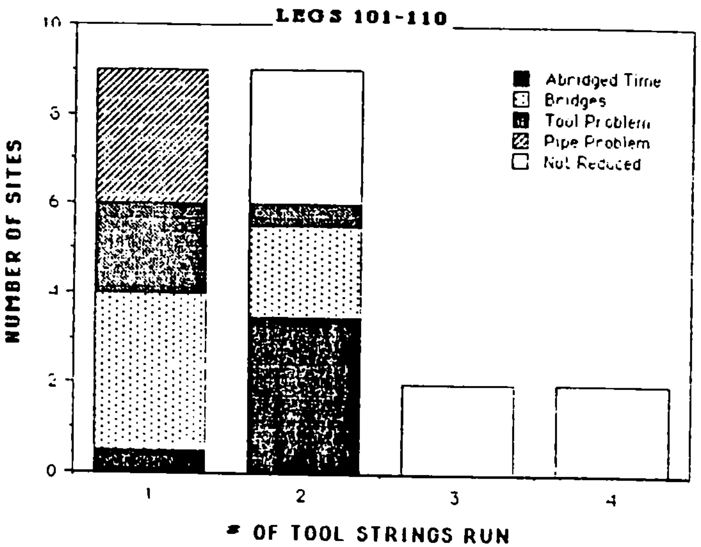


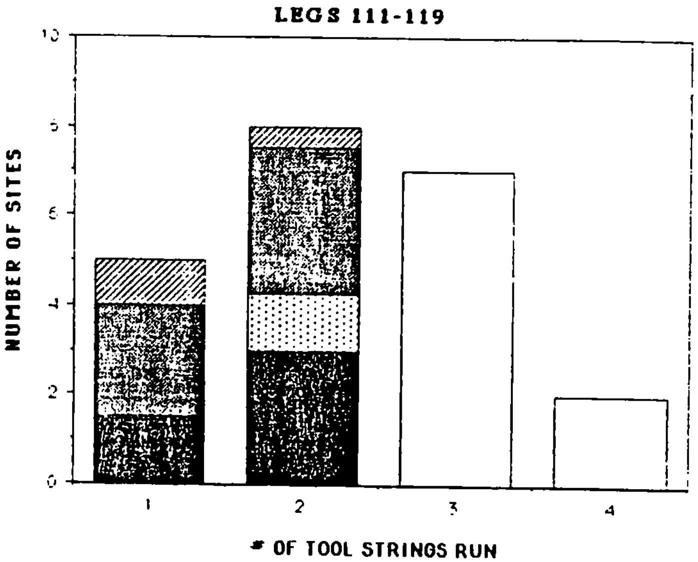
Other logging-related causes of unlogged hole, such as tool problems, have also been reduced since Leg 110. However, drilling-related problems (not shown on the two previous figures) have increased substantially. In particular, the quality of XCB coring has led to pushing XCB bits to failure, thus no attempt at logging was possible. In the future, very deep XCB holes can be logged in two stages, so that much of the hole will be logged even if XCB failure occurs.

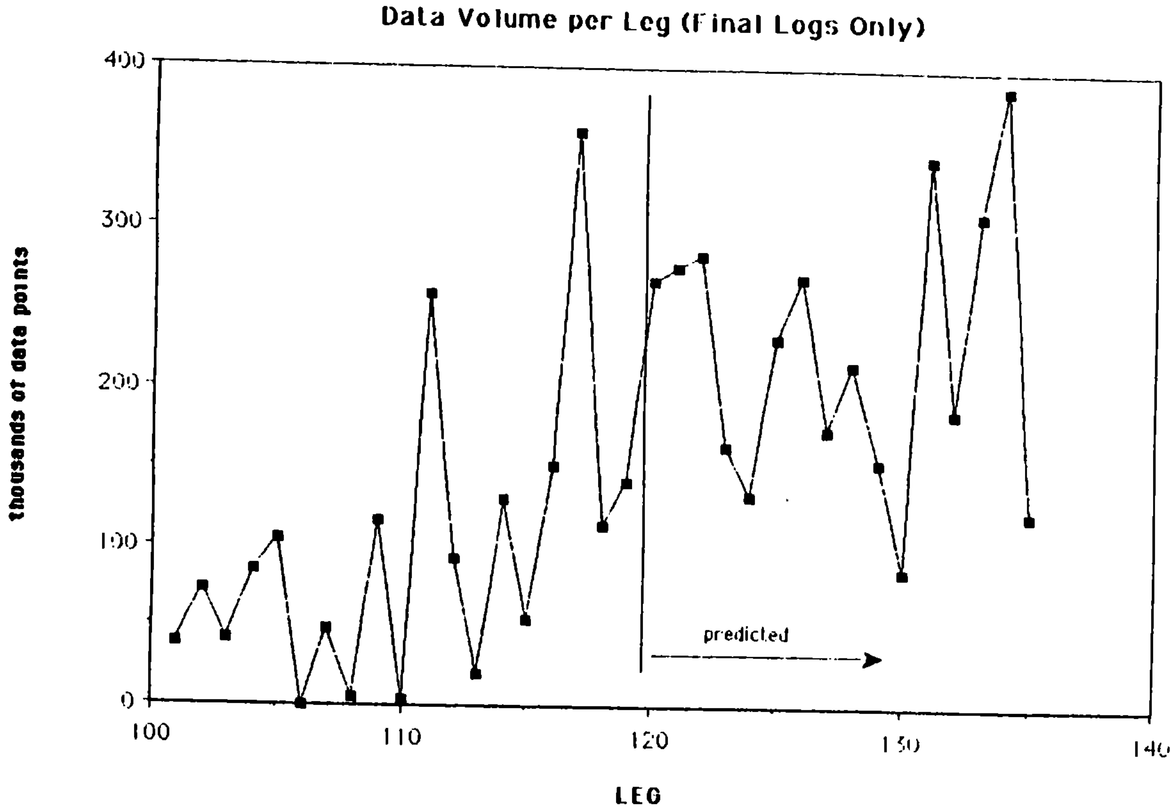


The actual number of logging days used per leg is usually much less than the number of days planned. This generalization is not true for deep basement legs (102, 109, 111, 118) but is virtually always true for sediment legs. The reduction has two primary causes: 1) cancellation of logging due to drilling problems (previous figure), or 2) reduction in the number of tool strings run (next figure).

L' 'TATIONS ON NUMBER OF TOOL STRINGS



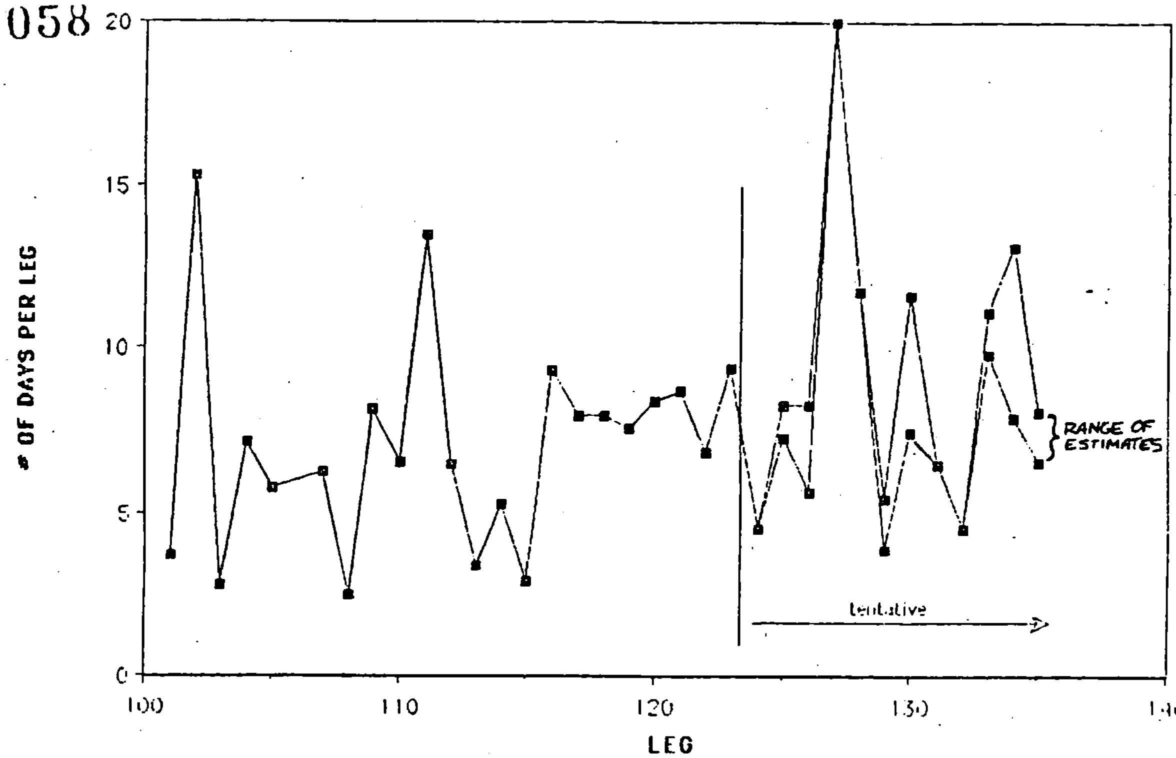




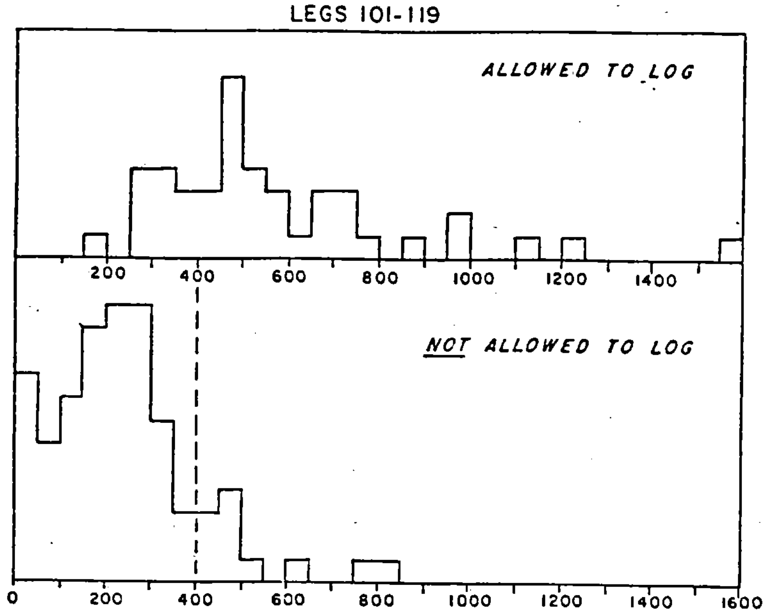
Starting on about Leg 103, "standard" Schlumberger logging has involved three tool strings. However, in the first 10 legs the number of strings run was almost always reduced in number to 1 or 2, primarily because of logging time reductions due to bridge problems or cochiefs' decision not to log. For Legs 111-119, the full three strings were run more often, partially because of the reduction in bridge problems. For the majority of sites using <3 strings, two key logging capabilities were lost: 1) continuous major element geochemistry, and 2) detailed normative mineralogy, including clay typing. We may improve our success at obtaining full standard logging suites by better tool repair and combining tools into only two tool strings.

The increased logging success has dramatically increased the data volume per leg, from Leg 101 to 119. In this figure, only final logs are included (e.g. 4 raw sonic logs produce 1 final sonic log, 256 GST logs produce 9 elemental logs). Televiewer and FMS (formation microscanner) logs are not included because one log can produce a million data points. Assuming no increase in the Leg 111-119 logging success rate, data volume will be even higher during WPAC.

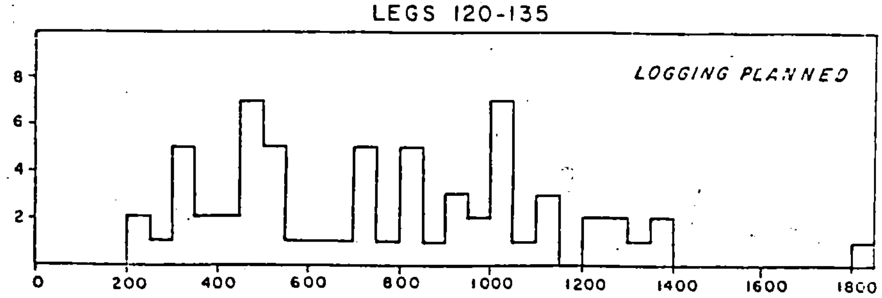
CHANGING AMOUNT OF ODP LOGGING PLANNED



LEGS 101-119



LEGS 120-135



The increased data volume during Legs 120-135 will be accomplished without an increase in average logging time per leg, primarily because these legs are expected to have deeper-penetration holes than the first 19 legs (upper figure). Logging efficiency is generally higher in deeper-penetration holes than in shallow holes. The anticipated reduction of standard logging from three to two tool strings will permit standard logging plus FMS logging in the same time previously required for standard logging alone.

TERMS OF REFERENCE
Science Advisory Structure of JOIDES for the Ocean Drilling Program (ODP)

4. Thematic Panels

Thematic Panels are mainly, but not exclusively, process orientated. They are established by the Planning Committee to redefine as scientific drilling objectives scientific problems identified by COSOD (16-18 November 1981) and by the JOIDES 8-year program for drilling (April 1982). They are responsible for reviewing any other scientific objectives proposed by the pre- and post-1983 reports and "white papers," the national science structures of the various non-U.S. participants, and the scientific community at large. Thematic Panels maintain a constant review of science in their discipline. Thematic Panels are composed of a number of members from U.S. institutions and one member from each non-U.S. participant. PCOM approves the panel membership. Panelists appointed in 1985 and future years will serve 3 years, with one-third of the panelists being replaced each year. The chairmen are appointed by PCOM. Thematic panels meet at least twice a year, but may meet more frequently as requested by PCOM. PCOM convenes the panel meetings and approves their meeting dates, locations, and agendas. The mandates are guidelines and do not restrict panels. Considerable overlap in thematic coverage has evolved and is expected to continue to evolve. The Planning Committee may ask Panels to take up topics not in their original mandates.

4.1 Ocean Lithosphere Panel: Mandate

4.1.1. The Ocean Lithosphere Panel is concerned with the origin and evolution of oceanic crust, and more particularly with volcanic, metamorphic, hydrothermal and diagenetic processes occurring in the ocean crust:

(a) Processes of submarine volcanology, intrusion and plutonism; crustal construction at spreading axes; petrology, geochemistry, mineralogy, and magnetic and other physical properties of igneous and metamorphic rocks from the ocean floor, from seamounts, from oceanic plateaus, from volcanic arcs and from basins adjacent to volcanic arcs.

(b) Processes of submarine hydrothermal circulation; petrology, geochemistry and mineralogy of hydrothermally altered rocks and hydrothermal deposits from the ocean floor; geochemistry and physical properties of hydrothermal solutions.

(c) Processes of submarine diagenesis; geochemistry of pore waters from sediments and hard rocks; petrology geochemistry and mineralogy of diagenetically altered sediments and hard rocks.

4.1.2. The Ocean Lithosphere Panel will be responsible for planning the drilling of sites concerned with these problem areas at the following levels:

(a) Long-range identification of objectives and review of research proposals for future drilling operations.

(b) Selection of target areas within which these objectives can be met.

(c) Helping the site survey organization to plan surveys of the target areas.

(d) Identification of proponents or working groups for particular target areas.

(e) Selection of sites for location of drill holes within the target areas, so that objectives can be reached.

(f) Advice to the Planning Committee and the project chief scientist on the selection of co-chief scientists and other scientists.

(g) Encouragement of specific shore-based laboratory work on the samples recovered by drilling.

(h) Advice to the project curator on the handling of recovered samples.

(i) Advice to the Planning Committee and the project chief scientist on provision of equipment for use on the drilling ship and in shore-laboratories run by the Science Operator.

(j) Coordination of plans for downhole experiments in projected holes.

4.1.3. In the course of the work specified in paragraph 4.1.2., the Ocean Lithosphere Panel will maintain the closest contact with the appropriate Regional Panels and other specialists.

4.1.4. The Ocean Lithosphere Panel is responsible to the Planning Committee, and will respond directly to requests from it, as well as reporting to it on a regular basis.

4.1.5. The Ocean Lithosphere Panel will act as a means of disseminating and correlating information in the appropriate problem areas by:

(a) Receiving reports from co-chief scientists on the progress with shorebased research on samples.

(b) Encouraging and sponsoring symposia at which the results of drilling will be discussed.

(c) Publishing progress reports in the open literature to inform and encourage participation in the project.

(d) Generating "White Papers" as requested by PCOM.

INSTITUTE OF OCEANOGRAPHIC SCIENCES
DEACON LABORATORY

Director: Sir Anthony Laughton, Ph.D., F.R.S.

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United Kingdom

Our Ref. Your Ref.

Dr. Nick Pisias,
Chairman JOIDES PCOM,
College of Oceanography,
Oregon State University,
Corvallis,
Oregon 97331,
U.S.A.

12 July, 1988

Dear Nick,

Lithosphere Panel Mandate

I have studied the mandate of the 'old' Lithosphere Panel on pages 12 and 13 of JOIDES Journal XI, Special Issue No. 4, and suggest the following revisions:

4.1.1(a) "Processes of submarine and volcanology, ..." does not make sense - a word is missing either before or after the "and". I am not sure which.

4.1.1(c) Since in the new panel structure there will be a Sediment Processes and Diagenesis Panel, "from sediments and" should be deleted.

4.1.3 Delete "Regional Panels" and replace by "Detailed Planning Groups".

With these minor modifications the mandate should be appropriate for the 'new' Lithosphere Panel.

John Malpas will send his comments to you directly.

Yours sincerely,

Tim

T.J.G. Francis

cc: Dr. J. Malpas

Canadian National Committee - ODP / Comité National Canadien - ODP

Centre for Earth Resources Research / Centre de Recherches en Ressources de la Terre
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Telephone: (709) 737-4708/4382
Bitnet: ODP@MUN
Omnet: J.MALPAS

MEMORANDUM

TO: Nick Pisias, Chairman, P.COM

FROM: J. Malpas, CANADA

SUBJECT: Rev. of Terms of Reference: LITH-P

DATE: July 20, 1988

Nick: Attached are some suggestions for revision of the Lith-panel mandate. I have used the previous mandates (JOIDES Journal VXI #4, p. 12-13) as a guide). The main changes are to:

a) include mantle interests;

b) delete diagenetic aspects; and

c) refer to new working group set up.

Section #'s are those referred to in JOIDES Journal (copy attached). Hope this suffices for discussion. I understand Tim has contacted you with his ideas.

Sincerely,

John

Att.

cc: Tim Francis

OCEAN DRILLING PROGRAM

PROGRAMME DE FORAGES DES OCEANS

Lithosphere Panel Terms of Reference:

4.1.1 The Ocean lithosphere panel is concerned with the origin and evolution of oceanic crust and mantle. In particular, important areas of investigation are volcanic, metamorphic, hydrothermal, structural and alteration processes occurring in the ocean crust. Also of importance to the lithosphere panel are mantle-crust interactions, mantle dynamics and composition, and solid-earth geochemical cycles.

a) OK

b) Processes of submarine hydrothermal circulation; petrology, geochemistry and mineralogy of hydrothermally altered rocks and hydrothermal deposits from the ocean floor; geochemistry and physical properties of hydrothermal solutions; ageing of ocean lithosphere.

c) Processes of mantle convection, melting and their relationship to basaltic rocks of the ocean basins. Mapping of mantle (geochemical) reservoirs and domains. Implications of solid earth geochemical cycles and fluxes of the global plate tectonic cycle. Mass balance problems.

4.1.2 OK

4.1.3 In the course of the activities specified in paragraph 4.1.2, the Ocean lithosphere panel will work in concert with designated working groups and other specialists.

4.1.4 OK

4.1.5 OK

4.2 Tectonics Panel: Mandate

The Tectonics Panel is concerned with the standard history of ocean margins and plates, especially studies in critical transects and along-strike by coordinated geological, geophysical, and drilling programs:

(a) Special emphasis is placed on the early rifting history of passive continental margins, on the dynamics of forearc evolution, and on the structural sedimentological and volcanic history of island arcs, back-arc basins, and marginal seas.

(b) Additional problems under the purview of this panel include the development of continental slopes and rises; detailed histories of vertical movements at margins; thermal and mechanical evolution of passive margins; structural variability along-strike; sheared margins; post-rifting tectonism of passive margins; the study of stress fields at active margins; global relations among arc systems; collision tectonics; the development of passive margins in back-arc basins; studies of transform faults at fracture zones; the origin, structure and tectonic evolution of oceanic plateaus and aseismic ridges; and the determination of plate-kinematic models.

(c) Of interest to this panel as well as to other panels are the composition, structure and formation of the oceanic crust and upper mantle, tephrochronology, and the study of "global" unconformities and the synchroneity of tectonics and sea level events along margins as well as coral atolls and guyots.

MANDATE FOR TECTONICS PANEL

Tectonics is the study of large-scale structural features, and their origin, evolution, and interrelations. The Tectonics Panel is correspondingly concerned with large-scale processes of deformation, including those that are active today at plate boundaries and those that are recorded in the structures and sediments of former plate boundaries. The Panel is also interested in the origin and evolution of large-scale constructional crustal features. The drilling-based tectonic studies that are evaluated and promoted by the Tectonics Panel fall into six groups, each listed below with some specific (but not exclusionary) examples:

1) Passive (extensional) margins - rifting history, rift-drift evolution and associated igneous activity, structure and origin of continent-ocean boundary zones; structural symmetry/asymmetry of conjugate margins; passive margins in back-arc basins; structural variability along-strike; thermal and mechanical evolution; history of vertical crustal movements; post-rift subsidence, tectonism, and sea-level history, their interrelations, and their effects on the sedimentary record; tectonic synchroneity.

2) Sheared (translational) margins - deformational history including crustal extension, shortening and vertical movements; structure and evolution of continent-ocean boundary zones; effect of tectonics on syn-rift and post-rift sedimentary record.

3) Active (convergent) margins - mechanics, kinematics, and mechanisms of deformation within accretionary wedges; thermal evolution and fluid flow; history of island-arc magmatism; sedimentation and deformation in fore-arc and back-arc basins; collision-associated deformation.

4) Divergent oceanic plate margins - structural evolution of mid-ocean ridge axes along "normal" spreading segments; origin and evolution of ridge-axis discontinuities (small offsets, overlapping spreading centers, transform faults, etc.); tectonic segmentation along mid-ocean ridges; origin of structural/tectonic asymmetries across spreading centers and ridge-axis discontinuities.

5) Origin and history of submarine plateaus, microcontinents, aseismic ridges, seamount (atoll, guyot) chains, and other large-scale features constructed, fragmented, or deformed during ocean-basin evolution; history of vertical motion of these features and its relation to eustacy.

6) Global measurements that are not uniquely identified with a particular type of plate boundary--Examples: kinematic histories of large and small plates; present-day states of stress within plates and near plate boundaries; rates and magnitudes of strain at active plate boundaries and at deforming zones within plates.

by Tucholke & Cowan

4.3 Sediments and Ocean History Panel: Mandate

The Sediments and Ocean History Panel is concerned with investigations of marine stratigraphy, marine sedimentology and paleoceanography. Areas specifically include:

(a) Stratigraphy including the subdivision, correlation and dating of marine sediments. Examples are refinement of magnetostratigraphy, radiometric dating, chemostratigraphy, biostratigraphy, tephrochronology, and seismic stratigraphy.

(b) Processes of formation of marine sediments, diagenesis, organic and inorganic sedimentary geochemistry and global mass balancing of oceanic sediments.

(c) Long-term history and driving mechanisms of the oceanic atmosphere and biosphere. Central to this theme are relations among plate tectonics and ocean paleocirculation, sedimentation patterns, global paleoclimates, glacial and ice-sheet evolution, sea level change and its effects on marine sedimentation and evolution of marine life.

DRAFT MANDATE

PALEONTOLOGY AND OCEAN PALEOENVIRONMENTS PANEL

The Paleontology and Ocean Paleoenvironments Panel is concerned with the various (all) aspects of the paleontological record in the oceans. Specifically included are:

1. The history and evolution of the marine biota - record, processess (drive), mechanisms.

2. The relationships between the evolution of the earth's biosphere, hydrosphere, atmosphere, and lithosphere.

3. The biostratigraphic record and its relationship to chronostratigraphy (via radiometric dating, magnetostratigraphy), isotope and chemostratigraphy, litho-, seismic-, and cycle-stratigraphy.

4. The marine environment as a record of ocean history

5. The marine environment as a record of the earth's climate.

DRAFT MANDATE

The Geochemistry, Diagenesis and Physical Properties Panel (GEODIP) is concerned with marine sedimentation and diagenetic processes, origin and evolution of marine sediments and seawater chemistry, global sediment and geochemical mass balances, hydrothermal processes in sedimented regions, and the aging of the oceanic crust. More specifically with four major themes:

1. ORGANIC AND INORGANIC SEDIMENTARY GEOCHEMISTRY AND DIAGENESIS

   Study the rates and nature of early to late diagenetic processes; the evolution of sediments to rocks; geochemistry of interstitial and formation waters; petrology, mineralogy, magnetic and other physical properties, and geochemistry of diagenetic phases and of bulk sediment; chemical paleoceanography.

2. TEMPORAL AND SPATIAL GLOBAL MASS BALANCES OF SEDIMENTS AND CYCLING OF ELEMENTS

   How much and what types of sediments are being subducted; relationship to tectonic processes and paleoceanographic processes such as sea level fluctuations and oceanic anoxic events; unconformities and disconformities; the C, S and P cycles; marine evaporites in early rifting systems and evaporite giants.

3. FLUID CIRCULATION AND GEOCHEMICAL BUDGETS

   Magnitudes and rates and plumbing systems of gravity and tectonically driven circulation in passive and active continental margins; chemical fluxes, biological activity, physical, mineralogical and geochemical alteration of margin sediments induced by fluid flow; interaction between submarine hydrothermal fluids and sediments, mineralogy, petrology, physical and geochemical properties of the hydrothermally altered sediments, and the geochemical evolution of the hydrothermal fluids; the origin and distribution of base metal deposits in continental margins and sediment blanketed hydrothermal systems.

4. THE AGING OF THE OCEANIC CRUST

   Low to moderate temperature alteration of oceanic crust; rates and types of reactions and associated chemical fluxes; changes in physical properties and fluid circulation with age.

TERMS OF REFERENCE
Science Advisory Structure of JOIDES for the Ocean Drilling Program (ODP)

8. Service Panels

Service Panels provide advice, services and products to the JOIDES Advisory Structure, to the Science Operator, and to the various entities responsible for the processing, curation and distribution of samples, data and information (including publications) to the scientific community. The Service Panels, beyond their help to the JOIDES Advisory Structure, are not directly involved with selection of drilling targets or definition of cruise objectives. Service Panels have specific mandates. Service panels meet at least once a year or as requested by PCOM. PCOM appoints the chairman and panelists and keeps membership under review.

58 - 195

June 5, 1988

To: Greg Mountain

From: M. Langseth

Re: The thermal regime the Sumisu Rift near ODP proposed Site Bonin 1 (BON 1).

A question was raised at the last Site Survey Panel about Proposed Site Bonin 1 and whether high temperatures might be encountered during the drilling of this hole. It is located on an actively spreading rift and recent volcanism and high temperature hydrothermal activity are anticipated.

Yamazaki (1988) has just reported 11 heat flow measurements in the rift at about 31^{o} N. The gradient measurements were made with relatively short 1.5 and 2 m probes. The volcanoclastic sediments in the rift made penetration difficult. At 6 of the 11 stations only 2 sensors were buried. The heat flow is generally high and variable the range is 38 to 700 mW/m^2.

The observations most relevant to assessing the thermal regime near BON 1 is a short E-W transect of closely spaced measurements (.5 to 1km spacing) across the most active zone of the rift at 30^{o} 48' N. See Figure 5 from Yamazaki. This zone has the thickest sediment and the deepest basement. All of the values along this short section are high 124-700 mW/m2. The gradients range from 139 to 840 deg/km just below the sea floor, but probably decrease by 20 to 30% with depth due to the increase of conductivity. Nonetheless, over the active part of the rift temperatures could reach 300 to 400 ^{o}C at depths > 500 m.

The scale of the variability is not well determined, but appears to be on the order of the thickness of the sedimentary cover, which is somewhat greater than km below the transect. This suggests that the variation is due to hydrothermal circulation in the basement crust below the sediment and there may be a significant flow of water through the sediment especially along faults, as Yamazaki speculates. In a submarine hydrothermal regime very high gradients and very low gradients can be found within several hundred meters of each other.

Yamazaki's measurement verify that the final locations of BON 1 holes should be based on a detailed 2-D survey of the sea-floor heat flow **and** porewater gradients of calcium and magnesium. This will allow BON 1 to be placed is on spot where the thermal gradient is low enough not to cause problems with drilling or downhole measurements, and assure that the drill holes locations relative to the hydrothermal circulation pattern are be known. We will learn a lot more from the hole if we know where we are drilling relative to the heat and fluid flow pattern.

I am sending a copy of this letter to Suyehiro to pass to his colleagues who will be making further heat flow measurements this year.

cc: Y. Suyehiro
Brian Taylor
N. Pisias ✓

Yamazaki, T. Heat Flow in the Sumisu Rift, Izu-Ogasawara (Bonin) Arc. Bull. Geol. Survey of Japan, 39(1) 1988.

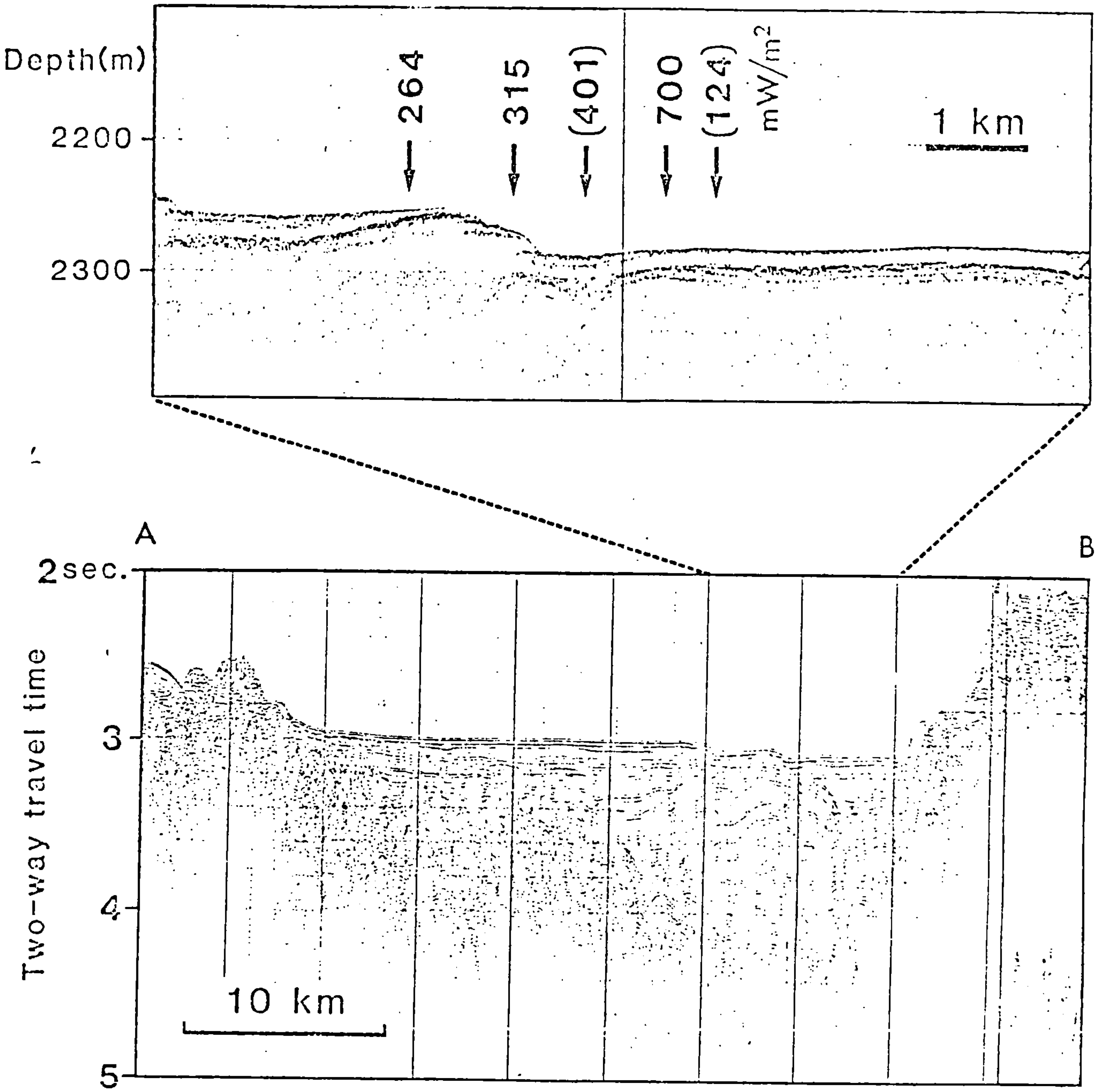


Fig. 5 Five closely spaced heat flow sites across an active normal fault. (Upper) Record of 3.5 kHz subbottom profiler and distribution of heat flow. Values in parenthese are less reliable. (Bottom) Seismic reflection profile. Location of the record is shown in Fig. 2. Several normal faults can be recognized on the profile.

From : Yamazaki, T. (1988), Heat flow in the Sumisu Rift, Izu-Ogasawara (Bonin) Arc. Bull. Geol.Surv. Japan, 39(1)

MEMO TO: PCOM
FROM: Brian Taylor *Brian Taylor*
RE: LEG 126

14 July 1988

At its April 1988 meeting, PCOM requested the Leg 126 co-chiefs "to justify the drilling depths for all sites". This followed a discussion of the "increased" drilling times estimated for BON-1 and BON-2 based on new MCS site survey data. This memo is a response to that request. The sites will be discussed in the order that they will be drilled (2,1,5B,5A).

The Leg 126 sites are all located at the intersection of 96-channel seismic lines which have been processed through migration (Fig. 1). An overview of the four sites is given on the two MCS lines (4* & 8) which cross them (Fig.s 2 & 3). Details of the crossing MCS lines at all four sites are shown in Figures 4-7 and 9-12. Because the MCS array length is one to three times the water depth of the proposed sites, the stacking velocities of the sedimentary section are usually well defined. Examples of the semblance data used to calculate depths at sites BON-1 and BON-2 are given in Figure 8. A summary of the drilling and logging plans used to estimate site times is given in the tables at the end of this report. The site times are marginally less than those submitted to PCOM in April mainly due to corrected estimates for measuring temperature and taking fluid samples.

BON-2

This site is located on the uplifted footwall block which bounds the eastern side of the Sumisu rift. It is halfway between the island arc volcanoes of Sumisu Jima and Tori Shima (Fig.1). There are two primary objectives at this site: 1) to determine the nature of the arc basement between, and distal from the proximal pyroclastic deposits of, the major arc volcanoes.

2) to determine the differential vertical motion history with respect to the rift basin in order to constrain models of the extensional tectonics.

The MCS dip line (Fig.s 2 & 4) shows that the site is located on the central horst of the footwall block. However the strike line (Fig. 5) and the SeaBeam data show that the site is on the flank of the structural apex. Single channel seismic data did not penetrate below the strong reflector at 535m, which was therefore considered to be igneous basement. In the WPAC 3rd prospectus a re-entry site was planned to drill 200m into this "basement", requiring 17.5 days. The new MCS data show a stratified reflector sequence down to at least 1150m. At 900m the seismic velocities increase to 2.7km/sec and at 1150m they increase further to 3.5 km/sec (Fig. 8). Penetrating 50m into this higher velocity material is proposed. This will provide the first significant active arc section drilled by DSDP-ODP and would compare favourably with the 914m drilled at Site 448 (stopped only because of time constraints) and 930m drilled at Site 451 on the Palau-Kyushu and West Mariana remnant arcs respectively. An ALVIN dive last summer on the rift wall to the west of BON-2 suggests that the section will be similar to that drilled at Sites 458 and 451 (interlayered volcaniclastics and basalt) with the probable addition of pummice.

The drilling time estimates assume penetration rates (10m/hr) similar to those experienced at Sites 448 and 451. Rotary coring to 1200m with a mini re-entry cone will reqire 12 days to drill the site (16 days if full re-entry), for a total site time including logging of 14.3 days.

BON-1

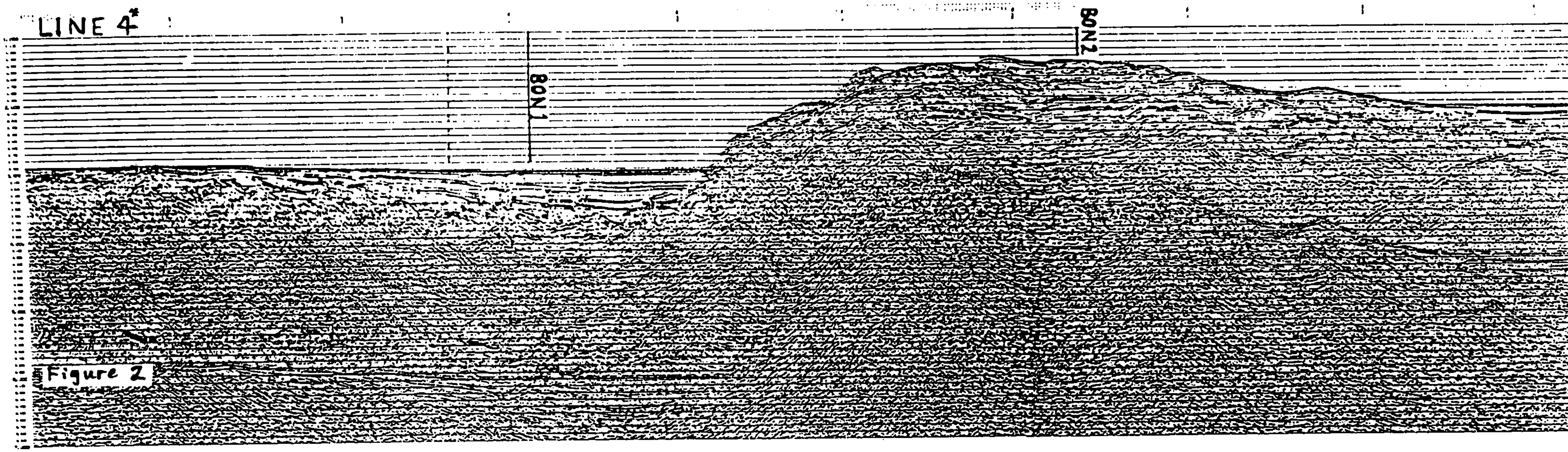
This site is located near the axis of the backarc rift basin to the west of BON-2. The primary objectives at this site are to determine:
1) the age of initial rifting
2) the nature of syn-rift sedimentation and volcanism
3) the subsidence history of the rift
4) the chemistry of circulating fluids
5) the extent of structural and metasomatic modifications to pre-rift stata.

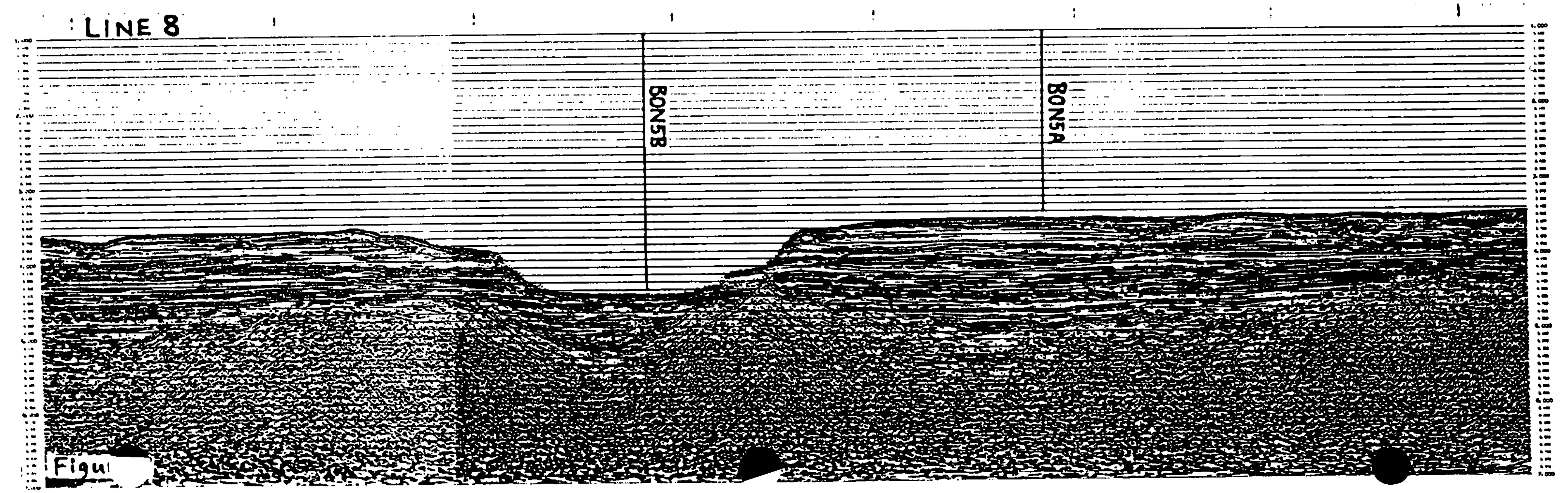
The MCS dip line (Fig.s 2 & 6) shows that the site is located in a tilted half graben cut by active synthetic normal faults. Together with the strike line (Fig. 7) the MCS data suggest that there is about 1km of syn-rift sediments overlying pre-rift stata. This is our best interpretation at this stage of processing (prior to pre-stack dip moveout). Certainly the syn-rift section is no thinner. Therefore the site is planned for 1050m, using a mini re-entry cone. The slow velocities of the upper 400m of sediments (Fig.8) suggests that they may be rapidly deposited hemi-pelagics and volcani-clastics which may be penetrated by the APC/XCB.

Also shown in Figure 6 is another site (BON-1A) updip to the west from BON-1, where the same targets are significantly shallower (the interpreted pre-rift strata are at 550m). A 600m hole drilled at this location would require about 9.1 days (7.2 days to drill an APC/XCB hole to 300m and an RCB hole to T.D., plus 1.9 days to log) - 4.5 days less than BON-1. However, (1) this location does not have a crossing MCS (or SCS) line and therefore may not be approved by PPSP, and (2) the syn-rift section may be thicker than our seismic interpretation suggests. The latter possibility makes the 1A site particularly desirable because the hole could be extended if the pre-rift strata (previously identified at BON-2) were not encountered by 600m. The next strong reflectors at BON-1A are at 4.1 seconds (Fig. 6) which is at an estimated depth of 1050m (Fig. 8). This was another reason for proposing to drill 1050m at the Sumisu rift site ("BON-1").

BON-5A & 5B

The locations are the same, and the depths and drilling times are very similar for these sites as in the WPAC 3rd prospectus (see end tables). Together, the two sites provide a complete section into basement of the central forearc. The estimated interval velocities and depths are shown on the seimic sections (Fig.s 9-12). Note that the basement reflectors at site 5B appear somewhat shallower on line 2 than on line 8 because of the cross-line dip to the south. See WPAC 3rd prospectus for detailed objectives.


LINE 4*
BON1
BON2
Figure 2


LINE 8
BON5B
BON5A
Figu

LEG 126: BONIN (B. Taylor, T. Ui)

Site #	Lat. Long.	Water Depth	Penetration Sed.	Bsmt.	Drill Days	Log Days	Total Days	Clearance	Prop.#
BON1	30°55'N 139°52.5'E	2270	1050	--	11.3	2.3	13.6	Japan	171
BON2*	30°55'N 140°00'E	1100		1200	12.0 (16.0)	2.3	14.3 (18.3)	Japan	171
BON5A	32°26'N 140°47'E	2700	925	--	8.6	1.5	10.1	Japan	171
BON5B	32°23'N 140°48'E	3400	800	100	12.3	1.6	13.9 51.9	Japan	171

ALTERNATE SITES

Site #	Lat. Long.	Water Depth	Penetration Sed.	Bsmt.	Drill Days	Log Days	Total Days	Clearance	Prop.#
BON1A	30°55'N 139°51.5	2270	600	--	7.2	1.9	9.1	Japan	171R
BON3	31°32'N 140°17.4'E	1250	860	40	8.6	1.4	10.0	Japan	171R
BON4	32°24'N 140°23'E	1800	850	50	8.9	1.4	10.3	Japan	171R

Total Days:

Transit (Tokyo-Yokahama)	2.0
Operational	51.9
Contingency	2.0
	56 days

Drilling Plan: BON1: HoleA - APC/XCB to 400m
HoleB - RCB to T.D. with mini-cone re-entry
BON2: RCB hole to T.D. with mini-cone re-entry
(Alternate scenario: HoleA - Exploratory RCB hole: 500m
HoleB - Re-entry RCB hole to T.D.)
BON5A: HoleA - APC to 200m
HoleB - RCB to T.D.
BON5B: RCB hole to T.D. with mini-cone re-entry
(temperature meas. & fluid samples every 100m at APC/XCB sites)

Logging Plan: FMS and 2 Schlumberger runs at each site
Mag/susc. at BON2 Wireline packer at BON1 & 2
Induced Polarization at BON1

Site BON1: Water Depth: 2270m
Penetration: 1050m sediment
Drilling Plan: Hole A - APC/XCB to 400m
Hole B - RCB to 1050m
(temp. meas. & fluid sample upper 400m)

		HOURS	
Locate site/Position ship		3	
Drillstring Roundtrip (APC)		12	
Wireline Time (APC):	17 cores @ 1.0 hr/core	17	
Wireline Time (XCB):	27 cores @ 1.2 hr/core	32.4	
Rotating Time (XCB):	240m @ 30 m/hr	8	
Drillstring Roundtrip (RCB)		12.5	
Drill 400m @ 30 m/hr		13.3	
Rotating Time:	600m @ 15m/hr	40	
	50m @ 10 m/hr	5	
Wireline Time (RCB):	71 cores @ 1.35 hr/core	95.9	
Freefall cone/Trip/Re-entry		25	
Temp. Meas. & Water Samples 4 @ (1.3 + 0.3)hr		6.4	
Secure ship/Get underway		1	
		271.5	= 11.3 days
Logging Plan:	Standard Schlumberger	30	
	Formation Microscanner	8	
	Wireline Packer	10	
	Induced Polarisation	7	
		55	= 2.3 days

Site BON2: Water Depth: 1100m interlayered
Penetration: 1200m volcanoclastics, pummice + basalt
Drilling Plan: RCB to 1200m with mini re-entry cone

		HOURS	
Locate site/Position ship		3	
Drillstring Roundtrip		9	
Wireline Time (RCB):	131 cores @ 0.9 hr/core	118	
Rotating Time (RCB):	1200m @ 10 m/hr	120	
Freefall cone/Trip/Re-entry		22	
Roundtrip + Re-entry (bit change)		14	
Secure ship/Get underway		1	
		287	= 12.0 days
Logging Plan:	Standard Schlumberger	30	
	Formation Microscanner	8	
	Wireline Packer	10	
	Magnetometer/Susceptibility	7	
		55	= 2.3 days

Site BON5A: Water Depth: 2700m
Penetration: 925m sediment
Drilling Plan: HoleA - APC to 200m
HoleB - RCB to 925m
(temp. meas. & fluid sample 2*100m)

		HOURS	
Locate site/Position ship		3	
Drillstring Roundtrip (APC)		13	
Wireline Time (APC):	22 cores @ 0.95hr/core	20.9	
Switch BHA		1	
Drillstring Roundtrip (RCB)		14	
Washing Ahead thru APCed section		2	
Wireline Time (RCB):	80 cores @ 1.4 hr/core	112	
Rotating Time (RCB):	725m @ 20 m/hr	36.3	
Temp. Meas. & Water Samples	2 @ (1.4 + 0.3)hr	3.4	
Secure ship/Get underway		1	
		212.0	= 8.6 days

Logging Plan:	Standard Schlumberger	29	
	Formation Microscanner	7	
		36	= 1.5 days

Site BON5B: Water Depth: 3400m
Penetration: 800m lithified sediment; 100m stratified basement
Drilling Plan: RCB to 900m with mini re-entry cone

		HOURS	
Locate site/Position ship		3	
Drillstring Roundtrip		16	
Wireline Time (RCB):	104 cores @ 1.7 hr/core	177	
Rotating Time (RCB):	800m @ 15 m/hr	53.3	
	100m @ 5 m/hr	20	
Freefall cone/Trip/Re-entry		26	
Secure ship/Get underway		1	
		296.3	= 12.3 days

Logging Plan:	Standard Schlumberger	30	
	Formation Microscanner	8	
		38	= 1.6 days

Site BON1A: Water Depth: 2270m
Penetration: 550m syn-rift sediment
50m pre-rift strata (like BON-2)
Drilling Plan: Hole A - APC/XCB to 300m
Hole B - RCB to 600m
(temp. meas. & fluid sample upper 300m)

		HOURS	
Locate site/Position ship		3	
Drillstring Roundtrip (APC)		12	
Wireline Time (APC):	16 cores @ 1.0 hr/core	16	
Wireline Time (XCB):	17 cores @ 1.2 hr/core	20.4	
Rotating Time (XCB):	150m @ 30 m/hr	5	
Drillstring Roundtrip (RCB)		12	
Drill 300m @ 30 m/hr		10	
Rotating Time:	250m @ 15m/hr	16.7	
	50m @ 10 m/hr	5	
Wireline Time (RCB):	33 cores @ 1.25 hr/core	41.3	
Freefall cone/Trip/Re-entry		25	
Temp. Meas. & Water Samples 3 @ (1.3 + 0.3)hr		4.8	
Secure ship/Get underway		1	
		172.2	= 7.2 days

Logging Plan:	Standard Schlumberger	25	
	Formation Microscanner	6	
	Wireline Packer	8	
	Induced Polarisation	6	
		45	= 1.9 days

Site BON4: Water Depth: 1800m
Penetration: 850m sediments, 50m basement
Drilling Plan: RCB to T.D. with mini re-entry cone

		HOURS	
Locate site/Position ship		3	
Drillstring Roundtrip		11	
Wireline Time (RCB):	99 cores @ 1.0 hr/core	99	
Rotating Time (RCB):	850m @ 15 m/hr	57	
	50m @ 3 m/hr	17	
Freefall cone/Trip/Re-entry		25	
Secure ship/Get underway		1	
		213	= 8.9 days

Logging Plan:	Standard Schlumberger	27	
	Formation Microscanner	7	
		34	= 1.4 days

Site BON3: Water Depth: 1250m
Penetration: 860m sediments, 40m basement
Drilling Plan: RCB to 900m with mini re-entry cone

		HOURS	
Locate site/Position ship		3	
Drillstring Roundtrip		10	
Wireline Time (RCB):	97 cores @ 0.9 hr/core	87.3	
Rotating Time (RCB):	860m @ 15 m/hr	57.3	
	40m @ 2 m/hr	20	
Freefall cone/Trip/Re-entry		24	
Condition Hole		4	
Secure ship/Get underway		1	
		206.6 =	8.6 days
Logging Plan: Standard Schlumberger		27	
Formation Microscanner		7	
		34 =	1.4 days

U.S. GEOLOGICAL SURVEY
OFFICE OF ENERGY AND MARINE GEOLOGY
BRANCH OF ATLANTIC MARINE GEOLOGY
WOODS HOLE, MA 02543

JULY 8, 1988

MEMORANDUM

TO: Nick Pisias, Chairman, JOI-PCOM

88-260

FROM: Mahlon Ball, Chairman, JOI-PPSP

REC[illegible]

SUBJECT: PPSP meeting of 6/28 - 29/88

This meeting was held at the College of Oceanography, Corvallis, Oregon.

Attendance:

Yutako Aoki, JOI-PPSP
Mahlon Ball, JOI-PPSP
Graham Campbell, JOI-PPSP
George Claypool, JOI-PPSP
Dietrich Horn, JOI-PPSP
David McKenzie, JOI-PPSP
Karl Hinz, Co-Chief Scientist, Leg 124
Eli Silver, Co-Chief Scientist, Leg 124
Nick Pisias, PCOM Chairman
Michael Wiedicke, Joides, OSU
Lou Garrison, ODP/TAMU
Glen Foss, ODP/TAMU
Marta von Breymann, ODP/TAMU
Thomas Thompson, ODP Safety Comm.
Kiyoshi Suyehiro, SSP Liaison
Carl Brenner, JOI, Data Bank, LDGO
Lee Stevens, JOI, Washington, DC

Carl Brenner led a rediscussion of site AAP-2. The site was approved anywhere along line 4 between 4 Nov. 1330-1515 or along line 6 between 7 Nov 2140 - 8 Nov 0000 of Atlantis II cruise: 93-14.

Carl Brenner, Lou Garrison and Mahlon Ball led a rediscussion of sites EP7V and EP12P. Both these sites were approved by PPSP at the 5 April 88 meeting with the stipulation that EP12P must be drilled first. Subsequently, it has been determined that time is only available for drilling one of these holes.

PPSP decided that if only one of the two sites, EP12P and EP7V, can be drilled, that site must be EP12P.

Eli Silver led a discussion of leg 124 site, Banda 2. PPSP approved this site to be drilled at 0600 on Kana Keoki line 23 to a depth of approximately 1000 m sub-bottom. Permission is granted to drill beyond 1000 m to reach basement as long as there are no indications of continental section underlying this site.

Karl Hinz led a discussion of Celebes and Sulu Sea sites.

Celebes 1 site was approved between SP 100-300 on line S04902 to a depth of approximately 850 m sub-bottom. Permission was granted to drill beyond 850 m to basement.

Sulu Sea site 3 was approved as proposed with alternate SS3 alpha approved at SP 2180 on line S049#5 to approximately 1300 m sub-bottom with permission to drill to basement.

Sulu Sea, site 4, was approved at SP 4000 on line S049#5 to 1200 m sub-bottom with the understanding that a cross line would be shot to confirm the northward basement slope inferred from lines parallel to S049#5.

Sulu Sea, site 1, was approved at SP 1000 to 1250 m sub-bottom, with alternate sites approved at SP 1179 to 1100 m and SP 1309 to 1100 m; all on line S049#7.

Sulu Sea, site 2, was approved at SP 1782 to 1100 m sub-bottom on line S049#4.

Cugayan Ridge, site 1, (PCOM proposal, Sulu 4) was approved to 400 m sub-bottom at SP 624 on line S049#7.

South China Sea, sites SCS 10, 10A and 10B were approved as proposed.

Manila Trench Transect, sites MTT5 and 9A lacked sufficient documentation and PPSP deferred any decisions on these sites pending presentation of more sufficient documentation.

Lou Garrison and Glen Foss led discussion of the engineering test drilling on Leg 124E. PPSP approved engineering sites, ENG 1-4, as proposed.

Kiyoshi Suyehiro led a preview discussion of legs 127 and 128 in the Sea of Japan. PPSP saw no reason to rule out Sea of Japan drilling but asked that heat flow measurements in that area be used to calculate temperature-depth profiles in order to arrive at hydrocarbon maturation depths for this region.

Kiyoshi Suyehiro also presented PPSP with a preview exposure to an excellent seismic reflection multichannel dip line across the Nankai Trough.

George Claypool led a discussion of his letter and graph expressing methane-ethane (C_1 - C_2) ratio relationship to subsurface temperatures. This letter and graph (attached) will be made available to shipboard scientific parties and incorporated as an addendum to the next revision of the safety manual. It was decided that George Claypool would contact Barry Katz of Texaco concerning data compiled by Katz on DSDP/ODP oil shows and that ODP/TAMU would set in motion a compilation of DSDP/ODP gas shows. These show histories should provide additional information for analysis of C_1 - C_2 ratios.

Mahlon Ball led a discussion of revision of Guidelines for Safety Reviews. It was decided that Ball would assemble a draft of the revised Guidelines incorporating revisions proposed by Safety Panel members and Joides would mail this draft to panel members for final editing and submission to Ball by July 21, 1988. Ball will in turn compile a final draft and submit it to Joides by July 28, 1988.

PPSP decided to request its next meeting in Honolulu, Hawaii to review legs 125 and 126, to review or preview Nankai, site 2 and to preview the N.E. Australian Margin.

MEMORANDUM

Graduate School of Oceanography
University of Rhode Island
Kingston, RI 02881

To: Nick Pisias, PCOM Chairman
Dave Rea, CEPAC Chairman
From: Bob Detrick, LITHP Chairman
Subject: CEPAC Drilling Program

Date: Tuesday, July 12, 1988

88-251
RECEIVED JUL 14 1988

At the last PCOM meeting a number of issues concerning drilling in the Pacific were raised that will be discussed again by both CEPAC and PCOM before LITHP meets again in September. In order to insure that LITHP's positions on these matters is clear, I am taking the liberty of responding to those questions in this memo. In composing this response I have relied on the panel's previous discussions, its White Paper, and direct consultations with some members of the panel and other proponents of lithospheric drilling.

General Comments

LITHP has repeatedly stated that a minimum lithospheric drilling program in the Pacific should consist of 6 1/2 legs addressing four of our panel's highest priority global thematic objectives:

Structure of the lower oceanic crust	Hole 504B (Proposal 286/E)	$1^{1/2}$ legs
Magmatic and hydrothermal processes at sediment-free ridge crests	EPR (EPR Working Group Report)	2 legs
Magmatic and hydrothermal processes at sedimented ridge crests	NE Pacific (232/E, 224/E, 284/E, 275/E)	2 legs
Early evolution of hot spot volcanoes	Loihi (282/E)	1 leg

Geochemical reference holes, which we consider primarily a WPAC program, are also a high priority LITHP objective. Our panel also has endorsed TECP and SOHP drilling in the M-Series/Jurassic Quiet Zone, Hawaiian flexural moat and on Ontong-Java Plateau since these programs have some lithospheric objectives..

LITHP is deeply disturbed by efforts to limit CEPAC drilling to nine legs, especially since this totally arbitrary time limit has no scientific justification, but appears to be motivated entirely by political considerations. LITHP, perhaps more than any other panel, has identified the Pacific as the area where our most important global drilling objectives can be best addressed. LITHP has patiently "waited its turn" while SOHP and TECP drilling at high latitudes and in the western Pacific was completed. In our view it is now time for ODP to address the drilling objectives of the lithospheric community. However, the four legs allocated by PCOM to lithospheric drilling in CEPAC are simply not enough to complete even the minimum drilling program identified by LITHP. With this plan one important Pacific drilling objective won't be addressed at all (young hot spot volcanism), and others will not have enough drilling time to be done properly (e.g. sedimented ridge crests; 504B). Moreover, with only an 18-month CEPAC program there is a real danger that not enough time will be available to carry out the engineering development legs that are a necessary prelude to the East Pacific Rise program. We hope both CEPAC and PCOM will **insist** that enough drilling time is allocated to CEPAC to achieve the most important thematic drilling objectives in this area.

Loihi Drilling (282/E)

At the last PCOM meeting some questions were raised about drilling Loihi; specifically what added scientific objectives could be addressed by drilling at Loihi that can't be learned from dredging, drilling on Hawaii, or by extending the drilling program on atolls. Loihi has consistently ranked among the top LITHP drilling programs in the Pacific. Loihi is the best place in the world to examine the early stages of hot spot volcanism. The discovery of alkalic basalts on Loihi was a milestone in the development of our concepts of oceanic intraplate volcanism. Prior to Loihi it was generally accepted that the early stages of hot spot volcanism were tholeiitic in character. Data from Loihi has suggested that the early tholeiitic stage is preceeded by an alkalic stage. Drilling at Loihi will provide critical new insight into this juvenile alkalic stage of Hawaiian volcanism and the physical and chemical processes involved in mantle plumes and their interaction with the lithosphere. Drilling may also give us a better understanding of the mechanics of hotspot propagation and formation. Finally, long-term instrumentation of this hole will provide new information on the seismicity and hydrothermal activity associated with a young, active submarine volcano.

Drilling can provide three unique contributions to Loihi investigations that are unavailable from dredging or submersible sampling. First, drilling can sample deeper crustal levels not generally accessible at the sea floor and reveal details of the early magmatic history of a hot spot volcano. Submersible sampling on Loihi has given ambiguous results. The western pit crater walls display alkalic basalts at the base and tholeiites near the top, while the eastern pit crater exposes only tholeiites. Surface flows are a mixture of alkali basalts and tholeiites. These observations are consistent with the interpretation that the alkalic basalts precede the tholeiites, but they do not eliminate the possibility that both types of lavas have been erupting simultaneously. The role of alkali basalts and tholeiites in the construction of Loihi can only be determined by drilling.

Second, drilling can provide a vertical stratigraphy of lavas, unavailable from dredging, that can be used to investigate temporal variations in the chemistry of juvenile hot spot magmas. Clague and Moore determined the age relationships of tholeiites and alkali basalts by palagonite rind dating. This technique is, however, poorly worked out and unreliable, especially when comparing different rock types. The stratigraphically derived ages determined from drilling will thus provide critical new constaints on the sequence of the eruptive activity at Loihi and the origin of its distinctive isotopic signature.

Finally, the drill hole itself is extremely valuable as a potential site for long-term geophysical monitoring and borehole experiments. The proximity of Loihi to Hawaii makes this an ideal site for a long-term, ocean bottom observatory. The potential value of such an observatory, especially in the vicinity of the most accessible and best studied active volcano on Earth is enormous.

Could we obtain these same objectives by drilling on Hawaii or on older atolls and guyots? Absolutely not. We would have to drill over 5 km at Hawaii to reach the Loihi stage of formation. Even if that were technically feasible, the rocks would be so modified (both chemically and mechanically) by subsequent intrusive activity that they would be unrecognizable and would tell us nothing about early hot spot volcanism. The same problem exists on atolls. Deepening an atoll drill hole a few hundred meters into basement will tell us nothing about the early stages of hot spot volcanism.

Loihi presents a great opportunity to address a problem of fundamental significance to marine geology. The proposed site has been extensively studied, and is ideally located for long-term instrumentation and monitoring. It is in relatively shallow water (1000 m) making it a technically feasible target for the new mine coring system, even with its drill string limitations. Loihi drilling should be a key element of any CEPAC drilling program.

Geochemical reference holes

PCOM has asked LITHP to again reconsider the geochemical reference hole drilling program in the western Pacific, and its integration with potential CEPAC programs in this area. Questions were also raised about the availability of site survey data for these holes and the chert problem.

A viable reference hole drilling program requires sampling the three major components being subducted: 1) a normal, marine pelagic sequence, 2) normal oceanic crust, and 3) ocean-island lavas and volcanogenic sediments (in some areas Cretaceous lava complexes may also be important). In addition, we wish to examine the origin of the first-order geochemical differences between the Bonins and Marianas. While every effort should be made to integrate this drilling with other programs in this area, these primary objectives should not be compromised.

Two of these three components (normal sediments and oceanic crust) can be sampled in a single hole - BON-8 or its alternative A2-2. This is thus the highest priority reference hole site. Next in priority would be sites on a seamount apron and on "normal" crust seaward of the Marianas (e.g. MAR-5 and MAR-4, respectively). These holes would get at the third component, establish the differences between the two arc inputs, and possibly determine whether off-axis Cretaceous flood basalts have influenced Mariana arc volcanism. Finally, a seamount summit hole (MAR-6) would establish the ocean-island lava component.

Can this drilling be integrated with other proposals for drilling old crust in the western Pacific? LITHP suggested that A2-2 (on anomaly M-18) might be an alternative site for BON-8 (on anomaly M-13) that could also partly satisfy the objectives of the Handschumacher et al.(285/E) proposal (Fig. 1). Both of these sites target crust roughly equivalent in age, with presumably similar sedimentary/crustal sections, to those beneath the active Mariana-Bonin arc system. They thus satisfy the minimum requirements for the reference hole sites. As WPAC has noted, A2-2 lacks MCS site survey data, however BON-8 is located at the intersection of two MCS lines (Conrad lines 21 and 22). Thus if MCS data coverage is essential for choosing this site (and it certainly would be desirable) then BON-8 should be favored over A2-2. Lancelot et al. (306/E) have suggested older sites (older than M-30) in the Pigafetta and East Mariana Basins as potential alternative "reference hole" sites. While these older sites would be more useful for calibrating the geomagnetic time scale, they are not suitable as replacements for either BON-8 or A2-2. No crust of this age underlies either arc, the sites are hundreds of km from the Bonin arc, and the interpretation that the sedimentary sections are similar is speculative at best. There may be ample justification to drill these sites, but they should not be sold as geochemical reference holes.

Good site survey data are available for MAR-4 which is located near DSDP 452 (see DSDP Volume 60). Seismic refraction data of LaTraille and Hussong at Site 452 reveal unusually high velocities in the uppermost crust, leading them to suggest that some off-axis volcanism occurred here. MAR-4 is thus a well-positioned reference hole site which also might get at the problem of Cretaceous volcanism. For the same reasons given above, sites EMB-1 or 2 are not suitable substitutes for MAR-4 as a geochemical reference hole site (Fig. 2).

There is more flexibility on possible locations for the seamount apron and summit holes. FM35-12 crosses the apron of a large seamount near 15°N, 152°E (Fig. 2), although I have not seen these data. Other possible sites with adequate site survey data suggested by Jim Natland include Dutton seamount ridge, which intersects the Mariana trench near 20-22°N, Hemler Seamount southwest of PIG-2, and an unnamed seamount north of DSDP 452 (MAR-5 and 6). None of the sites in other CEPAC proposals for western Pacific drilling would be suitable substitutes for holes on one of these features.

Chert will be a potential problem for **all** drilling in the western Pacific. With the improved drilling technology of ODP, the chert problem may not be the major obstacle to drilling it once was. However, even if basement is not reached, sampling the pelagic and volcanogenic sediments will provide important constraints on two major components of this geochemical system. Sites 196 and 197 drilled on Leg 20 are convincing evidence that near BON-8 (or A2-2) cherts can be drilled and basement is reachable (Site 197 on M-22 was on a local basement high and reached basement, although core recovery was very low).

In summary, LITHP continues to recommend 1 1/2 legs be devoted to reference hole drilling in the western Pacific. The highest priority is for a basement re-entry site at BON-8 (alternative A2-2). The objective here should be penetration 200-500 m into basement which, together with a complete logging program, may require half to two-thirds of a leg. The remainder of this leg, which should be part of the WPAC program, could drill MAR-4. A second leg could complete drilling at MAR-4, drill a seamount apron target (e.g. near Dutton chain), and, if time permits, drill a seamount summit. The remaining half of this CEPAC leg could be devoted to one or more targets in the Jurassic Quiet Zone. LITHP had previously endorsed Handschumacher and Vogt's site J-5, but PIG-3 or EMB-2 of Lancelot et al. look attractive based on the new MCS data presented in their proposal.

Ridge Crest Drilling

The objectives, drilling strategy and technical requirements of the East Pacific Rise program have been outlined by the East Pacific Rise Working Group. The report of this group has stimulated several new site survey-related proposals and provided guidance to the ODP engineering development group. The EPR working group will meet next winter to review available site survey data and select specific drilling sites. Two legs are believed by LITHP to be adequate for the EPR during this phase of Pacific drilling.

The consensus of LITHP at its last meeting was that two drilling legs are also required at sedimented ridge crests; one devoted to magmatic/hydrothermal processes, the other concentrating on ore genesis and sulfide deposition. The EPR Working Group will be meeting at the end of July to review this situation and make recommendation to LITHP on the objectives, drilling strategies and time requirements for drilling at sedimented ridge crests.

Deep crustal drilling (504B)

This is LITHP's top-ranked CEPAC program. Approximately one half-leg of engineering work will probably be required at 504B before drilling can proceed. LITHP believes a full leg of drilling is needed to have a reasonable chance of achieving the major scientific objective of reaching layer 3. The chances of success at 504B would be severely compromised by squeezing the engineering work and scientific drilling into only one leg. We thus recommend 1 1/2 legs be devoted to 504B (these two legs could be separated in time if logistically feasible).

I hope the above, rather lengthy, memo has provided information which will be of use to your panel. If you have any additional questions, you know where to find me.

cc: M. Kastner and J. Malpas (PCOM liaisons)
B. Taylor (WPAC Chairman)
LITHP Panel

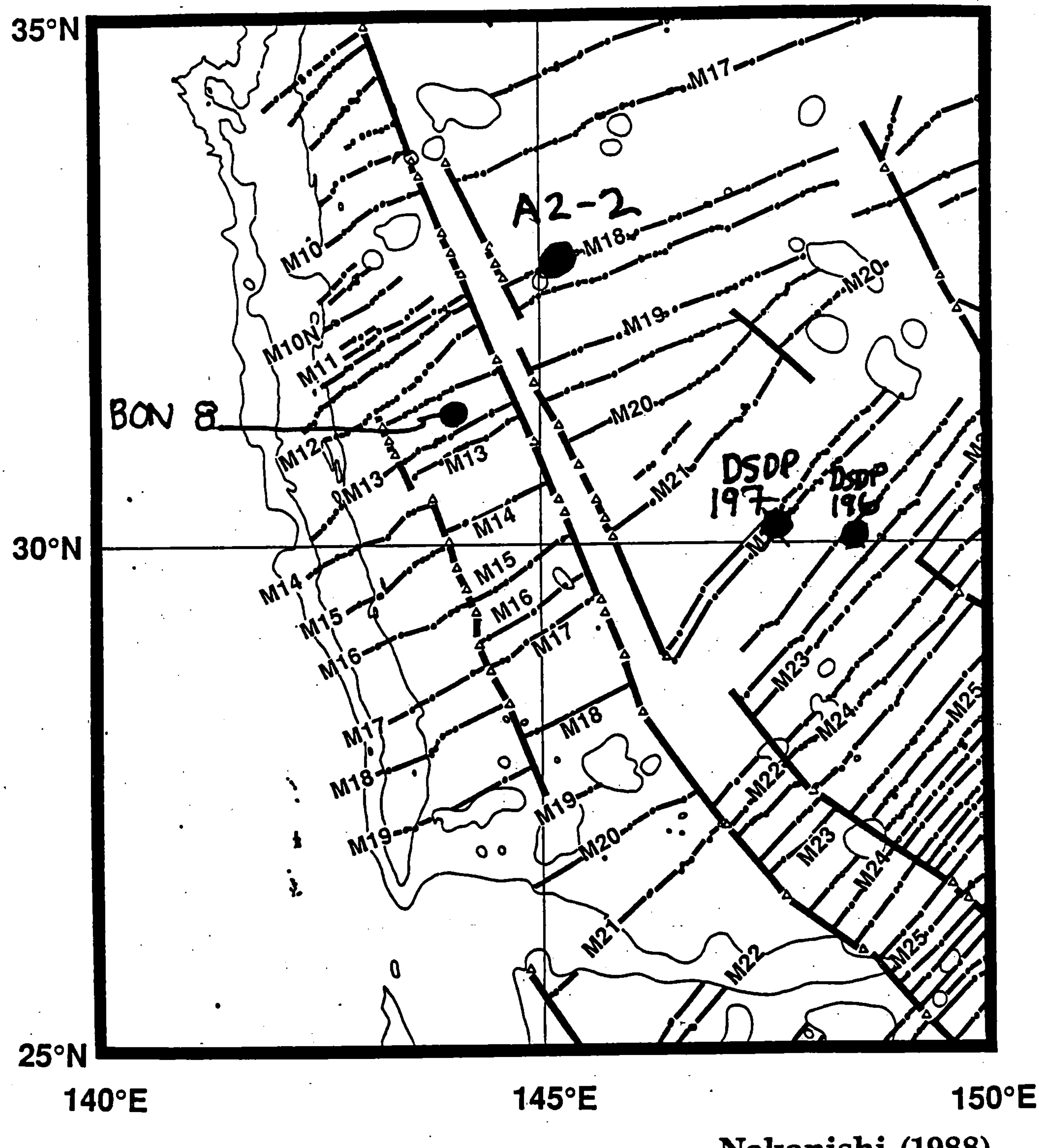

35°N
30°N
25°N
140°E
145°E
150°E
A2-2
BON 8
DSDP 197
DSDP 196
M10
M10N
M11
M12
M13
M14
M15
M16
M17
M18
M19
M20
M21
M22
M23
M24
M25
Nakanishi (1988)

Fig. 1

Fig. 2 (from Proposal 306/E Lancelot et al.)

WATCHDOG REPORT

Drilling Proposals on Mesozoic-Paleogene Paleoceanography and Sea Level, Atolls and Guyots CEPAC (Proposals 202E, 203E, 260D)

Brian Tucholke

88-256

RECEIVED JUL 18 1988

Proposal Objectives

These proposals address the objectives summarized in Table 1. Proposal 260D also includes sites (OP 4, OP 5) designed to address jamming of the Mariana-Bonin Trench by the Ogasawara Plateau/Marcus-Wake Ridge. The latter sites are not considered to be of high priority by TECP.

Sea-level changes are to be investigated by drilling reef caps on guyots in the Geisha and Marcus-Wake "chains", the Mid-Pac Mountains, and the north Marshall-Gilbert chain (Figure 1). Drilling in all but the Geishas is considered high-priority by SOHP. Determining eustatic vs. relative sea-level changes in the Marshalls may be complicated by multi-stage volcanism (e.g.?Cretaceous, Eocene). The other atolls presumably have a simple subsidence history from the time of their initial formation, except that the Ogasawara Plateau (OP 3, western Marcus-Wake) has geologically recent perturbations caused by entry into the Mariana-Bonin Trench. Sea-level changes would be investigated from intra-reef diagenesis and "paleosoils", turbidite input to atoll aprons (Marshalls), and possibly reef drowning.

Platform drowning is to be tested for synchronism or for coherent lateral patterns that may indicate either sea-level or regional tectonic controls.

Further sedimentary objectives include reef anatomy, history and cause of reef-margin advance/retreat, correlation of biostratigraphic zonations between shallow-water and planktonic fossils, paleoceanographic record of pelagic carbonates overlying the reefs, and volcaniclastic sedimentation.

Non-SOHP objectives are potentially important products of the proposed drilling. Several fit with general LITHP or TECP themes, although the proposals on their own are not ranked as high priority by these panels. Drilling into guyot basement proposed in 202E and 203E could provide 1) age constraints (biostratigraphic, radiometric) on timing, patterns, and episodicity of volcanism, 2) paleolatitude data as an independent check on plate motion, and 3) geochemical information on mantle sources (e.g. possible relations to the DUPAL anomaly). The OP 3 site in proposal 260D may have potential for elucidating vertical-motion history of the Ogasawara Plateau during its jamming in the Mariana-Bonin Trench. Some combination of the "seamount/apron" sites also could help satisfy the geochemical-reference-site objectives of TECP (see P. Vogt summary of 3/14/88 appended to TECP 15-18/3/88 minutes).

Potential Problems and Other Considerations

It must be recognized that the reef material can be highly porous, poorly cemented, and diagenetically altered. Thus the ease of drilling, amount of core recovery, and biostratigraphic control in reef material often have been notoriously poor in past deep-sea drilling operations. Without good core recovery and high-quality biostratigraphy, the paleoceanographic objectives of the drilling will be seriously compromised.

A question remains as to whether turbidites originating from carbonate banks are more frequently deposited during sea-level highstands or lowstands. Thus the use of turbidite frequency on guyot aprons as a proxy for sea-level fluctuations may leave uncertainties about the sea-level record; resolution of uncertainties via the shallow-water biostratigraphy can have its own problems as noted above.

The seamount (atoll/guyot) groups proposed for drilling form only poorly defined "chains". It seems unlikely that a relatively few sites, especially if scattered across several "chains", will be of much help in defining patterns of volcanism (e.g. age-progression). There also is some evidence for multiple episodes of volcanism over long periods of time, for example possible Cretaceous and then later Eocene volcanism in the Marshalls. Such areas should be avoided if uncomplicated determination of sea-level history is the prime drilling objective.

None of the proposed drillsites, except Sylvania 1, 2 and Harrie 1, 2, appear to have adequate site surveys.

General Assessment

There is strong potential for 1+ productive drilling legs devoted to "Mesozoic Paleoceanography" (atolls/guyots, sea-level history, etc.). However, SOHP and TECP should assess carefully whether their principal objectives can be met, given the available technology and the possible problems outlined above. In formulating a plan for "Mesozoic Paleoceanography", CEPAC should seek input from the thematic panels on how multiple objectives best can be integrated into a coherent drilling package.

TABLE 1
"MESOZOIC PALEOCEANOGRAPHY"
CEPAC

PALEOCEANOGRAPHIC OBJECTIVES
#Relative Changes in Sea Level
- # - Presumably simple subsidence history
- +#* - Paleo "water tables" and paleosoils
- * - Turbidite apron

+*Anatomy of Reefs and Associated Carbonate Complexes
*Carbonate Diagenesis
+*Shallow-Water-Fossil/Planktonic Zonal Correlations
#Platform Drowning
- # - Synchronism?
- # - Cause?

#Platform Margin Advance/Retreat
- # - Sea level, $CaCO_3$ production rates, feedback loops

+Volcaniclastic Sedimentation on Aprons

OTHER OBJECTIVES (TECP-LITHP)
#*Latitude Changes
- #Independent check on plate motion

#*Ages of Seamounts (Biostratigraphic/Radiometric)
- #*Age-progressive volcanism?

#Mantle Sources
- #Relation to Dupal anomaly?

+#*Multiple Episodes of Volcanism?
#Regional Uplift
+Vertical-Motion History of Ogasawara Plateau
Geochemical Reference (Seamount, Apron).

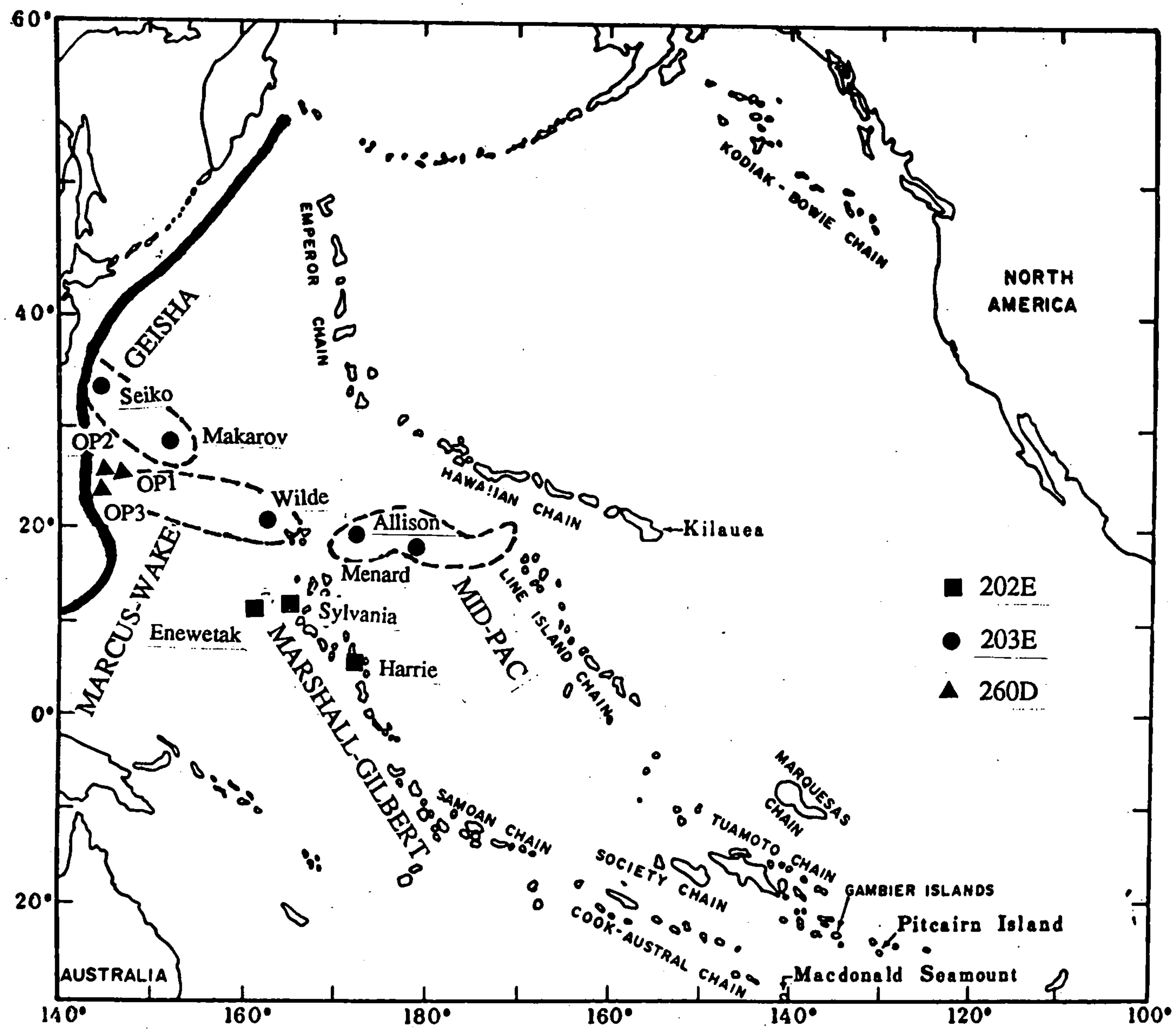
Objectives outlined principally in proposal number:
* - 202E
# - 203E
+ - 260D

TABLE 2

CEPAC
"MESOZOIC PALEOCEANOGRAPHY"
-- SUMMARY OF ALL PROPOSED SITES --

Proposal	Site	Water Depth (m)	Proposed Penetration (m) Sed.	Bmt.	Total	Proposed Coring	Proposed Re-Entry
202E	Sylvania 1*	1350	400	250	650	RCB	Yes
"	Sylvania 2*	1350	400	250	650	RCB	Yes
"	Sylvania 3	4600	700	100	800	HPC/RCB	No
"	(Enewetak 1)	1450	300	200	500	RCB	No
"	(Enewetak 2)	1350	300	200	500	RCB	No
"	(Enewetak 3)	4000	700	100	800	HPC/RCB	No
"	(Harrie 1)*	1500	400	250	650	RCB	Yes
"	(Harrie 2)*	1260	300	150	450	RCB	No
"	(Harrie 3)	4500	700	100	800	RCB	No
203E	Allison	1650	900	100	1000	RCB	Yes
"	Menard	1370	700	100	800	RCB	No
"	Seiko	1440	<100	100-200	200-300	HPC/RCB	No
"	(Takuyo-Daini)	1450			200-300	HPC/RCB	No
"	Makarov	1340	<100	100-200	200-300	HPC/RCB	No
"	(Isakov)	1340	<100	100-200	200-300	HPC/RCB	No
"	Wilde	1270	<200	300+	500+	HPC/RCB	Yes
"	(Miami)	1210	<100	400+	500+	HPC/RCB	Yes
260D	O P 1 [Saddle]	3200	600	50	650	HPC/RCB	No
"	O P 2 [Broken Top]	1070	450	50	500	RCB	No
"	O P 3 [Ogasa. Plat.]	1920	1000	50	1050	HPC/RCB	No

SOHP interest
TECP possible interest
* Existing site survey probably adequate
( ) - Alternates or lower priority



60°
40°
20°
0°
20°
140°
160°
180°
160°
140°
120°
100°
GEISHA
Seiko
Makarov
OP2
OP1
OP3
Wilde
Allison
Menard
MARCUS-WAKE
Sylvania
Enewetak
Harrie
MARSHALL-GILBERT
MID-PAC
EMPEROR CHAIN
HAWAIIAN CHAIN
Kilauea
LINE ISLAND CHAIN
KODIAK - BOWIE CHAIN
NORTH AMERICA
202E
203E
260D
MARQUESAS CHAIN
TUAMOTO CHAIN
SAMOAN CHAIN
SOCIETY CHAIN
GAMBIER ISLANDS
Pitcairn Island
COOK-AUSTRAL CHAIN
Macdonald Seamount
AUSTRALIA

FIGURE 1

Drilling proposal by S.C. Cande: "Southern Chile triple junction".
CEPAC Watchdog report from Olav Eldholm.

The proposal addresses the consequences of subducting a spreading ridge and how it effectcs the tectonics of the margin before and after the actual ridge-trench collision. The junction of the Chile Trench and Chile Ridge is suggested as a drilling target because simple and well understood plate geometry and the fact that the change from a pre- to a post collisional setting takes place over only a few hundred kilometers.

Two main scientific problems are raised. First, the nature of the ridge-trench interaction at the present collision zone. It is documented that the process of tectonic erosion is much different here than elsewhere along the trench. However, little is known about the actual collision zone particularly the extent of erosion, the geometry of the accretionary prism, nature of basement and the extent of metamorphism associated with high heat flux. A drilling strategy of two marginal transects is proposed. 1) A transect (B-B', 1-2 holes) directly across the transition zone, 2) another (A-A', 1-2 holes) 100 km to the north as a reference line for the margin in a non-eroded area.

The second problem deals with the character and the effects of the Neogene subduction on inner trench wall south of the triple junction. Particularly, Neogene vertical movements of the upper inner wall, nature of basement below the outer arc ridge and beneath the upper slope basins (Paleozoic metamorphics?), and how the collision relates to the evolution of the Madre de Dios sedimentary basin on the shelf/upper slope. Again two transects are suggested. One (profile 10) to sample the inner wall where collision occurred 10 my with little apparent deformation (2 holes). Another (profile 7) closer to the triple junction (5 my) to drill the outer arc ridge and upper slope (2 holes).

Finally, the possibility of drilling recently sediment covered "zero-age" crust is raised.

Priorities. High: Transect line 10, transect B-B'. Middle: transect A-A'. Low: Transect line 7, "zero-age" crust.

Evaluation: I find it a somewhat difficult task because the proposal (submitted in 1984?) is based on two preprints (Cande & Leslie, in press) which I did not had access to. Moreover, I do not know the status of more recent work, if any. Basically, it appears a sound proposal addressing an important problem in a well-defined geologic setting. The transect strategy also makes sense. On the other hand, I feel that the present site documentation is inadequate for actual site location and that more detailed surveying is needed prior to a final decision. Too little geophysical documentation exists to recommend drilling "zero-age" crust.

Recommendation: Stress the need for site surveying and/or additional site documentation. Evaluate if any of the targets are covered by other active margin drilling programs.

****WATCHDOG REPORT****

DRILLING PROPOSALS IN THE JUAN DE FUCA/GORDA RIDGES
Miriam Kastner and Mark Langseth

Relevant proposals:

Proposal 284: Drilling in Escanaba trough, Southern Gorda Ridge, Zierenberg et al. July 1987.
Addendum: Proposal 224: Additional sedimentation and geochemical studies on Middle Valley sediments, and responses to lithosphere panel concerns.

Proposal 232: Drilling into high temperature zero-age crust in Middle Valley, on the Northern Juan de Fuca Ridge. Main proposal Davis et al. May 1986.
Addendum: Clay mineralogy and geochemistry of hemipelagic sediments under hydrothermal influence in Middle Valley.... Blaise et al. March 1987.

Proposal 290/E: Deep drilling on Axial Seamount: Central Juan de Fuca Ridge, Johnson et al. No date.

ESCANABE TROUGH DRILLING:

Seven single bit holes at three sites are proposed in the southern, thickly sedimented end of the Gorda Ridge, north of the Mendocino Fracture Zone. DSDP Site 35 was drilled just north of the Mendicino F.Z (south of the proposed sites), and penetrated 390m of hemipelagic sediment of which 95 m were recovered.

Proposed site 1 is a reference hole through the sediment into basement in an area away from volcanic or hydrothermal structures. Hole 2A,B,C and 3 A,B,C are placed to penetrate the summit and near the base of 100m high hills with flat tops and thick sedimentary caps. These structures are enigmatic, they appear to have been punched up through the sedimentary cover from below. Drilling will examine the structure of these hills and the massive sulfide deposits found skirting the bottom of the hills.

Questions:
1. Why drill both sites 2 and 3? since the structures in the NESCA and SESCA areas appear to be very similar.

2. The proposal does not address the high temperatures that will be encountered during the drilling. Heat flow measurements in the Escanaba Trough (Abbott et al., 1986) show isolated very high values up to 1.8 W/m 2 , with an estimated gradient is of 1.5 to 2.0 degrees per meter. Thus, temperatures could reach 200 deg. C just 100m below the sea floor. Most of the measurements range from 300 to 400 mW/m 2 , or gradients of 30 to 40 degrees per 100m. Existing heat flow measurements are not close enough to the proposed drill sites to predict subseafloor temperatures.

3. The proposers realize that the existing site survey data are not adequate. Detailed single channel seismic, deep-towed side scan, detailed heat flow around the drill sites are essential. MCS traverses of the ridge are desireable.

General, in principle the Escanaba Trough is an excellent region to explore the regime of a thickly sedimented, active spreading center. It seems to have some features that Middle Valley does not have, e.g. the punch up hills and the associated mature sediment-hosted massive sulfide deposits. The location of the active spreading center is better defined than at Middle Valley. However, the geology and geophysical survey data in the Escanaba Trough are meager compared to Middle Valley.

No active venting has been observed during dives in the area, and mature hydrothermal systems have been studied on land. Questions about hydrothermal processes are better addressed in an active system in which the relationship between chemical evolution of fluids and alteration of rocks and sediments, and the chemistry and mineralogy of the sulfide deposits can be monitored and characterized. The objectives and rationale for drilling in Escanaba Trough, as presented in the proposal, are too narrowly focused. There is time to improve the survey information and the proposal.

Reference:
Abbott, D.H. J.L. Morton and Mark L. Holmes, Heat Flow Measurements on a hydrothermally active slow spreading ridge: The Escanaba Trough, Geophys. Res. Ltrs, 13 pp678-680, 1986.

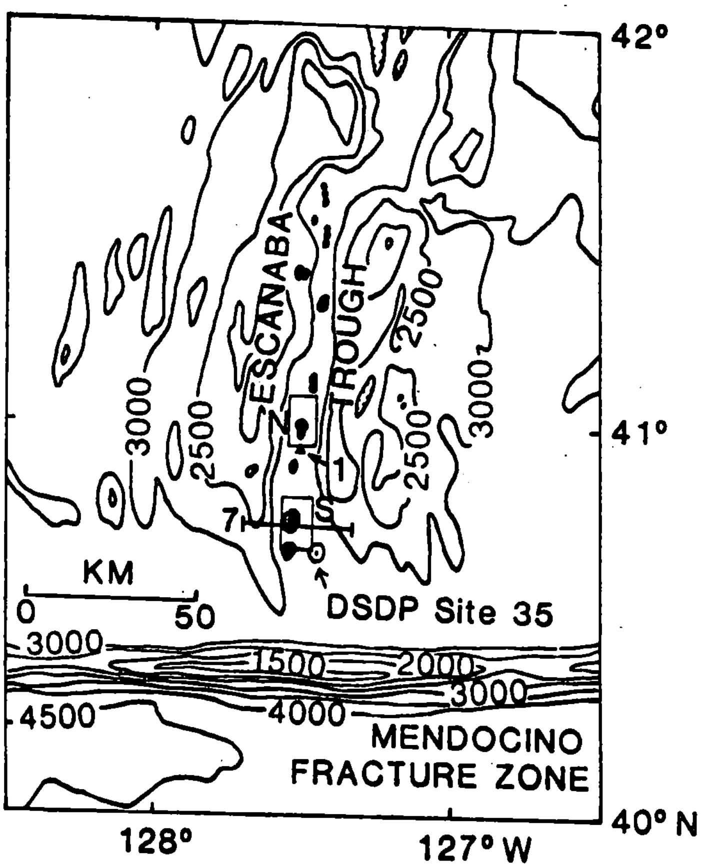


FIGURE 3

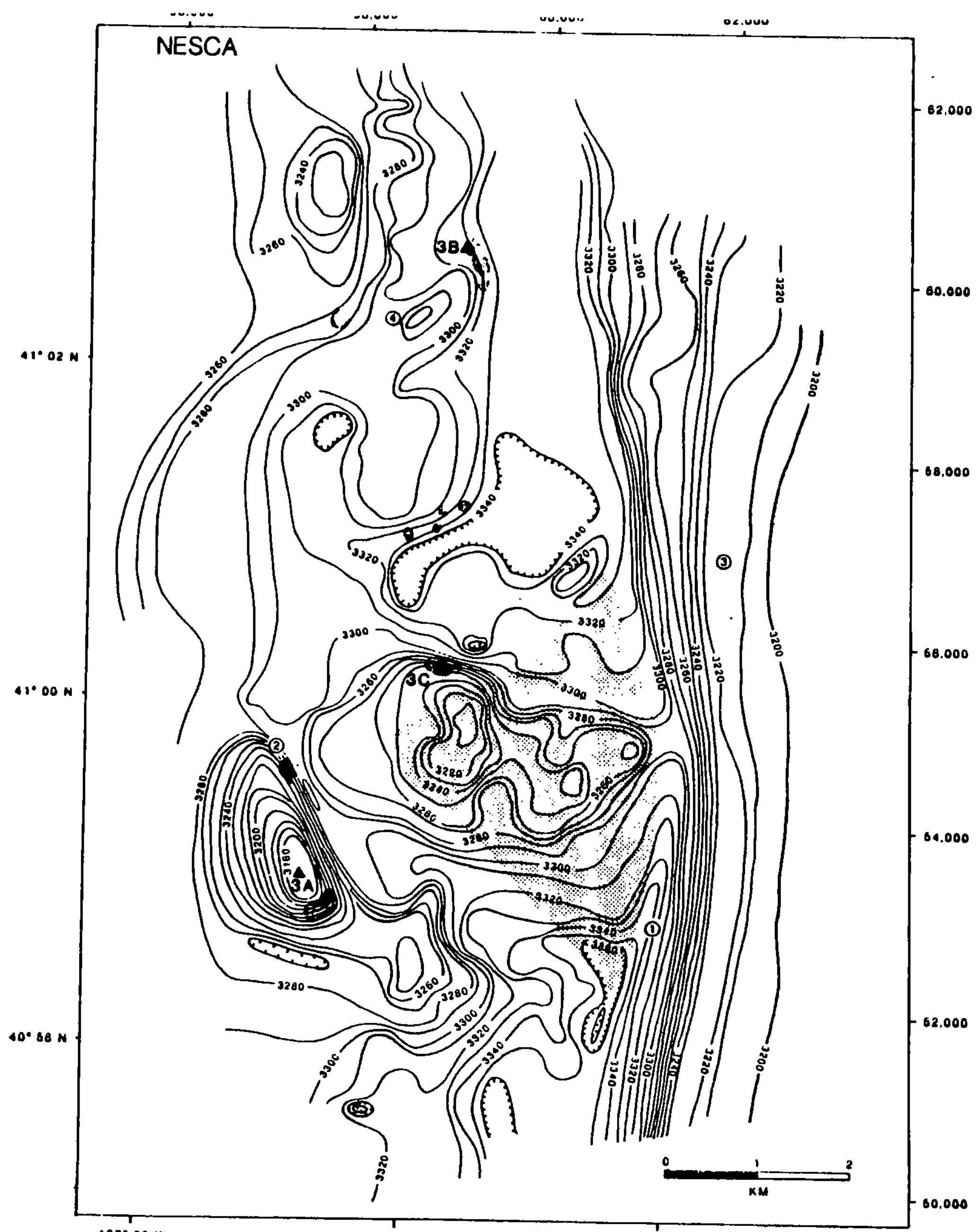


FIGURE 5

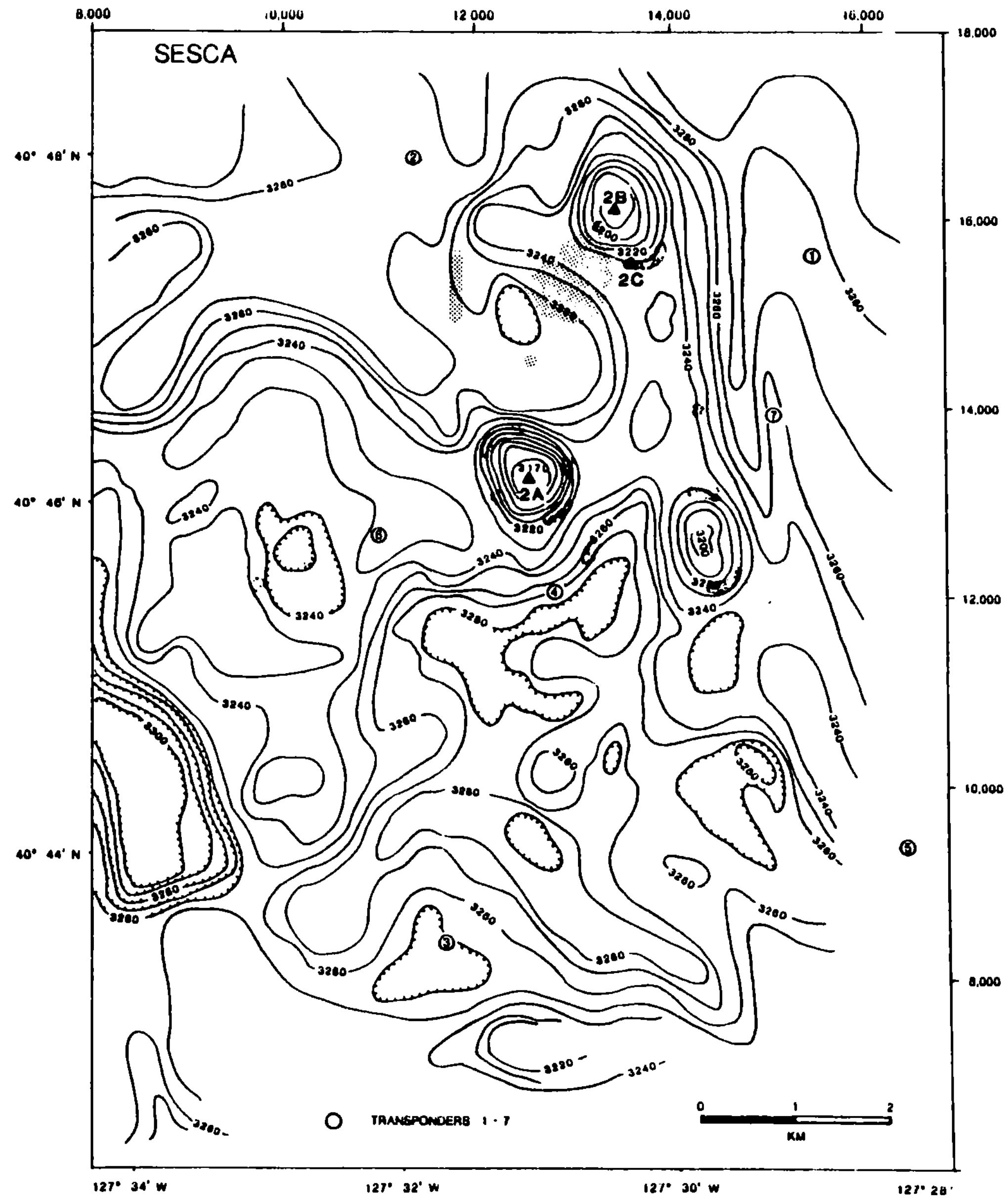


FIGURE 6

MIDDLE VALLEY DRILLING: JUAN DE FUCA RIDGE

The Davis proposal is a model drilling proposal. Concise yet sufficient for the purpose!

Middle Valley is a large, turbidite-filled rift valley in the Northern Juan de Fuca Ridge. It lies near the center of the Bruhnes Magnetic anomaly indicating that the valley floor is geologically very young. There has been debate in the past whether zero age crust lies below Middle Valley. A negative excursion in magnetic intensity near the center of the valley may result from shallow high temperatures, and perhaps recent magmatism.

Middle valley has been extensively surveyed. A high density geothermal survey indicates a heat flow varies inversely with sediment thickness, between 200-700 mW/m 2 , and temperatures at the sediment/basement interface of 100 to 400 0 C are predicted.

On the East side of the Valley hydrothermal fluids penetrate through the sediment and form a large mound of hydrothermal material. One massive sulfide deposit has been cored in this part of Middle Valley.

Two multihole drill sites to be done on a single leg are proposed:
Site 1 is near an active hydrothermal seep, where sediment is about 300m thick, three holes will be cored with HPC/XCB to basement. One of the holes will be deepened 100m into basement.

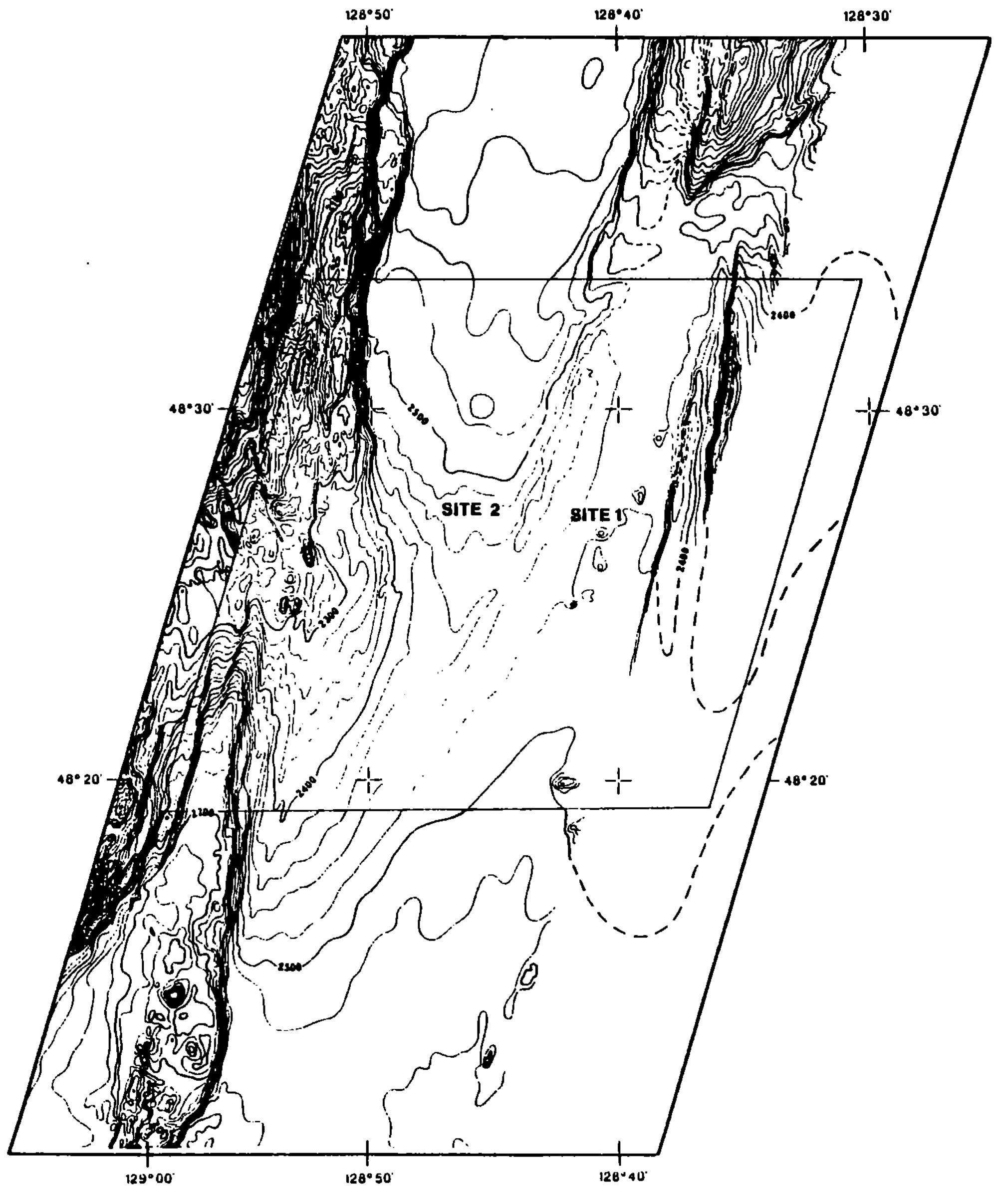
Site 2 is near the center of Middle Valley where sediment is about 400m thick. Three APC/XCB holes will be drilled to basement. Two of these holes will be deepened 300m into basements. These holes will be close together to allow hole-to-hole experiments. The basement holes will be prepared for later re-entry for downhole experiments and measurements.

The proposal lists eleven objectives that include studies of biology, paleo-oceanography, clay mineralogy, geochemistry, lithology and diagenesis and catagenesis in a high temperature environment, a sealed, axial hydrothermal system and sampling of zero age crust.

Middle valley has been surveyed in detail using a wide variety of geophysical and geological techniques. Hoever it is important to map geochemical gradients in the porewater of sea floor sediments to estimate actual flow rates involved with the hydrothermal flow.

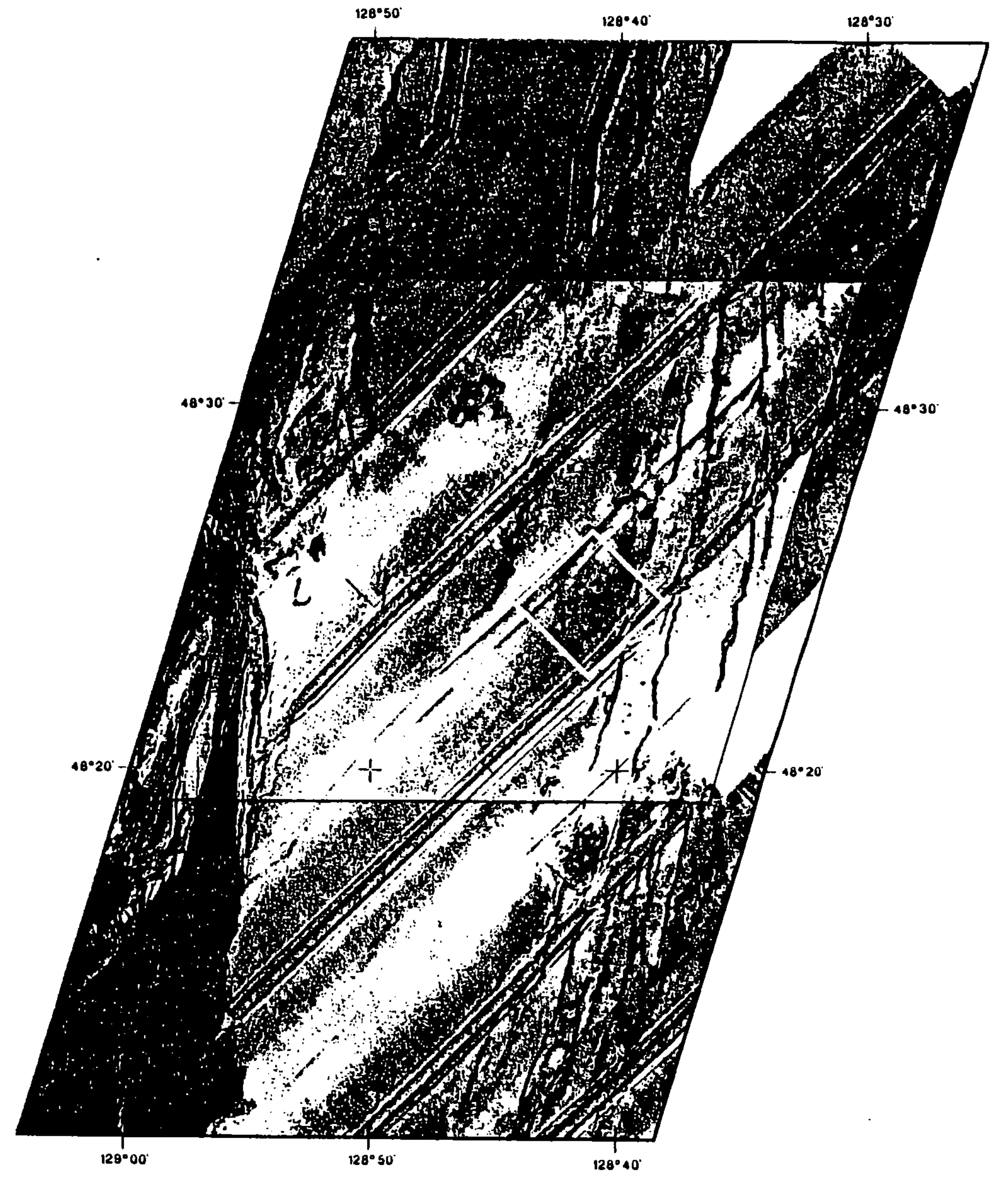
The Middle Valley drilling program is the best documented and most comprehensive of the Juan De Fuca proposals. Because of the importance of understanding the sedimentary and thermal regime of a thickly sedimented active ridge, and the unique opportunities it presents to sample zero age crust, and penetrate an active hyrothermal system, the middle valley drilling should rank high among all Mid Ocean Ridge targets.

The principle problem will be proper preparation for high temperature drilling and downhole measurements.



128°50'
128°40'
128°30'
48°30'
48°30'
SITE 2
SITE 1
48°20'
48°20'
129°00'
128°50'
128°40'

FIG. 1



128°50'
128°40'
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129°00'
128°50'
128°40'

FIG. 2

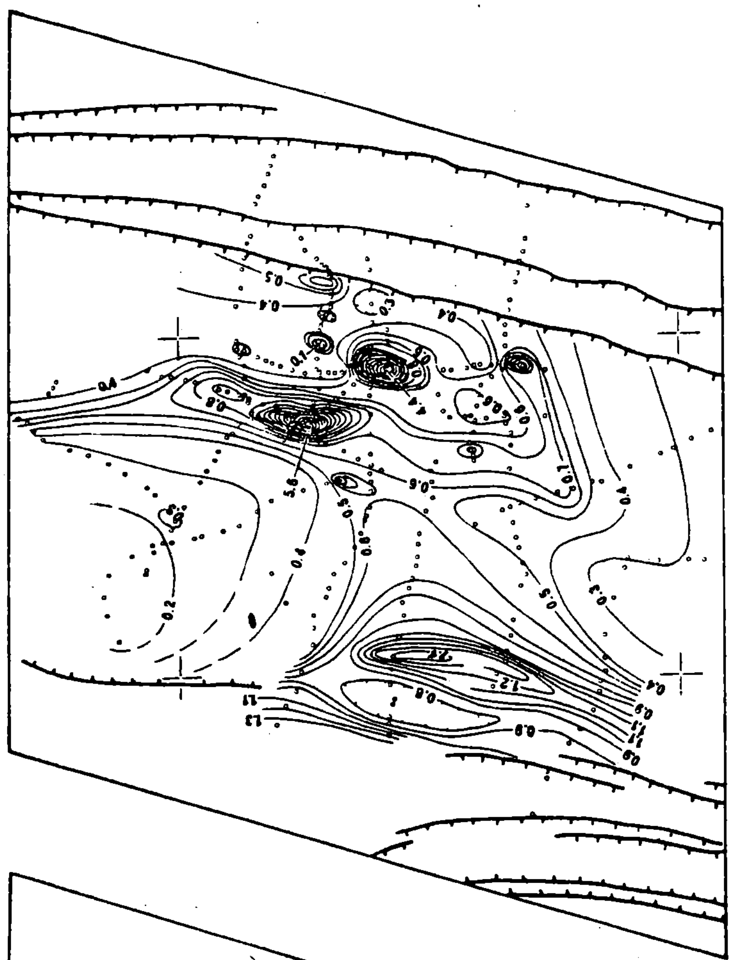


Fig. 5

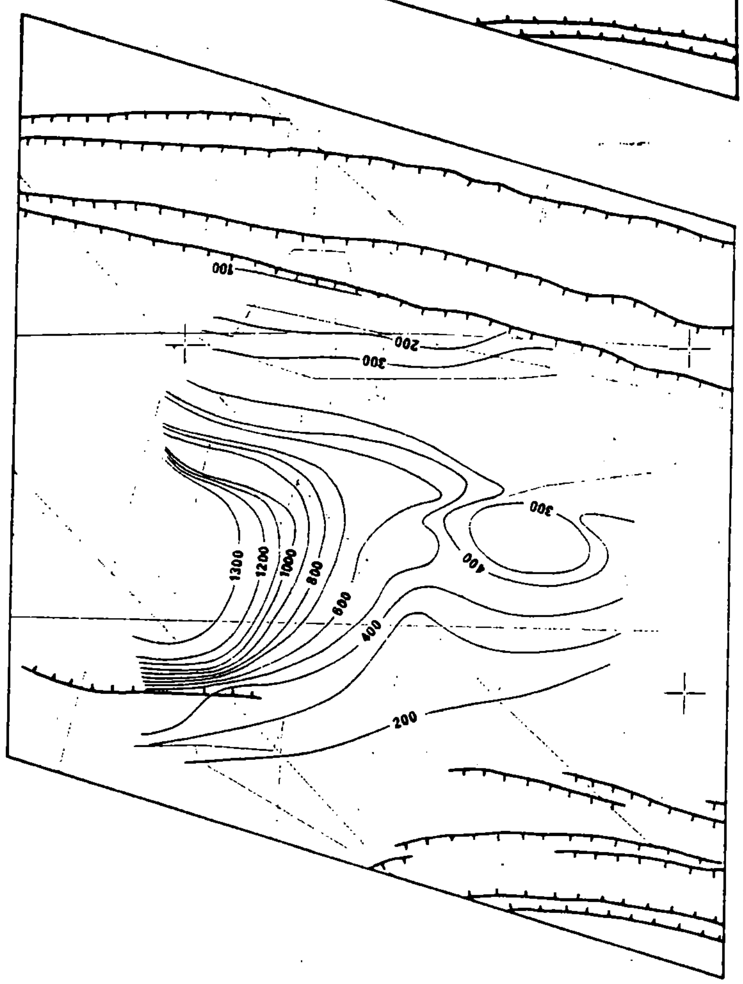


Fig. 4

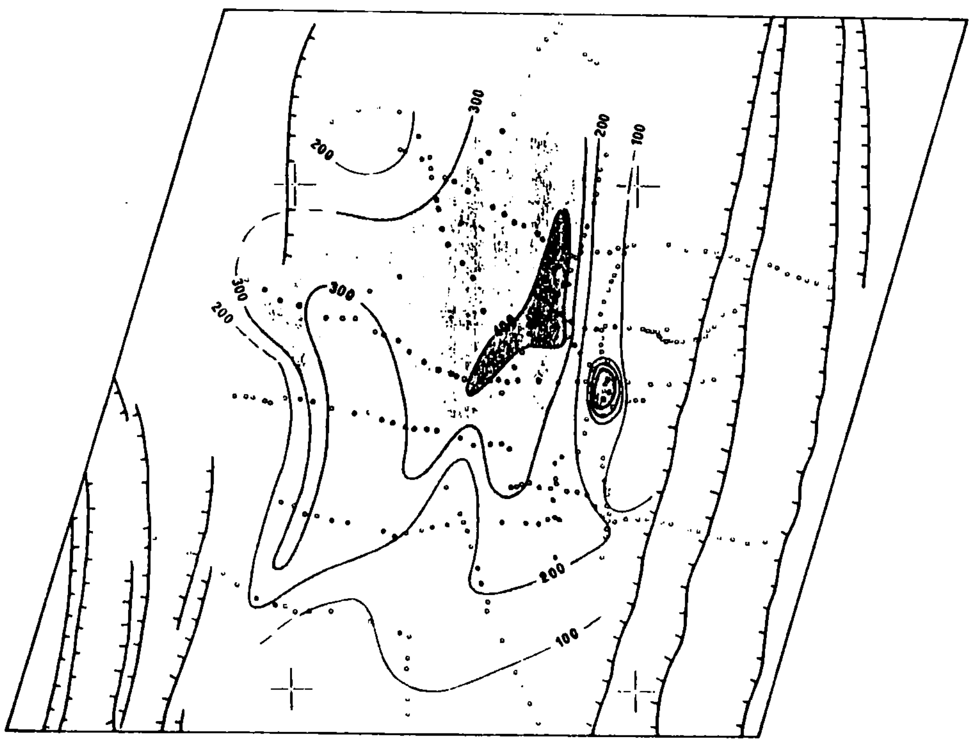


Fig. 6

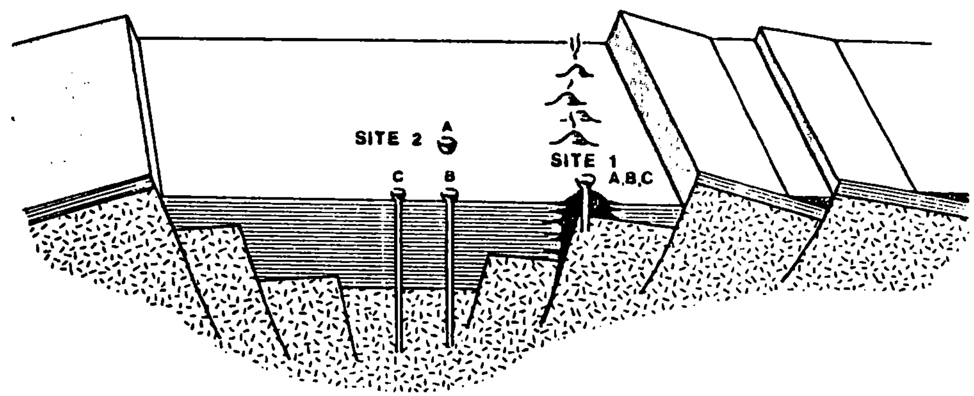


Fig. 9

AXIAL SEAMOUNT DRILLING:

Axial Seamount is an extensively explored Caldera structure that sits astride a small left lateral offset of the Juan de Fuca spreading axis about midway along the length of the ridge segment. The Caldera is defined by a steep horseshoe-shaped escarpment that is open to the south. Active hydrothermal vents have been found near the foot of the walls of the caldera.

A principal objective of the drilling is to examine the internal structure, volcanic stratigraphy, hydrothermal system and petrology of an actively forming volcano on a spreding center axis.

A second objective is to drill into the summit of a recently active, but now extinct off-axis seamount (Brown Bear Seamount) with many of the same objectives. No data on Brown Bear seamount are presented in the proposal.

A third objective is to define the early evolution of Axial Seamount by drilling a hole on the Southeast flank of Axial Seamount to compliment the caldera site.

Proposal 290/E puts forward three possible drill targets:

Site 1. Located in the floor of the caldera near the foot of the bounding e.Grpment where hydrothermal venting and recent magmatic activity has been observed. An objective is to have the hole intersect the stockwork of the active hydrothermal system. It would be exciting to investigate an active volcanic and hydrothermal system in a caldera setting. Drilling at Site 1 will certainly require a barerock guidebase, however it is an attractive drilling target that can probably be achieved in half a leg.

Site 2. Is on the summit of Brown Bear seamount, which only recently became inactive. The objective would be define the structure and petrology of an off-axis seamount and compare it with that at Axial Seamount.

Site 3 A hole on the southeastern flank of Axial Seamount is the third target, which the proposers have given a second priority relative to first two sites.

Sites 2 and 3 should be given a much lower priority than Sites 1 or any of the Middle Valley Sites.

The authors of the proposal report that there are sediment ponds at sites 2 and 3 that could be used to spud in the drill bottom hole assembly. No data are shown to verify this. A large amount of near-bottom, high resolution data have been obtained over Axial Seamount so that the morphology and sea-floor processes are well known. Magnetic and gravity surveys allow broad inferences to be drawn about the subseafloor structure and temperature, the detailed structure below all of the sites is virtually unknown. An MCS and SCS survey over the seamount may provide a clearer picture of the subsurface stucture, but there is no assurance that seismic techniques will define the structures important to optimally locating the holes.

The proposal suggests additional survey work such as near bottom experiments and measurements, that would help delineate the thermal structure, and the foci and intensity of tectonic activity, but these will not be relevant to locating the best drill holes. The subseafloor thermal regime is also unknown and will likely remain so until holes are drilled. The presence of the hydrothermal vents and recent lava flows indicate very high temperatures may be found at shallow depths at Site 1.

One can question whether drilling Axial and Brown Bear Seamounts at this time will teach us much about the deep structure and evolution of an axial seamount. Money would be better spent on near-bottom and on-bottom observations and high resolution imaging. A proposal to drill into an axial seamount may be premature. Much more can be done to define the problem before the drill ship is called in.

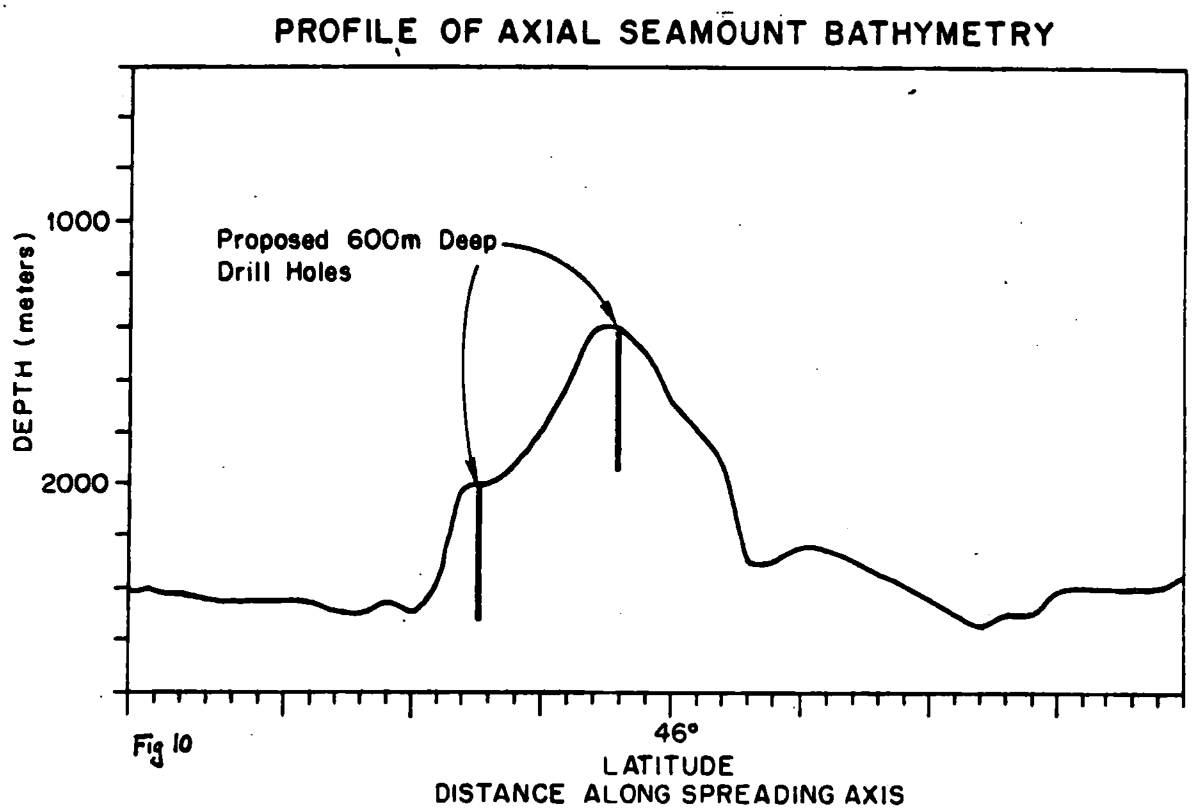


Fig 10

Fig.10. Bathymetric profile over Axial Seamount (left to right is south to north), showing the relative penetration into the seamount of two 600 meter drill holes, one in the caldera and one on the outer flank.

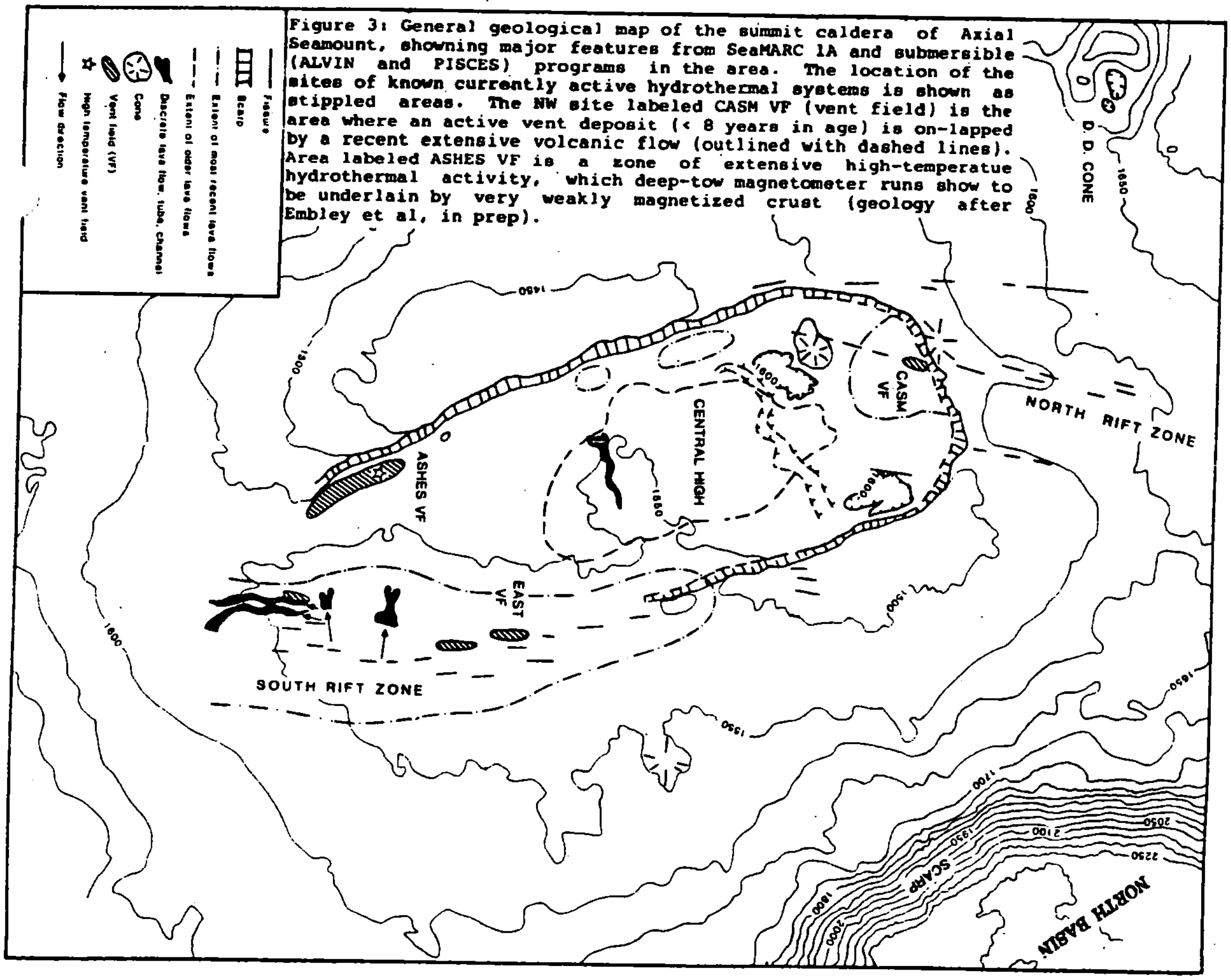


Figure 3: General geological map of the summit caldera of Axial Seamount, showning major features from SeaMARC 1A and submersible (ALVIN and PISCES) programs in the area. The location of the sites of known currently active hydrothermal systems is shown as stippled areas. The NW site labeled CASM VF (vent field) is the area where an active vent deposit (< 8 years in age) is on-lapped by a recent extensive volcanic flow (outlined with dashed lines). Area labeled ASHES VF is a zone of extensive high-temperatue hydrothermal activity, which deep-tow magnetometer runs show to be underlain by very weakly magnetized crust (geology after Embley et al, in prep).

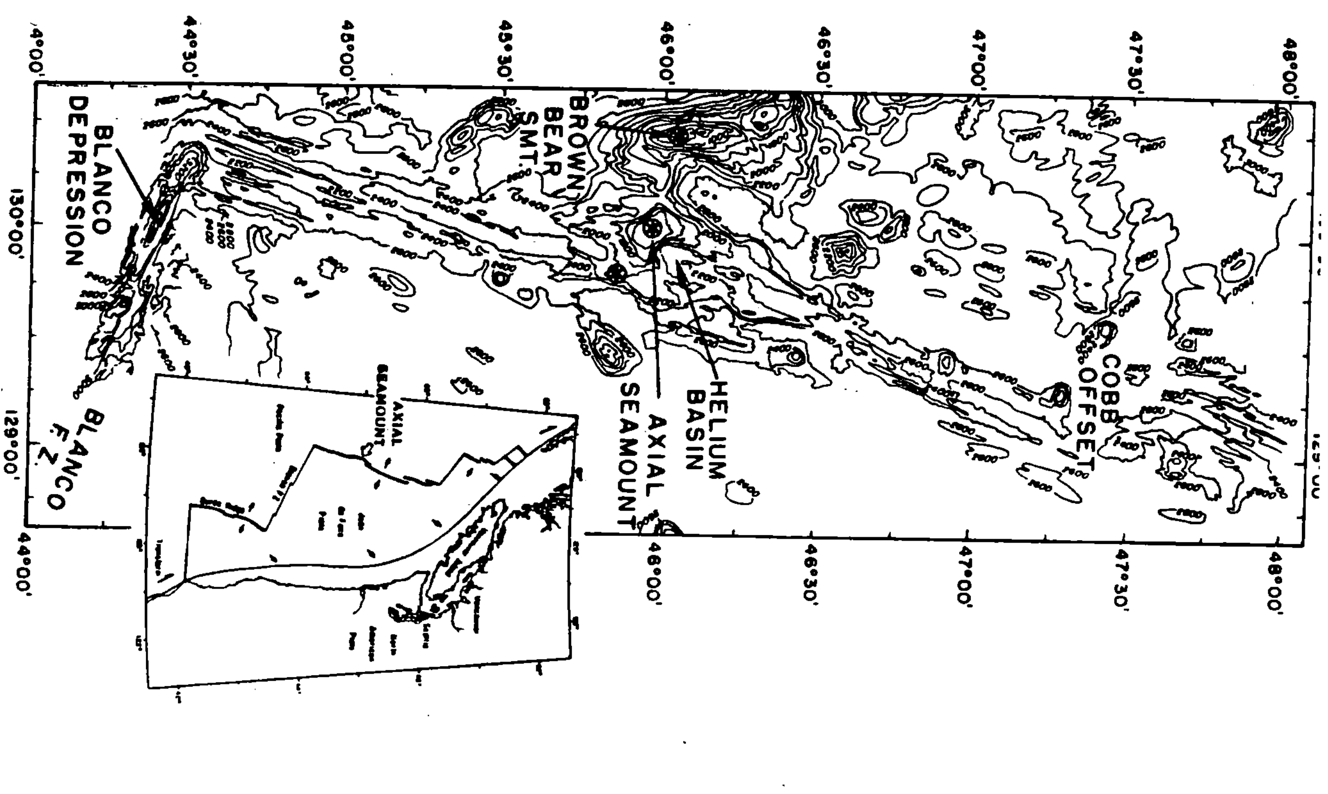


Figure 1: General location map of Axial Seamount on the central Juan de Fuca Ridge. Proposed drilling sites are located in international water, approximately 250 nautical miles west of the Washington-Oregon coast. The stars represent the proposed drill sites on the summit and SE flank of Axial, and the eastern summit of Brown Bear. Axial SEABEAM coverage is adapted from Crane et al., 1985.

The University of Rhode Island Graduate School of Oceanography
Narragansett Bay Campus, Narragansett, RI 02882-1197

June 17, 1988

Dr. Nicklas G. Pisias
JOIDES Planning Office
College of Oceanography
Oregon State University
Corvallis, OR 97331

88-213
RECEIVED JUN 20 1988

Dear Nick:

I was pleased to hear that EXCOM has approved the changes to the panel advisory structure recommended at the last PCOM meeting. This step, together with the development of a Long Range Drilling Plan, should go a long way toward giving us a more thematically-driven drilling program. Although I have concerns about how these changes will be implemented, and the lingering role of politics on long-range planning (witness the controversy over extending the CEPAC program beyond 18 months), I believe it is time for me to pass the torch of "thematic" drilling to a fresh, energetic idealist who is willing to continue the battle.

I therefore plan to resign as LITHP chairman following our September meeting. In order to insure continuity with the incoming chairman, I am willing to represent LITHP at the annual PCOM and Panel Chairman's meeting in December, and to attend (although not chair) the Spring LITHP meeting. However, I hope PCOM can appoint a new LITHP chairman as soon as possible, ideally at your August meeting.

My personal view is that after two geophysicists as LITHP chairman, it would be appropriate for the next chairman to be a petrologist or geochemist. My first choice would be Charlie Langmuir who was a valuable LITHP panel member for several years and did an outstanding job as chairman of the Crust-Mantle Interactions Working Group at COSOD II. My second choice would be Rodey Batiza. Rodey is presently on the panel and has both a broad expertise in lithospheric problems and the wily bureaucratic skills necessary to survive in the ODP advisory structure.

Sincerely,

RSD

Robert S. Detrick, Jr.
LITHP Chairman

RSD:cs

cc: M. Kastner
J. Malpas

MEETING OF JOIDES DOWNHOLE MEASUREMENTS PANEL

Texas A & M University
College Station

June 9 - 10, 1988

88-239
RECEIVED JUL - 7 1988

EXECUTIVE SUMMARY

1. Panel recommended that early reciprocal liaison be established between DMP and proposed shipboard measurements panel.

   [Rec: 88/9]

2. Concern was expressed that proposed LFASE experiments in Hole 418A would place the hole at risk: Panel consensus was that this was scientifically unacceptable.

3. Panel recommended that the diamond coring system should be designed so that the required suite of logs and other downhole tools can be run: the design currently being pursued does not make this provision.

   [Rec: 88/10]

4. A proper analysis should be made of the cost of drilling deep log-compatible diamond-cored holes versus that of slimholing logging tools and instruments, and the necessary redesigning of physical properties equipment on board ship. Costing should make provision for compatibility tests of slimhole and regular tools.

   [Rec: 88/11]

5. DMP should be represented during course of developments re broadband seismometers in the deep ocean.

6. Subcommittee appointed to redraft guidelines on monitoring of third party specialist tools.

7. DMP is establishing liaison with KTB of FRG. Panel recommended that KTB staff be invited to give a presentation on the KTB project to EXCOM and PCOM as soon as possible.

[Rec: 88/12]

8. DMP adopted as its thematic thrusts:

- lithospheric stress on a global scale
- sediment cyclicity
- composition and structure of the crust
- hydrogeological phenomena
- monitoring of modern geological processes.

These themes will guide the input of non-standard downhole measurements to future ODP programmes.

9. DMP re-affirms the importance of logging and downhole measurements at the old crustal reference site AAP1B and recommends that this site be drilled first during Leg 123.

[Rec: 88/13]

10. JOIDES office have indicated a shortness of time in relation to the planning of downhole measurements for Nankai (Leg 129). This panel meeting evaluated three related proposals. Panel considered that Nankai downhole measurements scenario was becoming very complex and, in view of communication from JOIDES office that there is "some pressure re time", adopted the following recommendation.

A working group be established to formulate the detailed programme of downhole measurements for the Nankai Leg. A two-day meeting to be held in College Station on 25/26 July 1988. Recommended members are: P F Worthington (Chairman), K Becker, B Carson, D Huey, R Jarrard, D Karig, M Kastner (or J Gieskes), H Kinoshita, G Moore (or T Shipley) and K Moran.

[Rec: 88/14]

11. Panel recommended that standard logging suite be run in SUL 4 (Leg 124) because of the importance of this site in sediment cyclicity studies.

[Rec: 88/15]

12. Panel encouraged the submission of a proposal to JOI-USSAC to hold a geochemical logging workshop around mid-June 1989 with a subsequent thematic volume.

13. DMP to meet next in October 1988.

Paul F Worthington

15 June 1988

MEETING OF JOIDES DOWNHOLE MEASUREMENTS PANEL

Texas A & M University
College Station

June 9 - 10, 1988

MINUTES

Present

Chairman:	P F Worthington (UK)
Members:	B Carson (USA) E. Howell (USA) D Karig (USA) R Porter (USA) R Stephen (USA) R Wilkens (USA) H Kinoshita (Japan) J Kopietz (FRG) J Legrand (France) K Moran (Canada)
Liaisons:	R Anderson (LDGO) R Jarrard (LDGO) S O'Connell (ODP/TAMU) M Langseth (PCOM) K Becker (LITHP)
Guests:	H Draxler (KTB/FRG) R Hanel (KTB/FRG) G Foss (ODP/TAMU) * L Garrison (ODP/TAMU) * B Harding (ODP/TAMU) * W Meyer (ODP/TAMU) * T Pettigrew (ODP/TAMU) * D Ruddelheuber (ODP/TAMU) * M Storms (ODP/TAMU) *
Apologies:	G Olhoeft (USA) C Sondergeld (USA)
Absent:	A Kristensen (ESF) R Traeger (USA)

* attendance for agenda items 10 - 12 only

1. Welcome and Introductory Remarks

The meeting was called to order at 8.04 am. The Chairman welcomed DMP Members, Liaisons and Guests, especially the representatives of the Continental Deep Drilling Programme of the Federal Republic of Germany (KTB of FRG).

2. Review of Agenda and Revisions

(i) An additional proposal (304F) was received by the Chairman on June 3, 1988. This proposal relates to an ODP Nankai downhole observatory. The accompanying telex from JOIDES made reference to the pressure of time since Nankai is scheduled as Leg 129. DMP was asked to discuss 304F as soon as possible. The proposal was distributed to the Panel and scheduled for discussion under Item 16.

(ii) Item 19 (vii)

Should read "Geological information from wireline logs".

(iii) JOI-USSAC workshop on "Broadband downhole seismometers in the deep ocean". Report by R. Stephen included as addendum to Item 6.

(iv) A report on the Navidrill be included as part of the TAMU briefing, Item 11.

(v) Staffing matters pertaining to the Western Pacific legs be discussed under Item 23.

Subject to these modifications, the pre-circulated agenda was adopted as a working document for the meeting.

2. Minutes of Previous DMP Meeting, University of Miami, January 19-20, 1988

These were adopted without modification.

The Chairman signed the master copy for ODP records.

Matters Arising

(i) Letters to Co-chiefs

These are intended to inform Co-chiefs of the scientific value of logging in order to improve the prospects of maximum scientific returns from each Leg. The Chairman will, with supporting input from LDGO, finalize appropriate drafts for signature by the PCOM Chairman.

[ACTION: JARRARD/WORTHINGTON]

(ii) Malfunctioning of Barnes/Uyeda tool

This turned out to be an intermittent electrical fault which caused erroneous recording of temperature. It was of limited occurrence, easy to recognize, and has now received attention.

(iii) Proposal 66F

Karig reported that his correspondence with the proposers had indicated that borehole televiewer (BHTV) core orientation would suffice. The proposers are aware of the limitations of this method of core orientation but wish to proceed. Their equipment will not subsequently be remaining on board ship.

3. PCOM Report

Langseth reported on the PCOM meeting held in College Station on April 20-22, 1988. Initially he reported on the PCOM response to DMP recommendations 88/1 - 88/8.

DMP Recommendation	PCOM Action/Response
88/1 Appoint TAMU staff scientist to evaluate performance and quality of those downhole measurements under TAMU control	PCOM endorses: passed to ODP/TAMU for action
88/2 ODP/TAMU and LDGO develop a display-capable core data base to automate the production of barrel sheets and to facilitate the integration of log and core data on board ship	PCOM endorses
88/3 Future vacancies on SOHP and TECP be filled with priority given to a least one member on each panel having downhole measurement expertise	PCOM consider recommendation within constraints of panel member selection
88/4 For Leg 121 holes NNER-9, NNER-10, 90ER-2, it is recommended that borehole televiewer be deployed in basement and over limited section of sediment for as long as data remain useful	PCOM endorses

88/5 A packer/hydrofrac scientist should be included as a member of the shipboard party for Leg 123	There will be two people with packer/hydrofrac experience on Leg 123
88/6 Subgroup meeting with WPAC	Already actioned
88/7 Next DMP meeting on June 9-10, College Station	Accepted
88/8 TAMU be asked to report to next DMP meeting on reasons for the processing bottlenecks on board ship together with their proposed solutions	PCOM asks DMP to be more specific. Will upgrades planned for FMS solve the problem? (TAMU report forms part of Item 11)

PCOM was impressed by the thorough job done by DMP on third-party tool policy. Further action was requested. Deferred to Item 7.

A Shipboard Measurements Panel (SMP) will be created as part of a reorganisation of the JOIDES advisory structure.

DMP Recommendation 88/9

"Reciprocal liaison be established between DMP and SMP."

In future, long-range science will be thematically rather than regionally driven.

The Engineering Leg (124E) has been extended to 35 days, principally to accommodate the programme recommended by DMP.

Darrel Cowan (UW) has been appointed as an alternative PCOM liaison to DMP.

The Chairman thanked Langseth for his excellent report.

4. LITHP Report

Becker reported that two relevant meetings had been held since the last DMP meeting, the LITHP meeting itself at which CEPAC matters had been the focus, and a meeting of the EPR working group. LITHP had identified several thematic objectives. These can be addressed during CEPAC, requiring 6.5 legs. Minimum hole size stipulated for EPR drilling was 4 inches.

LITHP did not endorse Proposal 300B (ref. Item 20).

LITHP minutes contained reference to a Geochemical Logging Workshop being organised by Brass and Kastner of PCOM. DMP have no knowledge of such an initiative: the topic is scheduled for discussion later (Item 21).

DMP expressed concern over the low frequency acoustic seismic experiment (LFASE) planned for hole 418A south of Bermuda, because of the admitted risk to a hole of this scientific value. This experiment could damage the hole or equipment could be left therein. DMP supports the development of technology in wireline re-entry and borehole geophysics. However, 418A is important because it is the only hole which penetrates deeply 100 My old oceanic crust with a record of alteration. 418A is a natural candidate for wireline re-entry since it has not been logged with the high technology tools that have only recently become available, eg the geochemical logging tool. Only the choice of 504B would have been worse. The proposed experiment is not site-specific: 418A was chosen because of its proximity to another hole. 395A and 396 would meet the LFASE programme requirements without the risk to a hole of the highest scientific importance.

DMP Consensus

"Hole 418A should not be put at risk."

5. <u>TEDCOM Report</u>

The Chairman, as DMP Liaison to TEDCOM, reported on the TEDCOM meeting held in Houston, Texas, on February 4-5, 1988. The major thrust of this meeting was an evaluation of how mining technology might contribute to the drilling of deep penetration holes, especially in young oceanic crust. A full report is attached as Annexure I.

The Chairman emphasised that any new drilling technology should not be developed without taking account of the requirements of ODP scientists. For example, does the time and monetary dedication needed for deep drilling developments impact too heavily on other interests? What is the minimum size of core needed? What is the minimum hole size needed for an adequate logging suite? These questions are important especially with the emergence of a panel dedicated to shipboard measurements and the commitment of COSOD II to logging in young oceanic crust.

It was reported that the diamond coring system (DCS) is being developed for a 4-inch hole. DMP considered this inadequate for their logging purposes. Panel prepared a table indicating the wireline information lost for each of several hole diameters (Annexure II). The following tools could <u>not</u> be run in a four-inch hole:

- full waveform sonic (all tools)
- VSP
- wireline packer
- lithodensity tool
- geochemical logging tool

- borehole gravimeter
- magnetometer
- induction
- formation microscanner
- thermal/epithermal neutron porosity

Panel considered this to reflect a serious loss of information. KTB representatives stated that their preference for minimum hole size is 6.25 inches, the size of commercial fishing tools. Mining technology is currently being used to drill 6-inch holes. Panel expressed concern that no cost analysis had been undertaken of 6-inch diamond coring vs. 4-inch coring with 6-inch reaming vs. miniaturization of logging tools with redesign of physical properties equipment. Further, some logging tools cannot be miniaturized.

DMP Recommendation 88/10

"Diamond coring system should make provision for the required suite of logs and other downhole tools to be run."

[The required suite is that which would be run on scientific grounds without diametral restrictions (see Annexure II)]

DMP Recommendation 88/11

"A proper cost analysis be undertaken of drilling deep log-compatible DCS holes vs. the slimholing of tools and instruments, and the necessary redesigning of physical properties equipment on board ship. Costing to make provision for compatibility tests of slimhole and regular tools."

6. Vertical Seismic Profiling

(i) JOI-USSAC workshop on VSP

Stephen reported on the JOI-USSAC workshop on VSP held at CSM on August 27-29, 1987. The workshop report is not yet available. The workshop provided scientific support for VSP surveys in ODP and recommended that a U.S. national VSP laboratory be established to carry out VSP work as required by the U.S. science community, to coordinate development of VSP technology and analysis, and to assist in specialized borehole seismic experiments.

In essence, the workshop recommended that VSP surveys should become an integral part of ODP science, that zero-offset VSP should be performed at all structurally simple sites where sonic log(s) will also be run, and that offset VSP should be performed for specialized applications in structurally complex settings. Substantial improvements in tools and analysis capabilities must be accomplished to ensure a viable programme, eg broad-band tuned source arrays, three-component tools, multi-element vertical arrays of geophones and hydrophones, and computer processing and modelling capability at sea and on shore.

The national laboratory would interface with other groups working on wireline re-entry and long-term earthquake monitoring, with JOIDES contractors, and with the JOIDES DMP. The laboratory would be funded through the USSAC programme and would report to the USSAC committee.

(ii) VSP strategy

Stephen conveyed a summary of the meeting of the USSAC committee in Corvallis, Oregon, on May 10-11, 1988 which reviewed the workshop recommendations. Although general support for VSP was re-affirmed, the long-term details of a national laboratory have not been worked out. Obvious difficulties are management structure, how to handle international cooperation, and the level of commitment and funding required. USSAC will review progress in addressing these difficulties at their September 1988 meeting.

DMP await developments with interest.

(iii) JOI-USSAC workshop on Broadband Seismometers in the Deep Ocean

Stephen also reported on this JOI-USSAC workshop held at Woods Hole on April 26-28, 1988 and which was a natural successor to the earlier JOI-USSAC workshop on wireline re-entry. The driving force behind the workshop was a desire to extend the worldwide seismic network into the oceans. This would require low frequency instrumentation. The workshop brought together whole-earth seismologists and marine geophysicists. The feeling was that seismometers would perform better in boreholes rather than on the sea floor, and therefore there was considerable interest in wireline re-entry. The workshop identified targets to be achieved within a ten-year period.

DMP Consensus

"DMP should be represented during the course of further developments in the deployment of broadband seismometers in the deep oceans."

7. Monitoring of Third Party Specialist Tools

DMP had produced a strategy for PCOM which had now been returned for modification.

PCOM Liaison reported that PCOM was impressed by the thorough job started by DMP on third party tool policy. Specific areas were identified for further attention.

After much discussion it was felt that the Panel were being drawn into legalistic details which are best resolved in subcommittee.

Chairman to redraft the guidelines in accordance with PCOM representations; draft to be reviewed by LDGO, LITHP and PCOM liaisons; revised draft to PCOM by end-July 1988.

[ACTION: WORTHINGTON/LANGSETH/BECKER/ANDERSON]

8. Report on Continental Deep Drilling Programme of FRG

Hanel reported on KTB activity (total budget: 450 million marks). The objectives set by the scientific community have led to the formulation of a key project which can be carried out only by means of a superdeep hole. The programme provides for a pilot hole of depth 3-5 km and a superdeep borehole down to 10-14 km. The pilot hole was spudded on September 22, 1987 and has now reached a depth of about 2.1 km.

A comprehensive logging and testing programme has been established: this includes research and development projects on fundamentals and interpretation techniques. The programme has undertaken a market survey of high temperature tools rated up to 300°C. The programme also includes:

- a set of new tools, eg four-pad formation microscanner, geochemical logging tool, reactivated spontaneous potential tool;
- hydraulic tests, 3-D seismics, multi-offset VSP;
- tool development, eg thermal conductivity, acoustic televiewer.

Collaboration with ODP would be mutually beneficial for it would allow:

- participation on panels;
- dovetailing of activity;
- cost saving;
- exchange of reports, DMP minutes, etc.
- mutual utilization of tools, eg magnetic susceptibility, acoustic BHTV, thermal conductivity tool;
- cooperation on research projects, eg facies log, geochemical logging tool, stress measurements, cooling for downhole measurements.

The deep hole is scheduled for spudding in late 1989/early 1990 and will be drilled over a period of about eight years.

There is also an excellent rock properties laboratory at the wellsite which contains comprehensive and contemporary petrophysical equipment.

The Chairman thanked Dr Hanel for his most interesting overview. The panel supported active collaboration with KTB. The obvious liaison is the FRG representative on DMP (H. Villinger). Representatives of KTB are, of course, welcome to attend DMP meetings themselves when it is considered especially desirable.

The following actions were proposed.

A KTB report be given at each DMP meeting and vice versa through the liaison.

[ACTION: VILLINGER]

A KTB/ODP joint workshop be held in FRG around September 1989 at which case histories from the KTB pilot hole and from ODP would be reviewed, common problems exposed, and joint solutions proposed.

[ACTION: WORTHINGTON/ANDERSON/HANEL/DRAXLER]

A DMP meeting be held in FRG at the time of the above workshop.

[ACTION: WORTHINGTON]

KTB representatives to seek direction on the desirable frequency of their attendance at DMP meetings.

[ACTION: HANEL]

To pave the way for these actions DMP considered that EXCOM/PCOM should be made aware of the scope of KTB activity.

DMP Recommendation 88/12

"KTB staff should be invited to give a presentation on the KTB project to EXCOM and PCOM as soon as possible."

Progress towards ODP/KTB collaboration will be reviewed at the next DMP meeting.

9. DMP Thematic Thrusts

Panel identified five areas where specialized downhole measurements would always be strongly supported.

(i) Lithospheric stress on a global scale;

(ii) Sediment cyclicity;

(iii) Composition and structure of the crust;

(iv) hydrogeological phenomena;

(v) Monitoring of modern geological processes.

These themes will determine the input of non-standard downhole measurements to future ODP programmes. They are not exclusive: specialized downhole measurements in pursuit of other objectives will always be recommended where justified.

Strategic use of these themes in long range planning will allow some initial provision for non-standard logging to be made when the initial leg structure is being devised. Where one or more of these themes is pertinent to the scientific objectives of a proposed leg, provision should be made in the initial leg schedule for appropriate specialized tools to be run. It should be presumed that DMP will require the most comprehensive logging suite in support of each pertinent theme. LDGO liaison is asked to provide details of specialist tools and deployment times appropriate to themes (i) - (iv).

[ACTION: ANDERSON]

The mechanisms for incorporating the DMP thematic strategy into planning cycles will be developed further at the next panel meeting.

10. Logging Contractor's Report

Anderson reported events from recent and current legs.

Leg 118

Hole 735B was investigated with virtually every downhole measurement on board ship. Core recovery was 87%. This provides substantial scope for the calibration of tool response, eg the geochemical logging tool.

Leg 119

Four holes were all logged with standard technology.

Leg 120

The death of Lamar Hayes is deeply regretted by all.

Leg 121

The seismic stratigraphy tool was lost at Site 752B but was successfully fished. After fishing the Co-chiefs still made time available for the three standard logging runs. The Chairman complimented the Co-chiefs on their flexibility.

Jarrard reported on the LDGO performance evaluation.

There was a marked increase in the percentage hole logged around Leg 111 because of an improved mud programme through salting which resulted in much less bridging. However, there has been a big increase in XCB sticking because this is being pushed beyond its limit in seeking the better core recovery it provides. It is for this reason that the 750m rule has been introduced: logging is carried out when hole depth reaches 750m, then drilling is continued with XCB, then lower hole is logged.

TAMU is more rigorously enforcing PCOM logging objectives.

LDGO is seeking to improve Schlumberger tool performance. For example, the sonic digital tool (SDT) is being removed from the ship: the tool is not sufficiently robust and reliable for shipboard use. The long spacing sonic (waveform) is being re-introduced.

In WPAC more holes have a TECP objective so there are fewer shallow holes and there will consequently be a large logging effort.

In CEPAC more holes have a LITHP priority, more time is assigned to drilling, with less time for logging. Consequently, the logging effort can be expected to be smaller.

Anderson reported on COSOD II implications for tool development.

(a) High resolution logs

The contract to miniaturize the formation microscanner (FMS) was let to Schlumberger on March 1, 1988 with delivery by year end. A test is scheduled for Leg 124E.

(b) Geochemistry

A prototype high spectral resolution, germanium crystal, cryogenic tool has been tested at 100m/hour. This is a very sharply resolved version of the geochemical logging tool. The Schlumberger cryogenic tool is to be run in the KTB hole.

(c) Stress

The need for stress measurements has been re-emphasized. The FMS caliper locks into the ovalized hole so the inferred stress direction may be incorrect. The FMS does not provide stress magnitudes. The BHTV can furnish stress directions and magnitudes. It is therefore important to maintain BHTV capability.

11. <u>TAMU Briefing</u>

Harding reported on the following topics.

(i) Side entry sub (SES)

The SES on board ship can be run up to the present drill string weight limit. LDGO are commissioning a finite element stress analysis (with Stress Engineers of Houston) to investigate whether more pipe can be hung on to SES. TAMU prepared the specification for and will monitor the study.

(ii) Quantification of acceptable level of risk to drillstring

Can't quantify: too many factors, some of which can only be assessed on board ship. Defer to judgement of operations superintendent.

(iii) Mud programme

Contract at TAMU to improve hole cleaning capability through flow loop analysis of lifting capacities of different muds. It is hoped to use some recipes in deep penetration hole planned for Leg 122. Message is to use bentonite or gel rather than polymers. Key issue to be resolved is effectiveness of small volumes of very viscous muds vs. larger volumes of lighter muds. However, all options are salt muds.

LDGO request notification of the addition of barite because of the adverse effect on the geochemical logging tool.

More time has been spent conditioning holes and this has contributed to a reduced bridging problem. Also a better mineralogical capability on board ship allows mud composition to be tuned to formation type.

(iv) Lockable flapper

This is used with XCB: allows logging through the bit. Will allow 750m logging. No longer in development phase.

(v) XCB stuck core barrels

New XCB design on Leg 121. Overtorquing the lowermost connection has been the main problem. New design has more than doubled the strength of that connection. Recovery is higher than with rotary system. Design is continuously evolving.

(vi) Navidrill

Tested on Leg 121 at three sites to date. Ability to provide geoprops pilot hole proven. Core quality has been excellent in basalt and in limestone/chalk/chert sequence. Remaining problem areas include some core jamming, especially in interbedded formations. Projected use of the Navidrill is to drill 50m into basement (without reaming). This would remove the logging option.

Meyer reported on computer aspects.

(vii) Computer bottlenecks on board ship

ODP has grown beyond shipboard processing power. Excess capacity is needed because of work-load peaks, heavy use of graphics, and need for adequate idle time for system work. Upgrade of two VAX 3600 processors will add much CPU power to the system which will provide adequate capacity.

It is not TAMU's brief to process logging data. LDGO have committed funding for the purchase through TAMU of a VAX 3600 processor dedicated to the formation microscanner.

(viii) Disc storage of core barrel data

Many but not all of these data are available for shipboard display. Need to complete this and be able to compare with logs. A working group should assess the situation from a shipboard standpoint and report to TAMU within 3 months (ie by September 10, 1988) with TAMU response to proposal within 3 weeks (ie by October 1, 1988). Matter to be reviewed at next DMP.

[ACTION: JARRARD/WILKENS/CARSON]

12. <u>Engineering Leg</u>

Harding reported that, with one exception, the DMP recommendations have all been incorporated into the leg schedule which has been extended to 35 days to accommodate the programme of downhole-measurement tests. The exception is the test of the ODP rotatable packer which is top of the reserve list. The reserve list also includes the testing of a combined BHTV/susceptibility/three-component magnetometer tool.

The priority list of logging tests now reads:

(i) drill dedicated hole for downhole measurements to approximately 200m into basement (1.5 days)

(ii) wireline heave compensator (0.5 days)

(iii) wireline packer (2 days)

(iv) formation microscanner (0.5 days)

(v) GST through-wiring (1 day)

(vi) SES hot hole evaluation (1 day)

In addition the Geoprops Probe, or a dummy if the probe is not ready, will be subjected to a trial emplacement within a Navidrill test hole.

The primary aim of the leg is to test the high-speed diamond coring system. Target is 200m penetration into a fractured formation. Hole diameter is 4 inches: core diameter 2.5 inches.

Panel noted that:

(i) COSOD II emphasized the need for logs in young ocean crust;

(ii) high temperature SES is not compatible with DCS.

The engineering leg is fully staffed.

13. Budget FY 89 et seq.

Anderson reported on the BCOM-approved budget status up to FY 92. Items that have been cut are indicated in parentheses.

FY 89	FMS, gyro, packer parts
	(3rd packer, computer upgrades)
FY 90	Zero
	(IP tool, digital BHTV)
FY 91	Lease of high temperature logging tools
FY 92	Lease of high temperature logging tools, digital BHTV
	(computer upgrades)

A major item of concern is the deferral of the digital BHTV to FY 92. LDGO view was that the existing televiewers could not fully support the programme over the next four years. Significant periods of downtime could be expected during breakdowns and repairs without adequate back up. DMP were especially concerned in view of emphasis on stress measurement both by COSOD II and by DMP itself (see DMP thematic thrusts, item 9).

DMP Consensus

"In the light of its identified priorities, DMP notes that the LDGO budget status fails to make provision for adequate downhole-measurement support for the characterization of lithospheric stress on a global scale. The early acquisition of a digital televiewer would partly alleviate this shortfall."

14. Technical Review - in situ Probe Tools

(i) Geoprops Probe - status

Karig reported that the feasibility study for the Geoprops

Probe was completed in March 1988. This formed the basis for an NSF proposal ($ 154 000) for the development of two probe tools, spare parts and a data stripping system. Development is scheduled in three phases.

Phase I - testing of sensors in the packer ($ 7 000, funded by residual money from feasibility study)

Phase II - development of prototype electronics ($ 10 000, funded by JOI-USSAC; work to commence week of June 13, 1988; estimated to take 1-2 months)

Phase III - actual construction of the probe by TAM, Inc ($ 154 000, needs NSF approval of proposal; decision estimated late July 1988)

Estimated completion date is early 1989. TAM cannot guarantee that the probe will be ready before the Engineering Leg. If not, it is hoped to deploy a mechanical dummy in one of the Navidrill holes to test latching and Navidrill hole conditions. Land testing of the complete probe is anticipated in early 1989 and shipboard testing as soon as possible thereafter.

Geoprops Probe measures permeability, pore pressure and temperature, and takes fluid samples.

(ii) Lateral stress tool (LAST)

Moran described the objectives of LAST which are to measure the lateral stress and deformation of soft sediments on the Canadian margins and in those areas of ODP where a knowledge of lateral stress is important.

A feasibility study carried out in 1986 proposed two phases of development.

Phase I - tool to measure lateral stress (LAST)

Phase II - tool to make deformation measurements, stress and strain, shear modulus, creep

Phase I tool is being developed now. It is due for offshore testing in July 1988 after some ground testing.

Phase 1 tool measures lateral stress in three locations around the tool, pore pressure and temperature, and retains a disturbed rock sample.

15. <u>Legs 121 - 123 General Overview</u>

O'Connell and Jarrard reviewed plans for imminent legs.

Leg 121 - under way

Scheduled logging is standard suite + BHTV

Leg 122 - tie-in with industry wells on NW Shelf

Standard logging suite

Leg 123 - French susceptibility tool to be run. Magnetometer from GPIT. Co-chiefs cut out VSP to allow increased basement penetration but PCOM extended Leg and VSP now reinstated.

VSP scientist needed for Leg 123

DMP Recommendation 88/13

"DMP re-affirms the importance of logging and downhole measurements at the old crustal reference site AAP1B and recommends that this site be drilled first during Leg 123."

16. <u>Nankai Leg</u>

Chairman reported that 20 days had been set aside for downhole measurements. Several priorities had been recommended by DMP (refer previous minutes). PCOM had subsequently asked DMP to comment on drilling strategy as it affects downhole measurements, and to develop logging scenarios for availability/non-availability of Geoprops Probe.

Panel considered two issues pertinent to Nankai logging programme.

(i) LAST

DMP considered that this tool should be incorporated within the high priority list for Nankai downhole measurements.

It was noted that LAST as a soft sediment tool is complementary to the Geoprops Probe which is designed for consolidated sediments. Furthermore the scope of LAST largely encompasses that of the new Barnes/Uyeda WSTP which WPAC have recommended for all their legs.

(ii) Proposal 304 F

As presented this would require an extra week for the proposed dedicated hole for long term temperature measurements. This, in turn, would displace some logging runs. A dedicated hole is not essential to the objectives but the condition of a non-dedicated hole might deteriorate before probe emplacement. Better hole conditioning seems the optimum solution.

DMP Response

"DMP strongly endorses the scientific objectives of Proposal 304 F but questions the need for a dedicated hole which would impact adversely on other downhole measurements because of time considerations. Panel view is that the experiment be carried out in a conditioned hole or perhaps be incorporated within a second engineering leg."

DMP considered that the programme of downhole measurements for Nankai was becoming very complex and was not well structured. Panel felt that a working group of interested parties should be convened to meet as soon as possible, in view of stated urgency (refer Item 1 (i)). This working group should draw upon engineering input and should produce a draft report before next PCOM.

DMP Recommendation 88/14

"A working group be established to formulate the detailed programme of downhole measurements for the Nankai Leg. A two-day meeting to be held at College Station on 25-26 July 1988. Recommended members are:

P F Worthington (Chairman), K Becker, B Carson, D Huey, R Jarrard, D Karig, M Kastner (or J Gieskes), H Kinoshita, G Moore (or T Shipley), K Moran."

Since this meeting is scheduled before next PCOM, Chairman should convey recommendation to JOIDES office directly for approval.

[ACTION: WORTHINGTON]

Chairman will telex identified members of working group to solicit agenda input.

[ACTION: WORTHINGTON]

17. Western Pacific

(i) Sub-meeting to revise WPAC logging

Chairman reported that DMP having noted discrepancies in WPAC data at last meeting, a subgroup was identified to finalize the WPAC logging programme. Subgroup to comprise DMP and WPAC chairmen and representative of LDGO. Meeting scheduled for April 8, 1988.

WPAC chairman declined to attend and so Worthington and Jarrard met in Europe on appointed date and fine-tuned the WPAC logging programme as far as Leg 130.

(ii) WPAC meeting on April 11-14, 1988

Villinger represented DMP. WPAC essentially accepted all the DMP recommendations for logging arising from the sub-meeting on April 8, 1988.

(iii) Programme for Legs 124-130

Leg 124 - Sulu/SCS

Standard suite at SUL 5 (now called SS1) and Celebes, and possibly at SUL 4 (350m site)

DMP Recommendation 88/15

"Standard logging suite to be run in SUL 4 because of the importance of this site in sediment cyclicity studies."

Leg 125 - Bonin/Mariana

DMP recommended FMS for all sites. FMS is unlikely to be ready so it is no longer scheduled. This raises the importance of the BHTV on this leg. Current plan allows for standard suite in all holes, BHTV in MAR 3A and BON 6, and wireline packer in MAR 3A, MAR 3B and BON 7. Also packer experiment and magnetometer/susceptibility in BON 6.

Leg 126 - Bonin

FMS now included in "standard suite". Standard suite in all holes. Wireline packer in BON 1 and BON 2, BON 5A and BON 5B. Induced polarization log in BON 1 and BON 2 (if mineralization encountered). BON 1 may be high temperature (up to 600°C).

Panel to report to LDGO individually with knowledge of IP tool availability.

[ACTION: PANEL]

Leg 127 - Japan Sea I

Standard suite in all holes.

BHTV and magnetometer/susceptibility in J1b and J1e (and J3a). Packer/hydrofrac at J3a. VSP and packer at J1b.

VSP and packer are sometimes incompatible in the same pipe trip. It might save time if packer was moved to Leg 128. Until VSP tools are identified, DMP cannot take a position.

Leg 128 - Japan Sea II

Standard suite in JSa and JS-2. Return to J1b, deploying seismometer array, geoelectrical study, oblique seismic experiment. VSP at J2a. Induced polarization deleted at J2a. WPAC prefer packer to wireline packer for broadscale permeability at J2a.

Leg 129 - Nankai

see Item 16

Leg 130 - Geochemical Reference Leg

Old crustal site; logging programme similar to site AAP1B of Leg 123.

(iv) Programme for Legs 131 et seq.

The second year of WPAC will be tuned up at next DMP meeting. A potential problem concerns Vanuatu where the study of decollements and fluid flow requires time for the ODP rotatable packer as well as the wireline packer and possibly the Geoprops Probe.

18. Central and Eastern Pacific

There is no CEPAC leg structure as yet. In addition to DMP thematic thrusts (Item 9), downhole-measurements issues are high temperature logging and diamond coring systems. All EPR and other rise holes will be hydraulically active and will require sealing. Sealing mechanisms will need to be developed.

DMP input to CEPAC will be mapped out at the next panel meeting.

19. Scientific Value of Logging

Reports were received on actions intended to promote an increased awareness of the scientific benefits of downhole measurements.

(i) Post-cruise data access

Anderson reported that an ODP licence contract had been offered by Terrasciences. This was a $ 30 000 institutional licence which made no provision for hardware but allowed an unlimited number of workstations for accessing Terralog. Initial panel response was that this offer is hardly preferential.

(ii) Keynote paper

Chairman reported that this paper, which was prepared for COSOD II but which did not appear in the COSOD II report, will be submitted for publication by 1 July 1988.

(iii) Logging schools

Anderson reported that two logging schools had been scheduled in the USA; 29 October 1988 in Denver, Colorado, immediately prior to the GSA meeting, and 4 December 1988 in San Francisco immediately prior to AGU.

Canada seemed committed to a logging school during 1989.

(iv) Keynote presentations

Chairman reported that Tom Pyle's efforts to secure a keynote slot on ODP downhole measurements at IGC had drawn a blank because the keynote aspect of the IGC programme was already fully developed. It is possible, if sufficient abstracts are submitted, to generate a logging session but this would be by circumstance rather than design. As such, it is not preferred. ODP will have a booth at IGC which will include a logging display.

(v) JGR thematic volume

Becker reported that an AGU special poster session on crustal logging would form the basis for a JGR thematic volume with manuscript deadline of 1 February 1989.

(vi) Shipboard presentations

Anderson reported that these are being given by LDGO scientists early in each leg.

(vii) Video

Chairman reported that the production of a video on "Geological information from wireline logs" for shipboard viewing was going ahead.

20. <u>Proposals</u>

(i) 76E - Hekinian & Francheteau

Superseded by EPR working group.

(ii) 298F - Moore

Provisionally endorsed: refer to Nankai working group.

[ACTION: WORTHINGTON]

(iii) 299F - Brandon & Moran

Panel encourage initiative and look forward to further developments. Panel emphasize need for reliable in situ calibration.

(iv) 300B - Dick et al

Not endorsed by LITHP

(v) 301D - Gieskes et al

Panel endorses concept of physical and chemical characterisation of accretionary prisms but awaits a decision from PCOM/TECP.

(vi) 302F - Hamano et al.

Strongly supported: noted that time requested is three days.

21. Geochemical Logging Workshop

No proposal has been submitted to USSAC. Brass and Kastner reported to be organising (ref. Item 4). Panel considered that DMP must be involved in organisation. To be successful, workshop needs a well-worked database, adequate case histories, and to be broader-based than ODP. To hold such a workshop now would be premature.

DMP Consensus

"Encourage the submission of a proposal to JOI-USSAC to hold a geochemical logging workshop around mid-June 1989 with a subsequent thematic volume."

DMP nominated Worthington and Howell to pursue this initiative. Chairman to contact Brass and Kastner in the first instance. DMP preference was for these four to organise workshop.

[ACTION: WORTHINGTON/HOWELL]

22. Date of Next Meeting

Chairman had difficulty identifying suitable dates due to conflicting activities. Venue chosen as LDGO. Provisional dates for next DMP meeting chosen as 21 and 22 October 1988: these are tentative.

23. Other Business

Staffing: ODP/TAMU are always pleased to receive nominations for JOIDES logging scientists.

[ACTION: PANEL]

There is an urgent need for a nomination for a JOIDES logging scientist for Leg 125 from the FRG. Representatives to investigate and submit names through appropriate contact to the ODP/TAMU Operations Manager.

[ACTION: KOPIETZ/HANEL/DRAXLER]

24. Close of Meeting

The Chairman thanked Members, Liaisons and Guests for their contribution to the meeting, ODP/TAMU for their kind hospitality and Dr S O'Connell for her gracious hosting. The meeting closed at 3.09 pm on 10 June 1988.

Paul F Worthington

15 June 1988

Annexure I

MEETING OF JOIDES TECHNOLOGY AND ENGINEERING DEVELOPMENT COMMITTEE (TEDCOM)

Airport Holiday Inn

Houston, Texas

4 - 5 February 1988

REPORT

Summary

The major thrust of this meeting was an evaluation of how mining technology might contribute to the drilling of deep penetration (2 - 3km) holes. Important scientific issues should not be prejudiced by the choice of technology. Thus there is a need for the scientific community to make its views known on such matters as time dedication vis-a-vis shallow drilling, minimum core size that is necessary for study, minimum hole size needed for downhole experiments, etc. The Downhole Measurements Panel will be collating an advisory brief for TAMU during the next few months.

1. Function

The undersigned attended in his capacity as Liaison to TEDCOM from the JOIDES Downhole Measurements Panel. These notes relate specifically to those matters which impact on the activities of DMP.

2. Engineering Liaison

PCOM have approved liaison of TAMU engineers (in addition to TAMU staff scientists) to important meetings of JOIDES scientific panels in future. This decision is in accord with the philosophy that scientific achievement is not possible without engineering development.

3. Operations Highlights - Recent Legs

Leg 116: 9 " APC/XCB bit successful in achieving 2 - 3 times faster coring rates.

More frequent mud sweeps used for hole cleaning to aid logging attempts.

XCB hole cored to 935.0m, deepest XCB ever.

Leg 117: Lockable flapper successfully field tested to log through.

Leg 118: First positive offshore operation of the Navidrill. The Navidrill bit design would be greatly enhanced by real-time physical properties measurements, e.g. compressive strengths. It is ludicrous to design bits without this information. It is recognised that physical properties has been the poor relation of shipboard measurements.

In response, PCOM liaison stated that a major thrust to rectify the situation is now underway within ODP.

4. ODP Engineering R & D Projects

(i) Drilling/coring fractured crustal rocks.

(ii) Bare rock spudding.

(iii) High temperature drilling/coring.

(iv) High temperature logging

- LDGO responsibility.

(v) Recovery of alternating hard/soft sequences.

(vi) Recovery of coarse-grained unconsolidated sediments.

(vii) In-situ physical properties including pore pressure and permeability measurements

- providing engineering liaison for third party tool development including pressure meter, TAM drilling/tubing packers, Geoprops probe and pore water sampler.

(viii) Recovery of gassy sediments under in-situ pressure.

(ix) Maintaining deep/stable holes (2 - 3km).

TAMU emphasised the need for advance planning (3 - 4 yrs) of potential technical problems that will need to be addressed in ODP.

5. TAMU Mud Programme

A flow loop has been constructed. This encompasses a scale model of the APC/XCB configuration together with drill pipe. The aim has been to introduce pill sized cuttings to simulate drill cuttings and to study slip velocities using a video system. This was unsuccessful and further experimentation is underway. Ultimate goal is improved hole stability and thence better logging prospects.

6. <u>COSOD II Results and Goals</u>

COSOD II exposed the realization that scientific goals will not be accomplished without engineering developments. There is almost a conflict of requirements within ODP, i.e. a few deep holes vs. lots of shallow holes. For this reason an alternative platform concept has been discussed as an addition to JOIDES Resolution.

7. <u>Mining System Technology into ODP Drilling</u>

Object: deep penetration drilling (hard rock). There are five concepts that have been studied by TAMU:

(a) Navidrill Core Barrel (NCB)

- high speed diamond coring
- limited (<200m?) basement penetration through APC/XCB B.H.A.
- currently under development

(b) Mud motor with conventional core barrel

- at design stage

(c) As for (b) but compatible with wireline coring

- contingent upon (b) being successful
- if (b) unsuccessful, shift emphasis to (d) or (e)
- feasibility study planned

(d) Hollow rotor turbine with hydraulic thruster

- system feasibility related to successful deployment/operation of the NCB

(e) Drill rod inside drill pipe/mini-riser

- limited testing already done
- investigate possibility of rotating the core barrel downhole while drill string stays stationery in the guide horn.

8. <u>Deep Penetration Holes - Development Strategy</u>

The above concepts may provide the key to deep penetration holes. There are other alternatives as per COSOD II document, e.g. deep water riser drilling, but these may be prohibitively expensive. For example, the development of an oilfield riser system for ODP has been costed at $20 000 000.

A recommendation was made to dedicate engineering time and budget to perform the testing of slim hole (mining) type coring operations. In so doing, engineering issues that need to be addressed are:

(1) Drill-rod evaluation (compatibility with ODP pipe)

(2) Measurements of mining system

(3) Heave compensation

(4) Surface equipment (rig & platform)

(5) Mud (lubricants)/hole cleaning

(6) Latch-in of pipe and seafloor

(7) Seafloor structure - standard re-entry cone (?)

(8) Core barrels and recovery technique

(9) Bits/cutting shoes

(10) Pumps and circulating equipment

These efforts will assume 1000m water and a good formation from a drilling standpoint.

There is a need to identify at the outset the requirements of ODP scientists. What is the minimum size of core needed? What is the minimum hole size needed for logging? What core size will permit extraction of horizontal core plugs of the minimum dimensions necessary for accurate physical properties measurement on board ship? If these questions are not taken into account there becomes a danger of drilling to greater depths at all cost, that cost including some of the scientific objectives of ODP.

9. <u>Engineering Leg</u>

It was reiterated that a shipboard physical properties measurement capability is essential for the Engineering Leg (125) to aid the drilling experiments in real time.

The current status of physical properties in ODP is that the recommendations of the Downhole Measurements Panel have been passed to TAMU for costing/feasibility.

Annexure II

LOGGING CAPABILITY IN BOREHOLES OF DIFFERENT DIAMETERS

Tool	Tool Diameter (inches)	Slimhole Capability	Loggable Hole Diameter			
			6½"	5½"	4½"	4"
Phasor Induction	$3\frac{5}{8}$	No	X	X		
Dual Induction	$3\frac{5}{8}$	Yes	X	X	X	
Dual Laterolog	$3\frac{5}{8}$	Yes	X	X		
HEL Dual Laterolog	$2\frac{3}{4}$	Yes	X	X	X	X
Microlog	$4\frac{1}{2}$	No	X	X		
Dipmeter	$3\frac{5}{8}$	No	X	X		
FMS	$3\frac{5}{8}$	No	X	X		
Induced Polarization	$2\frac{3}{4}$	?	X	X	X	X
Full Waveform Sonic	$3\frac{5}{8}$	No	X	X		
HEL Velocity	$2\frac{3}{4}$	Yes	X	X	X	
Slimhole Velocity	$1\frac{11}{16}$	Yes	X	X	X	X
Thermal/Epithermal Neutron Porosity	$3\frac{5}{8}$	No	X	X		
HEL Porosity	$2\frac{3}{4}$	Yes	X	X	X	
Slimhole Porosity	$1\frac{11}{16}$	Yes	X	X	X	X

Lithodensity	$3\frac{5}{8}$	No	X X
HEL Lithodensity	$2\frac{3}{4}$	Yes	X X X
Slimhole Density	$1\frac{11}{16}$	Yes	X X X X
Induced Gamma Spectral (GST)	$3\frac{5}{8}$	No	X X
Aluminium Activation	$3\frac{5}{8}$	No	X X
Natural Gamma Spectral (NGT)	$3\frac{5}{8}$	No	X X
Natural Gamma	$3\frac{5}{8}$	Yes	X X
Borehole Televiewer	$3\frac{5}{8}$	Yes	X X
Slimhole BHTV	$1\frac{11}{16}$	Yes	X X X X
Borehole Gravimeter	$3\frac{5}{8}$	No	X X
Magnetometer	$3\frac{5}{8}$	?	X X
Drill-string Packer	$3\frac{5}{8}$	Yes	X X X X
Wireline Packer	$3\frac{5}{8}$	No	X X
Borehole Fluid Sampler	$1\frac{11}{16}$	Yes	X X X X
Packed-off Fluid Sampler	$3\frac{5}{8}$	No	X X
VSP Multi-shuttle 3-component	$3\frac{5}{8}$	No	X X
VSP Single 3-component	$3\frac{5}{8}$	No	X X
VSP Single vertical component	$3\frac{5}{8}$	No	X X

MEMORANDUM

To: Dr. Ted C. Moore
Chairman, IHP

RECEIVED JUL

From: Dr. David K. Rea
Chairman, CEPAC and
frustrated *Resolution* computer user

Date: 17 June, 1988

Re: Shipboard capabilities and services

We have just hit basalt at the last site of Leg 121, so there is time for the sedimentologists to sit and write our reports. You will get a report from Ian Gibson on the manner and method of computing on the *Resolution*. We are all delighted to see Ian's concern for how the on board computing works and doesn't work, and believe that one member of IHP should go to sea every year to insure a supply of first-hand information to your panel. Presumably you get direct feedback from all the Co-Chief Scientists as well. None the less, I want to convey the impressions of one who is only an ordinary computer user, me, in addition to the impressions of someone as knowledgeable as Gibson.

The scientific party needs to accomplish three tasks while on board, assemble data, construct graphic displays of the data, and write reports. The nature of drilling cruises, as you know, is that about half of the subject material is routine and can be planned for, and about half is serendipitous, the exciting discoveries by the on board scientists. These aspects of any cruise are much harder to anticipate. The recent installation of WORDPERFECT means that the writing portion of the task goes reasonably well, and as of now there are only hardware (keyboard and printer) problems. Tasks of assembling and plotting data generated on board are, however, so cumbersome that they inhibit the degree of scientific inquiry achievable on the ship. The *Resolution* computing capabilities are dominantly curatorial in concept and not set up to serve the needs of a perpetual team of transient scientists.

The real problems come when one is required to interface with the VAX. The VAX is overburdened and thus very slow. It often takes more than five minutes to logon. The steps to get into any useful program, or create a data file are lengthy, confusing, and not "cookbooked" for beginners. One can not plot from the spreadsheet program without extensive manipulations, and even the daily-use, core programs have significant drawbacks.

The University of Michigan Department of Geological Sciences 1006 C.C. Little Building Ann Arbor, MI 48109-1063 (313) 764-1435

As a first example, consider the program SLIDES. In the days of yore, one of the jobs of the sedimentologists was to keep track of the sedimentary components of the dominant lithologies on what was essentially a relative-abundance graph; we called it the Lancelotogram, after Yves who (might have) began the practice. Now comes the program called SLIDES, which is supposed to do that automatically, simply enter the data and presto: data tabulation and graphs. There are two difficulties with this program, first only one person can use it at a time so when the rush comes at the end of every site there is no way to speed up data entry. This is a minor problem compared to the second, which is that the program can not construct a useful Lancelotogram. SLIDES does not distinguish between major and minor lithologies, so routine oozes are spiked with ash layers, limestones appear to interfinger with thick beds of pure pyrite or glauconite, etc. (see attached). Only five components can be plotted and it is impossible to combine any of them, like diatoms plus rads equals opal. Any useful graphic lithology depiction must still be done by hand after great amounts of time are spent entering the data. It should be a quick programming change to distinguish between major and minor components, allow summation of individual categories, etc., but nobody has done it.

There is a program on board called PICSURE which is supposed to make nice plots which it does; unfortunately it is very difficult to use beyond the truly canned procedures for magnetic and %$CaCO_3$ data. Command code strings and file recalls are dozens of characters long in order to step through various subdirectories (I think). Logarithmic scales don't exist and scales that go from high to low, like some isotopic information or phi size, have to be faked by pretending all values are negative. Reprogramming this program to be interactive and prompt responses, like the old OSU programs, would make it much more useful; as of now only about three or four of the scientific party of 26 can use it to any great extent, and one learned on a previous leg. Even so, it is so demanding of computer time that if we could all use it, we couldn't. Two persons brought Macintosh units on board with them and one exists already. Many of the Leg 121 plots and diagrams, especially the all-important hole summary figures, impossible on PICSURE, have been done on the Macs (see attached). More and more it seems as if ODP is assuming an ostrich-like pose regarding the utility of Macs and their superb graphics capabilities.

There is a simplistic spreadsheet program on board called 20/20. It manipulates columns and rows of numbers, but is noticeably more cumbersome than LOTUS 1-2-3 and the graphics aspect is more difficult to use. A major handicap is that there is no straightforward way to make simple plots on this or any spreadsheet program and then get them to plot on any of the on board printers. In contrast, the EXCEL/CRICKET GRAPH combination on the Mac is simple to learn but powerful enough to be both useful and elegant. I found that the single greatest limitation of the on board computing system is that there is no simple method for creating a data file, say several parameters against age or depth in core, and plotting it either for my own information or for report figures. This situation will persist until present methods of data file creation and graph construction are significantly modified.

On paper, the computer capabilities of the Resolution are far superior to that of the Challenger, but the shipboard operations belie that impression. 80% of the shipboard scientists are unable to construct a simple data file of whatever they like to think about and then plot the relationships they feel are important. Lessons and information packets are pitched at the level of those familiar with VAX-type systems and not for the basic LOTUS or EXCEL user. There is no "cookbook". In the long run, then, the scientist is worse off than on the Challenger, because the on board and shore-based backup capabilities have been replaced by a computer which is not usable by most of us. For instance there is no good drafting facility on board to make drawings.

No listing of problems is particularly useful without some suggestions. Installation of WORDPERFECT is a great leap forward over the old in-house program; now TAMU and ODP can communicate with the rest of the world. The same concept needs to be applied to the data manipulation - graphics capabilities. PICSURE needs to be significantly reprogrammed to make it userfriendly rather than userphobic, or, even better, abandoned. Interactive programs are essential for the type of transient personnel that will always be on the ship. If plots could be made from a standard spreadsheet program, then 80% of the scientific party could participate. Even better, go to Macs and programs like CRICKET or EXCEL.

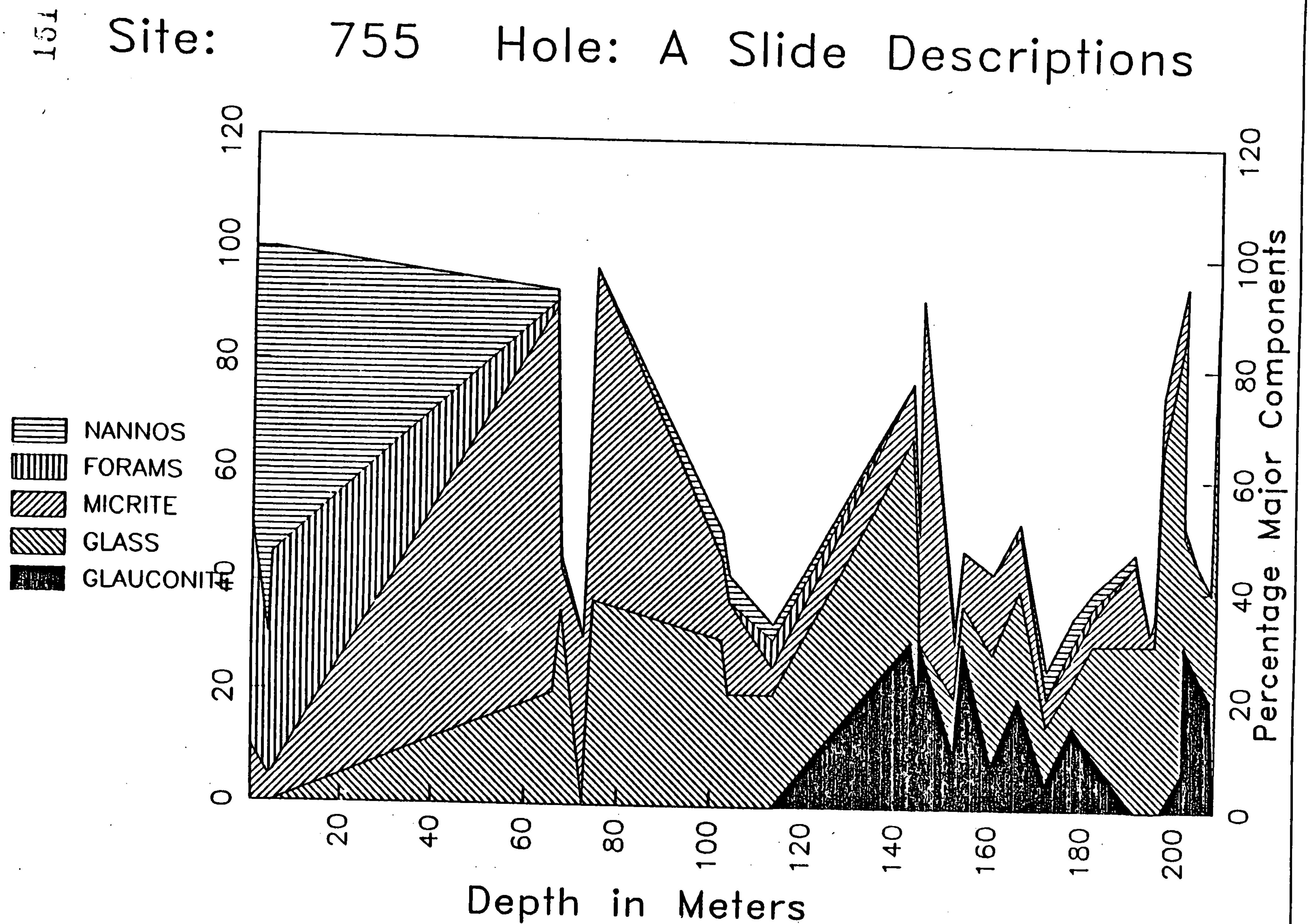
The computer people on board are very good and dedicated, but are not in the position to do all the scientists' computing. One possibility might be to establish a computer-yeoperson or a "systems consultant" who would have the job of doing everyone's data manipulation and plotting for them. Having a person on board who knows all the little tricks and traps of packaged programs and whose full-time job it is to teach transients would make a world of difference.

It is my understanding that there are funds available to "upgrade" the system. I would add my voice to those who are urging that these monies be spent on a group of networked PC's that incorporates several, if not entirely, Macs, with good new printers including several laser printers. The present printers can not even do superscripts and subscripts. Keep the present VAX for all the inventory sort of chores it does now.

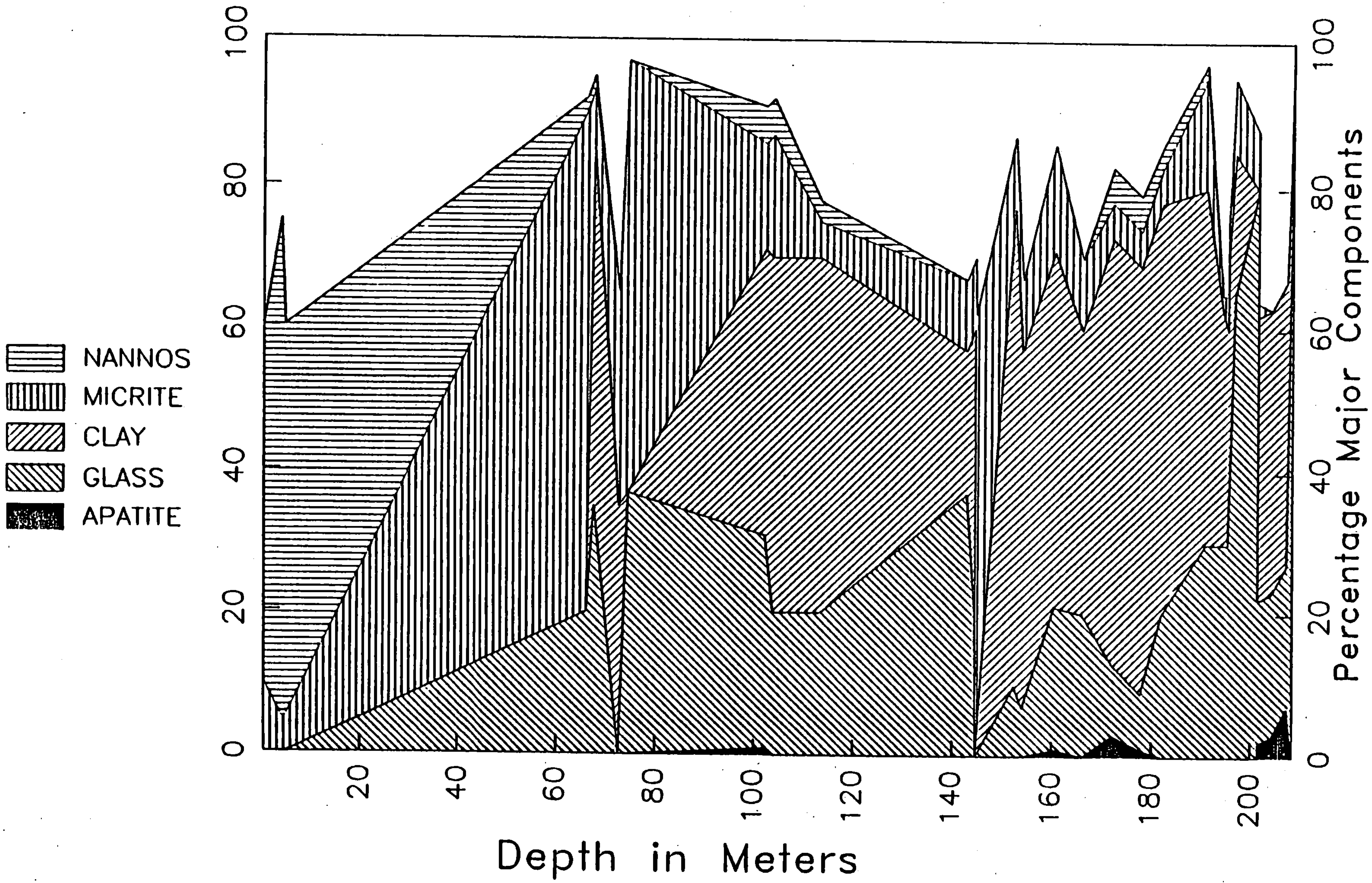
The success of the Ocean Drilling Program, like that of DSDP, will be judged on not the basis of the data it archives, but rather on the basis of the quality of science it produces. Right now the on board computing system does not greatly assist in that effort, and in some cases hinders it. Now that the data curation aspects are adequate, helping the scientific party to do the best job it can should be the top priority of the ODP computer operations, even if it means a change of either direction or concept.

Attachments: Examples of output from SLIDES
Hole summary diagrams done on the Mac

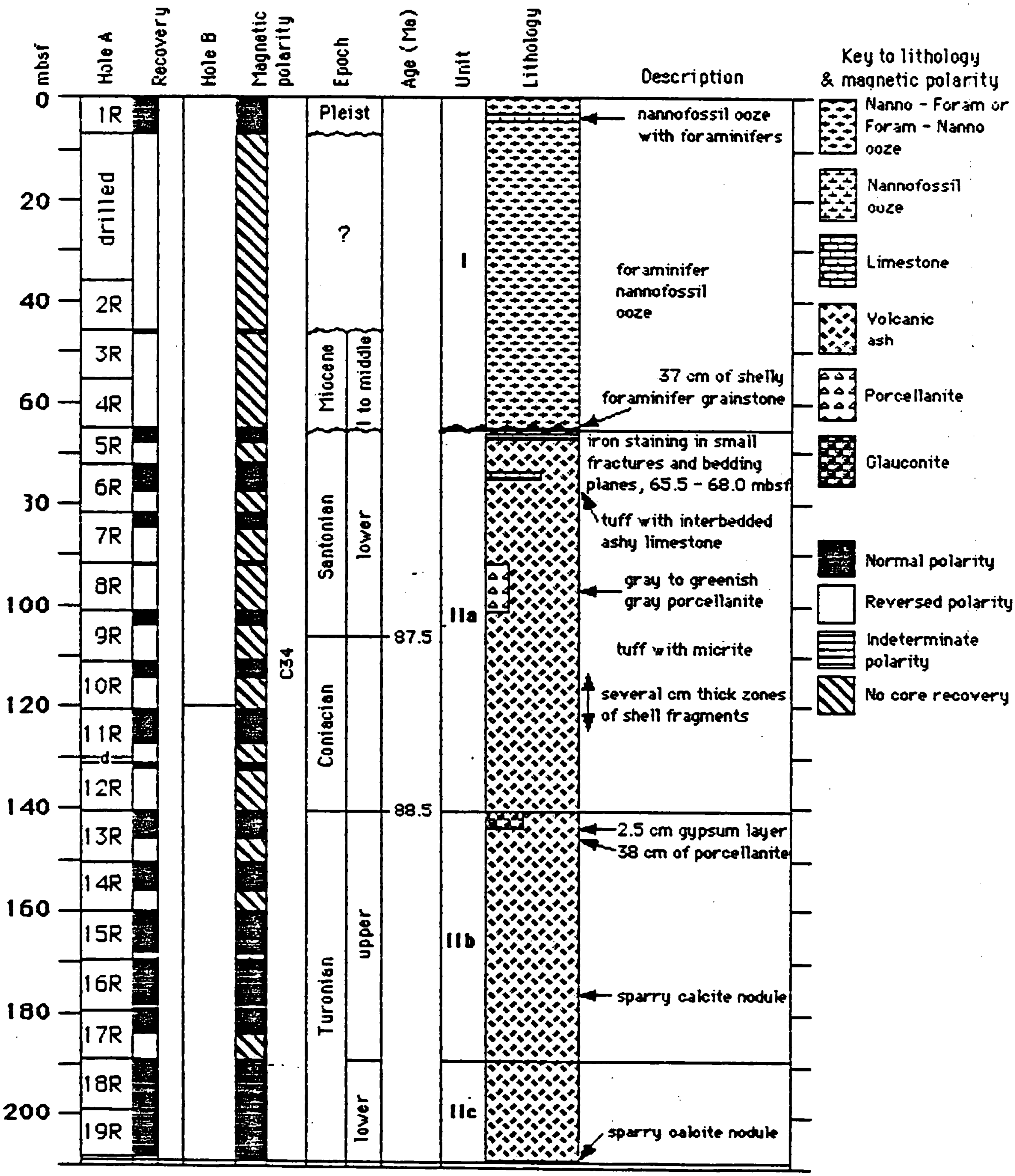
xc: Nick Pisias, PCOM
Ian Gibson, IHP
Russ Merrill, ODP
Audrey Meyer, ODP
Tom Pyle, JOI


Site: 755 Hole: A Slide Descriptions
NANNOS
FORAMS
MICRITE
GLASS
GLAUCONITE
0
20
40
60
80
100
120
20
40
60
80
100
120
140
160
180
200
Depth in Meters
Percentage Major Components

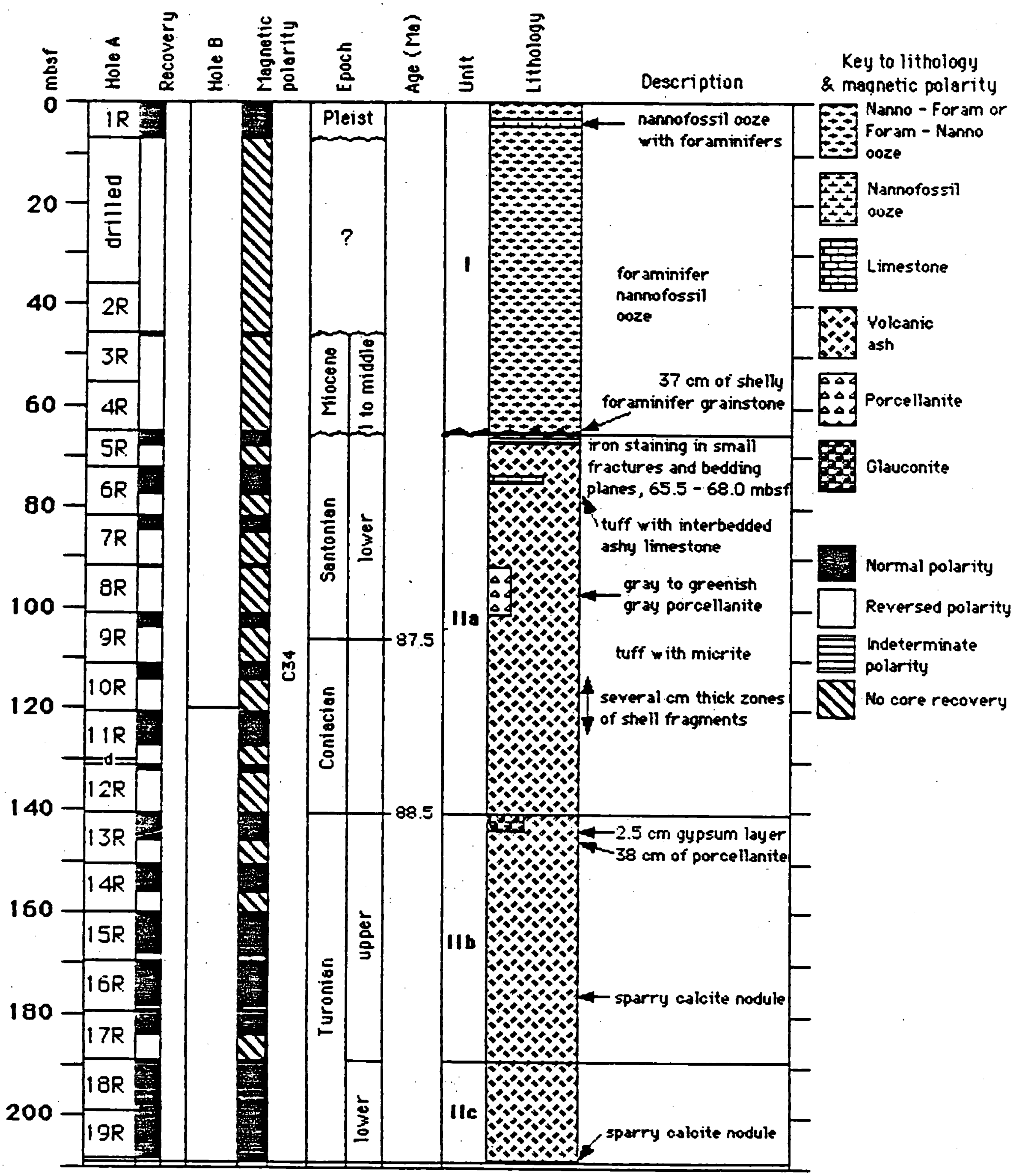
Site: 755 Hole: A Slide Descriptions



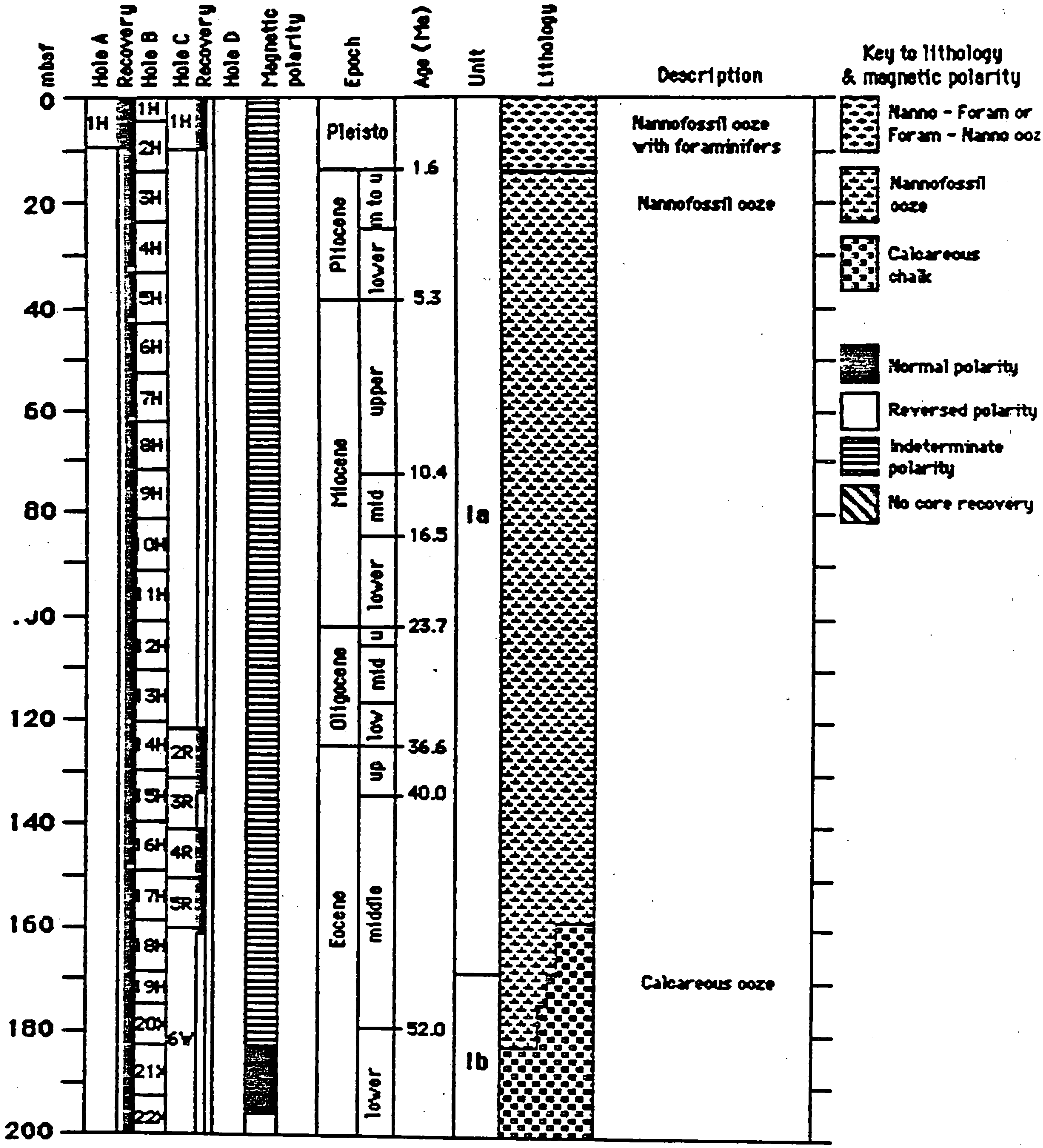
ODP LEG 121 GRAPHIC CORE SUMMARY: SITE 755



ODP LEG 121 GRAPHIC CORE SUMMARY: SITE 755



ODP LEG 121 GRAPHIC CORE SUMMARY: SITE 757



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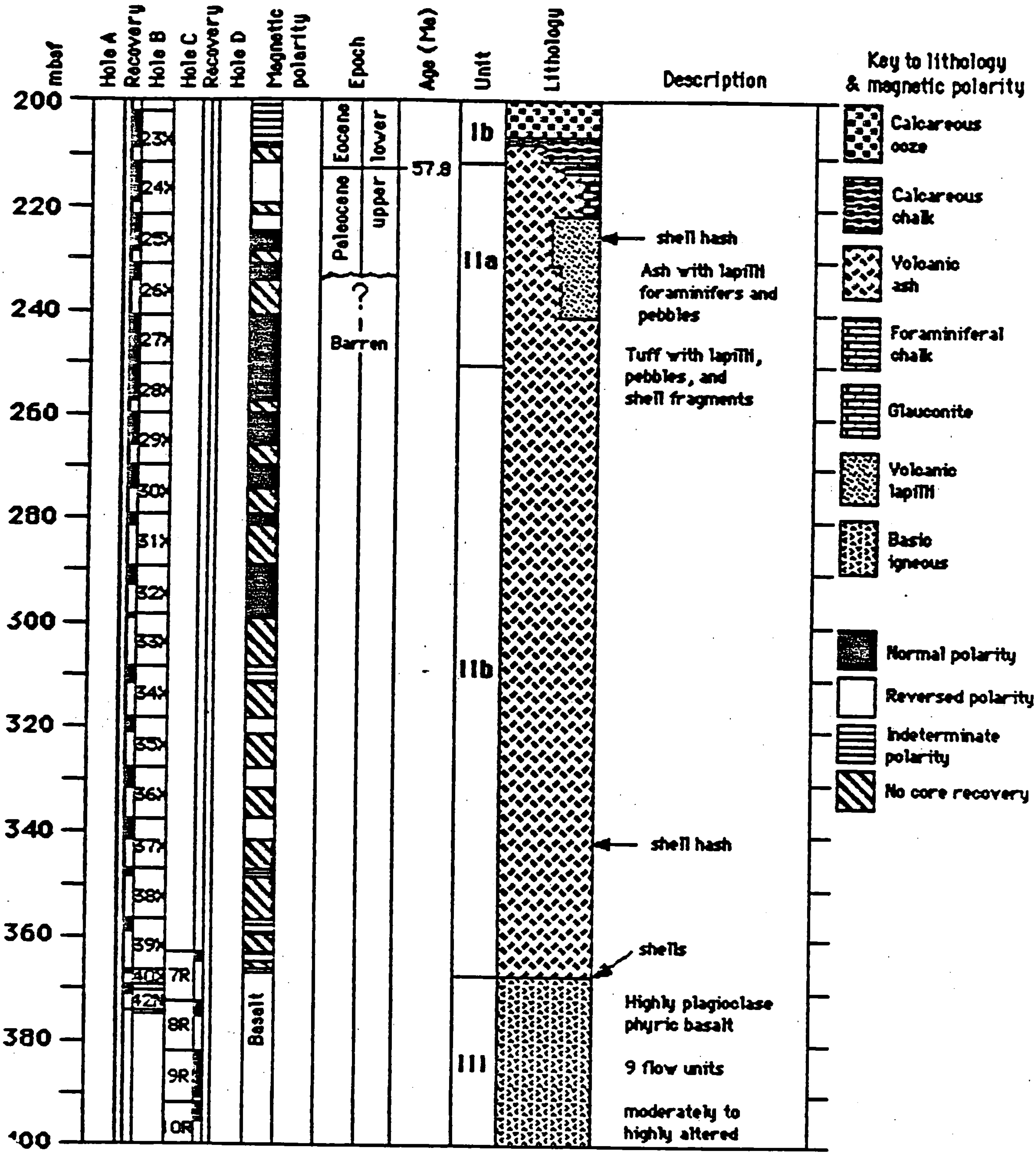

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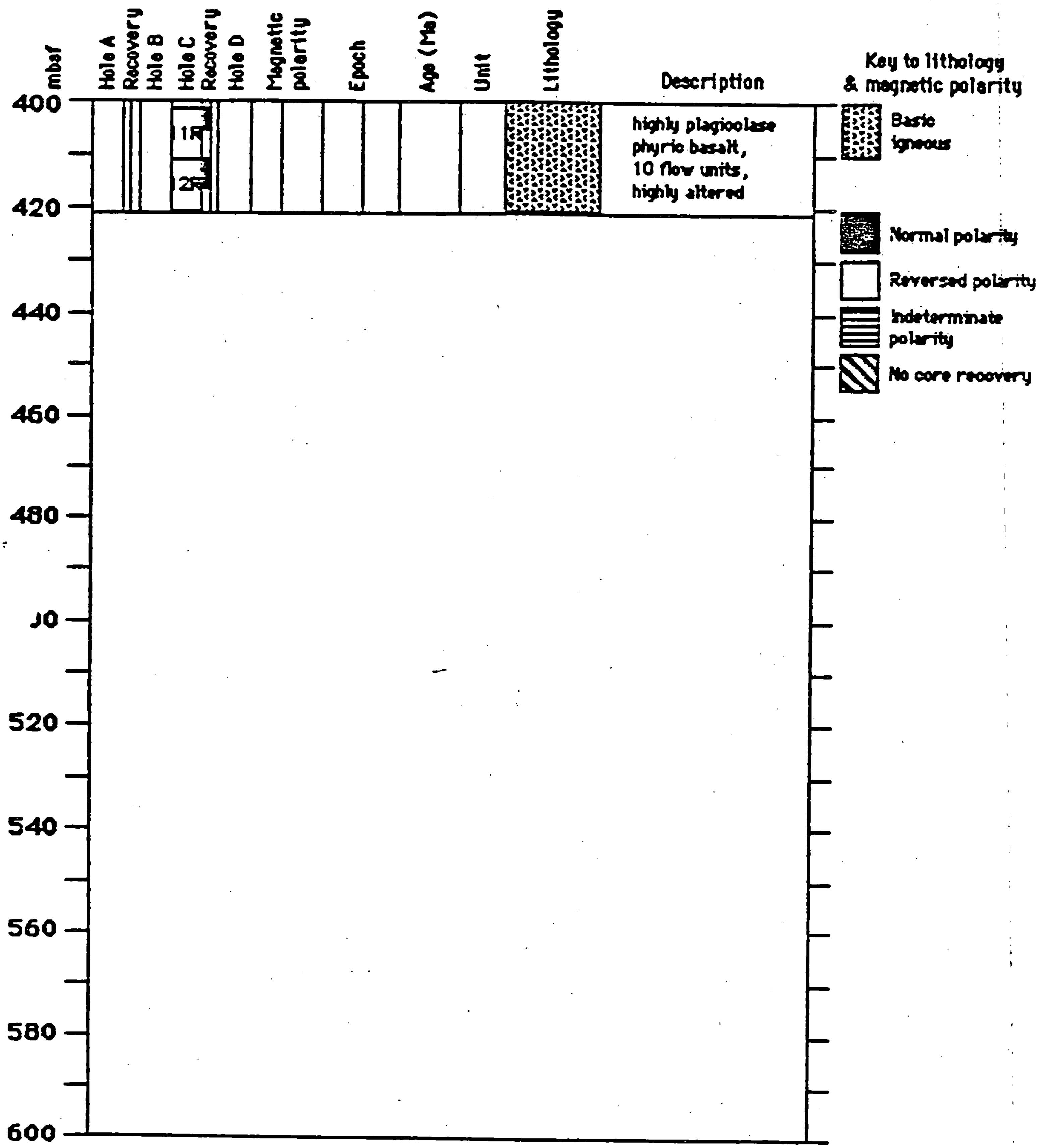


The Florida State University
Tallahassee, Florida 32306
Department of Geology

RECEIVED
88-254

July 8, 1988

Dr. Thomas E. Pyle
Vice President and Director, Ocean Drilling Programs
JOI, Inc.
Suite 800
1755 Massachusetts Ave., N.W.
Washington, D.C. 20036

Dear Dr. Pyle:

Thank you for your response of June 29th to the group letter distributed by members of the Leg 120 Shipboard Party. The letter was drawn up on our behalf by Dave Lazarus, who also wrote an excellent 3-page critique of the shipboard computer facilities as part of the end-of-cruise evaluations requested of shipboard participants. By this letter, I will ask Dave to send you a copy of his report. Another of our party, Mike Coffin, also wrote Phil Rabinowitz an interesting suggestion concerning installation of a Mac system onboard, and by this letter I will also ask him to forward you a copy of that proposal.

Unfortunately, I am not yet a Mac user. No one in my building is a Mac/Apple owner or user, so this Leg 120 experience was my introduction Mac graphics. My perspective on this issue as a Leg 120 Co-chief Scientist is pretty well spelled out in the attached telex to Audrey Meyer, which was transmitted at mid-cruise after we had drilled our first three sites. Before we departed on the cruise, I was tutored at crossover on the VAX-based PicSure program by Jack Baldauf, Leg 119 Staff Scientist, so that we could generate graphic hole summaries compatible with those Jack did for Leg 119. This we eventually did, but only at a high cost in time and frustration. In speaking with Jack this past week, I learned that he and I had independently come to the same conclusion after our respective cruises: PicSure just won't do; there's got to be something better.

The something better soon became evident to us during our transit out from Fremantle as we tried the "Son of Volkard experiment" referred to in our telex to Audrey. During Leg 113, a paleomagnetists, Volkard Spiess, had written from scratch a 2000 line program on the VAX to do sedimentation rate diagrams. It was a typical computer hacker's job, convoluted and intelligible only to himself, but the results were quite good. Unfortunately, only Volkard could run the program. During our Leg 113 postcruise meeting in College Station, I asked him to work with ODP's Bill Meyer to get his program into a format others could understand and use. They tried, and Bill, at my urging, worked with the program further at sea during Leg 119,

(letter to Dr. T. E. Pyle, 7/8/88, cont., p. 2)

where he was Systems Manager, but to no avail. As a last resort, I asked Dave Lazarus to try to sort it out during our long transit to the Kerguelen Plateau. I knew that if anyone could do it, Dave could. Dave gave up after about 4 days of trying, but within another couple of more days, came up with what I wanted, but on the Mac. He had done in two days what he, Volkard, and Bill had failed to accomplish over the course of several months. The rest is history, and I enclose a couple of examples of some of the output. After that, there was no stopping the Mac attack aboard the ship, as the sedimentologists and paleontologists all got into the act. People had no trouble learning the system, and we left templates of all our charts and diagrams for the next legs to follow.

Basically, co-chief scientists are looking for things at sea that get the job done and the mission accomplished. I'm most grateful to Dave and the others who worked tirelessly to give us this breakthrough in the graphics area. A lot of credit goes to Kerry Kelts, who shelled out $1200 to rent and make available to everyone a Mac Plus, which was the real workhorse on our cruise. I wouldn't leave home again without one. I don't blame ODP for not providing this capability previously, because computers are a rapidly evolving field and one is always having to play catch up. I see no reason, however, why ODP/JOI should not achieve this capability in the near future.

Ironically, I've just heard that the JOIDES RESOLUTION on Leg 122 has suffered a major power outage, and that as a result the VAX system will be down for quite some time. The only computer system available at the moment for the entire scientific operation is the one little token Mac (retrofitted, but without hard disk) onboard.

Sincerely,

Woody Wise

Sherwood W. Wise, Jr.
Professor

cc: W. J. Merrill, D. Caldwell, P. Rabinowitz, N. Pisias, Audrey Meyer, Leg 120 Shipboard Party.

TO: AUDREY MEYER

FROM: SCHLICH, WISE

RE: MAC GRAPHICS

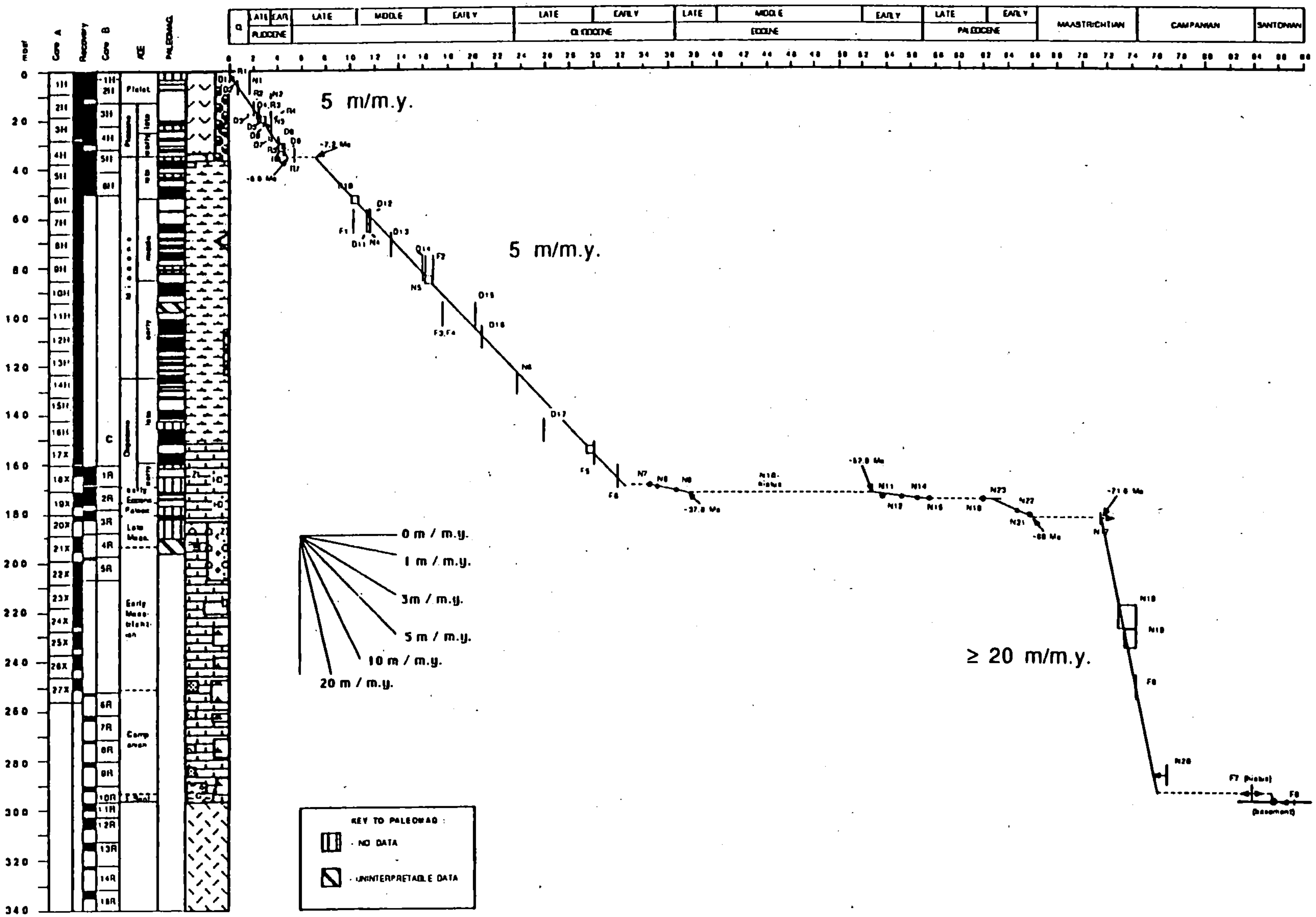
A few weeks ago, when it became evident that we had quite a few experienced graphics enthusiasts onboard, we asked Amanda to query you about Mac compatiblity at ODP HQ. Since then, the situation out here has evolved somewhat. The shipboard party has gone for the available Macs the way we have gone for mini cones, and for the same reason: they work where nothing else will. We therefore wish to focus and clarify our request on behalf or ourselves and the Leg 120 scientists. We are not concerned here with the word processing and data bank systems onboard or at ODP, we are concerned basically with graphics. This shipboard party has produced and will produce a large quantity of sophistocated graphics on the Mac (from both the one on board and another that one of our scientists rented in Australia for $1200). We did try to produce our graphics on the VAX (our Son of Volkard experiment) and by PicSure, were not able to come close either way to what we needed. As the onboard system has not provided what we need, we have turned to the Macs. As it turns out, there are more MAC users on board than any other user group (the $1200 was actually a great investment). The graphics being produced are outstanding, and even Son of Volkard is alive and well on the Mac.

Our Leg 120 scientists now see frustration for them and the Project in three areas: 1) There is no laser printer on board to produce from the Macs publishable quality output for the Shipboard Report, Preliminary Report, Nature and Geotimes articles. We wish to have an Apple Laser Writer on board for that purpose. 2) There is no way to blast our output back to the project because there is no Mac at ODP HQ to receive and process the output. That means that everything will have to be redrafted at ODP, which is a waste of time, effort and money, and will frustrate your original request to have the Geotimes and Nature articles blasted back in toto. 3) There is no Mac and Apple Laser Writer at ODP HQ which our people can use to update their graphics at the postcruise meeting. They will either have to present their graphics without updates or the graphics will have to be redrafted by hand, again wasting time, effort and money.

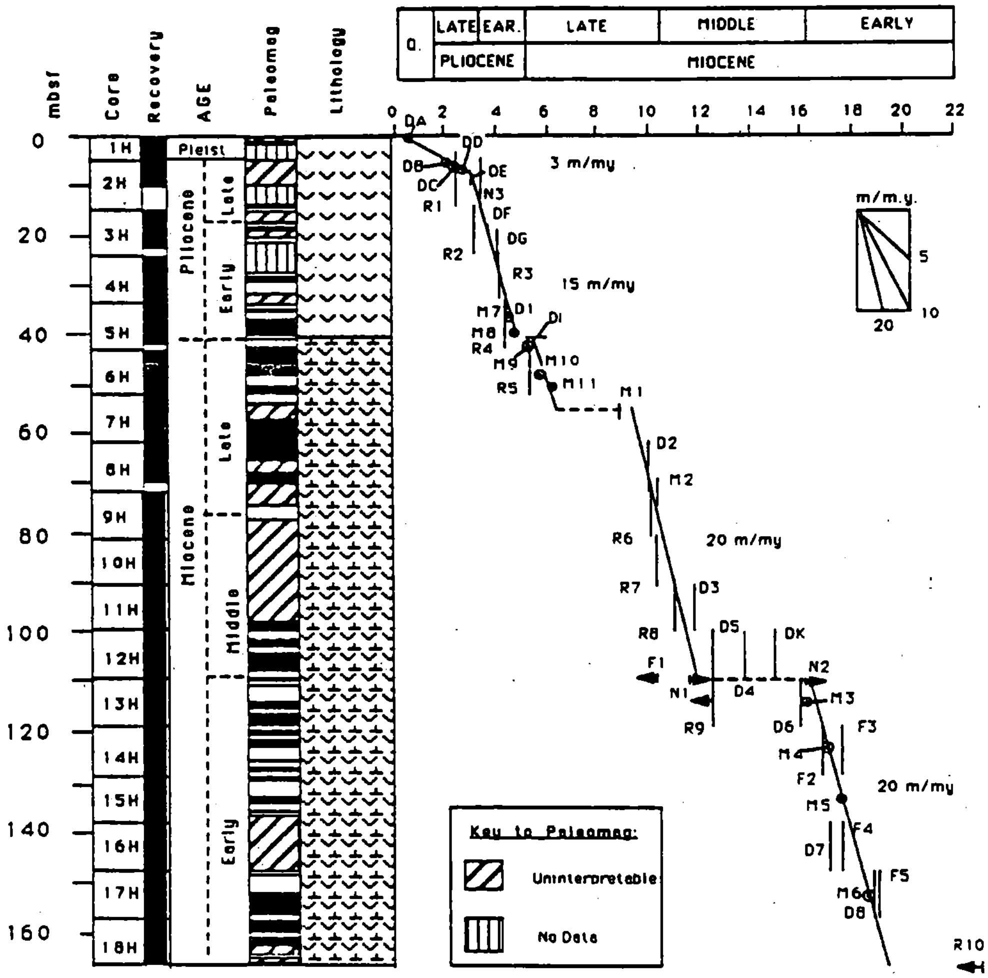
In short, our request is to have one Mac II and one Apple Laser Writer on board and the same at ODP HQ. As far as Leg 120 is concerned, it is too late for the former, but there are 7 to 9 months to obtain the latter. The investment for one Mac II and one Apple Laser Writer plus the necessary software is about $10,000. If this cannot be procurred by about September, then we request that such a system be rented and made available for our post cruise meeting.

We have had long discussions with Larry and Amanda about ODP's philosophy on all of this and believe we understand that rather well. We see our needs in the graphics area as something separate and beyond ODP's need for a particular type of data bank and word processing system. The onboard system and the one to be installed simply don't address our problem. A Mac and Laser Writer at ODP HQ would. Thanks for your help.

SITE 747 SEDIMENTATION RATES



SITE 751 SEDIMENTATION RATES



JOIDES SEDIMENTS & OCEAN HISTORY PANEL

(Draft) WHITE PAPER

INTRODUCTION

As part of the long-term JOIDES/ODP planning process, the Sediments and Ocean History Panel has been asked to identify the highest priority scientific questions related to sediments and ocean history and to formulate these into drilling programs that could be included among the primary targets for future drilling. In formulating a response to this request, we draw upon five years of Panel discussions as well as many more years of collective experience participating in ODP programs and conducting ODP- related research. In addition we draw upon numerous discussions with colleagues and upon the important contributions of COSOD I and COSOD II. Based on these inputs we have developed six major themes that we believe should guide future sediment and ocean history related drilling. These themes will be discussed under six headings:

1- Short period changes -- Neogene Paleoceanography

2- The history of sea level

3- Longer period changes -- Pre-Neogene Paleoceanography

4- Paleo-upwelling and productivity

5- Geochemical cycling, diagenesis, and metallogenesis: Chemical processes within sediments

6- Depositional manifestations of continental uplift and erosion.

Given the extremely broad mandate of the Sediments and Ocean History Panel, the selection of a limited number of themes has been difficult. Nonetheless, in the course of our discussions, (and through numerous changes in Panel membership) the six themes listed continue to emerge as top priority. These same themes (in one form or another) were also among the highest ranked recommendations of the COSOD I and II reports. We therefore are reason ably confident that the programs presented herein indeed represent the most pressing ODP-related questions facing the sediments and ocean history community over the next ten years.

As has been elegantly pointed out in the COSOD II report, our science is increasingly directed towards an under standing of the overall operation and controls of the Earth's ocean - atmosphere - cryosphere - geosphere - biosphere system. The physical, chemical and biological processes at work in these complex systems, and that ultimately are responsible for the sediments that form the focus of our studies, are so intertwined that it is often difficult to separate them. The themes selected in this document represent components of the overall system that are, at present, conveniently tackled as separate entities because they define distinct sets of scientific problems, or require distinct sampling strategies or analytical approaches. For example, we separate Neogene paleoceanography from Pre- Neogene studies because fundamental differences in climatic forcing, the nature of the oceans, and in the resolution we are capable of achieving in these different time intervals dictate distinct methodologies for their study. Despite these distinctions, it will become clear that there is still considerable overlap amongst the themes, especially in terms of drilling strategy.

In evaluating these themes it is necessary to keep in mind that they represent global problems that often require a widely distributed network of sites. We can no longer look at a drill site as a single regional entity, but rather, it must be viewed as a key component in the solution of a fundamental global problem. We must approach such drilling with a long-term outlook, patiently collecting the pieces of the puzzle with the realization that the final product may offer far more than any one individual contribution.

For each of the themes we will present an overview, outline specific scientific objectives, develop a drilling strategy to address these objectives, recommend example drilling targets and evaluate the technological developments necessary for their achievement.

1.0 SHORT PERIOD CHANGES -- NEOGENE PALEOCEANOGRAPHY

1.1 OVERVIEW AND IMPORTANCE OF THEME

Understanding the causes and consequences of global climatic and environmental change is one of the most important challenges facing us today. One reason is that virtually all aspects of the history of life on Earth are controlled by the surface environment. Another reason is that an understanding of the complex interactions in the Earth climate system is essential if we are to learn to predict future global change. All the ingredients of global change at timescales shorter than those at which tectonic processes have effect, are relevant to possible change in our present environment and are the the scope of this theme. Paleoceanographic records give us the chance to reconstruct the temperature, chemical composition and circulation of the atmosphere, the changing wind and water- borne flux of materials from the continents, the level of productivity of different regions of the ocean, and the evolutionary response of the biosphere to all these changes. Thus they allow us to test current models of the fundamental processes controlling the working of the global ocean-atmosphere-cryosphere-biosphere system.

When less than a decade ago deep ocean drilling gained the capability to recover truly undisturbed records of Neogene sediments, it was rapidly appreciated that the ultimate origin of most environmental variability on geologically short timescales is changes in the geometry of the Earth-Sun orbital system. The amplitude of response to this external forcing was surprisingly high during the Middle and Late Pleistocene (ice-age cycles). This discovery provides us with the basis for constructing and testing useful models describing the operation of the whole climate system; these models in turn permit us to target future drilling with increasing precision towards the probing of specific, critical aspects of the climate system. Were this the whole story it would be appropriate to focus only on the most recent past. However, we have also learned that the sensitivity of the system to orbital forcing has changed in the past- sometimes slowly and sometimes rather rapidly. The changes that will occur over the next century will depend very much on whether the sensitivity remains stable as projected atmospheric carbon dioxide levels going outside the range that has been experienced at least over the past million years.

1.2 SCIENTIFIC OBJECTIVES AND OPPORTUNITIES FOR THE FUTURE

The record of the history of global change has proved to be best studied in pelagic sediments. One reason is that the regional overprint in marginal marine and lacustrine sediments is usually large enough to interfere with the recovery of the global signal. For the past 0.3 million years the ocean record is accessible to conventional piston coring. However for any older material ocean drilling, using the hydraulic piston corer, is the only tool capable of recovering sequences of appropriate quality and resolution to tackle these problems.

<u>Ground Truth: Basis for Future Drilling</u>

As we enter this phase of ocean drilling we do so with the advantage of a substantial data base. We already have a significant inventory of cores recovered in earlier phases of ocean drilling. In these sequences we have established that climate-related signals can be recovered and decoded. We have also demonstrated that we can correlate and date these signals with sufficient precision that they can be integrated, allowing us to build up a picture of the working of the whole system and to evaluate the phase relationships between different components of the system. In addition, thanks to the computer revolution, we are beginning to have models of varying complexity that evaluate this system and that can guide us towards those parts of the system that are under-determined due to lack of geological data. These modelling efforts will be of increasing value in guiding us as interaction between modellers and observational scientists in the drilling program increases.

Heat Budget

For today's state oceanographers have constructed atlases and sections describing the distribution of temperature, salinity, dissolved oxygen, nutrients, radiocarbon, and other tracers in three dimensions. These distributions are used in constructing models of considerable complexity describing the dynamics of ocean-atmosphere interaction in terms of the heat budget, enabling us to evaluate the role of the ocean in climate development. Future drilling will be designed to approach this kind of coverage for the past, but now encompassing the time dimension. Since total coverage is of course impossible to even contemplate, our task is to identify and sample those specific regions of the past ocean that are critical to the understanding of particular aspects of the system.

In order to reconstruct variability in the heat budget of the ocean we in principle need high-resolution paleotemperature records through the water column and across latitude in each ocean. This will require depth transects be drilled in a few areas additional to those that will already have been covered. In addition, now that we have better constraints on the history of deep water flow we need better high-resolution coverage in areas close to former deep-water sources in order to characterize the variability of deepwater formation processes. Until recently the reconstruction of surface temperatures has been limited to areas under which microfossils are well preserved, which has given us a very incomplete picture. With the recent development of the use of organic biomarkers to estimate past temperatures it may become important to recover sequences from areas that were previously regarded as valueless due to paucity of fossil material. There is a strong link between surface temperature and productivity, mainly because of the relationship between the upwelling of deep waters and the availability of nutrients. Thus the high-resolution investigation of high-productivity regions will also contribute significantly to our paleoclimatic reconstructions.

The Carbon Cycle

Within the past few years we have rapidly gained in understanding of the way in which the atmospheric carbon dioxide level has varied over the last major climatic cycle (160ka), and at the same time have made great steps in understanding the mechanisms by which this is controlled by the chemistry of the ocean. We are now in a position to build up records of the changing ocean carbon-related chemistry of the ocean and so to reconstruct a longer record of the composition of the atmosphere. This in turn will enable us to evaluate the sensitivity of the climate system to changes in atmospheric carbon dioxide. We now know that for this purpose it is extremely important to develop high-resolution carbon isotope records that will span the extremes in $^{13}C/^{12}C$ ratio through time, requiring sections containing well preserved benthic Foraminifera from both close to and far removed from bottom water sources, as well as sections containing planktic Foraminifera from low productivity areas in low latitudes. Trace element measurements (Cd/Ca, Ba/Ca) will play an increasingly important role in elucidating the nutrient cycles and deep water flow and thus in constraining the carbon system.

The controls on the overall productivity of the ocean are very poorly understood, even for the present ocean. For the present ocean this will be improved through the GOFS program. For the past, the analogous method is to study the history of biogenic and abiogenic fluxes to the sea floor in different regions. This is now possible thanks to enormous improvements in the geochronology of the Cenozoic. Magnetostratigraphy has had a major impact and is continuing to provide greater resolution; in addition biostratigraphy and chemostratigraphy (^{87}Sr, ^{18}O etc) are also continually improving, while our ability to detect orbital signals provides an enormous increase in the resolution with which fluxes can be measured. It is important to determine the history of the productivity of different characteristic regions: the central gyres as well as the upwelling regions, the tropics as well as the high latitudes.

In order to separate the effect of internal cycling from changes in the throughput as controls on the chemical mass budget of the ocean, it is necessary to gain further insight into the history of fluxes of nutrients as well as of carbonate and silica into the ocean, and of dissolution fluxes from the sea floor. Studies of the chemical and isotopic history of ocean water, recorded by calcareous and siliceous microfossils, will contribute enormously to our understanding of the history of the budget of the ocean, but this will require both the recovery of sequences containing pristine microfossils, and a much better understanding of the role of diagenetic and hydrothermal recycling in controlling ocean chemistry.

Evolution

Virtually all our tools utilize microfossils as signal carriers. This in itself is sufficient reason to continue paleobiological work. However, the evolution of marine organisms provides a host of other important topics for study, the more so as this evolution can frequently be related to environmental change. The investigation of evolutionary mechanisms remains a central area in the Earth Sciences, and the sequences that are available from deep-sea drilling are those best suited to address some of the most pressing problems being discussed at present (e.g. the question of punctuated versus gradual evolution). The study of interactions within the biosphere at times of evolutionary change may also give us insight into the implications of massive anthropogenic intervention in the marine biosphere.

1.3 DRILLING STRATEGY

How has the temperature structure of the deep ocean varied in response to orbital forcing? By what mechanism is Milankovitch frequency variability imprinted on deep ocean sediments (including their seismic character) in glacial and pre-glacial times? What aspects of whole-ocean chemistry have responded to orbital forcing? How has the abyssal fauna responded to high-frequency variability in food supply? These questions all require drilling transects to recover sediment deposited over a range of water depths. Ideally the sites are closely spaced so as to have experienced the same flux of material from the photic zone, in which case the dissolution flux can be determined as a function of paleo-waterdepth. Examples would be the Ceara Rise; the Walvis Ridge (where DSDP Leg 74 obtained very valuable Paleogene sequences but poor Neogene records); the North Pacific (where a depth transect could only be constructed from widely spaced topographic highs); the 90°E Ridge; both sides of the sills bounding the Norwegian Sea.

How has the latitudinal temperature gradient, the mid latitude East-West temperature gradients, the East-West equatorial temperature gradient (all monitoring heat transport) varied? These questions require the drilling of carefully planned transects capable of monitoring the gradients and their evolution. Some examples will be covered in detail below as examples of high productivity areas. Others would be the California Current; the Subantarctic Indian Ocean around Broken Ridge; the Subantarctic Pacific Ocean on the East Pacific Rise; the equatorial Atlantic (well covered only on the East); the mid-latitude South Atlantic. Arctic coverage has extremely high priority; when the Arctic Ocean was not ice-bound (perhaps only a few million years ago) as it is today it must have played an important role in climate control that cannot be evaluated so long as we have absolutely no records from the whole ocean. In addition, we believe that when the results of recent Antarctic drilling have been evaluated it will be found that there are still gaps in our knowledge of the Neogene at high Southern latitudes that must be filled if we are to understand opearation of the carbon system.

How has the mass budget of the ocean varied? How has ocean productivity changed? How has the flux of aeolian sediment changed? How has the input from the world's great rivers changed? These questions are addressed in some of the transects outlined above, with a few additional sites towards the gyre centers. An important additional requirement here is that extremely precise time control is needed to generate flux estimates; virtually no DSDP site, and only selected ODP sites, have sufficiently good recovery and continuity for this purpose.

Many of the important questions regarding the changing chemistry of the ocean (including the carbon system) will be tackled in the transects outlined above. However the solution of these question will guide their prioritization; for example for nutrient cycling and atmospheric carbon dioxide reconstruction it is especially important to record the "new" (at present, North Atlantic) and "old" (at present, North Pacific) extremes of the first order deep circulation path. On the other hand the average chemical composition of the ocean is best monitored at an intermediate point along this path.

1.4 TECHNOLOGY ISSUES

A requirement that is common to all the objectives considered under this theme is the complete recovery of undisturbed sections. We believe that the Joides Resolution is capable of achieving this very effectively; if any different platform were to be considered it would be imortant not to sacrifice the advances that have been made since the end of DSDP. At present the HPC is not being deployed as efficiently as is desirable so that frequently optimum recovery is not being achieved, but in general the quality of the material recovered is excellent. However, sample requirements are increasing rapidly as the quality of recovery improves, and thought should be given to ways of increasing the quantity of material available for study.

2.0 THE HISTORY OF SEA LEVEL

2.1 OVERVIEW AND IMPORTANCE OF THEME

Sea level fluctuations provide some of the most dramatic and pervasive influences on the stratigraphic record, with ramifications for almost all aspects of earth history. The hypothesis that certain sea level events are globally synchronous and are expressed as depositional sequences of onlap and offlap (and intervening unconformities on continental margins) has been one of the most exciting of the past decade and has revolutionized the interpretation of seismic data from many marine sedimentary environments. As our stratigraphic, geophysical and geochemical tools improve, the originally proposed 'eustatic sea level curve' is now recognized to be the result of a complicated interaction between sediment supply, tectonic history, sediment and water loading, and eustacy. We have recognized links between sea level fluctuations and climatic variations, tectonic events, ocean chemistry and circulation changes, and faunal boundaries. However, fundamental questions remain with regard to the true synchroneity of these events and the causal linkages between them.

Much of our present knowledge of the timing and amplitude of sea level changes has been derived from studies of passive margins and the oxygen isotopic records from pelagic and benthic microfossils. Sea level fluctuations clearly influence the sedimentary records on passive margins. This signal is greatly influenced by changes in subsidence, sediment supply and tectonic uplift, and is susceptible to numerous sources of error. The best opportunity for reconstructing a relatively complete picture of global sea level history lies in a well formulated program of drilling a series of holes in the slopes, rises and abyssal plains of the world -- a program that only ODP can undertake.

The problem of sea level history is so complex that no single technique or single site can be expected to provide the answers to these critical questions. In support of the recommendations of the COSOD II we propose three independent approaches to attempt to document and quantify global sea level history. These include passive margin and atoll drilling and recovery of a complete pelagic sedimentary sequences to establish a complete high resolution oxygen isotope record. As pointed out in COSOD II, each approach has its limitations and advantages. Probably more than any other SOHP objective, drilling to establish a global sea level curves will have to be supported by high resolution geophysical surveys, high quality well log records, and complete core recovery.

2.2 SCIENTIFIC OBJECTIVES AND OPPORTUNITIES FOR THE FUTURE

The preliminary task of a global sea level history program is to quantitatively establish the timing and amplitude of major in global sea level fluctuations. Once such data with documented margins of error are established we will be able to evaluate different sea level models and understand causes and effects between eustatic sea level and other parameters, including climate, subsidence, tectonic uplift and sediment supply.

Specific objectives for sea level related drilling include:

1. Determination of the timing and global correlation of sea level cycles. The precision of our determination of the timing of major fluctuations in sea level

is inappropriate to be used in predictive models at the present time. Global correlation is difficult because 3rd and higher order cycles are at or below the limit of biostratigraphic resolution. Integration of physical, bio and magneto stratigraphies with high frequency cyclic patterns of the Plio-Pleistocene may improve our ability to establish the timing of sea level fluctuations.

2. Determination of amplitude of sea level cycles (2nd and higher order).

3. Mechanisms responsible for global sea level cycles. At present, variation in the continental ice volume provides the dominant mechanism for post-Oligocene global sea level cycles. Documenting pre-Oligocene (ice free?) cycles may require other mechanisms (e.g. intraplate stress, spreading rate changes).

4. Extraction of the regional sea level signal from the composite and global signals and understanding of mechanisms responsible for the regional signal (subsidence/uplift, sediment supply, climate variations, evaporitic cycles).

5. Effect of sea level fluctuation on basin sedimentation and the deep sea record. There is growing evidence that global changes in sea level are also expressed in the sediments that accumulate in the deep sea. If these relationships can be established, a more continuous record of sea level fluctuations may be obtained along with important insight into the global geochemical and ocean circulation feedback systems.

2.3 DRILLING STRATEGY

Three independent approaches defined by COSOD II and SOHP include (1) passive margin and (2) atoll drilling, and (3) recovery of continuous sedimentary sequences to establish oxygen isotopic records. By combining these different approaches it may be possible to overcome the different limitations inherent to each approach. By integrating the sea level histories derived from different passive margins, atolls and isotopic record, it may be possible to extract a global sea level signal.

Passive Margin

The passive margin approach, developed by Vail and his colleagues, derives an estimate of global sealevel variations from stratigraphic information coded as a coastal onlap and offlap pattern on different continental margins. Because of the uncertainty of the prediction of subsidence and other factors affecting sea level fluctuations in any one area, it is necessary to stack information from different margins to extract the eustatic component. It is proposed to drill transects on passive margins with different tectonic and sediment (carbonate and siliciclastic) histories. Margins with relatively simple subsidence histories are required, preferably where there are good outcrop sections on the nearby land, and available industry data from wells on the continental shelf. At least one transect per margin is needed. It should extend from the continental shelf onto the adjacent basin plain, and should penetrate a sedimentary sequence as complete as possible. The Neogene section will contain the highest resolution biostratigraphic and isotopic record to date and is the best chance to document sealevel events. First we need to establish a global high resolution global sea level curve obtained with quantitative estimates of timing and amplitude for the Plio-Pleistocene; this curve could be used to test and compare the passive margin approach with the oxygen isotope approach. This comparison will be useful and necessary to develop sea level curves for the Neogene, Paleogene and possibly the late Mesozoic.

There are only a limited number of areas on the globe with both a high resolution (3rd and higher order) seismic stratigraphic and isotopic record. Potential areas for the Neogene/Quaternary record include the Northeast Australian Margin, the South China Sea Margin, the Maldives, and the Gulf of Mexico. Transects along the east coast of North America or the west African Margin, the Exmouth Plateau and a transect along the east African Margin are proposed to obtain the longer Mesozoic-Cenozoic history.

Atoll Drilling

The atoll approach has recently evolved based on developments in Sr-isotope dating of carbonate sequences. This approach uses the stratigraphic record of atoll carbonates as dipsticks in areas having a subsidence history that is simple enough to be predicted with some accuracy. Although this strategy yields discontinuous records with variable resolution, it may offer the best chance of obtaining reliable, quantitative, low-frequency (greater than 2 Ma) information on the amplitude of Tertiary eustatic sealevel variations. It is important to locate sites in areas where the uncertainties in modeling subsidence history are minimal. These conditions appear to be met in the Marshall-Gilbert Islands, where ocean floor has a small geoid anomaly and low heat flow. Because these islands lie on crust that is locally compensated, it is probable that they have undergone a straightforward subsidence history since the Eocene. Paired atoll/drowned atoll transects are preferable along the length of a major atoll chain that extends over a wide latitude and plate age range in order to drill the early sea level record on the drowned atoll, and the most recent record on the current atoll. The transects should also include atoll apron, rim and lagoon sites. It is recommended that lagoon sites be drilled on a current atoll to provide a tie into the platform top. The USGS Enewetak and the French Mururoa existing sites may provide this information.

To test the validity of results based on atoll drilling, core transects along low relief carbonate bank/slope/basin systems should be compared to the proposed transects on Pacific high relief atoll transects. Gentle carbonate slope to basin transitions contain low stand sedimentary records although the banks themselves once emergent, develop subaerial disconformities. Sea level curves derived from the lower relief areas of the Maldives and Queensland Plateau may be an ideal comparison with sea level curve derived from Pacific atoll drilling.

Oxygen Isotopic Record

The oxygen isotopic approach infers changes in global ice volume from the isotopic composition of benthic and planktic foraminifers. Although this strategy can provide continuous information at periods as short as 10 ka, its reliability depends strongly upon the accuracy of assumptions regarding water temperature and the isotopic composition of glacial ice. In order to use the isotopic record as an indicator for glacioeustatic sealevel, the relationships between seawater $\delta^{18}O$, and ice volume must be established. This can be done by empirically determining a relationship between independent sealevel estimates and d18O record. A major goal of Quaternary passive margin drilling and paleoenvironmental transects is to establish a detailed comparison of timing and amplitude of the sea level signal with the present well established oxygen isotopic signal. It is proposed to drill to develop a longer isotopic record a series of logged, double-cored HPC/XCB drill sites supplemented by high-resolution downhole logging to fill in, extend, and strengthen the isotopic record. These sets of HPC/XCB sites will be also used for the Neogene paleoceanographic objectives. These comparative approaches should focused on the present discrepancies between the margin and the isotopic approaches during the mid-Miocene, mid-Oligocene and Early Eocene records.

Each of these approaches to understand sea level history has its own limitations. In the case of the seismic stratigraphic analysis of passive margins it is difficult to separate out the effects of subsidence and other factors. Atoll record can indicate the minimum amplitude of sea level rise during how high sealevel may have been times when the platforms were flooded, but may not be useful during times of sea level rise when the platforms remained emergent. The isotopic approach is complicated by temperature effects, geographic and ocean depth variations, and by diagenesis.

2.4 TECHNOLOGY ISSUES

There are demanding engineering developments required to be able to address the topic of global sealevel fluctuations. Further developments in the short term should emphasize:

1) continuous core recovery of all types of sediment including sands, gassy sediment, and chert
2) continuous core logging
3) pressure core barrel

Long term developments should be aimed at the ability to drill deep (2500-3000 m) stable holes and the ability to drill through salt. Both these objectives will require riser capability.

3.0 LONGER PERIOD CHANGES -- PRE-NEOGENE PALEOCEANOGRAPHY

3.1 OVERVIEW AND IMPORTANCE OF THEME

The Paleogene and Cretaceous oceans are, conceptually, our entry into a vast period of late Paleozoic-Mesozoic warm ocean dominance, with circulation and sediment patterns entirely different from those of today. After 20 years of deep drilling this promise has not been realized yet: there are wide gaps in our knowledge of how the oceans and their biota behaved during the Jurassic, Cretaceous and Paleogene. The available stratigraphic record is surprisingly limmited, not only for the Mesozoic, but for the Paleogene as well.

Reconstructing the ocean-climate history during this expanse of time represents a major challenge of future ocean drilling. For the Paleogene, the challenge will be to elucidate important ocean-climate changes that include the transition from an ice-free to a glaciated world and the formation of deep cold waters formed in polar regions. For the Cretaceous, the next ten years of drilling will focus on better understanding the interaction of global warmth, widespread anoxia, carbonate chemistry, high global sea levels, and changes in atmospheric and oceanic circulation on the evolution of oceanic biota. For the Jurassic, where recovery is necessarily spotty, sampling will allow drawing analogies to the Cretaceous and testing for differences.

Questions to be addressed by this next phase of ocean drilling include: Did the tectonic and orbital forcing functions drive the course of global environmental changes during these time periods as they did during the Quaternary? What are the mechanisms linking changes in the global environment with the successive rise to dominance of various calcareous and siliceous plankton groups in the ocean? Was the Earth environment periodically perturbed by some extra-terrestrial causes as evidenced by the episodic recurrences of mass extinctions of biota at differing severity? How were those large volumes of organic material concentrated and preserved on the continental margins, during certain periods of the Mesozoic and Tertiary when sea level stood higher and climate was more equable than at present?

<u>State of Knowledge</u>

The key point in the study of pre-Neogene oceans is to recover concepts about the range of ocean dynamics which are outside of present day experience. Examples are haline dominated deep circulation, slow deep water renewal, low oxygen content and hyper-stratification. In addition, the pre-Neogene offers insights into the transitions from warm to cold-ocean dynamics (e.g. onset of psychrosphere in the late Middle Eocene). Considerable progress has been made along these lines, but a satisfactory understanding eludes us as yet.

Our knowledge about the geographic configuration of ancient ocean basins has increased rapidly in the last two decades. However, we do not know how changes in geographic configuration translate into changes in circulation, ocean chemistry, productivity, and evolution. Although speculation abounds, our models are qquire primitive. Much of our information on the early history of present day ocean basins comes from sequences of the former Tethyan margins (mostly disturbed by subsequent orogeny and plate collision) or from sequences deposited in shallow epicontinental seas.

Paleogene

The limitation of the Paleogene record is derived from an incomplete geographical sampling, specifically from the Pacific. For example, the Paleocene-lower Eocene Pacific carbonate record is represented at only one site (577), while there is no suitable middle Eocene Pacific carbonate record in low latitudes. Moreover, coverage is limited by incomplete records due to hiatuses, drilling gaps, and core disturbances, and diagenetic alteration of most deeply buried sections (>500 m burial depth), and slow sedimentation rates. The problem of diagenesis versus sedimentation rate is particularly acute when dealing with older Paleogene strata.

Nevertheless, the Paleogene records a series of biotic changes correlated with changes in temperature and ocean chemistry. The general biotic changes include the recovery of calcareous nannofossils and planktonic foraminifers in the early Paleocene, the first appearance of *Discoasters* and the recovery of radiolaria in the late Paleocene. The Paleocene-Eocene boundary is marked by a major benthic turnover followed by the highest planktonic foraminiferal diversity and the widespread latitudinal distribution of Antarctic benthic foraminifers in the middle Eocene. The Oligocene is characterized by lower diversity and more cosmopolitan nature of most of the planktonic organisms with the exception of the diatoms.

Pre-psychrosphere Eocene

Opportunistic forms such as *Guembelitria* or *Thoracosphera* dominate the assemblages across the K/T boundary in several places. A cold pulse and a decrease in ^{13}C gradient precedes the abrupt decrease and finally the extinction of the Cretaceous forms.

Carbon-oxygen isotope plots in the earliest Paleocene are the opposite from those today. A gradient similar to today's was obtained by the late Paleocene Zone P4. That signifies that the peculiar conditions which probably caused the extinction of the highly diversified globotruncanids and large heterohelicids disappeared several million years after the maximum of the crisis. The Early Eocene is characterized by a warm, equable ocean with the lowest meridional and vertical thermal gradients. Planktonic foraminifers attained the maximum diversity during the middle Eocene when the old taxa inherited from late Paleocene-early Eocene are associated with new middle Eocene taxa.

A major overturn occurs within Zone P11 where benthic foraminifers also change. That is possibly the result of the decoupling of surface to bottom temperature curves and to a generalized decrease towards lower temperatures. It is also the time of major bioprovincialism at least in the Atlantic. Data from Indian ocean are now understudy (Leg 115) and at first sight repeat those collected from the Atlantic.

Paleoceanographically, the most intriguing data concern the similarities between late Paleocene faunas from the Falkland Plateau and those from the Caucasus and Central Asia province. What oceanic current system through the eastern part of the Tethys was responsible for the southern migration of the eurasian faunas? Pacific data are mainly from the equatorial belt and from the southwestern arm of the tropical gyre. No data are available from northern latitudes or from the southeastern Pacific.

Post-psychrosphere Eocene and Oligocene

The onset of psychrosphere is marked by the appearance of deep-water ostracodes, which quickly invade the Tethyan area by the late middle Eocene. Their appearance may be related to the production of cold deep Antarctic bottom water.

After the extinction of the warm, ornamented planktonic foraminifers that mark the middle to late Eocene boundary, the trend is towards a homogenization of bioprovinces. Temperatures are lower than in middle Eocene, but we may not have measured the real surface water temperatures. Diversity among planktonic foraminifers and calcareous nannofossils remain relatively high but the $\delta^{13}C$ gradient once more decreases, signaling a low productivity regime which was acting in the ocean across the Eocene/Oligocene boundary.

Low productivity still characterizes the earliest Oligocene ocean which experienced an important drop in temperature. Most of the Oligocene is characterized by a very unstable environment particularly concerning paleotemperature. This trend apparently reversed only by the Late Oligocene. A synopsis of the available data reveals that most analyses again are derived from the Atlantic and very few from the Pacific, whereas the Indian ocean is under study.

Is the onset of the psychrosphere related to the closure of the Tethys seaway in the Middle East as suggested by Dercourt and others (1986)? How far north was the influence of the Mediterranean Outflow Water (MOW) felt along the European coast? Did it enter into the Arctic? What happened when the MOW stoped in the late Eocene? Was it resumed during the late Oligocene-early Miocene? What is the influence of the MOW on the water structure of the South Atlantic?

Mesozoic Oceans

Characterization of Mesozoic oceanic conditions will be based on the more extensive, more stratigraphically continuous Cretaceous record. Fortunately, there is a broad correspondence in biogeochemical patterns between teh Cretaceous and Jurassic periods, i.e.,
- old Jurassic - mid-late Jurassic anoxia - late Jurassic - biological turnover
- old Cretaceous - mid Cretaceous anoxia - Late Cretaceous - biological turnover

Each of these biogeochemical modes and their accompanying transition periods are characterized by a specific set of biotic events that highlight major, but poorly understood, changes in the oceanic environment. The modeling of Jurassic ocean history will thus be drawn from the more complete Cretaceous record. It will nevertheless be important to recover Jurassic samples wherever possible, regardless of the broad geographic spacing to augment the modeling process based on the Cretaceous framework. Events in ocean history that characterize the Jurassic and Cretaceous models are as follows:

In the Early Jurassic, the first diversification of calcareous nannofossils and a turnover in radiolaria accompany the opening of the central North Atlantic. In the Middle Jurassic, a bloom in radiolaria and the appearance of the first planktonic foraminifers are associated with the onset of oceanic anoxia and the opening of the Tethys to the Pacific and the development of equatorial circulation.

The Late Jurassic is characterized by abundant radiolaria that resulted in the deposition of radiolarites, the appearance of calpionellids and nannoconids, and most importantly, a bloom in calcareous nannoplankton, which redirected the bulk of carbonate sedimentation from the shelves to the deep sea. The first appearance of aragonitic tests among benthic foraminifers signaled the differentiation of the outer shelf-upper bathyal zone.

A similar set of biotic events is recognized in the Cretaceous. The Early Cretaceous is characterized by an abundance of calcareous nannoplankton and the disappearance of calpionellids. These changes are followed by a gradual increase in temperature and rise in global sea-level. In the mid-Cretaceous, a major diversification of planktonic foraminifers accompanied the return of ocean anoxia with dissolution events and the opening of the South Atlantic. These changes corresponded with the appearance of new benthic foraminifers in bathyal water depths and a turnover in radiolaria. The Late Cretaceous exhibits increased diversification of planktonic foraminifers, the appearance of silicoflagellates and an increase in diatoms and the full development of benthic foraminifers within the bathyal zone. These biotic changes accompany a high stand of sea level, the initial closing of the Tethys and the opening of the Arctic Ocean to the North Atlantic through the Baffin Sea.

The Mesozoic record is progressively decreasing with increasing age. Late Cretaceous sediments are relatively well represented, although common hiatuses in the deep sea characterize the end of the Mesozoic era. Carbonate sediments are common during hte late Cretaceous and they become infrequent early in the Cretaceous, when varicolored shales, including anoxic black shales, are the most representative sediments of the abyssal plains. One of the few lithologic units rich in carbonate is the Cape Hatteras formation straddling the Jurassic-Cretaceous boundary, adjacent to the eastern US margin.

Much less than 1% of the total recovery of deep-sea sediments is pre-Cretaceous in age. To date, however, open marine sediments of Early Liassic age either on land or through deep drilling (Leg 79) rest on subsiding passive margins of the Tethys during the opening process of the central North Atlantic. No data are available on the type of sediments that accumulated in the abyssal plains, if indeed they exist. The oldest sediments recovered overlying an ocean ridge are Early to Middle Callovian in age; Site 534 on Black Spur (western North Atlantic) that consist of baked, oxidized limestone rich in pelagic pelecypods, immediately followed by black and red to green shales of Middle to Late Callovian age.

A reconnaissance of all deep-sea sites, where Jurassic deposits have been recovered, reveals that the deeper sediments during most of the Late Jurassic were poor to very poor in carbonate and frequently deposited under poorly oxygenated conditions. The data are mainly from the North Atlantic, the Falkland Plateau and Argo Abyssal Plain off Northwestern Australia. In the Pacific the oldest samples are fragments of earliest Cretaceous limestone and chert recovered from Shatsky Rise.

3.2 SCIENTIFIC OBJECTIVES AND OPPORTUNITIES FOR THE FUTURE

1. To learn about circulation in a warm ocean, entirely different from today's.

2. To study productivity and biogenic sedimentation patterns in a low-oxygen ocean: much different from the present. Can we identify other nutrient limitations?

3. To find out whether evolution is strongly dominated by environmental change and stability, or whether internal (biolobical) mechanisms are important.

4. To study the mechanisms of climatic change, i.e., amplification of outside forcing, in a system without ice or snow. Was CO_2 the main amplifying factor?

5. To determine the oceanographic conditions leading to the onset of ocean anoxia. Were the conditions constant through each Mesozoic interval or were the conditions different between the Jurassic and Cretaceous periods of anoxia? Was there basin to basin fractionation? Were the events synchronous? Were changes in the biota during these intervals related to the development of global anoxia? Was the ecologic specialization of bathyal foraminifers during the mid-Cretaceous related to the development of oxygen minimum zones or to changes in density stratification of the water column or in surface productivity?

6. To find out what environmental conditions led to transitions from silica-rich to carbonate-rich conditions, and the increase in deep sea carbonate. Are these global changes due to major evolutionary changes or are they driven by changes of environmental parameters, i.e., productivity, temperature, water structure, oceanic circulation, etc.? What are the consequences for the cycling of carbonate and carbon in the oceans? How did the oceans function in the absence of this biogenic cycling? How did this affect atmospheric circulation?

7. To study conditions that led to major and minor extinction events, i.e., the Jurassic/Cretaceous boundary, the early Albian decline in planktonic diversity and turnover of calcareous nannofossils, the Cenomanian/Turnian boundary event, the Cretaceous/Tertiary boundary, the late Paleocene benthic event and the Eocene/Oligocene boundary. Although well documented, the causes of extinction are yet poorly understood. Do species extinctions occur independently of one another, or are they "clumped" in time? Are mass extinctions simply scaled-up versions of smaller, clumped extinctions? To what extent was the biota affected by global anoxia? What is the relationship of changes in productivity to the evolutionary turnover of marine biota?

8. To investigate biotic radiation events. Examples include a rise to dominance of a biotic group, and radiation following extinction events. What are the rates of diversification? Do they differ between the styles of radiation events? Are the rates uniform or do they fluctuate with time? Do the rates become high immediately following extinction events, or are there substantial lags?

<u>Where can Objectives be Addressed</u>

1. <u>High Latitudes</u>. Knowledge of pre-Neogene ocean history suffers from a lack of data from high latitude sites. Speific target areas include the Arctic Ocean, Bering Sea, areas surrounding Antarctica, especially on the Pacific side, and sites originally formed at high latitude, i.e. Louisville Ridge and areas adjacent to Australia.

2. Old Crust. Of particular interest are targets in the Pacific, Caribbean and Somali Basin.

3. Ontong-Java pre-Neogene Record.

4. Atolls, Guyots, Rises. Drilling of caps and flanks of topographic highs to recover a record of subsidence, sea level changes and biogeochemical changes resulting from plate motions.

5. Continental Margin Transects. Deep sequences needed to examine anoxia, high productivity, i.e. upwelling areas.

6. Eastern Mediterranean. History of Old Tethys to Paleogene closing of the seaway.

3.3 DRILLING STRATEGY

Successful results of this theme requires the recovery of undisturbed oceanic sedimentary sequences from different ocean basins to obtain a tangible record of global environmental changes with five temporal resolution. This program will require the recovery of cores from thick, continental margin sequences, deep ocean sediments, and carbonate caps on submerged volcanic edifices. The recovery will form a global array of Cretaceous and Jurassic sites that will utilize HPC to multiple reentry technologies and single sites to multiple hole transects.

3.5 TECHNOLOGY ISSUES

To achieve many of the goals identified, it is imperative to have good recovery of geologically older material. The occurrence of chert and limestone in otherwise soft sediments has been a source of frustration to scientific drilling since the early days of DSDP. Poor recovery of alternating hard and soft layers require new technology to be developed.

The chronostratigraphic analysis of deep sea sediments is one of the important basic requirements for correlating evolutionary events of oceanic biota and establishing synchroneity of global environmental changes. Various forms of magnetic and stable isotope stratigraphy, as well as radiometric dating, provide both relative and absolute time scales for studying long continuous sedimentary sequences. The improvement in geochronology considerably enhance our ability to define major environmental and biotic changes in much finer resolution than heretofore achieved and it is the area which calls for exploitation and refinement of those chronologic techniques relative to what has been done previously.

Inability of achieving penetrations of the ocean floor more than 2000 m in the present riserless mode of drilling has been the source of frustration for meeting many of the objectives of longer time-range study. Use of a full marine riser system would solve many of the problems preventing deeper penetration of the ocean floor.

Well log data obtainable with the use of such well logging technologies as borehole televiewer and microscanner are complimentary to laboratory core data and their continuity often leads to the solution of problems, such as those of cyclicity, which continuous core data alone cannot address satisfactorily.

4.0 PALEO-UPWELLING AND PRODUCTIVITY

4.1 OVERVIEW AND IMPORTANCE OF THEME

Regions of high productivity are unevenly distributed in present and past oceans. They occur in both small and large ocean basins, and are most pronounced in areas of upwelling. Since they lie at the extremes of ocean behavior, upwelling zones produce climate sensitive facies which may record fluctuations in the global ocean-climate system in a very precise manner. At times they may, in fact, have controlled such fluctuations through linkages involving excess carbon storage, lowered atmospheric CO_2 and buildup of polar ice caps. Ocean productivity is the major control on partitioning of carbon dioxide between the large ocean reservoir and the relatively small atmospheric reservoir. Productivity fluctuations are therefore important in providing feedback to climate change. During times of intense upwelling, coastal upwelling processes may be said to control the biogeochemistry of the oceans because such events result in loss of carbon into nutrients and continental margin sediments. Knowledge of paleoupwelling systems is thus pivotal to understanding ocean history.

The relatively high rates of sediment accumulation beneath upwelling systems yield much expanded records in comparison with equivalent but telescoped sequences from deep sea sites in adjacent central water masses; consequently the details of climatically forced sedimentary cycles become especially well recorded. In addition, hemipelagic sediments of coastal upwelling systems may clearly reflect climatic-tectonic events on the adjacent continents. Finally, sediments of upwelling systems, because they are important repositories of carbon and phosphorous, are major sites for the formation of hydrocarbons, phosphorites and authigenic carbonates.

Scientific Achievements to Date

A good understanding of the dynamics, processes and sediments of modern to late Pleistocene systems has emerged through study of conventional cores and dredge hauls in several regions (e.g., Peru margin, Gulf of California, Antarctic margin). Sampling of older systems has been quite uneven during prior DSDP/ODP legs. Perhaps the best studied examples are those of the equatorial Pacific and, to a lesser extent, the circum-Antarctic region where Cenozoic variations in sediment character, fauna and flora and other parameters can be linked to the evolution of Antarctic glaciation. Fragmentary and poorly resolvable pre-Quaternary records of upwelling were recovered off NW and SW Africa.

Quaternary-Pliocene diatomaceous sediments in the Gulf of California, the Peru margin, the Arabian Sea exhibit striking cycles whose forcing mechanism has not yet been resolved. Whereas upwelling as well as the intensity of the oxygen minimum zone (OMZ) apparently increased during Pleistocene glaciation off Peru and NW Africa, they may have decreased during much of the same interval beneath the monsoon-driven upwelling system of the Arabian Sea. Quaternary sediments of upwelling systems in the Gulf of California, California margin, Peru margin, Arabian Sea, Sea of Japan, and Bering Sea contain dolomite, phosphorite, cherts and porcelanites, hydrocarbons, and other authigenic products which have yielded insights on diagenesis in organic-rich sediments. Pore fluids beneath the Peru shelf include striking brines which must affect diagenesis in a profound manner.

Aside from the equatorial Pacific region, only fragmentary records of Pliocene and older upwelling systems were recovered during drilling in the areas mentioned above. The records from these areas suggest most modern coastal and small basin upwelling systems began at some point in the Miocene. The existence of older coastal systems is suggested by the presence of Eocene-Oligocene diatomaceous onshore sequences in the circum-Pacific region and Cretaceous chert-phosphorite-black shale successions in the Tethyan region. There exists, therefore, a need for more expanded geographic coverage of younger upwelling systems, particularly at different latitudes, as well as increased sampling of older ones.

The work previously mentioned has provided a framework of scientific understanding as well as most of the necessary methodology. We have, for example, learned to identify proxy indicators of high productivity such as specific diatom assemblages and the abundances of certain planktic foraminifer species; and we are learning how to measure paleoproductivity by calculation of the accumulation rates for marine organic carbon, measurement of carbon isotopes, and identification of biomarkers. What is needed is a verifiable oxygen isotope stratigraphy from the isotopic composition of biogenic silica, a development required for precise chronostratigraphy of Quaternary, carbonate-poor siliceous sequences. Work now underway likely will provide this technology.

4.2 SCIENTIFIC OBJECTIVES AND OPPORTUNITIES FOR THE FUTURE

A number of critical issues relating to paleoupwelling and productivity should be addressed by the drilling program. These include:

1. History and Distribution of Upwelling Systems

What is the history of the present upwelling systems? When did they begin? How do they turn on and off? Can we identify paleoupwelling systems in regions where modern ones are absent? This involves a systematic comparison between changes in the geochemical and biological records in sediments beneath various upwelling areas. Emphasis should be given to determining and understanding systematic couplings between geochemical and biological tracers through time. Most prior effort on upwelling and paleoproductivity has focused on the Quaternary record. While we need still to develop better understanding of Quaternary upwelling, we also need to go back farther to examine older records of upwelling to understand the climatically driven changes in upwelling from the Cretaceous to the present. In addition we need to expand global coverage of past ocean productivity to include records of upwelling in high, medium, and low latitudes. Particularly critical are high latitude sections, and sections which will contribute to better understanding of asymmetry and symmetry of mixing and fertility between ocean basins.

2. Relationships Between Upwelling Systems and Global Climate

How have upwelling systems evolved in response to major identified paleoclimactic and paleoceanographic changes? We need to know how these changes affected global fluxes of C, P and Si, and whether different upwelling systems responded in similar or different ways to major climactic events like glaciation, changes in wind circulation, and sea level changes. For example, what effect did the development of Arctic/Antarctic ice masses have on the intensity and location of Cenozoic high productivity areas? Furthermore, it has been suggested that upwelling systems at times exerted controls on the character of the world ocean (e.g., the "Monterey Event"?), an important hypothesis which needs verification through additional sampling. Other questions include: What are the periodicities and forcing functions of sedimentary cycles produced by upwelling systems? How far back in time can we identify paleo-El Niño events, and can we relate their frequency to global climactic trends? How have climate fluctuations affected the intensity and geometry of the oxygen minimum zone?

3. Role of Small, High Productivity Ocean Basins in Global Productivity (e.g., Arctic Ocean, Bering Sea, Sea of Japan, Sea of Okhotsk):

How important are these areas as sinks for nutrient accumulation and storage? What are the effects of opening and closing of deep (and surface) water passages between these areas and the world ocean? Can we relate the climate records of mid-latitude marginal basins to the high latitude climate record?

4. Nature of Diagenetic Reactions

Sediments of upwelling areas, with their abundant carbon, phosphate and opal-A, are chemically very reactive and known to produce varied authigenic products during diagenesis. As discussed in a later section, the nature of this distinctive diagenesis needs amplification. In the context of paleoupwelling studies, it will be important to determine whether various upwelling systems in high and low latitudes, with different fluxes of C, P and Si yield markedly different sequences of diagenesis, and whether the pore fluids in sediments of coastal upwelling sequences show marked latitudinal differences.

While many of these objectives were not explicitly stated in the COSOD II document, they are implicitly covered in the Working Group I recommendations that deal with paleoclimate, Arctic Ocean drilling and exploratory drilling along continental margins and into older sediments.

4.3 DRILLING STRATETY

Specific drilling strategies necessary to achieve the objectives of this theme include:

A. Sampling of a variety of upwelling systems, including those with possible different responses to upwelling in the Quaternary and those from high to low latitudes.

B. Continuous coring of selected sites to depths sufficient to sample the records of pre-Quaternary upwelling systems (Neogene, Paleogene and Cretaceous, where present) and to recover the products of deep burial diagenesis as well as the pore fluids in deeply buried sediments.

C. E-W transects through zones of coastal upwelling connected with major eastern boundary current systems, in order to gauge changes in the width of the currents and associated upwelling system.

D. Transects across major fronts, such as (1) fronts between coastal upwelling zones and adjacent Central water masses, and (2) polar fronts (Antarctic and Arctic).

E. Expansion of global coverage of past ocean producitvity data to include selected small ocean basins.

F. Determination of the history of siliceous sedimentation in high latitude areas.

Detailed site surveys (seismic, piston coring) are essential for defining the seismic characteristics and shapes of the organic-rich sediment lenses beneath upwelling areas. Every HPC and XCB site should be doubled-cored until refusal. Continuous coring is essential, as is continuous pore water sampling and analysis. Because sediments of upwelling systems and their diagenetic products (e.g., phosphorites) are rather clearly imaged by logging methods, (which, for example, may precisely record cycles), complete logging will be essential. Further details on transects, etc. are supplied in a following section.

Where can Objectives be Addressed (Letters in parentheses refer to drilling strategies in the preceeding section.)

1. Polar, Polar Frontal and High Latitude Regions

Arctic Ocean. As noted in the COSOD II report, lack of information on the history of the Arctic Ocean, a probable region of high productivity, is a major gap in our knowledge. Systematic coring could be expected to add substantially to knowledge of productivity during the Cenozoic and Late Cretaceous. It is not yet possible to predict the drilling time needed in this region, as it will depend on the drilling platforms utilized. (A,B,D,E,F).

Bering Sea. Provides opportunity to acquire high latitude record of Neogene climate and productivity and to sample possible Paleogene and Cretaceous upwelling systems. Minimum of three drilling sites and one leg would be needed (A,B,D,E,F).

Antarctic. To supplement prior legs, additional drilling is needed to amplify the paleoupwelling and climate records in Quaternary and pre-Quaternary sediments; this drilling should also include transects to study carbonate/sililca fluctuations in the Pacific and Indian Oceans. Two to three legs, each with five to eight sites, are needeed (A, B, D).

2. Middle and Low Latitude Regions (see also Gulf of California below)

California margin. This mid-latitude region would provide a detailed Neogene history of the California Current and associated upwelling, as well as the chance to explore for older systems. One drilling leg and 8 to 10 drilling sites required (A,B,C,D).

Peru-Chile margin. Building on results from Leg 112, opportunities exist during a single leg with 8 to 10 sites to expand knowledge of Quaternary upwelling through a broader latitudinal zone, as well as to sample Miocene and possibly Paleogene records of upwelling and to amplify understanding of pore water brines (A,B,C,D).

Equatorial Atlantic. In contrast to the equatorial Pacific, the record of this upwelling system is inadequately sampled. Coring at 5 to 10 sites could provide a record of upwelling and productivity for the Cenozoic and Cretaceous (A,B).

3. Small Ocean Basins (see also Bering Sea above)

<u>Sea of Okhotsk</u>. This semi-enclosed, high latitude small ocean basin should contain a detailed record of Neogene productivity, as well as changes in salinity due to fluctuations in river influx or isolation from the Pacific. A single leg with five to eight drilling sites would be needed (A, E).

<u>Gulf of California</u>. A mid-latitude upwelling system in a small ocean basin setting, the main goal in a single leg with 7 to 9 drilling sites would be refinement of the Quaternary paleoceanographic-paleoclimate history by expanding on the fragmentary record recovered during Leg 64 and expanding the geographic coverage in this region (A,B,E).

4.4 TECHNOLOGY ISSUES

Organic-rich sediments of upwelling zones impose the hazard of hydrocarbon escape, thus the development of riser drilling capability is desirable. For deep drilling into sediments of older systems, this become essential. This deeper drilling will likely also encounter cherts and porcelanites, thus a drilling technology to penetrate them is also essential. In addition, because of the abundance of gases in organic-rich sediments of coastal upwelling zones, development of a pressurized core barrel is essential. Alternate platforms may be necessary for Arctic Ocean Drilling (see COSOD II report and the report of the May 1988 Ottawa Workshop on Arctic Drilling).

<u>Special Costs</u>

Most notable cost will be development of riser drilling capability.

<u>Practical Spinoffs</u>

These include enhanced understanding of the genesis of hydrocarbons and phosphorites, as well as the linkages between climactic changes and productivity. Study of paleoupwelling systems should increase our knowledge of short-term climate events such as El Nino and the evolution of seasonality.

5.0 GEOCHEMICAL CYCLING, DIAGENESIS, METALLOGENESIS: CHEMICAL PROCESSES WITHIN SEDIMENTS

5.1 OVERVIEW AND IMPORTANCE OF THEME

The importance of fluid flow through the crust has gained widespread apppreciation in the past decade. In the marine realm, this revolution touches on several subjects including the evolution of seawater, the alteration of deep-sea sediments, and ore genesis. Specifically, our concepts about the history of seawater now reflect advances in tracing fluid-flow through the ocean crust. For example, the geochemical cycle of Mg could not be understood without recognizing the important sink for this element within altered mid-ocean ridge basalt. More recently, however, additional fluid flow regimes have been recognized involving fluxes from expulsion of pore fluids from subducting and accreting sediments on active margins, as well as free convection of seawater through low-temperature ridge flanks, and leakage of continental fresh and saline groundwaters along continental margins. As stressed in the COSOD II document, these sediment-based fluid flow systems may be equally significant for understanding the global Mg cycle and other cycles.

Processes of diagenesis are of great interest for geochemical, mineralogical as well as paleoceanographic reasons. In the present context, two aspects are if special importance. One, diagenesis can enhance physical property contrasts within a sedimentary sequence that allows for recognition of paleoceanographic events and cycles by seismic methods. Two, it produces an overprint stratigraphy that interferes with the interpretation of sediments in terms of paleoenvironment but can offer insights into the rates of reactions within the sediment column.

Entirely new perspectives have been opened on the genesis of ores from the study of modern depositional environments on the sea floor as well as metalliferous sediments in cores recovered by deep drilling. We presently lack a three dimensional picture of processes of ore formation which is a requirement to fully interpret deposits in a variety of marine host rock types (such as the Kuroko ores of Japan, and massive sulfides from throughout the world).

5.2 SCIENTIFIC OBJECTIVES AND OPPORTUNITIES FOR THE FUTURE

We are now positioned for a major attack on the role of fluid flow through sediments in contributing to the geochemical cycling of major seawater components, nutrients, and metals. We need to constrain the mass transport for the elements involved as well as the changes in mass transport which occurred through the last 100 million years. These constraints will come from a detailed quantification of fluid compositions and flow rates as a function of depth in key sedimentary bodies. The history will have to be pieced together from the evidence of alteration and authigenesis of minerals from these fluids. A major variable in this reconstruction is the nature of the sediment through which the fluid moves. This aspect of the problem requires that fundamentally different types of sediment be investigated to determine their influence on the composition of the circulating fluids. Just as the sediment types will vary, so also will the drives responsible for the movement of the fluid (gravity, heat, tectonic overpressure). Because some of the principles necessary to understand fluid flow have been worked out in terrestrial environments, there will be increasing interaction between marine and shore-based scientists on this issue that should be fruitful for both groups.

Diagenetic overprint poses both problems and opportunities. To achieve paleoceanographic objectives, the overprint has to be identified and its effects removed. This is true for the major biogenic sediment types including carbonate, silica, and organic compounds and may be true also in the case of clay minerals if they are used to reconstruct wind and river activity. In discovering the difference between expected properties (from algorithms based on resistant tracers within well preserved sediments) and actual properties, we shall obtain a type of diagenetic stratigraphy allowing us to reconstruct the dynamics and rates of alteration. The objective then of this type of investigation is to recover the overprint dynamics as a function of sediment type and geologic time. These alterations will be considerably different depending on the varying influence of fluid types and circulation.

One important manifestation of the migration of fluids through sediment and resulting diagenesis is the mobilization and concentration of metals, locally to economic levels when host sedimentary rock is later exposed on land. Special opportunities in studying these processes arise from the ability to examine in three dimensions the changes in metal and sulfur concentrations within the pore fluids. In particular the differences in sediment types hosting the pore fluids are of great interest both with respect to physical properties such as porosity as well as permeability, and chemical makeup. The final product ,that is, the accumulation of metals, will contain the fingerprints of both its source environment and the environment of deposition. This may provide clues to the oxygen content of bottom waters in contact with the site of deposition and thus could aid in constraining paleoceanographic reconstruction.

5.3 DRILLING STRATEGY

Fluid Circulation. The task is to assemble a matrix of different sediment types with different fluid driving forces. An appropriate strategy calls for transects of both active and passive margins. These transects are designed to evaluate the fluid-flow systems and associated sedimentologic-diagenetic phenomena in these sedimentary prisms. Such studies must be carefully linked to geophysical data on the tectonic/structural constraints upon this fluid flow. Suggested strategies for the study of continent-derived pore fluids along margins would be to drill transects perpendicular to the shoreline to establish gradients in pore water salinity and concentrations of specific cations/anions. Appropriate sites would be off the Atlantic margin of the U.S. where large fresh water prisms evidently occur or the coast of south America off Peru where continental derived brines occur in the sediments. A companion program should be to drill longitudinal transects parallel to the coast line crossing climatic zones (e.g. from near the equator to mid-latitudes) For example, we could examine pore fluids in forearc basins west of South America starting off Ecuador and extending south to Southern Chilie.

Accretionary ~~fans~~ prisms are known to be the sites of active fluid venting to the sea-floor. Transects of these systems (for example the Nankai prism, the Oregon prism) perpendicular to the shoreline should be linked to geophysical data on the tectonics of the fan deformation to develop an adaquate cross section of the fluid-flow rock alteration patterns.

For pelagic sediments, we need a program coordinated with the lithosphere objectives. Drilling would be conducted on transects on the flanks of both fast and slow spreading ridges in order to provide information on both crustal and sedimentary chemical exchange due to free convection of fluids.

Diagenetic Overprint Stratigraphy. Overprint stratigraphy is a phenomenon which is of importance in practically all environments and for a large range of investigations. The focus here is on a matrix which encompasses as many different types of sedimentary sequences as possible. Thus any strategy which results in providing a variety of sediments is appropriate to this purpose. Normally the coring strategies associated with detailed paleoceanographic work will provide an appropriate sampling space.

Metallogenesis. The focus of studies of metallogenic processes should be to define the three dimensional fluid flow-fluid chemistry and rock alteration characteristics within the oceanic ridge sediments hosting the metallic accumulations. Defining the three dimensional nature of a hydrothermal system requires both longitudinal and transverse sections.

Because sediment type can influence this fluid flow both physically and chemically, and thus constrain the development of the resulting metallic deposits, it is also necessary to study hydrothermal circulation in a matrix of sediment lithologies. For example, hydrothermal fluid circulation in the Guaymas Basin in the Gulf of California occurs within siliceous, organic rich muds. In contrast, hydrothrmal processes in the Escanaba Trough off the Oregon coast are hosted by organic poor turbidites. These contrasting sedimentary environments will have markedly different physical and chemical properties leading to marked differences in metallogenesis. Finally, because the fluid movement is thermally driven in these systems, it will be necessary to examine metallogenesis in rides with a variety of spreading rates.

5.4 TECHNOLOGY ISSUES

The study of sedimentary diagenesis, fluid flow and metallogenesis requires comparative study of undisturbed sediments and their contained pore fluids. For certain of the programs, physical property measurements of the sediments are also required. Because of the ephemeral nature of some of the chemical and physical properties some of these measurements will have to be made **in situ** or on undisturbed materials. This will require technological advances to achieve.

Each of the programs described requires a careful analysis of pore water chemistry and, for certain of the processes, the development of new technologies capable of measuring **in situ** pore pressure, temperature, pH and other dissolved constituents (perhaps with a top hole packer that contains passive (diffusive) tracers to monitor up-hole and/or down-hole advection of pore fluids.

A pressurized core barrel will be necessary to recover sediment at **in situ** conditions for analyses of gas clathrates and some volatile pore fluid constituents. This device should also be capable of preserving the sediment fabric for shore bases physical tests. A side wall corer with **in situ** pore water probe and sampler will be required to recover sediment from the hole in core gaps, and to provide additional solid and aqueous sample material at important depth boundaries. Finally, we look towards enhanced drilling capabilities for thin sediment cover (<50m), the ability to recover variable lithologies (chert/limestone sequences) without disturbance in order to address some of the important problems in sediment geochemistry.

6.0 DEPOSITIONAL MANIFESTATIONS OF CONTINENTAL UPLIFT AND EROSION

6.1 OVERVIEW AND IMPORTANCE OF THEME

The record of tectonic, volcanic, and surficial processes within continents is generally best preserved in the adjacent ocean-basin and in continental-margin sediment accumulations because the key products of these processes are removed by erosion. Until the advent of drilling in deep water, the history recorded in the offshore sedimentary basins only became accessible when later tectonism incorporated the sediment into mountain belts and subsequent erosion exposed the key strata. Moreover, the history is only partially resolvable in these ancient rock sequences because the events leading to uplift and exposure for land-mapping techniques tend to overprint and fragment the primary record. Thus, drilling of sediment sequences within modern continental-margin settings not only provides a relatively undisturbed record of biologic, geologic, and chemical processes on adjacent continents but in addition allows a direct tie to open-ocean sediment sequences, eg., the ability to apply time-scale constraints from continuous and detailed stratigraphic records unaffected by continental upheavals. Drilling along continental margins is a very effective way to integrate continental geology with modern marine-geologic studies.

Scientific Achievements to Date

The results of deep-ocean drilling to date have provided an inadequate example of the benefits that could be achieved by using deep-ocean drilling to augment classic onland geologic studies. With few exceptions, DSDP/ODP activity has focussed on open-ocean (eg., unpolluted to many marine geologists) crustal settings and sedimentary sequences; the reluctance to spend a great deal of effort within continental-margin areas has been reinforced in part by the somewhat greater degree of difficulty in selecting sites that are acceptable from the safety criteria as well as feasibility for depth penetration.Because most deep-water, ocean-crustal rock and sediment sequences generally are not incorporated into continental masses during subduction and related collision processes, there is a built-in dichotomy between classic onland-geologic studies and blue-water marine-geologic investigations. This dichotomy has been overshadowed to this point because deep-ocean drilling has provided a wealth of information about large areas of the earth for which we initially (pre-DSDP) knew relatively little (especially in areas dealing with biostratigrapy, which does have a direct tie with the geologic record exposed on land). A concern expressed during the COSOD-II review, however, indicated that there is a perceived need from outside the marine-geologic community to provide more information directly bearing on continental histories.

Where continental margin areas have been subject to DSDP/ODP scientific drilling, the results have been significant. The drilling on the Antarctic margin is the obvious example of the ability to detect structural and paleoclimatic events within a continental area that is otherwise extremely difficult to study. Drilling within rifted and passive margin sections in the North Atlantic and Tyrrhenian Sea have also well demonstrated the benefits to be gained by examination of continental-margin deposits. One site on Sohm Abyssal Plain established the onset of deep-water turbidite sedimentation that, in turn, marked the Late Pliocene sea-level lowering and onset of major terrigenous sediment accumulation on the Nova Scotia margin, which had been a site of slow hemiplagic sedimentation since the Cretaceous. The relatively few sites that have been drilled along transform and subduction margins, such as those off northern California and Oregon, have provided useful insights to the tectonic history of these margins.

6.2 SCIENTIFIC OBJECTIVES AND OPPORTUNITIES FOR THE FUTURE

There has been considerable current interest in sedimentary basins, particularly in terms of discriminating the effects of thermotectonic subsidence and sea level variations form the sedimentary record. Besides what goes down, there is the complementary aspect of basin evolution, uplift and erosion, processes that control the quantity and type of sediment available to the basin. Hay et al (1987) propose a model for using mass balance in a system of sources and sinks to derive paleotopography where the primary inputs are drawn from knowing the average stratigraphic column and variation of sea level. Comparatively little is generally known, however, about the timing, magnitude and rate of uplift and erosion, even though such information is critical to our understanding of, for example, orographic forcing of climate change, paleogeographic distribution of terrestrial floras and faunas (including homonids), and the underlying bases of geochemical and sedimentological cycles.

Despite the fundamental importance of uplift and erosion, direct documentation over geological time-scales is inherently difficult to obtain. Fortunately, the very materials that had been removed do find their way into the local sedimentary receptacles from which they can be extracted and the nature of their provenance inferred. Of particular interest are some of the great submarine fans such as the Amazon and Bengal/Indus, which are the depositional foci of some of the major mountain ranges (e.g., Andes and Himalaya). A detailed understanding of the development of such fans would lead to greatly improved insights into the uplift histories of many principal topographic features of the continents using methods such as those suggested by Hays et al (1987).

Drilling sites within continental slope- and rise-deposits and adjacent abyssal plain areas will require more site documentation than is commonly needed for blue-water areas. The great lateral variability in composition and internal organization of these sediment bodies makes it more difficult to select the best sites for meeting the drilling objectives; the design of site-survey activities will need to be tailored to the specific questions being posed.

Investigation of the depositional manifestations of continental uplift and erosion through deep-ocean drilling can provide unique insights to a wide range of geologic questions; a partial listing includes:

1. <u>Sea Level History and Sedimentary Cycles</u>

Sediment flux to the deep sea is quite sensitive to sea level changes, which can effect the areas, rates, and composition (including the nature of the weathering) of sediment supplied to the coastal areas, alter the temporary sites of storage along the path to the deep sea, and modify the dispersal paths across the continental margins. Long-period sedimentary cycles (time scales of tens of millions of years) are best examined within fine-grained areas of continental rises on older passive margins, eg., the Amazon Fan, where sediment redistribution by bottom currents has apparently had minimal effect on the form and structure of the deposit. Shorter-period cycles can be addressed through drilling in back-arc basins, foreland basins in areas of high sedimentation rates, eg., Aleutian arc region, and rift basins along transform margins. See the discussion of objectives under Theme 2 for the importance of drilling margin environments relating to processes affected or controlled by sea-level changes.

2. History of Sedimentary Basins

The sediment within marginal basins will record the tectonic activity within the adjacent continent through the effects of uplift, lateral displacement, thermal history, and sequences of events effecting sedimentation. The determination of in situ sedimentary facies in the offshore basins can provide important refinements to the facies analyses now used to determine depositional histories of ancient, deformed rock sequences. The uplift history of the Himalayas, for example, is probably most easily accessible through drilling appropriate parts of the Bengal or Indus fans. The long-term volcanic history of the Andes is not well preserved along the trench slope or floor but is probably well recorded in the deposits of the Amazon Fan; in this case, drilling away from the main channels, which are conduits for the coarsest sediment moving to the fan, in the fine-grained distal overbank (levee) sediment should provide a relatively continuous record of sediment moving across the Amazon drainage basin.

3. Sediment Mass Balance

An effective drilling program along continental margins will provide information on the long-term terrestial-sediment flux to the ocean. With data for a comprehensive range of paleoclimatic conditions and tectonic settings from the world's ocean, a realistic long-term sediment mass balance can be obtained.

4. Origin of Unconformities

The seismic-stratigraphic techniques used to interpret the sedimentary sequence along continental margins rely heavily on the recognition of unconformities and regional breaks in the sedimentation record to establish interval stratigraphy. A comprehensive drilling program will provide better controls on the origin and nature of regional unconformable surfaces. Determination of the origin of unconformities within major sediment prisms along passive margins, especially within the Atlantic region, can provide a check on the sedimentation models based on the Vail et al concepts. Unconformities along active margins should relate more directly to local tectonic episodes.

5. Volcaniclastic Sedimentary Facies

The sequence of tectonic events along active margins can be reflected in the accompanying volcanic activity. The sedimentary products of these events will be preserved in the offshore basins. A major objective of the drilling program should be to characterize the volcaniclastic sedimentary facies preserved in the modern offshore basins; this would greatly improve the ability to interpret the history of ancient margins and island-arc deposits. Existing volcaniclastic facies distinctions are generally based on accreted wedge deposits and uplifted basin along the arcs themselves. Along present arcs, the primary drill sites are within forearc basins; such sites also afford the chance to drill into the accreted wedge sequences that may lie underneath. In those cases where little sediment is present within trench slope basins, the trench floor itself becomes an important site.

6. <u>Submarine fans</u>: turbidite facies and origin of submarine canyons

Submarine fans are but one type of deep-marine clastic sequences that are formed by deposition from turbidity currents and associated gravity-driven flow processes. As such, fans and related turbidite deposits are the best record of continental surficial processes that provide sediment to deep water. Especially within the fine-grained (muddy) components of these deposits, nearly continuous sedimentation records are available. It is important to utilize the deep-sea drilling capability to document modern turbidite facies, both coarse-grained and fine-grained units, to improve our ability to document the history of ancient continental margins.

Drilling on submarine fans requires good site-survey geophysical coverage that is specific to the objective to be studied. Objectives A through D noted above, for example, can be obtained by drilling distal overbank sequences, the muddy levee complexes adjacent to the channel facies, or the distal end of the fan. Overbank facies are easily distinguished from channel and other coarse-grained facies such as lobes through seismic-reflection profiles. Thus, drilling near the head of the fan but laterally (along the margin) from the primary feeder canyons can provide stacked sequences of overlapping distal levee units generally without thich sand beds (mapped through seismic reflection profiles) providing a relatively continuous record of sediment input to the basin. In some cases, the rate of sedimentation even in the distal levee areas on fans is so high that the total section is too thick; in these cases, drilling on the distal fan can provide a continuous record of sedimentation with a greatly reduced section. In this area, however, the turbidite input will not be continuous but only reflect the major events in the fan history. Thick sand sections are common in this environment that may complicate drilling.

To study turbidite facies to allow a tie to the established facies scheme for ancient fans will require a much different drilling strategy. The existing facies schemes are based on the sandy components of fans, so drilling will have to address this problem. Also, the type of ancient fans that have been studied are from continental basins and are much smaller than the open-margin fans noted above. In this case, small, well-studied deposits in marginal basins, such as the Navy Fan, are the appropriate target.

7. <u>Slope stability</u>

Mass wasting is a unbiquitous process affecting submarine sedimentation over a wide range of slopes and sediment types. This type of deposit is well represented in ancient sequences from scales of tens of centimeters across to blocks many kilometers across. The style, origin, and extent (both lateral and vertical scales) of the slope failures varies with steepness of slope, tectonic setting, sedimentation rate, sediment composition, diagenesis, and other factors. Drilling of modern continental slope and basin environments would provide the most direct method to study the causes for slope failure and the processes involved in the transport and disperal of the failed sediment masses.

8. <u>Melanges and diapirism</u>

Collision and subduction-margin sequences commonly include substantial sections of melange deposits; diapirism is known from all types of margins at widely varying scales, but is well expressed and best understood for salt movement within mature passive margins. Drilling of modern trench slopes will provide better controls on these processes as related to collision tectonics and the development of sedimentary wedges.

6.3 TECHNOLOGY ISSUES

Drilling in continental margin environments for the objectives posed under this theme will require good recovery in sequences that may locally contain thick coarse-clastic beds. Although drilling sites can be chosen to minimize the amount of such materials that will be encontered, nevertheless attention must be given to improved sample recovery with the HPC system. Logging techniques should be advanced to permit routine use for the entire hole, not just the sections below 200 m. The studies of slope stability, melange processes, and diapirism could benefit from use of a pressure core barrel in specific regions.

(Larry---the technology issues that we continue to discuss cover the main area of concern for this theme; keep pushing for riser drilling, better recovery of coarse sediment, pressure core barrel. Since they haven't solved these probems in the years of ODP to date, let's not add to the shopping list and dilute the focus. Probably one statement for this area (1.5,2.5, 3.5 etc is sufficient for the white paper and it will help with the length problem.)

<u>Special Costs</u>

Many of the objectives under this theme could be attained with relatively shallow holes (100's of meters subbottom) in water depths well less than normal oceanic crust. It might be cost effective to consider use (perhaps for a relatively short period) of an alternate drilling vessel that will focus on the margin problems. This suggestion may not be generally well received but it should remain an item for discussion as we look ahead to the program for the mid 1990's.

A DRILLING STRATEGY FOR SEDIMENTED RIDGE CRESTS
ODP EAST PACIFIC RISE WORKING GROUP

EXECUTIVE SUMMARY

The East Pacific Rise Working Group met July 26-28, 1988 at the Pacific Geoscience Center in Sidney, BC to discuss the scientific objectives, drilling strategies, technical requirements and site selection criteria for drilling at sedimented ridge crests. These discussions were guided by the scientific objectives outlined in earlier reports (e.g. COSOD I and II, LITHP White Paper), and a review of existing data from the sedimented ridge crests of the eastern Pacific. A long-term drilling strategy for sedimented ridge crests was developed and specific recommendations were made on a drilling program for the upcoming phase of CEPAC drilling.

Scientific Objectives

The working group identified three fundamental problems that can be addressed by drilling at sedimented ridge crests:

* the hydrogeology and geochemistry of a sediment-dominated hydrothermal system
* the structure and formation of sediment-hosted sulfide bodies
* the magmatic and tectonic processes associated with crustal accretion

Although the working group recognized that hydrothermal and magmatic processes are closely inter-related, it felt the primary focus of drilling at sedimented ridge crests should be on hydrothermal problems. Specifically, the working group agreed the two highest priority drilling objectives at sedimented ridge crests should be: (1) a three-dimensional characterization of the fluid flow within the hydrothermal system, including a quantification of the chemical fluxes within the high-temperature reaction zone, and (2) a systematic investigation of the styles of sulfide mineralization in a variety of geologic and tectonic settings.

Strategy

Sedimented ridge crests provide a unique opportunity to investigate an active submarine hydrothermal system. The sediments are easily drilled, the recharge and discharge zones can be readily identified using conventional heat flow measurements, and the critical high-temperature reaction zone is probably located within a few hundred meters of the basalt-sediment interface making it feasible to reach using conventional drilling technology. In order to characterize the major components of a sediment-dominated hydrothermal system, we propose a suite of six holes. The highest priority is a single basement re-entry hole which would have the objective of drilling into the high-temperature reaction zone of an active system. This hole, which would be drilled at least 300 m into basement, should be located on crust covered with 200-500 m of sediment in a well-defined high heat flow zone near, but not directly on, an active vent. Complementing this hole would be an array of five shallower holes to define the three-dimensional pattern of fluid flow over a 10 km x 20 km area. These holes would be designed to penetrate to, but not substantially below, basement and would be located on areas of high and low heat flow within both active discharge and recharge zones. At least two of these holes should be outfitted with re-entry cones for potential subsequent deepening into basement. At all six holes an extensive program of logging, fluid sampling and borehole experiments are recommended, and plans should be made to seal the three re-entry holes for possible latter hydrogeological and geochemical experiments.

Sulfide deposits forming along mid-ocean ridges are an important modern analogue of the large, economically important ore deposits found on land. Drilling can sample the internal structure of these deposits while they are forming, thus providing critical information on their origin that can be obtained in no other way. These deposits, however, vary significantly in size and composition. In order to understand the processes involved, and the nature of this variability, we recommend drilling sulfide deposits in a variety of geologic and tectonic settings. Sites that should be investigated include sediment-hosted deposits forming in areas with and without outcropping extrusives, deposits associated with sill-dominated sedimentary sections, and volcanic-hosted deposits. In most areas, the sulfide bodies can be studied by drilling 1-3 shallow, single-bit holes to depths of 200-300 m below the sea floor. Logging and fluid sampling should be carried out in each hole.

Engineering Requirements

Nearly all of the proposed holes will involve drilling in high temperature conditions up to 400oC. This will require some modifications to existing drilling systems, including high-temperature seals and metal core liners. Substantial improvements are also needed in ODP's high-temperature logging capabilities. The feasibility of using the side-entry sub to run the standard logging suite while circulation is maintained in the hole should be explored. However, even if this is possible modifications will still have to be made to a number of other tools including the wireline packer, drillstring packer, sediment pore water sampler, VSP/OSE and OEM instruments, and the GEOPROPS and Kuster samplers in order to use them under these high-temperature conditions. PCOM should immediately charge the L-DGO Borehole Research Group with developing and testing these new high-temperature tools since their availability is critical to the success of a drilling program at sedimented ridge crests.

High recovery (>90%) is required when drilling in sulfides where problems may be encountered with alternating hard and soft layers. This will necessitate improved bit and core catcher design. Crustal drilling at sedimented ridge crests may be feasible using conventional roller cone bits and the top-drive system. However, thermomechanical failure of the hole due to the large temperature difference between the hot wall rocks and the circulating drilling fluids may require use of the mine coring system now under development at ODP.

Improved techniques for fluid sampling, especially in the basaltic crust, would be desirable. Instrumentation for monitoring the temperature, pressure, conductivity, and flow rate during and after drilling is also needed. A means of sealing off a drilled hole for later hydrogeological and geochemical experiments should be developed.

Steam flashing and blow-out safety problems are not expected for the water depths of all potential drilling sites, however specific conditions at proposed sites should be modeled and all necessary safety precautions taken.

Site Selection and Survey Requirements

The working group reviewed available data from the three principle targets for sedimented ridge crest drilling in the eastern Pacific: Guaymas Basin in the Gulf of California, Escanaba Trough on the southern Gorda Ridge and Middle Valley on the northern Juan de Fuca Ridge. All three areas have been extensively studied and, in the long term, drilling should be carried out in each area since they are associated with distinctive geological settings and styles of hydrothermal and magmatic activity. However, in the short term, the working group strongly favored a thorough characterization of the hydrogeological system at a single site over a comparison of systems in two or three different areas. For reasons of simplicity, and the level of site documentation, Middle Valley was preferred for the experiment described above to characterize the three-dimensional fluid flow within a sediment-dominated hydrothermal system.

In contrast, a comparative drilling strategy was favored for investigating the different styles of sulfide mineralization at sedimented ridge crests. Potential drilling sites were identified in Middle Valley, in the NESCA area of Escanaba Trough (one fault-related, one associated with an intrusive volcanic dome), in the Guaymas Basin near a large sill complex close to DSDP 477, and in the volcanic-hosted deposits on the Endeavour ridge segment. In Guaymas the highest priority is a single deep re-entry hole through the sill complex into basement; all of the other holes are relatively shallow (200-300 m), single-bit sedimentary holes.

The level of site documentation in all of these areas is excellent. The most important deficiencies are the need for detailed heat flow measurements in Escanaba Trough comparable to that available in the other areas, and multichannel seismic reflection data in all three areas to resolve basement and sub-basement reflectors, especially the presence or absence of an axial magma chamber.

Drilling Time Requirements

Achieving both of the major drilling objectives identified by the working group will require two separate drilling legs, one to characterize the hydrogeology and geochemistry of the hydrothermal system, the other to investigate the structure and formation of sediment-hosted sulfide bodies. Both objectives are of the highest thematic priority to ODP, and both should be included as part of the upcoming phase of CEPAC drilling.

The breakdown of drilling time is approximately as follows:

Leg 1 - Hydrogeology Experiment

* 12 days to drill the array of six holes (2 days each), plus 18 days for logging and borehole experiments (3 days each hole)
* 9 days to wash down to basement and set three re-entry cones
* 9 days to extend one of these holes 300 m into basement, plus an additional 7 days for logging, borehole experiments and sealing of the three re-entry holes

Total time - 55 days

Leg 2 - Sulfide mineralization

* 30 days for drilling and logging 6 single-bit holes in the NESCA area of Escanaba Trough
* 15 days for drilling and logging 3 single-bit holes in Middle Valley, Juan de Fuca Ridge
* 5 days for drilling and logging one hole on Endeavour Ridge
* 10 days for drilling two single-bit holes in Guaymas Basin, plus 7 days for a basement re-entry hole

Total time - 67 days

GEOCHEMICAL REFERENCE SITES

1. Bonin-8 (proposal 171/D, rev.) is better documented than A2-2 (proposal 287/E), as it is located on MCS data with many supporting single channel lines nearby. A2-2 was sited on the basis of magnetic anomaly lineations with little attention paid to the seismic reflection data in the immediate region. These data are sparse, generally quite old, not strategically located to pick up the M-18 objective, and do not image basement conclusively. Perhaps there is higher quality Japanese data in the vicinity; the proponents should investigate this possibility. If this effort does not turn up better quality seismic data, thought should be given as to why the calibration of M-18 is so important that it should drag a geochemical reference program off of Bonin-8 and onto A2-2.

2. MAR-4 (267/F) is, of course, situated at DSDP 452, which was surveyed prior to Leg 60. There is plentiful single channel data of acceptable quality there, with decent MCS nearby. If the engineering tests on Leg 124/E are successful, and it is determined that basement is reachable here, this site is ready for geochemical reference drilling.

3. At this point, MAR-5 is lacking site-specific data (indeed, it is lacking site specificity altogether). The constraints are that it should be located on the apron of a large seamount or guyot, and should have, ideally, no more than 800-900 meters of sediment. Natland has been instructed to come up with a specific site location and supporting data; the Data Bank will assist in this task.

4. In general, the sites proposed in 306/E are more "mature" than those in proposals 285/E and 287/E. The FRED MOORE MCS survey has provided a sound basis (*ahem*) for sites PIG-3, PIG-4, EMB-1, EMB-2, while the upcoming SUROIT cruise will pick up sites PIG-1 and PIG-2. However, the appropriateness of those sites as geochemical reference holes is not universally accepted.

It should be pointed out that drillable geochemical reference sites can probably be found in the regions discussed in 285/E and 287/E, if the constraints dictated by the other objectives (e.g., locating a site on a specific magnetic anomaly) are ignored. However, since these were conceived as tectonic sites, this would clearly place the tail in control of the dog.

TERMS OF REFERENCE

Science Advisory Structure of JOIDES
for the Ocean Drilling Program (ODP)

The purpose of the ODP Science Advisory Structure of JOIDES is to enable the formulation of the most productive scientific plan for the program. JOIDES is open to suggestions and proposals from the entire scientific community, and its plans shall be open to continued review and revision.

1. <u>SCIENCE ADVISORY STRUCTURE</u>

The Science Advisory Structure of JOIDES will consist of a Planning Committee, a Technology and Engineering Development Committee, three thematic panels, five regional panels, and five service panels. <u>Ad hoc</u> working groups may be created by the Planning Committee as requested by the panels or by the Planning Committee itself.

2. <u>COMMITTEES, PANELS, AND WORKING GROUPS</u>

Each committee, panel and working group will operate under a mandate, along with guidelines as to membership and frequency of meetings. Mandates, guidelines, and their amendments shall be proposed by the Planning Committee for approval by the Executive Committee.

3. <u>PLANNING COMMITTEE</u>

3.1 <u>General Purpose</u>. The Planning Committee recommends to the Executive Committee and to the Science Operator plans designated to optimize the scientific productivity and operational efficiency of the drilling program, normally by coordinating, consolidating, and setting into priority the advice received from the panels. More specifically, the Planning Committee is responsible (a) for planning the general track of the drilling vessel about 4 years in advance of drilling; (b) for fostering communications among and between the general community, the panels, the Science Operator, and itself: (c) for soliciting, monitoring, and coordinating the advancement of drilling proposals; and (d) for the establishment of a scientific drilling program at the Planning Committee Annual Meeting for the next fiscal year, to be incorporated into the Program Plan.

3.2 <u>Mandate</u>. The Planning Committee is responsible for the mandates of the various panels and working groups and their membership. It approves their meetings and agendas and may assign special tasks to them. The Planning Committee sponsors and convenes COSOD-type conferences about every three years. It identifies the proponents of proposals and assigns to thematic and regional panels proposals for review. It sets the scientific objectives of the proposals into final priority after they are reviewed by the Thematic Panels and Regional Panels. The Planning Committee nominates the chief scientists to the Science Operator. It periodically reviews this advisory structure in the light of developments in science and technology and recommends amendment of its panel structure and mandates. Much of the working of the Planning Committee is carried out by the commissioning of reports from the panels, the working groups, and ad hoc subcommittees of its own membership, and by its chairman at the JOIDES Office.

3.3 Structure. The Planning Committee is empowered to establish an infrastructure appropriate to the definition and accomplishment of tasks described in its annual program plan as approved by the Executive Committee and the National Science Foundation. Communication with its panels is maintained by having their chairmen meet with the Committee annually, and by assigning committee members as non-voting liaison members to its panels and working groups. Where counsel and communication are deemed important, other individuals may be asked ad hoc to meet with the Committee or a panel.

3.4 Membership. Each member of the Executive Committee shall designate one member of the Planning Committee and an alternate to serve in the absence of the designated member. Commencing January 1, 1984, one quarter of the Planning Committee members shall rotate off the Committee annually, so that its membership is replaced every four years. Reappointment shall be made only in exceptional circumstances. All appointees to the Planning Committee shall satisfy the fundamental criteria of having the ability and commitment to provide mature and expert scientific direction to the program. Balance of fields of specialization on the Planning Committee shall be maintained as far as possible, by informed consultation amongst the U.S. member institutions prior to selection of their appointees. The chief scientists of the Science Operator and Wireline Logging Services Contractor and an appointee of the NSF are non-voting, liaison observers.

3.5 Organization. The planning Committee meets at least three times a year, normally in January, May, and September. Robert's Rule of Order govern its meetings.

3.6 Vote and Quorum. Within the framework of the Memoranda of Understanding with each non-U.S. participating country (or consortium designee), it is intended that the U.S. members shall constitute at all times at least a majority of members. Substantive issues decided by formal vote require the vote of a majority of all members. A quorum shall consist of at least two-thirds of the non-U.S. members and at least two-thirds of the U.S. members.

3.7 Chairmanship. The Chair of PCOM shall rotate with the JOIDES Office among the U.S. JOIDES institutions, excluding the Science Operator institution. The term of office is normally two years.

4. THEMATIC PANELS

Thematic Panels are mainly, but not exclusively, process orientated. They are established by the Planning Committee to redefine as scientific drilling objectives scientific problems identified by COSOD (16-18 November 1981) and by the JOIDES 8-year program for drilling (April 1982). They are responsible for reviewing any other scientific objectives proposed by the pre- and post-1983 reports and "white papers," the national science structures of the various non-U.S. participants, and the scientific community at large. Thematic Panels maintain a constant review of science in their discipline. Thematic Panels are composed of a number of members from U.S. institutions and one member from each non-U.S. participant. PCOM approves the panel membership. Panelists appointed in 1985 and future years will serve 3 years, with one-third of the panelists being replaced each year. The chairmen are appointed by PCOM. Thematic panels meet at least twice a year, but may meet more frequently as requested by PCOM. PCOM convenes the panel meetings and approves their meeting dates, locations, and agendas. The mandates are guidelines and do not restrict panels. Considerable overlap in thematic coverage has evolved and is expected to continue to evolve. The Planning Committee may ask Panels to take up topics not in their original mandates.

4.1 <u>Ocean Lithosphere Panel: Mandate</u>

4.1.1. The Ocean Lithosphere Panel is concerned with the origin and evolution of oceanic crust, and more particularly with volcanic, metamorphic, hydrothermal and diagenetic processes occurring in the ocean crust:

(a) Processes of submarine volcanology, intrusion and plutonism; crustal construction at spreading axes; petrology, geochemistry, mineralogy, and magnetic and other physical properties of igneous and metamorphic rocks from the ocean floor, from seamounts, from oceanic plateaus, from volcanic arcs and from basins adjacent to volcanic arcs.

(b) Processes of submarine hydrothermal circulation; petrology, geochemistry and mineralogy of hydrothermally altered rocks and hydrothermal deposits from the ocean floor; geochemistry and physical properties of hydrothermal solutions.

(c) Processes of submarine diagenesis; geochemistry of pore waters from sediments and hard rocks; petrology geochemistry and mineralogy of diagenetically altered sediments and hard rocks.

4.1.2. The Ocean Lithosphere Panel will be responsible for planning the drilling of sites concerned with these problem areas at the following levels:

(a) Long-range identification of objectives and review of research proposals for future drilling operations.

(b) Selection of target areas within which these objectives can be met.

(c) Helping the site survey organization to plan surveys of the target areas.

(d) Identification of proponents or working groups for particular target areas.

(e) Selection of sites for location of drill holes within the target areas, so that objectives can be reached.

(f) Advice to the Planning Committee and the project chief scientist on the selection of co-chief scientists and other scientists.

(g) Encouragement of specific shore-based laboratory work on the samples recovered by drilling.

(h) Advice to the project curator on the handling of recovered samples.

(i) Advice to the Planning Committee and the project chief scientist on provision of equipment for use on the drilling ship and in shore-laboratories run by the Science Operator.

(j) Coordination of plans for downhole experiments in projected holes.

4.1.3. In the course of the work specified in paragraph 4.1.2., the Ocean Lithosphere Panel will maintain the closest contact with the appropriate Regional Panels and other specialists.

4.1.4. The Ocean Lithosphere Panel is responsible to the Planning Committee, and will respond directly to requests from it, as well as reporting to it on a regular basis.

4.1.5. The Ocean Lithosphere Panel will act as a means of disseminating and correlating information in the appropriate problem areas by:

(a) Receiving reports from co-chief scientists on the progress with shorebased research on samples.

(b) Encouraging and sponsoring symposia at which the results of drilling will be discussed.

(c) Publishing progress reports in the open literature to inform and encourage participation in the project.

(d) Generating "White Papers" as requested by PCOM.

4.2 Tectonics Panel: Mandate

The Tectonics Panel is concerned with the standard history of ocean margins and plates, especially studies in critical transects and along-strike by coordinated geological, geophysical, and drilling programs:

(a) Special emphasis is placed on the early rifting history of passive continental margins, on the dynamics of forearc evolution, and on the structural sedimentological and volcanic history of island arcs, back-arc basins, and marginal seas.

(b) Additional problems under the purview of this panel include the development of continental slopes and rises; detailed histories of vertical movements at margins; thermal and mechanical evolution of passive margins; structural variability along-strike; sheared margins; post-rifting tectonism of passive margins; the study of stress fields at active margins; global relations among arc systems; collision tectonics; the development of passive margins in back-arc basins; studies of transform faults at fracture zones; the origin, structure and tectonic evolution of oceanic plateaus and aseismic ridges; and the determination of plate-kinematic models.

(c) Of interest to this panel as well as to other panels are the composition, structure and formation of the oceanic crust and upper mantle, tephrochronology, and the study of "global" unconformities and the synchroneity of tectonics and sea level events along margins as well as coral atolls and guyots.

4.3 Sediments and Ocean History Panel: Mandate

The Sediments and Ocean History Panel is concerned with investigations of marine stratigraphy, marine sedimentology and paleoceanography. Areas specifically include:

(a) Stratigraphy including the subdivision, correlation and dating of marine sediments. Examples are refinement of magnetostratigraphy, radiometric dating, chemostratigraphy, biostratigraphy, tephrochronology, and seismic stratigraphy.

(b) Processes of formation of marine sediments, diagenesis, organic and inorganic sedimentary geochemistry and global mass balancing of oceanic sediments.

(c) Long-term history and driving mechanisms of the oceanic atmosphere and biosphere. Central to this theme are relations among plate tectonics and ocean paleocirculation, sedimentation patterns, global paleoclimates, glacial and ice-sheet evolution, sea level change and its effects on marine sedimentation and evolution of marine life.

5. REGIONAL PANELS: MANDATE

The Regional Panels are responsible for:

(a) Helping Thematic Panels to translate their broad thematic programs into concrete regional drilling plans.
(b) Identifying regional problems not covered by Thematic Panels.
(c) Recommending integrated drilling programs in their regions.
(d) Monitoring the status of knowledge on regional geology and geophysics.
(e) Advising on regional and site surveys needed for future drilling.

PCOM chooses panel members for their expertise and experience in a region. PCOM nominates a number of members from the U.S. and from non-member countries as appropriate and each non-U.S. JOIDES member can nominate one member to each Regional Panel. Panelists appointed in 1985 and future years will serve 3 years, with one-third of the panelists to be replaced each year. The chairmen are appointed by PCOM.

Regional panels meet at the request of PCOM as frequently as required by ship scheduling and routing.

PCOM establishes liaison between Regional and Thematic Panels by the appointment of non-voting liaisons.

The map (Appendix 1) shows the general areas of prime responsibility for the Regional Panels, but the boundaries are not fixed limits. Panels view their responsibility as including all areas relevant to their regional problems. The

Regional Panels are:

A. Atlantic Ocean
B. Central and Eastern Pacific Ocean
C. Western Pacific Ocean
D. Indian Ocean
E. Southern Oceans

6. AD HOC WORKING GROUPS: MANDATE

Ad hoc groups may be created by the Planning Committee as requested by the panels or by the Planning Committee itself, for more intensive study of certain aspects of planning that may arise. Working groups will be held to the minimum necessary membership and travel expenses, chairmanship to be held by a member of the parent committee or panel, and will be dissolved when their assigned work is complete.

7. TECHNOLOGY AND ENGINEERING DEVELOPMENT COMMITTEE: MANDATE

The Technology and Engineering Development Committee is responsible for ensuring that the proper drilling tools/techniques are available to meet the objectives of targets to be drilled according to the planned schedule. The TEDCOM identifies within a proper time frame the new drilling tools/techniques to be developed, helps JOI/Science Operator write RFPs for engineering firms leading to the development of the tools/techniques, and monitors the progress of their development. The members of the TEDCOM are engineers nominated by PCOM. One of the functions of the TEDCOM is to collaborate with the Downhole Measurements Panel.

8. SERVICE PANELS

Service Panels provide advice, services and products to the JOIDES Advisory Structure, to the Science Operator, and to the various entities responsible for the processing, curation and distribution of samples, data and information (including publications) to the scientific community. The Service Panels, beyond their help to the JOIDES Advisory Structure, are not directly involved with selection of drilling targets or definition of cruise objectives. Service Panels have specific mandates. Service panels meet at least once a year or as requested by PCOM. PCOM appoints the chairman and panelists and keeps membership under review.

8.1 Site Survey Panel: Mandate

8.1.1. The general purpose of the Site Survey Panel is to provide information and advice to the Planning Committee on the adequacy of and need for site surveys in relation to proposed drilling targets.

8.1.2. The Site Survey Panel is mandated to:

(a) Receive mature proposals from regional and thematic panels, to review site survey data packages prepared by the ODP Data Bank and to make recommendations as to their adequacy to the Planning Committee.

(b) Identify data gaps in proposed future drilling areas and to recommend appropriate action to ensure that sufficient site survey information is available for pinpointing specific drilling targets and for interpretation of drilling results.

(c) Provide guidelines for proponents and panels as to required site survey data and to examine the opportunities and requirements for the use of new technologies for surveying potential drill sites.

(d) Promote international cooperation and coordination of site surveys for the benefit of the Ocean Drilling Program, particularly between participating ODP nations' survey activities.

(e) Promote the lodging of all data used for planning drilling targets with the ODP Databank.

8.2 <u>Pollution Prevention and Safety Panel: Mandate</u>

8.2.1. The general purpose of the Pollution Prevention and Safety Panel is to provide independent advice to the Planning Committee and to the Ocean Drilling Program with regard to safety and pollution hazards that may exist because of general and specific geologic circumstances of proposed drill sites.

8.2.2. All drilling operations involve the chance of accident or pollution. The principal geologic safety and pollution hazard in ocean drilling is the possible release of substantial quantities of hydrocarbons from subsurface reservoir strata. In most deep sea regions, the risk of hydrocarbon release can be reduced or eliminated by careful planning and proper site surveys. Additionally, safety problems may arise in drilling hot hydrothermal systems for lithosphere targets. Those who plan each Ocean Drilling Program cruise and select its drilling sites are initially responsible to propose only sites that are considered reasonably safe. The JOIDES Pollution Prevention and Safety Panel independently reviews each site to determine if drilling operations can be conducted safely.

The preliminary site survey information and the operational plan are reviewed for each site. Advice is communicated in the form of site approval, lack of approval, or approval on condition of minor site relocation or amendment of the operational plan. Approval is based on the judgment of the Panel that a proposed site can be safely drilled in light of the available information and planning.

8.3 <u>Information Handling Panel: Mandate</u>

8.3.1. The general purpose of the Information Handling Panel is to provide information and advice to the Planning Committee, the Ocean Drilling Program and the Deep Sea Drilling Project (DSDP) with regard to satisfying the needs of the scientific community for timely access to data, samples and publication and to assist program managers in setting priorities.

8.3.2. The Information Handling Panel is mandated to:

(a) Advise on (1) types of publications to be produced; (2) publication formats; (3) schedules and deadlines; (4) publications policy and goals of the publications program. (Both ODP and DSDP publications are included.)

(b) Advise on (1) the operation of the core repositories; (2) curatorial policy; (3) filling of sample requests; (4) curatorial data management; (5) long-term goals for the preservation of the core materials and other physical samples obtained by ODP and DSDP; and (6) establishment and operation of the various micropaleontology reference centers.

(c) Advise on (1) the types and contents of the data bases to be maintained by ODP and DSDP; (2) the treatment of raw data; (3) the establishment of uniform procedures and standards for data handling and processing; (4) the structure, philosophy and goals of the information systems produced by the program; and (5) the management of data bases, information systems and data centers. This last topic also includes coordination between various data centers established by ODP and DSDP.

(d) Advise on the minimum standards of quality and completeness necessary for data to be included in the various data bases and information systems, including data recording, transcribing and checking procedures.

(e) Advise on (1) shipboard and shore-based computer facilities, equipment and procedures; (2) software development; (3) data collection techniques; and (4) meeting the computational needs of shipboard and shore-based scientists, as well as providing access to data bases for all interested parties.

(f) Advise on (1) long-term preservation of the raw data generated by ODP and DSDP; (2) preservation of all past records bearing on sample history; and (3) preservation of any other records of the program which might benefit future workers.

(g) Advise on the relationship between the ODP and DSDP data centers and national depositories such as the National Geophysical Data Center, World Data Center A for Marine Geology and Geophysics, etc., and the fulfillment of statutory obligations for data transfer. It also includes transfer of data to data centers established by ODP member countries, such as the one in France, and to the Micropaleo Reference Centers.

8.4 <u>Downhole Measurements Panel: Mandate</u>

8.4.1. The general purpose of the Downhole Measurements Panel is to determine the physical state, chemical composition, and dynamic processes in ocean crust and its sediment cover from downhole measurements and experiments. Areas of responsibility include: routine logging (including industry standard and special tools widely used in ODP); routine data processing and interpretation; new and adapted logging tools, techniques, and data processing; downhole experiments and data acquisition (including downhole recording).

8.4.2 The Downhole Measurements Panel is mandated to:

(a) Report to and advise PCOM on logging and downhole measurement programs of ODP.

(b) Advise on and recommend to the ODP Wireline Service Contractor the required logging facilities.

(c) Advise the ODP Science Operator on the scientific desirability, technical feasibility, scheduling and operational requirements of proposed programs.

(d) Interface and coordinate with Woods Hole Oceanographic Institute (U.S.) and other national downhole instrumentation development groups.

(e) Solicit and expedite new logging capabilities and experiments.

(f) Evaluate new technology and recommend future measurement directions.

8.4.3. Membership consists of a well-balanced representation, and approximately half being logging and other downhole technologists and half having scientific backgrounds and interests. The Wireline Services Operator and Science Operator of ODP shall each be represented by non-voting members on the Panel.

(Revised 8/18/88, JOIDES Office)

TERMS OF REFERENCE

Science Advisory Structure of JOIDES for the Ocean Drilling Program (ODP)

The purpose of the ODP Science Advisory Structure of JOIDES is to enable the formulation of the most productive scientific plan for the program. JOIDES is open to suggestions and proposals from the entire scientific community, and its plans shall be open to continued review and revision.

1. Science Advisory Structure

   The Science Advisory Structure of JOIDES will consist of a Planning Committee, a Technology and Engineering Development Committee, four thematic panels and five service panels. *Ad hoc* Detailed Planning Groups (DPGs) may be approved by the Planning Committee as requested by the panels or by the Planning Committee itself.

2. Committees, Panels, and Working Groups

   Each committee, panel and detailed planning group will operate under a mandate, along with guidelines as to membership and frequency of meetings. Mandates, guidelines, and amendments to them, for the standing panels, shall be proposed by the Planning Committee for approval by the Executive Committee. Mandates and guidelines for the short-lived Detailed Planning Groups will be specified by PCOM as required.

3. Planning Committee

   3.1 General Purpose. The Planning Committee recommends to the Executive Committee and to the Science Operator plans designated to optimize the scientific productivity and operational efficiency of the drilling program, normally by coordinating, consolidating, and setting into priority the advice received from the panels.

   More specifically, the Planning Committee is responsible (a) for planning the general track of the drilling vessel about four years in advance of drilling; (b) for fostering communications among and between the general community, the panels, the Science Operator, the Wireline Logging Contractor and itself: (c) for soliciting, monitoring, and coordinating the advancement of drilling proposals; and (d) for the establishment of a scientific drilling program at the Planning Committee Annual Meeting for the next fiscal year, to be incorporated into the Program Plan.

   3.2 Mandate. The Planning Committee is responsible for the mandates of the various panels and planning groups and their membership. It approves their meetings and agendas and may assign special tasks to them. The Planning Committee sponsors and convenes COSOD-type conferences at intervals determined by long-term science plans for ODP. **PCOM**, through the JOIDES Office, assigns proposals to thematic panels, DPGs and, if relevant, to service panels, for review. ~~It~~ sets the scientific objectives of the proposals into final priority after they are reviewed by the Thematic Panels. The Planning Committee nominates chief scientists to the Science Operator, **who ultimately chooses them.**

PCOM periodically reviews the JOIDES advisory structure in the light of developments in science and technology and recommends amendment of its panel structure and mandates. Much of the working of the Planning Committee is carried out by the commissioning of reports from the panels, the **detailed planning groups**, and <u>ad hoc</u> subcommittees of its own membership, and by its chairman at the JOIDES Office.

3.3 <u>Structure</u>. The Planning Committee is empowered to establish an infrastructure appropriate to the definition and accomplishment of tasks described in its annual program plan as approved by the Executive Committee and the National Science Foundation.

Communication with the panels **and active DPGs** is maintained by having their chairmen meet with the Committee annually, and by assigning committee members as non-voting liaison members to its panels and working groups. Where counsel and communication are deemed important, other individuals may be asked <u>ad hoc</u> to meet with the Committee or a panel.

3.4 <u>Membership</u>. Each member of the Executive Committee shall designate one member of the Planning Committee and an alternate to serve in the absence of the designated member. One quarter of the Planning Committee members shall rotate off the Committee annually, so that its membership is replaced every four years. Reappointment shall be made only in exceptional circumstances.

All appointees to the Planning Committee shall satisfy the fundamental criteria of having the ability and commitment to provide mature and expert scientific direction to the program. Balance of fields of specialization on the Planning Committee shall be maintained as far as possible, ~~by informed consultation among the U.S. member institutions prior to selection of their appointees.~~ The chief scientists of the Science Operator and Wireline Logging Services Contractor, **the JOI program director** and an appointee of the NSF are non-voting, liaison observers.

3.5 <u>Organization</u>. The planning Committee meets at least three times a year, normally **in November, April and August, based on the timetable for producing the ODP Program Plan.** Robert's Rules of Order govern its meetings.

3.6 <u>Vote and Quorum</u>. Within the framework of the Memoranda of Understanding with each non-U.S. participating country (or consortium designee), it is intended that the U.S. members shall constitute at all times at least a majority of members. Substantive issues decided by formal vote require the vote of a majority of all members. A quorum shall consist of at least two-thirds of the non-U.S. members and at least two-thirds of the U.S. members.

3.7 Chairmanship. The Chair of PCOM shall rotate with the JOIDES Office among the U.S. JOIDES institutions, excluding the Science Operator and Wireline Logging Services Contractor institutions. The term of office is normally two years.

4. Thematic Panels

Thematic Panels are mainly, but not exclusively, process orientated. They are established by the Planning Committee to develop scientific drilling objectives based on COSOD type conferences. The Thematic Panels play an important role in defining the long-term scientific objectives of ocean drilling.

In developing the long-range plans for the Ocean Drilling Program, the Thematic Panels maintain a constant review of science in their discipline.

Thematic Panels are composed of a number of members from U.S. institutions and one member from each non-U.S. participant. PCOM approves the panel membership. Panelists will serve three years, with one-third of the panelists being replaced each year. The chairmen are appointed by PCOM. Thematic panels meet at least twice a year, but may meet more frequently as requested by PCOM. PCOM convenes the panel meetings and approves their meeting dates, locations, and agendas. The mandates are guidelines and do not restrict panels. Considerable overlap in thematic coverage has evolved and is expected to continue to evolve. The Planning Committee may ask Panels to take up topics not in their original mandates.

(NOTE: SECTION OF GENERAL DUTIES OF THE THEMATIC PANELS EXPANDED USING THE ORIGINAL MANDATE OF THE LITHOSPHERE PANEL AS A MODEL.)

4.1 Specific Responsibilities of Thematic Panels. Each thematic panel will be responsible for planning the drilling of sites at the following levels:

(a) Long-range identification of objectives, and Review of ODP proposals submitted to JOIDES, followed by written evaluations to PCOM for each proposal reviewed.

(b) Make recommendations for necessary site surveys needed to achieve the scientific objectives at a target area.

(c) Make recommendations to PCOM for establishing Detailed Planning Groups for further developing drilling plans for specific target themes and/or regions.

(d) Advise the Planning Committee on the selection of possible co-chief scientists.

(e) Provide advice to PCOM on requirements for technical drilling operations, downhole measurements, and shipboard/shore-based sample handling (in consultation with the appropriate service panel, if necessary.)

(f) Provide advice to PCOM on technical development needs required to achieve long-range scientific objectives.

4.1.1. In the course of the work specified in paragraph 4.1., the Thematic Panels will maintain the close contact with the appropriate DPGs and provide PCOM with written evaluations of the recommendations made by these planning groups.

4.1.2. Each Thematic Panel is responsible to the Planning Committee, and will respond directly to requests from it, as well as reporting to it on a regular basis.

4.1.3. The Thematic Panels will act as a means of disseminating and correlating information in the appropriate problem areas by:

(a) Monitoring the progress made by ODP cruise participants and other scientists on the results from shorebased research on samples; encouraging shore-based laboratory work on samples recovered through ODP drilling.

(b) Encouraging its members to contribute to symposia at which the results of drilling will be discussed.

(c) Publishing progress reports in the open literature to inform and encourage participation in the project.

(d) Generating "White Papers" as requested by PCOM.

(e) Providing input to PCOM for the summary of scientific achievements of ODP for inclusion in the ODP Program Plan.

4.2 Lithosphere Panel: Mandate

4.2.1. The Lithosphere Panel is concerned with the origin and evolution of oceanic crust and mantle. In particular, important areas of investigation are volcanic, metamorphic, hydrothermal, structural and alteration processes occurring in the ocean crust. Also of importance to the Lithosphere Panel are mantle-crust interactions, mantle dynamics and composition, and solid-earth geochemical cycles. [J.Malpas and T.Francis]

(a) Processes of submarine volcanology, intrusion and plutonism; crustal construction at spreading axes; petrology, geochemistry, mineralogy, and magnetic and other physical properties of igneous and metamorphic rocks from the ocean floor, from seamounts, from oceanic plateaus, from volcanic arcs and from basins adjacent to volcanic arcs.

(b) Processes of submarine hydrothermal circulation; petrology, geochemistry and mineralogy of hydrothermally altered rocks and hydrothermal deposits from the ocean floor; geochemistry and physical properties of hydrothermal solutions; ageing of ocean lithosphere [JM].

(c) Processes of mantle convection and melting and their relationship to basaltic rocks of the ocean basins. Mapping of mantle (geochemical) reservoirs and domains. Implications of solid earth geochemical cycles and fluxes of the global plate tectonic cycle. Mass balance problems. [JM]

4.3 Tectonics Panel: Mandate

Tectonics is the study of large-scale structural features and their origin, evolution and interrelations. The Tectonics Panel is correspondingly concerned with large-scale processes of deformation, including those that are active today at plate boundaries and those that are recorded in the structures and sediments of former plate boundaries.

The Panel is also interested in the origin and evolution of large-scale constructional crustal features. The drilling-based tectonic studies that are evaluated and promoted by the Tectonics Panel fall into six groups, each listed below with some specific (but not exclusionary) examples:

(a) Passive (extensional) margins - rifting history, rift-drift evolution and associated igneous activity, structure and origin of continent-ocean boundary zones; structural symmetry/asymmetry of conjugate margins; passive margins in back-arc basins; structural variability along-strike; thermal and mechanical evolution; history of vertical crustal movements; post-rift subsidence, tectonism and sea-level history, their interrelations, and their effects on the sedimentary record; tectonic synchroneity.

(b) Sheared (translational) margins - deformational history including crustal extension, shortening and vertical movements; structure and evolution of continent-ocean boundary zones; effect of tectonics on syn-rift and post-rift sedimentary record.

(c) Active (convergent) margins - mechanics, kinematics, and mechanisms of deformation within accretionary wedges; thermal evolution and fluid flow; history of island-arc magmatism; sedimentation and deformation in fore-arc and back-arc basins; collision-associated deformation.

(d) Divergent oceanic plate margins - structural evolution of mid-ocean ridge axes along "normal" spreading segments; origin and evolution of ridge-axis discontinuities (small offsets, overlapping spreading centers, transform faults, etc.); tectonic segmentation along mid-ocean ridges; origin of structural/tectonic asymmetries across spreading centers and ridge-axis discontinuities.

(e) Origin and history of submarine plateaus, microcontinents, aseismic ridges, seamount (atoll, guyot) chains, and other large-scale features constructed, fragmented, or deformed during ocean-basin evolution; history of vertical motion of these features and its relation to eustacy.

(f) Global measurements that are not uniquely identified with a particular type of plate boundary, e.g., kinematic histories of large and small plates; present-day status of stress within plates and near-plate boundaries; rates and magnitudes of strain at active plate boundaries and at deforming zones within plates. [Tucholke and Cowan]

4.4 Ocean Paleoenvironment and Paleobiology

(Note: Would the name Ocean History Panel be simpler?)

The Ocean History Panel is concerned with investigations of marine stratigraphy, aspects of marine sedimentology and paleoceanography. Areas specifically include:

[The Ocean Paleoenvironment and Paleobiology Panel is concerned with the paleoenvironmental, paleontologic and biologic aspects of marine stratigraphy.]

Specific areas covered by the Panel are:

(a) The history and evolution of the marine biota - the stratigraphic record, the processes and driving mechanisms for biologic change through time and responses to changing environmental conditions. An integral part of this theme is the biostratigraphic record and its relationship to chronostratigraphy (through radiometric dating and magnetostratigraphy), isotopes and chemostratigraphy, litho-, seismic- and cycle stratigraphy.

(b) Long-term history and driving mechanisms of the evolution ~~in~~ of the ocean, atmosphere and biosphere. Central to this theme are relations among plate tectonics and ocean paleocirculation, sedimentation patterns, global paleoclimates, glacial and ice-sheet evolution, sea level change and its effects on marine sedimentation and evolution of marine life.

(c) Relationships between orbitally caused changes and solar insolation and the response of the global climate system during the geologic past.

4.5 Diagenesis and Sediment Processes (From Miriam Kastner)

The diagenesis and sediment processes panel is concerned with marine sedimentation and diagenetic processes, origin and evolution of marine sediments and seawater chemistry, global sediment and geochemical mass balances, hydrothermal processes in sedimented regions.

Major themes of interest to the panel are:

(a) Organic and inorganic sedimentary geochemistry and diagenesis - The rates and nature of early to late diagenetic processes; the lithification of sediments; the geochemistry of interstitial and formation waters; petrology, mineralogy, magnetic and other physical properties, and geochemistry of diagenetic phases of bulk sediments; and chemical paleoceanography.

(b) Temporal and spatial global mass balances of sediments and cycling of elements. Compositions and quantities of subducted sediments; relationship of sediments to tectonic and paleoceanographic processes such as sea level fluctuations and anoxic events; unconformities and disconformities; the carbon, sulfur and phosphorus cycles; marine evaporites in early rifting systems and other settings.

(c) Fluid circulation and geochemical budgets. Magnitudes, rates and transport of gravity- and tectonically-driven circulation in passive and active continental margins; chemical fluxes, biological activity, physical, mineralogical and geochemical alteration of margin sediments induced by fluid flow; interaction between submarine hydrothermal fluids and sediments, mineralogy, petrology, physical and geochemical properties of the hydrothermally altered sediments, and the geochemical evolution of the hydrothermal fluids; the origin and distribution of base metal deposits in continental margins and sedimented hydrothermal systems.

(d) The physical manifestations of geochemical processes involved in diagenesis annd fluid flow in marine sediments.

(NOTE: TAKEN IN PART FROM REGIONAL PANEL MANDATES)

5. <u>Detailed Planning Groups: Mandate</u>

Detailed Planning Groups are short-lived planning groups which may be created by the Planning Committee, in response to requests by the Thematic Panels or by the Planning Committee itself, for more intensive study of certain aspects of planning that may arise. The Detailed Planning Groups will be held to the minimum necessary membership and travel expenses.

5.1 <u>Structure of the Detailed Planning Groups</u>

The Detailed Planning Groups are responsible for:

(a) Helping Thematic Panels to translate their broad thematic programs and highly-ranked ODP proposals into concrete drilling plans.

(b) Recommending integrated drilling programs for their assigned topics and regions of interest

(c) Advising on regional and site surveys needed for future drilling.

(d) Preparing drilling prospectuses which synthesize all thematic and site survey input.

5.2 Membership

PCOM chooses DPG members for their expertise and experience with respect to the assigned thematic topics and in regions where these topics can be addressed.

Members are recommended by the thematic panels and by PCOM and are appointed by PCOM or by the PCOM Chairman if necessary. The chairmen are appointed by PCOM.

The DPGs are composed of a number of members from U.S. institutions, and should maintain full representation, if possible, from the non-U.S. JOIDES institutions. A maximum number of 16 members is suggested.

Active DPGs meet at the request of PCOM as frequently as required by ship scheduling and routing.

PCOM establishes liaison between standing DPGs and Thematic Panels by the appointment of non-voting liaisons.

6. Technology and Engineering Development Committee: Mandate

The Technology and Engineering Development Committee (TEDCOM) is responsible for ensuring that the proper drilling tools/techniques are available to meet the objectives of ODP drilling targets, especially those for achieving highly-ranked objectives identified in ODP long-range planning.

TEDCOM identifies, within a proper time frame, the new drilling tools/techniques to be developed, helps JOI and the Science Operator write RFPs for engineering firms which lead to the development of the tools/techniques, and monitors the progress of their development.

The members of the TEDCOM are engineers nominated by PCOM. One of the functions of the TEDCOM is to collaborate with the Downhole Measurements Panel. An ODP/TAMU engineer is assigned to act as Science Operator liaison with TEDCOM.

7. Service Panels

Service Panels provide advice and services to the JOIDES Advisory Structure, and to the various entities responsible for the processing, curation and distribution of samples, data and information (including publications) to the scientific community. The Service Panels can respond to specific requests from the Science Operator, the Wireline Logging Contractor, or JOIDES panels, but in all cases, must report their findings to the Planning Committee as well. When recommendations from the service panels involve fiscal decisions, these must be channeled through PCOM.

The Service Panels, beyond their help to the JOIDES Advisory Structure, are not directly involved with selection of drilling targets or definition of cruise objectives.

Service Panels have specific mandates. Service panels meet at least once a year or as requested by PCOM. PCOM appoints the chairman and panelists and keeps membership, **including representation from the non-U.S. JOIDES institutions,** under review.

7.1 Site Survey Panel: Mandate

7.1.1. The general purpose of the Site Survey Panel is to provide information and advice to the Planning Committee on the adequacy of and need for site surveys in relation to proposed drilling targets.

7.1.2. The Site Survey Panel is mandated to:

(a) Receive mature proposals from **the Detailed Planning Groups** and thematic panels, to review site survey data packages prepared by the ODP Data Bank and to make recommendations as to their adequacy to the Planning Committee.

(b) Identify data gaps in proposed future drilling areas and to recommend appropriate action to ensure that sufficient site survey information is available for pinpointing specific drilling targets and for interpretation of drilling results.

(c) Provide guidelines for proponents and panels as to required site survey data and to examine the opportunities and requirements for the use of new technologies for surveying potential drill sites.

(d) Promote international cooperation and coordination of site surveys for the benefit of the Ocean Drilling Program, particularly between participating ODP nations' survey activities.

(e) Promote the lodging of all data used for planning drilling targets with the ODP Databank.

7.1.3 The Panel maintains liaison with the ODP Site Survey Data Bank Manager and the non-U.S. liaison at the JOIDES Office, who both attend SSP meetings.

7.2 Pollution Prevention and Safety Panel: Mandate

7.2.1. The general purpose of the Pollution Prevention and Safety Panel is to provide independent advice to the Planning Committee and to the Ocean Drilling Program with regard to safety and pollution hazards that may exist because of general and specific geologic circumstances of proposed drill sites.

7.2.2. Mandate: All drilling operations involve the chance of accident or pollution. The principal geologic safety and pollution hazard in ocean drilling is the possible release of substantial quantities of hydrocarbons from subsurface reservoir strata. In most deep sea regions, the risk of hydrocarbon release can be reduced or eliminated by careful planning and proper site surveys. Additionally, safety problems may arise in drilling hot hydrothermal systems for lithosphere targets.

Those who plan each Ocean Drilling Program cruise and select its drilling sites are initially responsible to propose only sites that are considered reasonably safe. The JOIDES Pollution Prevention and Safety Panel independently reviews each site to determine if drilling operations can be conducted safely.

The preliminary site survey information and the operational plan are reviewed for each site. Advice is communicated in the form of: (1) site approval, (2) lack of approval, or (3) approval on condition of minor site relocation or amendment of the operational plan. Approval is based on the judgment of the Panel that a proposed site can be safely drilled in light of the available information and planning.

7.2.3 **The Pollution Prevention and Safety Panel maintains liaison with the Site Survey Panel, and a designated SSP member attends its meetings. A representative from the Science Operator also attends the meetings. The Planning Committee Chairman is a non-voting member of the Panel and normally attends meetings.**

7.3 Information Handling Panel: Mandate

7.3.1 The general purpose of the Information Handling Panel is to provide information and advice to the Planning Committee and the Ocean Drilling Program with regard to satisfying the needs of the scientific community for timely access to data, samples and publication and to assist program managers in setting priorities.

7.3.2. The Information Handling Panel is mandated to:

(a) Advise on (1) types of publications to be produced; (2) publication formats; (3) schedules and deadlines; (4) publications policy and goals of the ODP publications program.

(b) Advise on (1) the operation of the core repositories; (2) curatorial policy; (3) filling of sample requests; (4) curatorial data management; (5) long-term goals for the preservation of the core materials and other physical samples obtained by ODP and DSDP; and (6) establishment and operation of the various micropaleontology reference centers.

(c) Advise on (1) the types and contents of the data bases to be maintained by ODP; (2) the treatment of raw data; (3) the establishment of uniform procedures and standards for data handling and processing; (4) the structure, philosophy and goals of the information systems produced by the program; and (5) the management of data bases, information systems and data centers. This last topic also includes coordination between various data centers established by ODP and those for DSDP archives.

(d) Advise on the minimum standards of quality and completeness necessary for data to be included in the various data bases and information systems, including data recording, transcribing and checking procedures.

(e) Advise on (1) shipboard and shore-based computer facilities, equipment and procedures; (2) software development; (3) data collection techniques; and (4) meeting the computational needs of shipboard and shore-based scientists, as well as providing access to data bases for all interested parties. Input from the Shipboard Measurements Panel on these issues, if necessary, should be reviewed.

(f) Advise on (1) long-term preservation of the raw data generated by ODP and DSDP; (2) preservation of all past records bearing on sample history; and (3) preservation of any other records of the program which might benefit future workers.

(g) Advise on the relationship between the ODP and DSDP data centers and national depositories such as the National Geophysical Data Center, World Data Center A for Marine Geology and Geophysics, etc., and the fulfillment of statutory obligations for data transfer. It also includes transfer of data to data centers established by ODP member countries, such as the one in France, and to the Micropaleo Reference Centers.

7.4 <u>Downhole Measurements Panel: Mandate</u>

7.4.1. The general purpose of the Downhole Measurements Panel is to advise JOIDES on methods and techniques for determining the physical state, chemical composition, and dynamic processes in ocean crust and its sediment cover from downhole measurements and experiments. Areas of responsibility include: routine logging (including industry standard and special tools widely used in ODP); routine data processing and interpretation; new and adapted logging tools, techniques, and data processing; downhole experiments and data acquisition (including downhole recording).

7.4.2 The Downhole Measurements Panel is mandated to:

(a) Report to and advise PCOM on logging and downhole measurement programs of ODP.

(b) Advise on and recommend to the ODP Wireline Service Contractor the required logging facilities.

(c) Advise the ODP Science Operator on the scientific desirability, technical feasibility, scheduling and operational requirements of proposed programs.

(d) Monitor progress reports, results, tools and techniques from U.S. and international downhole instrumentation development groups.

(e) Solicit and expedite new logging capabilities and experiments.

(f) Evaluate new technology and recommend future measurement directions.

7.4.3. Membership consists of a well-balanced representation, and approximately half being logging and other downhole technologists and half having scientific backgrounds and interests. The Wireline Services Operator and Science Operator of ODP shall each be represented by non-voting members on the Panel.

7.5 Shipboard Measurements Panel

(M.Lanseth with input from A.Meyer, TAMU/ODP)

The Shipboard Measurements Panel is concerned with the inventory, operation, condition and data handling procedures of scientific instrumentation on board the JOIDES RESOLUTION.

7.5.1 The objectives of the panel are:

(a) To provide expert advice and make recommendations to the Planning Committee regarding the inventory and utilization of scientific equipment on the drillship.

(b) To represent the interests of the ODP user community with respect to the scientific equipment on the RESOLUTION.

(c) To direct these activities toward acquiring and maintaining the best possible shipboard scientific capability within the constraints of the ODP budget.

7.5.2 Scope. The panel is concerned with general types of instrumentation and issues:

(a) Underway geophysical equipment

(b) Equipment for handling core samples

(c) Physical properties, paleomagnetics and geotechnical measurements

(d) Petrological, mineralogical, sedimentological, organic and inorganic geochemistry analysis and equipment for performing these measurements such as microscopes.

(e) Computers managing data from shipboard equipment (in consultation, if necessary, with the Information Handling Panel).

(f) Utilization of laboratory space on the RESOLUTION.

7.5.3 Membership. The panel will consist of members from U.S. institutions and from non-U.S.JOIDES members or consortiums. Representation from all non-U.S members should be maintained, if possible. The recommended number of members is 15 to 16, and these should be appointed so as to represent the range of disciplines within the scope of the panel's activities.

A majority of those serving on the panel should have participated on a cruise of the RESOLUTION.

7.5.4 Liaison. The SMP must maintain continuing liaison with the Planning Committee, the Science Operations of ODP/TAMU (in consultation with ODP/TAMU marine technicians and engineers), the Information Handling Panel, and the Downhole Measurements Panel. Ex-officio liaison representatives of these panels and organizations should attend each meeting.

7.5.5 Scheduling. As the SMP will normally not deal with time-critical issues, two meetings per year should suffice. Meetings at ODP/TAMU in College Station at regular intervals is recommended and occasional meetings that include a visit to the RESOLUTION would be valuable.

Draft mandate for the

SHIPBOARD MEASUREMENTS PANEL
June 1988

The Shipboard Measurements panel is proposed as a new JOIDES "technical panel" that will be concerned with the inventory, operation, condition and data handling procedures of scientific equipment and instrumentation on board the JOIDES RESOLUTION:

Objectives:

1. Provide expert advice and make recommendations to the Planning Committee, and/or funding agencies and/or TAMU regarding the inventory and utilization of scientific equipment on the RESOLUTION.

2. Represent the interests of the ODP user community with respect to the scientific equipment on the RESOLUTION .

3. These activities should all be directed toward acquirng and maintaining the best possible shipboard scientific capability within the constraints of the Drilling Program Budget.

Scope.

The panel would be concerned with the following general types of instrumentation and issues:

- Underway geophysical equipment.
- Equipment for handling core samples
- Physical properties and geotechnical measurements
- Petrological and mineralogical analyses
- Sedimentological analyses
- Organic and inorganic geochemistry analyses
- Computers that manage data from shipboard equipment.
- Utilization of laboratory space on the RESOLUTION.

Membership:

The panel should have members representing each non-US country or federation of countries and each US JOIDES institution. The recommended number of members is 15 to 16 and they should be appointed so as to cover the range of disciplines listed above. A majority of the people serving on the Panel should have participated on a cruise of the RESOLUTION.

Liason:

The SMP must maintain continuing liason with the Planning Committee, the TAMU science office, the Information Handling Panel, and the Downhole Measurement Panel. Ex-officio liason representatives of these panels and organizations should attend each meeting.

Scheduling:

Normally this panel will not be dealing with time-critical issues and meetings held twice a year should suffice. Meetings at ODP/TAMU in College Station at regular intervals is recommended and occasional meetings that include a visit to the RESOLUTION would be valuable.

29 July 1988

Dr. Mark Langseth
Lamont-Doherty Geological Observatory
Columbia University
Palisades, New York 10964

Dear Mark:

Thanks for sending me a copy of the draft mandate for the proposed new Shipboard Measurements Panel (SMP). I took the liberty of showing it to the ODP Staff Scientists for their comments and suggestions.

In general, the Staff Scientists are as enthusiastic and supportive of the formation of such a panel as I am. Their specific comments mostly concern broadening the scope of the SMP to include such things as: microscope equipment, paleomagnetics equipment and analyses, development of ODP downhole tools (e.g. pore water samplers, pressure core barrel), and augmentation to shipboard library book and paleo/sed reference slide collections. Some of these items may already be implicit in your listing, but we wanted to make sure they were included.

Also, in the section of the mandate entitled "Liaison", I think the liaison should be between SMP and the TAMU science (rather than shipboard) operations office. This makes it clear that SMP will be dealing primarily with my staff rather than either the engineers or the marine technicians (though I can certainly see that their input at meetings might be critical at times!).

Best of luck presenting the mandate to PCOM in August. Please give me a call if there's anything more I can do to help you.

Regards,

Audrey

Audrey Meyer

cc: Margaret Leinen
Lou Garrison
Staff Scientists

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DRAFT

JOIDES TECTONICS PANEL WHITE PAPER

1. INTRODUCTION

This White Paper represents the contribution of the Tectonics Panel (TECP) to the JOIDES/ODP long-term planning process. We attempt with this article to encourage the earth science community to generate proposals that will contribute to TECP's goal of developing a program that will use deep sea drilling to constrain as fully as possible our understanding of the structure and tectonic evolution of the earth. The program we advocate is based on the experience of TECP members past and present, the COSOD I and COSOD II reports, and the input of numerous colleagues through workshop documents and informal discussions.

The tectonic themes outlined in this White Paper embrace the deep structure of the planet as well as the crust, the driving forces of the plates as well as their relative motion, interaction and response to both compressional and extensional forces. Although many of the tectonic processes of interest to earth scientists, including the most fundamental ones, are beyond the reach of the drill, the philosophy of the TECP is that the ODP should contribute wherever practical to the understanding of these processes. Deep seated processes can be addressed by indirect methods such as seismology and stress determinations, shallow ones by examination of cores and *in situ* measurements of physical and chemical parameters. Both types of approach need to be undertaken in conjunction with other types of geological, geophysical and geochemical study. The only criteria for identifying a tectonic project suitable for the ODP are scientific quality and absolute need for deep sea drilling. The four principal themes emphasized by TECP are illustrated on the accompanying table.

We expand on the specific tectonic significance of each of these themes below, summarizing the state of knowledge and pointing out the contribution that can be made by ocean drilling. The background data and technical development necessary for a successful drilling program are outlined, and suggested drilling strategies are presented. Specific drilling

SUB-LITHOSPHERIC STRUCTURE AND PROCESSES

PLATE KINEMATICS **PLATE DYNAMICS**

LITHOSPHERE DEFORMATION

CONVERGENT MARGINS **DIVERGENT MARGINS**

INTRA-PLATE

targets are mentioned as examples only. We leave it to the community to develop these ideas and propose specific drilling experiments.

ODP must move into a phase characterized by technical development and increased use of physical and chemical measurements. Proposals to study any of TECP's main themes are likely to involve multiple related sites, including sites on conjugate rifted margins, along the length of hot spot chains, and across convergent margins. Consideration could also be given to designing carefully drilling programs in single oceanic regions or small ocean basins that involve interplay of key tectonic processes. The transect of holes drilled in the Tyrhenian Sea, for example, demonstrates the roles of rifting, passive margin development and convergence in a young small ocean basin that has considerable potential for ultimate preservation in the geological record. Comparable tectonic laboratories for integrated study include the Caribbean Sea, Atlantic Ocean, Japan Sea, Scotia Sea and elsewhere in the Mediterranean basin. The Mediterranean basin has obvious potential to unlock outstanding secrets of Alpine mountain building. The Japan Sea, Caribbean and Scotia basins have similar potential for Cordilleran orogenesis. Ocean drilling for tectonic goals could thus interface with other types of geoscience investigation, on land as well as at sea, and involve a broad cross section of earth scientists, as envisaged by the COSOD II participants.

2. ODP ACCOMPLISHMENTS RELEVANT TO TECTONICS

Because ODP is still in its infancy, significant accomplishments are not evenly distributed among thematic objectives; nonetheless, this brief review addresses drilling accomplishments in the context of the long-range objectives listed above.

2.1 Sub-Lithospheric Structure

This theme will be the subject of future drilling. For example, instrumentation of a hole in the Sea of Japan result in the first data on deep structure obtained as a direct result of ODP drilling. These data will improve resolution of the seismicity and structure of the Japanese island arc.

2.2 Plate Kinematics

The history of plate motions is fundamental to our understanding of global tectonics. Drilling is critical in many kinematic studies, as core material provides a means to date various segments of the ocean-crust and these ages are needed in order to calibrate plate vectors inferred from magnetic lineation analyses and/or hot spot trajectories. The history of spreading of the Atlantic Ocean basin is reasonably well known, while the plate kinematic histories of the Indian and Pacific ocean basins are less certain. Once ODP drilling commences in the Pacific, several significant results are anticipated. Principal results from Indian Ocean drilling include confirmation and refinement of the northward motion of India away from East Antarctica over the last 100 Ma, but more importantly, age relations of the various segments of hot spot traces drilled generally confirms the model that hot spots are stationary features in the upper mantle for periods as least as long as 100 Ma. Paleomagnetic results from core material from the Reunion hot spot in the Indian Ocean indicates, however, that inferred motion toward the magnetic pole is at variance with plate motion across the hot spot. Because of the congruence of hot spot traces which indicate a fixed frame-of-reference, these data seem to suggest that the magnetic pole has shifted in space relative to the mantle. Thus, the old idea of "true polar wander" is again rekindled.

2.3 Plate Dynamics

The physics and forces involved in plate tectonics are still poorly understood. The driving forces responsible for plate motions, convergent tectonics and plate rifting represent an area of great debate. The relations and relative importance of ridge-push, slab-pull and trench-suction forces will be a focus of future drilling through state-of-stress experiments on selected areas of crust. Limited experiments conducted to-date have illustrated the practicality of the techniques.

2.4 Plate Divergence

Rifting is one of the three end-member motions that characterize the paradigm of plate tectonics. The effects of rifting are well known as they relate to the formation of ocean basins, but processes and styles of rifting remain controversial. The roles of pure shear versus simple shear processes attendant to continental and oceanic rifting are debated. Additionally, rift margins may or may not be associated with large volcanic build-ups. A variety of drilling results have helped in characterizing the nature of specific rift margins, although results in several instances remain a topic of controversy. For example, ODP drilling on the Voring Plateau proved unequivocally that seaward-dipping reflector sequences (SDRS) that characterize the outermost regions of some continental margins are indeed large piles of volcanic material. However, the full range of composition of these volcanics is still not known, as drilling did not penetrate their full thickness, nor is the basement beneath these volcanics known, i.e., thinned continental or oceanic crust. Already, however, new models of continental rifting have been formulated as a result of ODP results.

Off the Galicia margin of the Iberia Peninsula, mantle-like ultramafic rock was found at shallow crustal levels, and in fact elsewhere along this margin peridotite is known to crop out on the sea floor. To some geologists, this is confirmation of the model of simple shear rifting involving low-angle detachments that cut the entire crust. An alternative interpretation however, holds that these peridotitic rocks are older remnants of accreted ophiolites from the late Paleozoic Hercynian orogeny.

Mountains and crustal uplift are not restricted to convergent margin settings. Prominent ranges such as the Transantarctic Mountains and the Sierra Nevada of California are believed to be flaps of crust that were uplifted as a result of breaking from a larger piece of more depressed lithosphere. Recent drilling on Broken Ridge in the Indian Ocean has provided another possible example. This rebound-style of tectonics is poorly understood, particularly as crustal subsidence normally follows a rifting event.

An important realization of the past several years is the way in which both divergent and convergent tectonics can occur simultaneously in a single orogen. Drilling in the Tyrrhenian Sea provided an example of this. Results there clearly documented the age of back-arc rifting to be post-Late Miocene and the formation of ocean crust to be Pliocene to Recent.

These young ages correspond exactly to the age of thrusting in the Appennine fold belt that is trenchward from the Tyrrhenian Sea.

2.5 Plate Convergence

Convergent tectonics is another major theme of interest. However difficulty has arisen in designing experiments to use the drilling platform in ways that add to our knowledge of collision-style tectonics. Nonetheless, drilling to date has provided some startling results which have altered the way many tectonicists think about convergent margins. Most dramatic is the recognition of the role of fluids. For example, drilling in the accretionary prisms of the Lesser Antilles arc near Barbados and offshore Peru has started to quantify the nature of fluid migrations and changes in fluid chemistry and pressure. Partitioning of fluids not only reflects compaction and tectonic consolidation, but may help to explain mechanics of thrust faulting and relations between subduction and accretionary underplating associated with the principal decollement surface of a subduction zone.

Along portions of some convergent margins, for example southern Peru, stratigraphic signals from cores have been interpreted to reflect episodes of regional subsidence. This in turn has been explained as the consequence of a phenomenon called tectonic erosion, i.e., the removal of portions of the upper plate by descending oceanic lithosphere resulting in isostatic collapse. Although this remains a poorly understood and sometimes disputed process, the potential importance is far reaching, not only to tectonicists but also to geochemists concerned with crust-mantle recycling.

3. MAJOR THEMES FOR FUTURE DRILLING

3.1 Sub-Lithospheric Structure and Processes

The overall objective of this initiative is to establish a permanent global network to monitor the world-wide pattern of stress accumulation and release and to investigate lateral heterogeneities in the Earth's properties with the purpose of mapping the pattern of flow in the Earth's interior. The entire facility would consist of a system of geophysical observatories equipped with a state-of-the-art seismograph equipment capable of recording the Earth's motion within a wide range of frequencies and amplitudes. Whenever possible, such observatories would be deployed on land, in part because of the simplicity of the logistics. However, there are regions of several thousand square kilometers without land. Such unevenness in coverage may introduce significant bias in the resolving power of the global array. Hence the need for deployment of ocean bottom observatories. Experiments with placing seismographs in boreholes indicate significant gains in the signal-to-noise ratio for some components, although the frequency band of systems used so far has been rather limited. Better coupling of the seismograph to the sub-stratum is another reason to favor borehole deployment. The concept of using the resources of the ODP for this purpose is a novel one, and some details regarding the global seismographic network are required.

Uniform distribution of seismographic stations is desirable in studies of planetary scale phenomena. This is particularly true with regard to features of the deep interior of the Earth, where an *a priori* assumption of correlation with the surficial tectonics may be invalid and misleading. For this reason, different groups planning deployment of global networks have aimed, as much as possible, at uniform coverage. Earlier global networks of consequence include WWSSN (World-Wide Standard Seismograph Network; about 125 analog stations deployed some 25 years ago), IDA (International Deployment of Accelerometers; a network of 20 LaCoste-Romberg gravimeters with digital recording, initiated in the mid 70's), GDSN (Global Digital Seismographic Network; a system of about 30 stations comprising 3 different types of instrumentation, established in the mid-70's) and GEOSCOPE (this trench network presently consists of some 20 operational 3-component stations). A non-profit corporation, IRIS (Incorporated Research Institutions for Seismology), was formed in the United States in 1984. The current membership of IRIS represents 57 U.S. universities and research institutions. One of the two primary objectives of IRIS is to work towards the establishment of a global network of some 100 state-of-the-art seismographic stations with very broad band response.

In addition to these "global" initiatives, regional and national scale networks have been built or are planned. These include: CDSN (China Digital Seismographic Network), CANDIS (Canadian Digital Seismographic Network), MEDNET (Mediterranean Network, operated by the Instituto Nazionale di Geofisica, Italy), POSEIDON (Pacific Orient Seismic Observation Network), German Broad-band Network and Australian Broad-band Network. The U.S. National Seismographic Network with 150 planned broad-band stations is currently under development. Because of the progress in technology, stations serving the purpose of regional seismic monitoring and those deployed for global scale studies need not be different. This made an idea of close cooperation between these different networks very appealing.

The Federation of Digital Seismographic Networks (FDSN) was formed in 1986 with the following primary objectives:

- establish common standards for broad-band digital seismographic stations;
- develop agreements and protocols for the timely exchange of data;
- facilitate coordination of station siting.

The FDSN currently has 10 member countries: Australia, Canada, China, France, Germany, Italy, Japan, Soviet Union, United Kingdom and the United States. In addition, ORFEUS - an organization formed by 15 west European countries - whose primary purpose is to collate and distribute the data collected by the member countries, is also a member of the FDSN. The United States is represented by both IRIS and the USGS. FDSN is affiliated with the International Commission on Lithosphere and International Association of Seismology and Physics of the Earth Interior.

Map 1 (Figure 1) is based on the current list (July 1, 1988) of the existing, planned and proposed stations that will satisfy the FDSN standards. The surface of the Earth is divided into 128 "squares" of roughly equal area. Their dimension is about 2000 X 2000 km. A shaded square indicates that there is at least one Federation station within its boundaries, there are squares that have as many as 15 (western Europe). There are 81 out of 128 squares that either already have or will have within the next few years at least one station.

There are land masses or oceanic islands to "fill" another 22 squares; the process of planning the land-based stations is not yet complete. The squares where a land-based station could be installed, but no member of the Federation included it in the plans are lightly shaded in Map 2 (Figure 1). But even with this additional coverage there are still significant deficiencies: a nearly continuous gap in the Eastern Pacific and large blank areas in the South Atlantic and Indian Ocean. The existence of these gaps would significantly lower the overall resolution of the planetary scale studies. Also, these gaps in coverage would impede monitoring of tectonically active continental margins (North and South America).

Map 3 (Figure 1) is the same as Maps 1 and 2, but 20 additional squares have been shaded (dark) through deployment of permanent ocean bottom (or sub-bottom) stations. Only a few isolated squares remain empty. Thus, the number of permanent ocean bottom observatories envisioned during the COSOD II Conference would secure virtually uniform global coverage with an average distance of 2000 km between stations. In addition to its function as a permanent monitoring facility, such a global network would represent a convenient base for temporary deployment of land- and/or ocean-based denser arrays designed for detailed studies of particular structural problems.

While the establishment of a truly global network, such as shown in Map 3 (Figure 1), would be an important element in a successful *Mission to the Planet Earth*, it should be remembered that detailed planning of the deployment of ocean bottom observatories is premature until some technical questions are satisfactorily resolved. Therefore, the numbers of stations used here represent only examples rather than rigid requirements.

3.1a <u>Tectonic Significance</u>

Scientific objectives of tectonic significance that can be addressed with seismological data from long-term ocean floor observatories working in unison with the land-based stations can be considered in six broad subject areas, the first three of which we consider to be primary:

i) *Global earth structure* - some examples of key questions are: heterogeneity or anisotropy of the inner core? What is the geometry of the core-mantle boundary? Are hot spots correlated with slow regions at the base of the mantle? What is the nature of upper mantle anisotropy? What is the geometry of the 400 km and 670 km discontinuities?

ii) *Oceanic upper mantle dynamics and lithosphere evolution* - can seismic anisotropy be used to map flow in the upper mantle? What is the degree of lithospheric thinning beneath hot spot swells? What are the spatial variations in the depth extent of anomalous structures beneath ridges? Do oceanic plateaus have roots like continents? What is the form of small-scale convection beneath plates? What is the origin of mid-plate volcanism?

iii) *Earthquake source studies*: Ocean floor stations are needed to improve source location (particularly depth), focal mechanism and rupture process determinations. This is critical to studies of the depth of the seismic coupled zone, depth extent of outer rise events and the rheology of the oceanic lithosphere. Near field data, in particular ocean floor recordings, are needed to improve the resolution of the source mechanism of events not caused by faulting but by slumping or magmatic injection. Such studies have important implications for estimation of long-term seismic hazard.

iv) *Oceanic crustal structure.*

v) *Tsunami warning and monitoring.*

vi) *Sources of noise.*

Broad-band, long-term ocean-floor observatories are needed for all these topics. They are uniquely needed to provide uniform global coverage in areas without islands, for regional studies of individual tectonic features and to sample wave propagation in 'normal' oceanic lithosphere. Oceanic islands are by definition located on anomalous structures with thick crust and, in many cases, unusual upper mantle velocities.

3.1b State of Knowledge

The land-based digital seismographic data collected since the mid-70's provided novel information on three-dimensional Earth structure and led to a significant improvement in the quantification of earthquakes. Even though the resolution of current 3-D maps of the Earth's interior is rather low because of the inadequate distribution of the stations, the information content was sufficient to discover the dominant role of very large wave-length lateral heterogeneities in the lower mantle.

The theory has been developed to interpret in a systematic fashion very different levels of seismic data: from splitting of free oscillations (period of the order of 1000 seconds) through waveform inversion of long-period body waves and surface waves (50-300 seconds) to travel time anomalies of P-waves (1 second period). Hence the requirement for the broad-band response of the stations.

Systematic inversion of waveform data from 1977 through 1988 has led to derivation of movement sensors for about 7,000 earthquakes. This data base is being more frequently used in studies of regional tectonics, evaluation of the rates of strain release, etc.

Very broad-based techniques of studying source time function allows the retrieval of fine details of source radiation and correct determination of the total moment released even for a very complex event. The current density of stations is yet insufficient to undertake a general analysis of the source radiation both in space and in time. The necessary theory has, however, been developed, but a network such as shown in Map 3 (Figure 1) would provide sufficient resolution to use these algorithms. Generally, there is a sufficient body of knowledge and technical means (computer software and hardware) to take full advantage of data provided by the new global network.

3.1c Contribution to be Made by ODP

It is expected that full deployment of the ocean bottom component of the global network will be an international undertaking. The example of FDSN in the case of land-based stations is most encouraging. The most important and irreplaceable contribution of ODP would be the drilling of holes for seismographic stations and initial emplacement of sensors and recording equipment. It is assumed that support for seismographic equipment will be available from other sources.

3.1d and e Background Data and Technical Developments

Four problem areas need investigation and experimentation before specific plans for deployment of permanent observatories can be made:

i) *Seafloor and subseafloor noise*: Measurements of inertial noise at intermediate frequencies (10 mHz - 100 mHz) are very limited and at low frequencies (3-10 mHz) do not exist. Although knowledge of deep ocean noise sources and propagation mechanisms has increased substantially in recent years, insufficient understanding exists to guide emplacement of permanent observatories. A key parameter that remains unknown is the depth of sensor burial required (in various tectonic settings) to optimize the signal-to-noise ratio while minimizing required drilling penetration. Pilot experiments are required to study these issues.

ii) *Islands and seafloor stations*: Island seismic stations play an important role in the global seismograph network and are at present the only locations where permanent observatories may exist in the oceans. But how adequate are these stations? Would ocean bottom observatories provide substantial improvements in broad-band signal-to-noise? How does local structure influence seismic signals received on islands compared with an ocean floor site? Pilot experiments are needed to make these comparisons.

iii) *Short-term technical issues*: 1 Hz geophones are the lowest frequency sensors routinely used on the ocean floor and they have little sensitivity to earth noise below 50 mHz. An urgent priority is to adapt a presently available broad-band sensor for operation on the ocean floor. One year recordings will be necessary during pilot experiments and, although systems with the data storage capacity and timing accuracy necessary for this are currently under development, they have never been deployed.

iv) *Long-term technical issues: telemetry, power, sensors*: The major problems here are related to how a permanent global ocean floor network would be operated. With a data rate of approximately 50 MBytes per day, the problems of both internal recording (with periodic data retrieval) or real-time telemetry are extremely challenging. Costs associated with use of fiber optic or existing telecommunication cables can be huge but completely remote packages produce the problem of power source. Completely new (micropower) sensors may need to be developed.

These issues require three classes of pilot experiments.

- 'Island' experiments: to make comparisons of seafloor and downhole sensors (>100 km from shore) with high quality island sites.
- 'Borehole' experiments: to investigate influence of depth of burial upon signal and noise.
- 'Telemetry' experiments: for development and proving of new sensor designs, telemetry schemes, power sources and long-term deployment capability.

All these experiments must be carried out at more than one site so that environmental effects can be taken into account. Wireline reentry capability is essential if these experiments are to be performed efficiently.

3.1f and g <u>Drilling Strategy and Locations</u>

Details of drilling strategy have yet to be worked out. They are dependent on the results of the experiments outlined above. The generalized locations shown in Map 3 should only be considered as an example. It is logical to assume that the greatest benefit for deployment of ocean bottom stations will be in places that are distant from land masses (including islands).

3.2 Plate Kinematics

3.2a <u>Tectonic Significance</u>

All plates are created within oceans. Ocean basins thus contain the majority of information used to reconstruct former positions of the world's plates. Fracture zones and magnetic anomalies provide the only direct measurement of the long-term divergence histories of the plates while paleomagnetic data and hot spot tracks are used to relate these displacement histories to various global reference frames. Global plate reconstructions in turn offer the critically important linkages necessary to study spatial and temporal relationships within nearly all branches of earth science. This synthesis of the geologic histories of oceans and continents demands well-determined oceanic basement ages for constraints on spreading history and magnetic time scales, an understanding of magnetic quiet zones, widespread data on hot spot tracks, and a large volume of high-quality paleomagnetic data.

3.2b State of Knowledge

Global plate displacement histories are fairly well determined for the past few tens of millions of years but poorly known prior to about 65 Ma. For instance, major uncertainties exist for plate kinematics within the Cretaceous Normal Superchron interval from 120 to 80 Ma. There is evidence that as yet unresolved magnetic anomalies may be present within this time. Basement ages are also badly needed for dating of the M-sequence magnetic anomalies from 170 to 120 Ma. These two time intervals account for about 90 million years of earth history. Plate motions within this interval will remain highly uncertain until more data are obtained.

Hot spot traces are widely used as a viable frame of reference for relating motions between oceanic and continental plates in areas where subduction has erased much of the record. However, valid applications of hot spot hypotheses to earlier times are possible only after the demonstration that they show consistency in Tertiary and younger times. Hot spot traces such as the Hawaiian-Emperor chain have shown a remarkable age progression along their small-circle trends, but few equivalent studies on other traces have been carried out. Critical comparisons of age progressions and relative positions of traces within each plate and between ocean basins are needed to establish further the validity of this valuable reference frame. Of equal importance is the extension of these types of data sets into the Mesozoic. Because of problems encountered with global circuits, the hot spot framework may be the only hope for establishing pre-80 Ma plate motions.

Paleomagnetic data from ocean basins have proven valuable in the determination of paleolatitudinal displacements, apparent polar wander paths and true polar wander. Episodes of relative motion between the spin axis (paleomagnetic) and hot spot (mantle) reference frames have been proposed and could provide important insights into earth's internal processes.

3.2c Potential ODP Contribution

Although many of the advances in the understanding of plate tectonics have come through marine geophysical techniques (in particular through magnetic and bathymetric surveys), the verification and calibration of ocean floor ages and magnetic time scales was perhaps the greatest achievement of DSDP. Drilling still remains the only available technique for widespread sampling of the ocean floor for age dating and paleomagnetic measurements. Continuing refinement of plate reconstructions and the understanding of plate motions is, in many instances, totally dependent upon an ongoing program of drilling.

The major areas in which ODP can contribute are:

- Hot spot reference frames;
- Sea-floor age;
- Mesozoic plate motions;
- Paleomagnetism.

- *Hot Spot Reference Frames*

The hot spot reference frame has been remarkably successful in establishing, confirming and underpinning global plate motions. Nevertheless, a number of both specific and generic uncertainties remain (do hot spots move?, how fast?, in which direction?). Manifested as seamounts, large portions of global hot spot chains do not appear above sea-level. Although magnetic anomaly modeling and dredging can give some information, only drilling can reach and sample the igneous rocks of these structures. Among the specific goals of a renewed program of ocean drilling should be:

- The age progression of hot spot chains (providing information about plate speeds and directions, particularly in places with no currently calibrated hot spot traces and on pre-Tertiary chains);

- Geochemical evolution and discrimination (providing information about the nature of hot spot volcanism itself and providing signatures for distinguishing superimposed, merged or cross-cutting hot spot traces);
- Relative motions (through paleomagnetism, establishing paleolatitudes and motions relative to the paleomagnetic framework and addressing fundamental problems of true polar wander and hot spot motion).

- *Sea-floor Age*

The magnetic reversal time scale is the fundamental tool for ocean floor age determination. Nevertheless, in many cases where magnetic anomalies are disturbed, subdued (the quiet zones), destroyed through hydrothermal processes or fragmented, the method cannot be applied. Large portions of sea-floor such as the Bering Sea, the Canada Basin, the Sulu and Celebes Seas (the goal of a currently planned ODP leg), and the South Pacific Ocean basin are undated. Plate reconstructions for major areas of the globe (e.g., Alaska and West Antarctica-New Zealand) remain uncertain until the age and provenance of these pieces of ocean floor can be fitted into a satisfactory framework.

- *Mesozoic Plate Motions*

The motions of older oceanic plates are less well-known because of their limited occurrence and increased uncertainties in the magnetic reversal chronology (particularly in the Cretaceous and Jurassic Quiet Zones). In consequence, global plate reconstructions become progressively less useful and less predictive in the Mesozoic. Through a coherent program of drilling, ODP can aim at reducing uncertainties to a minimum through:

- Identification of Mesozoic ocean crust and crustal remnants (e.g., Mozambique Basin, W. Pacific);
- Establishing the spreading geometry, history, evolution and 'absolute' motion of this crust;
- Improved calibration of the Cretaceous-Jurassic magnetic reversal time scale (M-sequence).

• *Paleomagnetism*

The number of fully oriented paleomagnetic samples from the ocean basins is remarkably small. This has resulted in a highly biased, land-based data set from which characteristics of the paleomagnetic field through the earth's history have been modeled. Currently it is not possible to obtain a good definition of possible non-dipole components of the earth's field prior to the Neogene. Clearly, as the paleomagnetic field remains one of the most critical reference fields against which motions are measured, refinement of these models is essential for more reliable calibrations in many fields of geoscience. ODP should aim to provide much more comprehensive paleomagnetic sampling in both age and geographic distribution for contributions toward this goal.

3.2d Background Data

The establishment of specific drilling sites for oceanic crust and seamounts requires the normal spectrum of marine geophysical techniques particular to the needs of each. In terms of oceanic crust (presumably sedimented in most cases), apart from bathymetric and seismic data to establish basement depths, the single most important parameter remains the magnetic anomaly field. Through a systematic magnetic survey grid (e.g., ≤10 km spacing) the grain and structure of the crust needs to be securely established. This is essential to ensure that a basement age sample comes from normal, lineated crust (undisturbed by transforms, propagators, ridge jumps or seamounts) from which the direction and polarity of spreading can be determined. Experience in areas over which detailed magnetic surveys have been carried out suggest that a line spacing of twice the ocean depth over an area of at least 50 X 50 km is not unreasonable.

In terms of seamounts, it is clear that detailed bathymetric (SEABEAM) and swath mapping (SeaMARC, GLORIA) are also essential to locate flows, slumps, incised canyons and other features that should be either avoided or targeted in a drilling strategy. A preliminary dredging program should have been carried out both to provide supplementary information for drilling results and perhaps to eliminate the need for certain holes. Ideally, drilling will be sited within a context such that it will be clear whether samples are likely to be the last eruptive phase, early flows or typical edifice geology. The age of the surrounding ocean floor, established through regional interpretation of magnetic lineations, is also an essential constraint.

3.2e Technical Developments

The major technical goal underlying the achievement of useful measurements for kinematic purposes is that of acquiring fully oriented samples (of both sediments and igneous rocks) for paleomagnetic and magnetic property measurements. Although limited methods have been developed commercially and are currently available, they suffer from a number of drawbacks and are not applicable in all modes of drilling. For instance, methods of downhole orientation of cores which depend on internal magnetic compass measurements are likely to be many degrees in error in basaltic sequences. It is clear that a significant initiative needs to be taken to develop new tools and orientation methods (perhaps considering the feasibility of a logging tool for measuring total magnetization direction *in situ*) before a number of the objectives outlined above can be efficiently and economically achieved.

Shipboard improvements in achieving a magnetically clean environment, core barrel demagnetization and preservation of core orientation during handling should also be addressed.

3.2f Drilling Strategy

- *Hot Spot Reference Frames*

Clearly, for the achievements of goals of determining plate motions and relative hot spot motions, it will be important to choose hot spot chains which, through length and position, satisfactorily define poles and rates of motion for individual plates. Ideally, two separated hot spot chains for each plate would satisfy the kinematic requirements. In practice, achievement of one fully calibrated hot spot chain on each major plate would be a significant advance on present knowledge. For the determination of relative hot spot motions, a broad global distribution of hot spot traces is necessary.

- *Sea-floor Age*

Certain major gaps in sea-floor dating are currently evident. The paucity of drilling results in the southern oceans may be partially compensated by magnetic coverage, but lack of knowledge of areas such as the Arctic Ocean and Bering Sea severely constrain northern hemisphere plate reconstructions. Drill sites should be proposed within the context of a thoroughly modeled plate reconstruction scheme so that results will have an immediate consequence in terms of prediction and can directly lead to the formulation of new, testable hypotheses. Careful attention should be paid to calibration 'gaps' in the paleomagnetic reversal time scale.

- *Mesozoic Plate Motions*

Drilling should be designed to provide secure calibration for M-series magnetic anomalies and where possible address any resolution of absolute motions for this period.

- *Paleomagnetism*

The principal successes in oceanic paleomagnetic measurements conducted to-date have been in basalts and limestones. Although pelagic and/or clastic sediments may provide more continuous sequences, sedimentary and diagenetic processes may produce systematic biases in paleomagnetic directions. Achievement of a broad spread of samples in both space and time is likely to come from a coherent plan of 'add-on' measurements to drilling sites initiated for other reasons. Recognition that this plan has priority even though drilling may be primarily sited for other purposes needs to be part of the approval process.

3.2g Possible Locations*

1. Hot spot framework:
   Louisville - Gilbert - Marshall - Marcus - Geisha
   Emperor (Detroit and 50-55 Ma)
   Gulf of Alaska
   New England
   South Atlantic hot spots?
   Oceanic plateaus?

*(TECP includes these for general reference. They are not intended as an exhaustive or exclusive list.)

2. Sea-floor age:
    - Bering Sea
    - Canada Basin
    - Polar oceans
    - Kula fragments?
    - Weddell Sea

   Quiet zones:
    - Cretaceous (84-118 Ma)
    - Jurassic (160-175? Ma)

3. Mesozoic ocean floor:
    - Atlantic margins
    - Mozambique - Somali
    - North Australia Basin
    - West Pacific (Mariana - Nauru Basins)

4. Paleomagnetism:
    - All areas, particularly polar oceans

3.3 Plate Dynamics

3.3a Tectonic Significance

Measurement of stress within plates and at plate boundaries can provide new understanding of fundamental tectonic processes. Data on the stresses within plates can help assess the relative importance of various forces acting on the plates: ridge-push, trench-pull, plate-drag, etc. Stress determinations at plate boundaries will help understanding of plate boundary processes in general, and specifically the nature and significance of transform faults, rift propagation, and the distinction between Marianas-type and Chilean-type convergent margins (respectively, those with and without back-arc basin development). Ultimately, this will lead to better understanding of orogenesis and help forge links between oceanic and continental tectonics.

3.3b State of Knowledge

At present, the global stress map (Figure 2) is sparse, with enormous areas virtually devoid of data. Stress indicators consist almost entirely of earthquake focal mechanisms, with only a very small number of direct downhole stress measurements (only three by ODP). Recent studies, particularly those around the San Andreas fault, have emphasized the potential usefulness of reliable stress orientation data in understanding tectonic processes. At the same time, they have highlighted the difficulty of using focal mechanisms alone to derive stress orientations near plate boundaries. Measurements of both the orientations and magnitudes of the stresses can be of enormous tectonic value, but there is also a great deal to be learned from measurements of stress orientations alone. Recent technological advances make a new program possible.

3.3c Potential ODP Contribution

- *Intraplate Stresses and the Driving Forces*

Although considerable progress has been made over the past 10 to 15 years, many aspects of plate driving forces are still poorly understood. One important way in which this deficiency can be attacked is by adding to the available data base of intraplate stress measurements. At present, stress fields in the oceans are virtually entirely unknown. Most stress orientation datapoints from the oceans are derived from seismic focal mechanisms, which are not direct indicators of stress orientation and therefore can yield ambiguous results.

The development of a truly global stress map might be considered analogous to the process of putting together the geological time scale: for the most part, it is an iterative, 'unglamorous' task, but it is of great importance to a wide range of geologic problems. Intraplate stress measurements can be very useful in differentiating between various possible plate driving force models, as long as the measurements are from areas in which the predictions of different models diverge. For this reason, measurements from areas near corners and bends in plate geometry are likely to be particularly useful.

- *Plate Boundary Stresses and Deformation*

Measurements of stress near strike-slip faults can yield important insights into the mechanics of crustal rocks, even if only principal stress orientations are obtained. Recent results for the area around the San Andreas (using industry data) demonstrate clearly that the San Andreas represents a weak zone within otherwise strong crustal rocks. This conclusion is based upon the observation that the San Andreas is inclined at an angle of only a few degrees to the least horizontal stress axis. Because it is so close to one of the principal stress axes, the shear traction along the San Andreas is far smaller in magnitude than the regional differential stress. This result neatly explains the well-known lack of an observed geothermal anomaly across the San Andreas. There are potentially important candidates for such studies in many other geologic settings, including oceanic transform faults and the strike-slip faults found in many convergent margins.

The stress field required to drive strike-slip faulting in arc and back-arc regions is of considerable interest because of the prevalence of such faulting, and because its activity appears to be related to other attributes of the margin, including the obliquity of convergence and the overall balance between contractional and extensional tectonics in the overlying plate. It is not well understood whether strike-slip fault activity in the overlying plate near subduction zones is controlled by the strength and geometry of coupling along the subduction boundary, whether fault strength is a function of total displacement(as some rock mechanical studies suggest), or if there are significant differences between strengths of such faults at different margins.

Active ridge-transform systems present other interesting mechanical questions related to stress fields. For example: How strong are transform faults? Are they sufficiently strong as to be a significant factor in the balance of plate driving forces? Is their strength dependent on age? Can thermoelastic stresses be resolved within the ridge-transform fault system stress field? How do spreading ridges propagate? What is the stress field around overlapping spreading centers?

One of the most intriguing areas in which to do marine stress measurements is in the overlying plate at convergent plate boundaries. Despite the assumptions that go into theoretical modeling of convergent margins, relatively little is actually known for certain about their stress fields. The stress measurements that exist are largely on or adjacent to islands, which are, by their nature, anomalies. The transition from contractional to extensional strain fields upslope from the trench and toward the back arc is commonly interpreted to mimic a transition in the stress field. Indirect geological indicators, such as fold axes and the geometries of volcanic structures, have been used to infer the orientations of stress axes, but there is little in the way of direct data. bearing on such critical questions, for example, as the origin and destruction of marginal basins.

The magnitudes of differential stresses beneath the landward trench slope can be uncertain by an order of magnitude or more. In many cases, a great deal can be learned from measurements of stress orientations over a wide range of depths. This is particularly true where rate of stress axis rotation with depth depends upon relative strength of two different forces (e.g., slope-related gravitational stresses and friction along a fault) that can be predicted theoretically to contribute differently to total stress.

Other subjects of study might include stresses related to bending, both seaward of subduction zones and near flexural loads (like seamounts) far from plate boundaries. Each of these settings is the subject of studies into which stress data could be easily and advantageously incorporated.

3.3d Background Data

No data are required beyond the standard geophysical information necessary to site the holes.

3.3e Technical Developments

The Borehole Televiewer provides a very useful tool for determining orientations of horizontal stress components. This instrument is expected to be able to obtain breakout orientations in well-lithified sediments, as well as in basalt. It is anticipated that it will be used on most logged holes. If so, it will offer the opportunity of gathering the sort of routine measurements of stress orientations that is necessary for the gradual building up of the data base. One possible limitation is that penetration of some holes may be shallower than the depths at which breakouts occur.

Packer experiments, like the one to be attempted in the Argo Basin, can also be of significance. There are numerous tectonic problems, particularly associated with strike-slip and thrust faulting, in which magnitudes of stresses are at the heart of important tectonic problems, but for which stress magnitudes are very poorly known. Although they can be combined with other valuable measurements such as permeability, measurements with a packer are inevitably time-consuming. Therefore, such measurements must necessarily be carried out only where there is a clear objective. However, fundamental issues related to the mechanics of deformation simply cannot be answered without judicious application of the packer. In the future, it may be possible for ODP to obtain information on stress magnitudes with alternative approaches, such as breakout shape used in conjunction with hydraulic fracturing.

3.3f Drilling Strategy

There are several alternative approaches that could be taken in planning ODP stress measurements. COSOD II has emphasized the importance of determination of stress in oceanic lithosphere, and pointed out the sparsity of the world stress map. There is a clear need to bring about a gradual filling of the stress map, but the map is now so sparse that a sporadic, target-of-opportunity approach is likely to yield useful measurements for several years into the future. TECP emphasizes that collection of stress orientations is something that should be done as a matter of course in at least one hole in any area where logging to sufficient depths is to be done. A dedicated hole may be justified where a critical gap exists on the stress map. Even if the drilling of an entire hole to obtain stress data in a certain area is not justified, it is important to take advantage of cases in which drilling carried out largely for other purposes has reached, or is close to a depth, at which stress measurements are possible.

A second approach is one of carefully planning regional stress measurement programs, especially where existing data provide a framework for constraining models of plate driving forces and/or the generation of important structures. Such an experiment would have the advantage of being able to resolve gradients in the stress field, and stress gradients can yield important information on the dynamic processes that are involved in the motions of the plates. It may be some time before enough stress measurements have been collected around the world's oceans to justify plate-scale experiments, but we do not believe that carefully posed experiments need be of this scale. Even a few measurements could conceivably yield very valuable results, if drilling were done at sufficiently critical locations with respect to plate geometry. It is important, however, to develop a set of models that yield predictions that are sufficiently different for the data to be able to discriminate between them.

Finally, opportunities should be taken in deep holes (including re-entered ones) to measure stress magnitude as a function of depth.

3.3g Locations

Several interesting and potentially valuable examples of stress measurement programs exist. For example, data from the northwestern corner of the Nazca plate suggest that trench-pull rather than ridge-push may be the dominant force there, since compression axes parallel the trench along the western margin of South America rather than lie perpendicular to the Nazca-Cocos Ridge. Additional measurements could resolve the forces acting on the Nazca plate and the overriding South American plate, where tectonic erosion is believed to be an active process. Comparison of the stresses on the South American plate above "flat-slab" subduction and "normal" subduction segments, and north and south of the Chile Rise triple junction, could also provide important constraints for orogenic processes. The South Shetland Islands margin of the Antarctic continent and the northeastern margin of the Indo-Australian plate are other potential sites to measure stresses associated with possible trench-pull. Small plates (e.g., Juan de Fuca and the Phillipine Sea) would make interesting targets because comparatively few measurements would produce stress gradients that could be related to different types of plate boundary and hence to possible driving mechanisms.

3.4 Processes at Divergent Plate Margins

3.4a Tectonic Significance

The rifting of a continent is commonly the first event in the formation of an ocean basin. Such breakup typically involves normal faulting, igneous activity, uplift and subsidence, erosion and sediment deposition, and encompasses the time interval between initial extension and normal sea-floor spreading. Breakup varies in duration from a few million years to 50 million years or more, and forms the basis for all important aspects of subsequent margin evolution. Patterns of continental breakup are one of the primary indicators of the structure and rheology of the continental lithosphere. Preexisting continental structures and tectonic fabric play a key role in controlling rift location and style. The age of the continental lithosphere controls its geotherm, the most important factor in determining its strength. Anomalous heating from mantle sources may produce weaknesses in continental lithosphere that are exploited by rifting. These and other factors control the lateral distribution of continental extension and its surface manifestation. The heat budget of the margin is also established by extension. Subsidence rate and its lateral variation are responsible for subsequent basin formation and sediment accumulation, and the tremendous variety of sedimentary environments known to be present in passive margin basins.

Rifted continental margins differ in width, distribution of crustal extension, amount, nature and timing of igneous activity and symmetry. End-member models for various tectonic aspects of continental breakup exist and are hotly contested. End-member models of rifting by pure or simple shear reflect a debate about whether extension is distributed evenly through the continental lithosphere or localized at one or a few large shear zones. Variations in volcanism late in rifting have sparked both debate and models to explain the observed differences. Transform rifts are predicted to behave quite differently from normal pull-apart rifts. Rift diversity is undoubtedly a result of the interplay of all of these phenomena.

3.4b State of Knowledge

Until recently, rifting was viewed as a symmetric tectonic process. Many geological and geophysical observations now emphasize the importance of asymmetric structures in the crust. For example, regionally extensive low-angle normal faults have been traced from the surface to mid-crustal depths in the Basin and Range of the western United States using seismic reflection techniques. A related class of asymmetric crustal structure is represented by certain metamorphic core complexes, where mid-crustal rocks have been carried to the surface by a low angle normal detachment fault. Strong topographic and volcanic asymmetries also exist across some conjugate rifted margins. Asymmetric deformation is commonly characterized as being a result of simple shear. This has led to the suggestion that the entire lithosphere may deform through simple shear.

Rifting must extend the crust and mantle portions of the lithosphere by the same overall amount, but the question remains concerning how that extension is distributed spatially and temporally. The problem of the spatial distribution of extension is often cast in terms of end-member models of pure versus simple shear deformation. The key difference between pure shear and simple shear models of extension is whether there is lateral offset of crustal extension relative to mantle lithosphere extension. For the simple shear model, there is spatial separation between crustal thinning and lithospheric thinning, while for pure shear rifting, the crust and lithosphere in any vertical crustal column extend by the same amount. Lithospheric deformation is surely more complex than these idealized models, but it is useful to try to evaluate data in terms of the amount of offset of crustal and lithospheric extension.

Some rifted margins require a component of simple shear extension. For example, the Newark Series basins on the United States east coast contain syn-rift sediments, but no post-rift section, and they do not exhibit thermal subsidence. So, the crustal thinning which produced these basins during rifting must have been laterally displaced from the lithospheric thinning which leads to thermal subsidence. However, these basins were eventually abandoned, and it appears that pure shear deformation, centered east of the Newark basins, lead to extreme crustal thinning and eventual formation of the North Atlantic Ocean basin. Off the Galicia margin off the Iberia Peninsula, sheared mantle rocks exposed at the ocean floor may have been brought to the surface by extreme simple shearing, but the data are as yet equivocal and other explanations seem possible.

There are also rifted margins where data suggest that pure shear deformation has been the dominant mechanism of extension. For example, heat flow data for the northern Red Sea require that most of the approximately 100 km of extension that has occurred there in the last 20 million years has not involved lateral offset of lithospheric and crustal thinning.

By modeling lithospheric deformation, we are beginning to quantify how the lithosphere can extend by mainly simply shear and then switch to essentially pure shear. Nonetheless, limited data exist on the timing of progressive changes in the mode and width of extension, and only drilling can supply such information.

In addition to determining the distribution of deformation, the role of volcanism in extension must be quantified. Some margins seem to have little or no volcanic rocks overlying extended continental crust. In other regions, volcanics appear in seismic data to cover broad areas, and their thickness may be greater than adjacent oceanic crust. Models are presently being developed for extensive volcanism on rifted margins. In one, the partial melting is related to anomalously high temperatures in the mantle. In another, extra melting is due to vigorous asthenospheric convection driven by lateral temperature gradients. These models are not mutually exclusive, but they predict different average degrees of partial melting and chemistry for the magmas produced. Again, the rocks essential for testing the models can only be sampled by drilling.

Over the past four years, ODP has made substantial strides towards understanding the geological evolution and kinematics of both volcanic and non-volcanic rifted margins. Site 642 completely penetrated a seaward-dipping reflector sequence (SDRS) on the Voring Plateau, suggesting strongly that these edifices, which are known to characterize some rifted margins from Norway to the Antarctic, are rapidly emplaced volcanic piles deposited at or near sea level. Off Galicia, Leg 103 addressed the geologic evolution of perhaps the best known example of a sediment-starved, non-volcanic margin. A transect of shallow holes not only refined pre-rift, syn-rift and post-rift sedimentary history, but raised provocative new questions concerning the nature of reflector S, a prominent, continuous seismic horizon which may be a low-angle detachment. Leg 121 showed that Broken Ridge formed by a rapid uplift event, documenting the importance of flexure during extension.

Before 1993, ODP will examine the geologic evolution of another non-volcanic rifted margin off northwestern Australia (Legs 122 and 123), and in the process make maximum use of combined ODP and industry ground truth. Furthermore, at least one shallow sedimentary transect on a rifted margin (off northeastern Australia) will be conducted for the combined purposes of assessing long-term thermal subsidence at a passive margin and its usefulness as one of several possible "dipsticks" in the continuing analysis and documentation of global sea level fluctuations, as mandated by COSOD II.

3.4c Potential ODP Contribution

In the decades to come, the main goal of ocean drilling on rifted margins will be to continue to test and discriminate among existing (and undoubtedly new) end member models of margin evolution. It is of fundamental importance that ODP develop process-oriented investigations aimed at resolving fundamental rifting mechanism(s) controlling extensional deformation. In order to do this, drilling will need to sample continuously thick post-rift, syn-rift and pre-rift sedimentary/volcanic sections en route to deep crustal structures elucidated both from remote sensing and other types of regional geologic studies. As an example, Leg 103 results have recently led some investigators to pose a simple shear origin for the Galicia margin and its conjugate off the southeastern Grand Banks. This hypothesis has been supported by new, deep geophysical control and a great deal of petroleum-industry derived well-control offshore eastern Canada. The model may be testable with the drill off Galicia, where one or more deep holes to horizon S could confirm its postulated identity as a through-going, low-angle detachment characteristic of a lower plate margin. The nature of continental crust thinned under extreme conditions of ductile shearing could also be determined in places like the Alboran Sea in the western Mediterranean.

As another example, geochemical studies of ODP samples of SDRS's from various rifted margins should offer one continuing and outstanding opportunity to understand one of the more obvious roles that volcanism plays during lithospheric extension. Leg 104 found that the Voring Plateau SDRS is a basaltic edifice, but did not confirm its "oceanic" affinity because of rocks of continental affinity encountered near the base of the hole. Basalts recovered from future SDRS drilling should improve our knowledge concerning degrees of partial melting and the nature of underlying mantle source(s) which produce SDRS's. An added complication is that SDRS's on other margins, like the one off southwest Africa, are known to be at least partially silicic rather than basaltic in composition, suggesting the probability of the complex involvement of continental fragments in the transition from continent to ocean basin. Detailed geochemistry may be able to constrain degrees of non-oceanic interactions during emplacement, thereby allowing more definitive assessments of the "oceanic" vs. "continental" character of SDRS's to be made. Furthermore, as ODP continues to sample rift basins in the marine environment, other, less seismically obvious, forms of volcanic involvement in rifting processes will undoubtedly be documented.

3.4d Background Data

The primary objective of rifted margin studies is to recognize and characterize the transition between oceanic and continental lithosphere and to understand the geologic processes that control that evolution.

Though on scales of thousands of km, the tectonic evolution of oceanic regions and initial plate configurations is now well understood, significant deviation exists on scales of hundreds of km and less. Consequently, the success of any drilling operation depends heavily on the collection and analysis of all possible geological and geophysical information from the region in which the drilling is to be carried out. To distinguish the wide variety of processes which may have taken place prior to the separation of large lithospheric plates, a precise understanding of the kinematic history of the adjacent oceanic basin is required. Therefore, systematic geophysical data on both conjugate margins must be collected and synthesized prior to drilling.

In particular, pre-drilling geophysical data must be able to discriminate pre-rift structures and syn-rift versus post-rift sedimentary successions within rift basins to ensure precise site selection. Acquisition methodologies should provide data allowing direct comparison between conjugate margins in terms of age and volcanic and tectonic history. Much of the focus should be on the deep crust and upper mantle, because the interpretation of detachment faults, the inferred role of pure versus simple shear extensional mechanisms, and the importance of magmatism during extension depend heavily upon establishing the nature of the lower crust and the manner in which it deformed. Furthermore, the formation of sedimentary basins landward of many rifted margins is fundamental because of the hydrocarbon resources that these basins contain and their almost continuous geologic record of rifting processes. Therefore, information obtained through the search for hydrocarbons must be integrated with ODP drilling results to formulate accurate ideas on rifting processes.

3.4e Technical Developments

Deep drilling on rifted margins will require significant advances in technology to improve hole stability and ensure adequate recovery while maintaining the requisite level of safety, even on young margins. Holes penetrating to depths of 2-3 km and more may require at least a slimline riser capability, but we are not convinced that the anticipated expense is justified until all attractive riserless sites have been exhausted. The COSOD II participants recommend even deeper holes on rifted margins. It seems to TECP that engineering development for such sites should be initiated, but implementation is probably several years away.

3.4f Drilling Strategy

Future studies of continental rifting, including ocean drilling, should examine a margin and its conjugate whenever possible. This should manifest itself both in the acquisition of data and in their interpretation. For ocean drilling, this does not necessarily require that holes be drilled on both sides, but it does require that in doing site surveys or other regional work, the conjugate margin be considered as part of the site "region." A common, though overly simplistic, way to distinguish between currently debated pure and simple shear models of rifting is the degree of symmetry of lithosphere extension. To evaluate this requires looking at conjugate margins and determining their configuration late in the rifting process. Conjugate margin basins also share common basement and sedimentary systems during rifting, and such similarities may be exploited by drilling one part of the system on one margin and the other on its conjugate.

A significant problem with using ocean drilling to solve tectonic problems on passive margins is the thickness of sediment deposited during and following rifting. While some useful information about subsidence history may be extracted from continuously deposited sediments, they can constitute a technological challenge to reaching rocks directly affected by rifting. However, this problem is less pronounced either when the rifting has been recent or there has been slow drift sedimentation. Therefore, ocean drilling should continue to focus on young and/or sediment starved rifted margins to study rifting processes. Types of targets that we feel are most valuable are 1) basement rocks, 2) pre-rift and earliest syn-rift sediments, and 3) prominent seismic reflectors of unknown geologic origin.

While it is tempting to argue for drilling deeply into a passive margin basin as an immediate goal for ODP, we caution against this approach. If there were no deep holes in any margin basin, then drilling one might be of high priority. However, deep stratigraphic test holes drilled by industry on some rifted margins are adequate for the moment.

3.4g Locations

ODP should concentrate on drilling young conjugate passive continental margin pairs, where the sediments are thinner, the thermal signature of rifting is more pronounced, and there is greater potential to discriminate between rifting models. These opportunities exist, for example, in the Red Sea and Bransfield Strait (late Tertiary rifting), Gulf of Valencia/Gulf of Lyon (mid Tertiary rifting), and SE Greenland/Norway (early Tertiary rifting). Attention should also be paid to sediment starved conjugate margins. An example is the Flemish Cap/Goban Spur of Late Cretaceous age. Significant tectonic problems can be addressed in each of these areas using current or only slightly augmented drilling capability to drill holes to 1-2 km depth. Immediate, significant effort should be made to develop extensive geological and geophysical data bases to support drilling on these margins. The importance of obtaining adequate geophysical data both before and after drilling cannot be overestimated. As most tectonic problems are basically two- or three-dimensional, drilling must be used in concert with geophysical data that can provide three dimensional regional control.

3.5 Processes at Convergent Plate Boundaries

3.5a Tectonic Significance

Convergent plate boundaries are first order tectonic features. Here, the lithospheric surface area added at divergent boundaries is consumed. In the process, material is scraped off the downgoing plate to generate an accretionary prism, or in other cases eroded from the overriding plate to contribute to an underplating process. The magmatism at long-lived convergent plate boundaries is second only to the generation of oceanic lithosphere at spreading ridges. Deformation of the overriding plate can, even without significant collisional events, generate major mountain ranges like the Andes. Generation and destruction of marginal ocean basins at convergent plate boundaries is a vital link, as yet poorly understood, between deep seated processes and orogenesis.

3.5b State of Knowledge

In the past few years, there have been significant advances in the understanding of processes that occur at convergent plate boundaries. Sediment accretion has been demonstrated at many margins, but non-accretion and/or tectonic erosion has been inferred at other margins. Increasingly sophisticated models have been developed to explain the geometry, kinematics and mechanics of accretion. That water flows out of accretionary complexes is known from direct observation and by inference from reduction in the porosity of the sedimentary rocks that form them.

Material transfer and mass balance are important underlying themes in convergent margin studies. We are concerned with how much sediment is added to accretionary wedges and how this sediment deforms, how much sediment is subducted into the mantle, whether accreted sediment can be lost by tectonic erosion, whether there are episodes of growth and loss, and the extent to which sediment drawn down into the mantle has been dewatered by shallower tectonic, diagenetic and metamorphic processes.

Although we have made rapid advances in our understanding of convergent margin processes, many questions still remain. Models of stress systems in accretionary wedges require high pore-fluid pressures at the basal decollement to reduce shear stress, but we have not been able to measure elevated fluid pressures directly in the vicinity of the decollement, and the distribution of fluid pressure within the wedge is unknown. We know little of the patterns of flow of fluid out of the wedge or the flow regime within the wedge. The distribution of stresses in the forearc is also poorly understood. Deeper processes within the wedge, such as subcretion (underplating), have only been inferred from seismic images and vertical movements of the wedge. While seismic images and drilling have revealed various styles of deformation in parts of accretionary prisms, we need to learn more about modes of deformation. Although topographic features, such as seamounts, ridges and oceanic plateaus, are carried into subduction zones, we do not understand much about the response of accretionary prisms to such collision.

3.5c Potential ODP Contribution

- *Stress in the Wedge and Mechanics of Deformation*

Most accretionary complexes exhibit a wedge shape in cross section. As sediment is added to the leading edge (toe) of the wedge, the wedge thickens in response to the increased horizontal stress resulting from the increase in its length. The processes by which wedges thicken include vertical extension associated with horizontal shortening, motion along and rotation of the thrusts along which sediment was accreted to the toe, the formation of new out-of-sequence thrusts, and subcretion of underplating, of sediment to the base of the wedge. Drilling and other data suggest that some wedges are undergoing tectonic erosion along their bases. The processes of accretion at the toe of the wedge have been well studied, but little is known about these other processes that add to or remove material from the wedge and how they are controlled by the stress regime strength of the wedge.

Accretionary prisms constitute a natural laboratory for studying the response of porous sediments to deformation and consolidation under differential stress. We need to quantify and relate stress, strain, physical properties (porosity, permeability, temperature) and mechanical state (strength, cohesion, internal friction, compressibility) in these deforming sediments.

It is important to determine the gradients in density and porosity of accreted sediments accurately as a function of both depth within the prism and distance from the toe of the slope. We need to understand the strength and state of failure in these deforming sediments. This can only be done with extensive experimentation and *in situ* measurements in ODP holes, including not only logging and geotechnical probes, but also vertical and offset seismic experiments.

Some models suggest that the whole wedge is maintained at near critical failure. Direct measurements of physical properties of rocks in relation to their structural setting and physico-chemical environment should become possible in the next several years as new geotechnical tools become available. Drilling into the wedge, initially to shallow depths in a mid-slope position, is possible, and should provide some stress information, other physical property data and deformation state of the rocks. In particular, we need to determine changes in the state of stress both vertically and horizontally across the forearc region.

Other methods to examine the deformational processes are possible by determining the movement history on major out-of-sequence faults, which is one method of preserving wedge taper. The processes that add and remove material from the wedge can also be examined indirectly by their effects upon the overlying accretionary wedge and slope drape sediments, principally uplift and subsidence. There may be situations that are sufficiently favorable for direct sampling where the wedge is thin and underplating occurs near the toe of the wedge.

The stress in the landward part of the wedge should clearly be affected by the development of a high strength 'backstop', but developing a drilling strategy to examine the significance of the backstop will be difficult because of the evolutionary nature of the growth of the backstop and forearc basin filling. The episodic development of many forearc regions is important to evaluate how these changes in relation to plate motion and sediment input. Many of these changes are recorded in the interaction between slope sedimentation and tectonic activity. The question of mass balance, particularly partitioning of materials which are being offscraped, underplated, eroded or subducted, will only be possible from a better understanding of how wedges 'work'. Until then, reliable estimates of the subduction zone contribution to the global geochemical cycle will be difficult to quantify.

- *Hydrogeology*

The pressure of pore fluids reduces the effective stress within a rock mass, and consequently can strongly influence deformation, especially if pore-fluid pressures vary to produce zones of locally very low shear strength. Some models suggest that fluid pressures in excess of 90% of the lithostatic pressure make low-angle faults with large offsets possible.

The production of high fluid pressures and expulsion of fluids are associated with compaction and diagenesis within both the sediments of the wedge andunderlying terrain. The fluids transport heat, and the chemistry of the fluids reflects the conditions in the source region and water-rock interactions along fluid migration pathways. Geochemistry of the fluids is important in detailing fluid motion and pathways within the prism, particularly in the deeper parts not accessible to direct sampling. Hydrogeochemical studies may be able to provide specific information on fluid flow rates and permeabilities in otherwise inaccessible parts of the wedge, critical to assessing the state of stress.

The current knowledge of the basic fluid budget is poorly known, but fluids are a critical component which controls the strength of rocks and deformation styles. We should be able to develop a comprehensive fluid budget and learn about migration pathways by a combination of geophysical and geochemical techniques. For example, long-term geochemical monitoring of selected boreholes should provide a sensitive method to evaluate temporal and episodic development within a wedge.

- *Collisional Processes*

One of the most challenging objectives over the next decade will be to relate processes at convergent margins to collision and continental orogenesis. Subduction dominates where oceans and continents interact, but after oceanic lithosphere is consumed, continent-continent, or arc-continent collision ensues, forming Alpine-type and Cordilleran-type mountain ranges.

Topographically high features, such as seamounts or aseismic ridges, may be swept into convergent margins with variable, and as yet poorly understood, results. An extreme example is the collision of a continental margin with a trench. Land studies (e.g., in the Tethys and Iapetus) suggest the early stages of continental collision show many features similar to oceanic convergence zones, although the nature of the sediments accreted and the structures may differ. Contemporary collision zones apparently vary considerably and it is not yet known how the thick sediment cover of continental margins interacts with the forearc, or how collision affects the distribution of deformation across the entire zone of convergence. Drilling incipient collision zones may shed light on the nature and timing of vertical and horizontal displacements, synchronous sedimentation, crustal flexure and deformation structure. But the precise targets need careful thought. Identifying the problem is easier than showing how the drill will resolve it.

During collision, large slices of oceanic crust (i.e., ophiolites) may be emplaced onto continental margins. Land studies suggest major ophiolite slices form part of the forearc that convergs on a subducting continental margin, but the deep structure and composition of oceanic forearcs remains very poorly understood. Well exposed ancient ophiolites document the end-product of deformation and emplacement, not the collisional mechanism. Young ophiolites, like those obducted in Papua-New Guinea, are partly concealed by young continental margin sediments. Critical relationships between the emplacing oceanic slab and the parent oceanic crust are not exposed. Key questions still to be answered include the petrology, geochemistry, structure and tectonic setting of ophiolite lithosphere genesis and detachment, uplift and emplacement onto continental margins.

Extensional collapse of high collisional ridges may result in the formation of arc-shaped orogenic belts (e.g., Alps, Carpathians, Betic Cordilleras/Alboran Sea). A phenomenon common to these structures is that they develop in convergent settings, yet they are underlain by thinned crust on the inner sides of the arc. Research into the dynamics of this is crucial for the understanding of mountain building. The study of the structure, subsidence history and basement of such inner-arc basins may be most rewarding in areas of restricted post-orogenic sedimentation.

3.5d Background Data

All of the above themes relevant to ODP drilling on convergent margins require a clear understanding of the geometry of the structures. It is necessary to image:

- the top of the undeformed lower plate and subducted sediments
- the internal geometry of the wedges, including folds, thrusts, normal faults, duplexes, mud diapirs
- the lateral evolution of the structures (3D), including thrust faults, ramps.

Accurate depth-corrected images must be provided. This requires improved geophysical estimates of the velocity structure.

Specific proposals to study the role of fluids would be greatly improved by initial reconnaissance of the hydrothermal vents, heat flow measurements and eventually direct diving observations.

3.5e Technical Developments

The principal technological development that is required to drill deeper and maintain hole stability in undercompacted sediments or clastic materials is a riser.

Development of packers for *in situ* pressure measurements is also of the highest priority. The clear understanding of the role of fluids will require a knowledge of pore pressures, flow rates and the fluids themselves. Long-term instrumentation should be planned for specific holes, in order to measure the thermal regime and fluid circulation over long periods of time.

Instrumentation needs to be improved for *in situ* stress and strain measurements. Besides existing dip meters, new tools for orientation of the cores are still needed. Logging time should be increased to allow for the increased downhole measurement and sampling required. Vertical and offset seismic profiles will be required in selected holes to provide precise ties to geophysical data and to estimate the physical state of the rocks away from the drill holes.

3.5f Drilling Strategy

Investigation of accretionary prisms should continue by focusing a broad suite of investigative strategies on a few selected regions and treating these regions as natural laboratories that would ultimately be permanently instrumented in order to investigate dynamic processes that have temporal as well as spatial variability. Drilling should be one component of a suite of investigative strategies, albeit a critical one for emplacing instruments as well as sampling the subsurface. Various processes that should be investigated include hydraulic circulation and related dewatering processes, the development of stress fields and related strains, and mass transfer processes that occur throughout the forearc region. A thorough investigation by geophysical means, including seismic reflection and side-scan sonar techniques, will lead to an image of structures which are related to these processes. Then holes can be drilled into these structures both to investigate the structures at scales smaller than the resolution of acoustic techniques and to measure physical and chemical parameters related to dynamic processes. This future drilling will vary in two fundamental ways from previous drilling efforts - improved drilling techniques will permit much deeper penetration and recovery of sediments, and improved instrumentation will permit a broader range of observation.

3.5g Locations

Drilling should take place in at least one clastic-dominated margin (e.g., Nankai or Cascadia), one pelagic-dominated margin (e.g., Barbados, Costa Rica) and one non-accretionary/erosional margin (e.g., Japan or Peru Trench).

An appropriate drilling strategy needs also to document the role of collisions, large and small, in orogenesis. The hypothesis of formation of melanges (e.g., in the Franciscan complex) by subduction of seamounts needs to be tested (e.g., in the Japan, Kuril and Nankai trenches) and integrated with land-studies (e.g., in SW Japan). The age and origin of basin-ridge collages that may in future be driven together by collisional orogenesis need to be recognized and documented (e.g., Celebes basin, Sulu Sea). Processes of intra-oceanic collision and amalgamation prior to continental orogenesis, as have been hypothesized in the western U.S. Cordillera also merit further study (e.g., Vanuatu-New Hebrides). The process of island arc-continental margin collision, involving back-thrusting of the island arc over continental crust, exemplified by the Sunda arc-Australian continent collision, also deserves to be better understood. Back arc basins formed during convergence may later collapse leading to arc-continent collision and subsequent mountain building, as hypothesized on land in the western Pacific region (S. China/Taiwan/Japan), southern Andes, the Alps and Appalachians. The initial stages of back-arc underthrusting appear to be taking place in the West Pacific region (Banda Sea, S. China Sea), and could be worthwhile drilling targets.

Collisional processes are diachronous in space and time. The Mediterranean Sea offers a unique tectonic laboratory to study comparative collisional processes, ranging from steady-state consumption of oceanic crust under the Hellenic arc, to possibly initial stages of collision in the Eolian arc in the western Mediterranean, and potentially more advanced collision along the Cyprean arc in the eastern Mediterranean.

4. INSTRUMENTATION APPENDIX

4.1 Background

The long-term tectonic objectives of ODP require data from the borehole itself to a far greater extent than previously attempted in order to use the unique capability of drilling for monitoring active tectonic processes. Present ODP operations carry out *in situ* borehole experiments in a routine manner through TAMU and LDGO/Schlumberger support. Logging in the ODP program has become increasingly more valuable in providing complete borehole physical and geochemical properties over logged intervals, especially where coring was incomplete. *In situ* temperature, limited pressure measurements, and pore water sampling are provided by probes and cutting shoe sensors. Special tools have been, and are being, developed by scientific groups. The use of these third-party tools, however, often falls solely on the shoulders of the developing party. Hydrogeological instrumentation includes drillstring, straddle and wireline packers. Stress measurements are obtainable through borehole televiewer (BHTV) surveys of borehole breakouts. Downhole magnetometers have also been deployed on limited ODP cruises. VSP and ESP surveys tied to the cored section have proven to be extremely valuable in tying the cored section to regional survey lines, and in extending the core and log information to a regional scale.

4.2 Proposed Programs and Experiments

Several aspects of *in situ* measurements and long-term monitoring are already in a stage of development targeted for western Pacific coring programs. These projects represent an early stage in what should continue to be a developing program striving to better and more complete measurements and coverage in different tectonic environments. Some near-future projects include:

• *Slimline formation micro-scanner (FMS),* which is expected to yield detailed resistivity information of the borehole wall. Structural, bedding and breakout information should be recoverable with this technology, enhancing the BHTV database, and perhaps extending it to less consolidated lithologies.

• *Geoprops Probe* for measurement of pore pressure, permeability, temperature and fluid sampling of sediment formations immediately after sampling (in minimal coring disturbance) is aimed to provide critical information of physical and mechanical aspects of the convergence process at the Nankai Trough. The use of this tool can be extended to numerous other environments in which these parameters are of importance (off-axis spreading centers, passive margins slopes).

• *Lateral stress APC tool* for acquiring formation relaxation and pore pressure information immediately following penetration of an APC core barrel. Initially expected to be tested at Nankai, this tool may provide stress information in a portion of the sediment column in which other tools are too robust.

• *Hydrofracture experiments* proposed for Leg 123 are expected to provide critical crustal stress information. This technology can continue to be used at numerous sites where appropriate lithologic conditions are encountered, to add to our understanding of the global stress field.

• *Large-scale resistivity experiments* planned for the Japan Sea are expected to yield information on the deep crustal structure there, extending the drilling, logging and seismic information downward beyond the limits of those technologies.

• The *ONDO Project* proposed for the Nankai program intends to emplace a long-term, five-year observatory at that convergent margin, which will provide a temporal view of temperature and pore pressures at the toe of the prism. Experience until now at other active margins seems to indicate that fluid expulsion, sediment deformation and *in situ* stress conditions all operate in non-steady state conditions.

4.3 Technical Developments and Future Directions

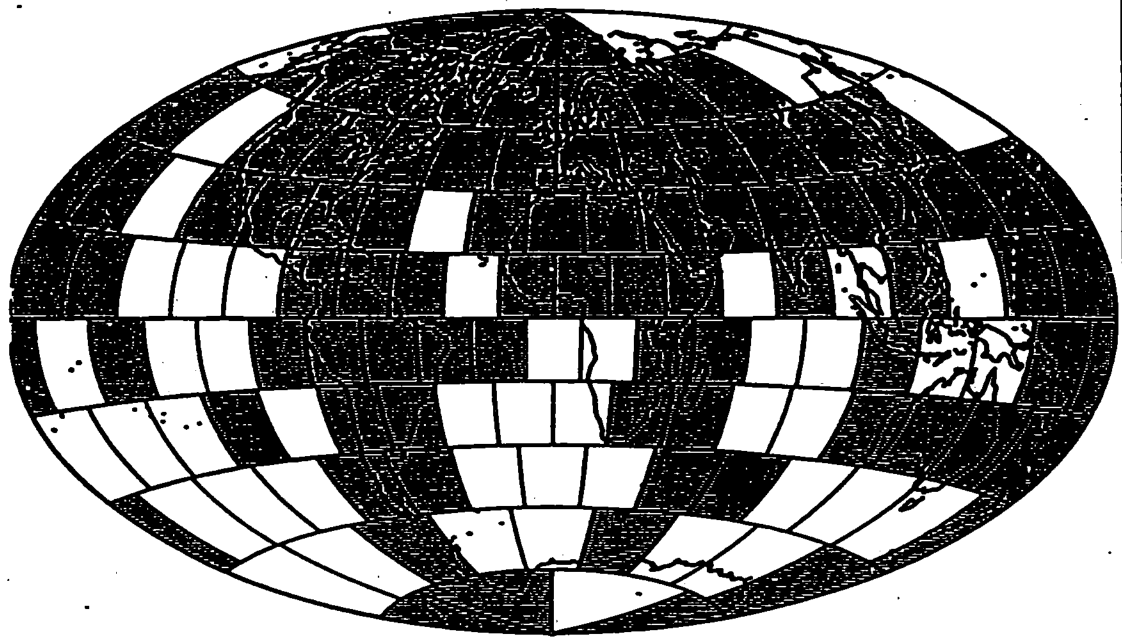
Several aspects of the major themes outlined here call for concerted efforts in the near future.

• *Core orientation* within the present program has several shortcomings. Uncertainty regarding the accuracy of the present APC Multishot system , and lack of core orientation in any rotary coring mode, precludes substantial paleomagnetic, structural, sedimentologic and physical-mechanical properties interpretation. A clear need is identified for obtaining azimuthal information from the recovered cores. Potential use of BHTV and FMS data may alleviate the problem in formations with good structural information; however, in homogeneous lithologic sections, these tools will not be able to provide key information.

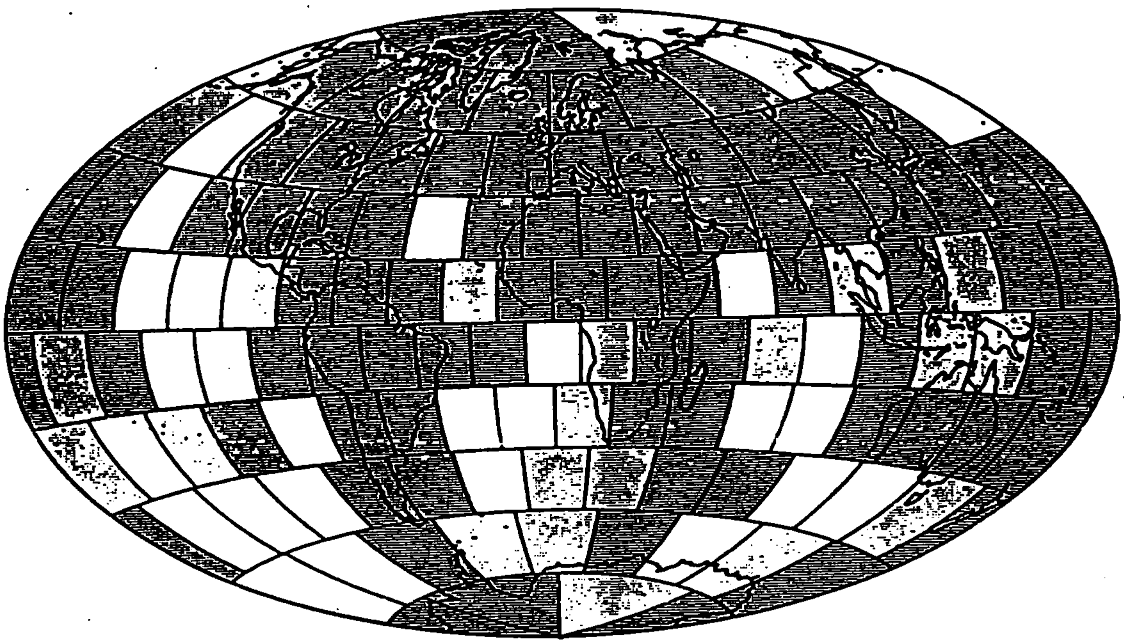
• *Long-term observatories* are clearly stations that can take full use of the ODP drill hole to extend our knowledge of crustal processes within numerous tectonic environments. Measurements of temperature, fluid flow, pore fluid pressures and geochemistry, borehole strain and seismicity are all feasible aspects of packages that should be developed and emplaced in boreholes, thus extending the instantaneous *in situ* measurements obtained during the coring program over a significant amount of time. Optimum use of these observatories demands the integration of various scientific programs into the design, deployment and servicing of these stations. Technological requirements must be met to emplace packages in harsh, high temperature, corrosive environments near spreading centers and in the unstable environments of convergent margins.

Wireline re-entry and submersible capabilities must continue to be investigated for their roles in emplacing and servicing long-term observatories.

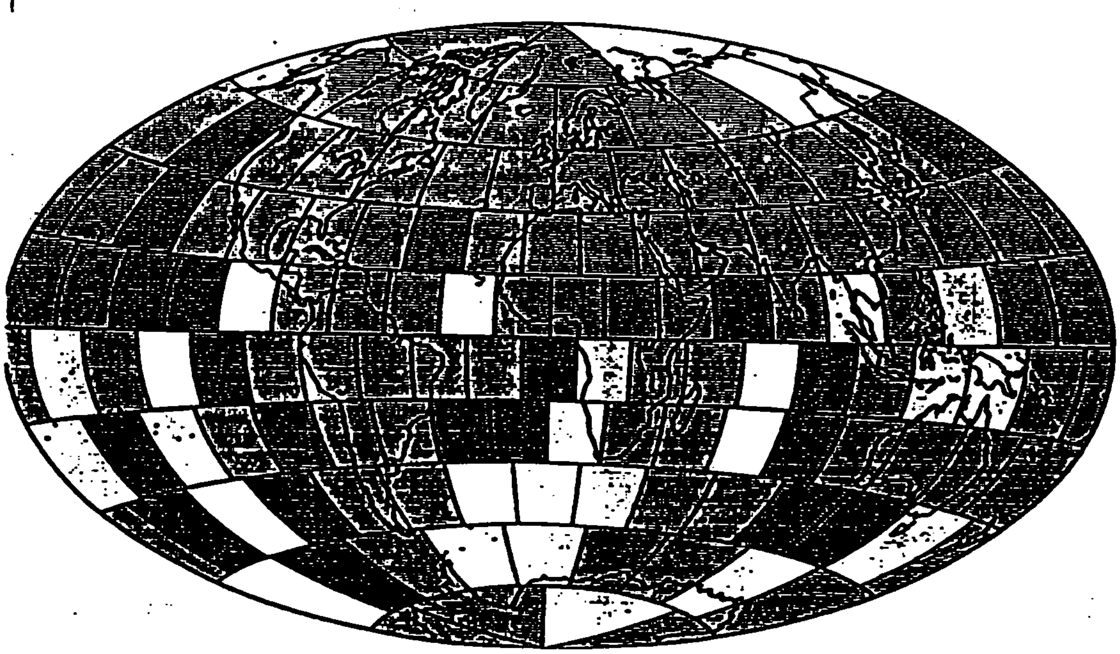
Figure 1



Map 1.



Map 2.



MAP 3.

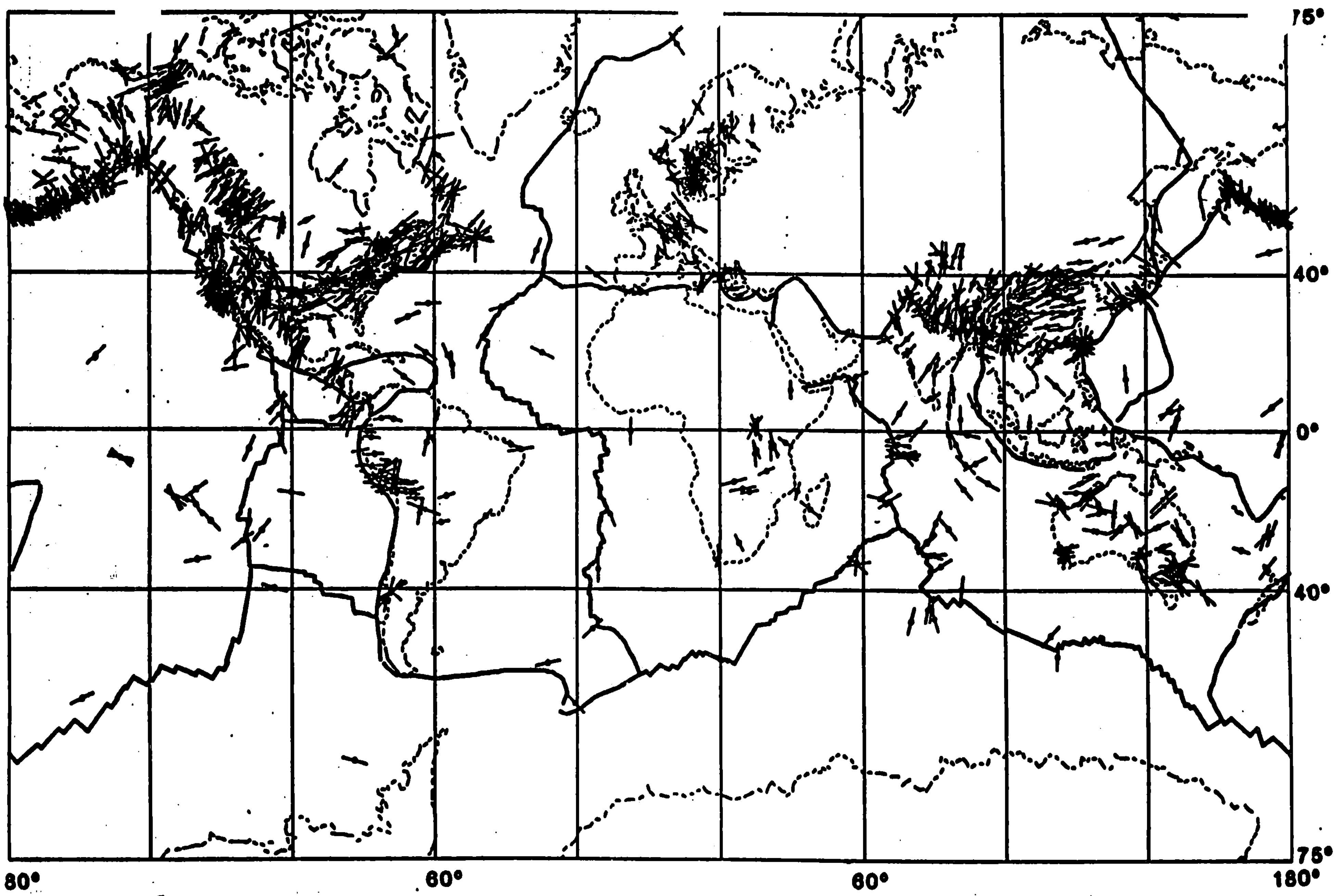


Figure 2 Preliminary compilation of *in situ* tectonic stress data around the world (Zoback, 1987). Data come from breakouts, earthquake focal plane mechanisms, *in situ* stress measurements at depth and post-Pliocene geologic indicators of stress.

2nd Draft August 1988

JOIDES Lithosphere Panel
Long Range Planning Document

Summary

The overall thematic objective of lithospheric drilling is to understand the origin and evolution of the oceanic crust and lithosphere, and associated magmatic, hydrothermal and metamorphic processes. Over the years, there has been a remarkable consensus within the lithospheric community on its drilling priorities. The two highest priorities have consistently been: (1) determining the structure and composition of the oceanic crust through deep crustal drilling, and (2) characterizing the processes of magma generation, crustal construction and hydrothermal circulation at mid-ocean ridges. Drilling can also provide important insights into the magmatic processes associated with the onset of sea floor spreading, mid-plate volcanism, geochemical fluxes at convergent margins, the physical properties of the oceanic lithosphere, and the composition and dynamics of the mantle.

Addressing these problems during the coming decade will require a focussed, interdisciplinary drilling effort with the following major goals:

- By 1996 drill at least three holes 2000-3000 m into the oceanic crust, with the prospect of extending one of these holes to Moho by the year 2000. One of these holes should be located on anomalously thin crust proximal to a fracture zone, the others on crust formed at fast and slow spreading ridges.

- Drill arrays of shallow (~300 m) and intermediate (1-1.5 km) depth holes in several locations along the mid-ocean ridge system, including fast, slow and sedimented ridge crests. One of these areas should be permanently instrumented to establish a sea floor "volcano observatory" by the year 2000.

- Establish 15-20 sea floor seismometer observatories by the year 2000 throughout the major ocean basins in 100-200 m deep crustal holes instrumented with short and long-period, broad-band seismometers

- Complete 50-100 shallow (<100 m deep) holes in crust of various ages, on seamounts, aseismic ridges, oceanic plateaus and across convergent margins to investigate intraplate volcanism, constrain global geochemical fluxes, and determine the state of stress of the lithosphere.

Many of these objectives can be achieved using present drilling technology (shallow crustal sampling, deep drilling in exposed plutonic sections, global stress mapping, establishment of sea floor seismic observatories). However, the long-term goals of deep crustal penetration and ridge crest drilling will require major new technological developments in drilling systems, logging equipment and borehole instrumentation. In

terms of drilling systems, three major problems must be overcome: (1) penetration and sampling of young, highly fractured, extrusive basalts comprising the uppermost part of Layer 2, (2) low penetration rates, short bit life, hole instability and incomplete flushing of cuttings in deeper crustal holes, and (3) low recovery rates. Logging equipment and borehole instrumentation will need to be adapted for use in smaller diameter holes and under high-temperature (up to 400°C) conditions. Other important needs are for improved borehole sampling techniques (fluids and rock), improved utilization of drill holes for a variety of borehole experiments and long-term measurements, and routine wireline re-entry capabilities.

The following implementation plan gives a rough estimate of the activities and level of effort that might be required to achieve these drilling objectives in coming decade:

Phase 1 (1989-1992)

- Establish detailed planning groups (DPGs) on "Deep crustal drilling", "Ridge crest drilling", "Sea floor seismic observatories", and "Global geochemical and stress mapping"
- Develop a long-term engineering development plan to improve crustal drilling technology, including cost estimates, manpower needs, and test-leg requirements
- Begin site survey work for at least 6 candidate sites for deep crustal drilling, 4 sites for ridge crest drilling, and 5-10 seismic observatories
- Complete 2 legs of deep crustal drilling at Hole 504B, or at another suitable deep crustal drill site
- Complete 4 legs of drilling on sedimented and unsedimented ridge crests of the eastern Pacific
- Carry out recommended pilot experiments for the establishment of a sea floor seismic observatory, probably at a site near Hawaii

Phase 2 (1993-1996)

- Complete site survey work for deep crustal holes, ridge crest drilling and seismic observatories
- Drill two or three holes 2000-3000 m into the crust (1 leg/yr for four years), including one hole near a large fracture zone (SWIR or North Atlantic)
- Begin Mid-Atlantic Ridge drilling; complete second phase of EPR drilling (1 leg/yr for four years)
- Establish 5 sea floor seismic observatories and drill 25-50 shallow crustal holes for global geochemical/stress mapping (2 legs/yr for four years)

Phase 3 (1997-2000)

- Extend one crustal hole to Moho (1-2 legs/yr for four years)
- Complete second phase of MAR drilling (2 legs)
- Establish a sea floor volcano observatory on a volcanically active part of the mid-ocean ridge system (1 leg/yr for four years)
- Establish 15 sea floor seismic observatories and drill an additional 25-50 shallow crustal holes for global geochemical/stress mapping (2 legs/yr for four years)

In this scenario, 4-5 legs (8-10 months) of drilling would be required per year to complete the four highest priority lithospheric drilling objectives by the end of the next decade. However, it is important to note that there is significant overlap in the interests of the Lithosphere and Tectonics panels, especially in the programs for global stress mapping and the establishment of sea floor seismometer stations. With careful co-ordination and planning this drilling may also satisfy some objectives of the paleoceanographic and paleontological communities.

Although lithospheric drilling objectives exist in all the major ocean basins, most are concentrated in the central and eastern Pacific and Atlantic Oceans. Many of our highest priority objectives also require multiple drilling legs at single site or in the same area. Thus it is critical that the drillship be scheduled so that it can reoccupy drill sites at intervals of 9-12 months. All of these considerations suggest that the circumnavigation philosophy that has driven the first eight years of ODP planning is **not** the optimal strategy for lithospheric drilling. Instead, we would favor a plan in which ship scheduling is driven not by regional political interests, but by the longer-term thematic drilling objectives outlined above.

JOIDES Lithosphere Panel
Long Range Planning Document

I. Overview of Scientific Objectives of the First Phase of ODP

COSOD I - The COSOD I Report in 1981 identified a variety of problems related to the origin and evolution of the oceanic crust and lithosphere that can be addressed by drilling. The two highest priority ocean crustal problems agreed upon at this conference were:

- Processes of magma generation and crustal construction operating at mid-ocean ridges
- Processes of hydrothermal circulation in the ocean crust

In addition, the COSOD I Report also discussed a number of other important lithospheric problems that could be studied by drilling. These included: (1) the compositional heterogeneity of the mantle and mantle evolution, (2) the aging and evolution of the oceanic crust, (3) the formation of overly thick crust, (4) the role of transform faults, (5) processes operating in young ocean basins, and (6) island arcs and backarc basins. The need to drill at least one hole as deeply as possible into Layer 3 was specifically noted in the conference report.

At COSOD I the role of "natural laboratories" in future crustal drilling was emphasized. As defined in the conference report, the natural laboratory concept includes: "arrays, or clusters of holes, some deep, some relatively shallow, grouped together in fours or fives in particularly critical (active) parts of the ocean floor . . . . They would be used for the emplacement of sophisticated instruments, some during the drilling period, and others for long-term monitoring after the drilling had ceased. Within each each laboratory complex, one hole would be targeted for deep penetration to allow sampling from hitherto unreached levels in the ocean crust." The need for improved drilling technology was also recognized, including the development of techniques for drilling in areas with little or no sediment cover.

LITHP White Paper - The JOIDES Lithosphere Panel (LITHP), following on the recommendations contained in the COSOD I Report, prepared a White Paper in 1986-87 which outlined a series of specific recommendations on the drilling strategies, priorities and technical development required to address these broad thematic objectives. The panel identified as its two most important long-term drilling objectives the completion of one or more deep holes into the lower oceanic crust, and the establishment of a suite of drill holes to investigate magmatic and hydrothermal processes at both fast and slow spreading ridges. It was noted that neither of these objectives could be attained with existing ODP drilling systems, and a major, long-term effort to improve crustal drilling technology was urgently needed. However, the LITHP White Paper also identified other shorter-term drilling objectives (e.g. drilling old oceanic crust, flexural moat drilling, and convergent margin drilling, including geochemical reference holes) that were feasible with present drilling technology. The White Paper suggested the most productive approach to lithospheric drilling was one which included these shorter-term objectives, coupled with a parallel engineering development effort to achieve the longer-term goals of the deep crustal and ridge crest drilling.

II. Scientific Achievements of ODP to Date

A. *Present status in achieving thematic objectives*

The progress to date in achieving the major lithospheric drilling objectives outlined above has been frustratingly little. This is attributable, in part, to the technical difficulties of drilling in young, highly fractured basaltic crust, and drilling into the deeper layers of the oceanic crust. Thus despite the successful establishment of the first "zero-age", "bare-rock" drill hole in the Mid-Atlantic Ridge rift valley on Leg 106, subsequent drilling at this site on Leg 109 was unable to extend this hole significantly into Layer 2. However, not much progress has been made in achieving even the more technically feasible lithospheric drilling objectives noted above. This is primarily attributable to the fact that through the first 29 legs of ODP (~5 yrs) the equivalent of only about 6 legs of drilling have been devoted to the major lithospheric objectives outlined in the COSOD I report.

Some progress, however, has been made. The most notable technical achievement of ODP has been the development of the hard-rock guide base, and associated drilling hardware, which has proven to be an effective means of spudding a drill hole on bare rock with only minimal support for the bottom hole assembly. This has long been a goal of the lithospheric drilling community and overcomes a major engineering obstacle to the establishment of the "natural laboratories" at ridge crests envisioned in the COSOD I Report. Over the past year substantial progress has also been made in adapting small-kerf, diamond-bit mine coring systems for use in ODP. These systems offer considerable promise for significantly improving the penetration and recovery rates for crustal drilling. Communication between the ODP Engineering Development Group and the JOIDES advisory panels has also been substantially improved during the past three years, resulting in much better co-ordination of development efforts with long-term program planning.

From the perspective of the lithospheric drilling community, there have been three main scientific accomplishments of ODP to date: (1) characterization of the *in situ* physical properties of oceanic Layer 2, (2) exploration of the deeper structure of the oceanic crust, and (3) new constraints on hot spot evolution and true polar wander.

In situ Physical Properties of Layer 2 - An important accomplishment of the first two years of ODP was the completion on ODP Legs 102, 109 and 111 of logging programs at the three deepest crustal holes drilled in the Deep Sea Drilling Project (Holes 504B, 395A and 418A). The extensive suite of state-of-the-art logging tools and borehole experiments carried out in these holes have provided unique data on the physical properties of both young and old oceanic crust. For example, at 504B it was found, somewhat unexpectedly, that the lower 1000 m of the hole, comprising the partially-sealed pillow lavas and sheeted dikes of Layer 2, is uniformly impermeable (5-20 x 10^{-18} m^2). Thus the only permeable section of the crust in this hole is the upper 100-200 m of pillow basalts. These results are extremely important for modeling hydrothermal processes at mid-ocean ridges and understanding the alteration history of the oceanic crust.

Exploration of the Lower Oceanic Crust - Drilling results from ODP Legs 109 and 118 on the Mid-Atlantic and Southwest Indian Ridges have provided important new constraints on the structure and composition of the oceanic crust and upper mantle along slowly accreting plate boundaries. On Leg 109 serpentinites and partially serpentinized harzburgites were recovered at Site 670 in the Mid-Atlantic Ridge rift valley only a few kilometers from the accretionary axis. The presence of these rocks, thought to be typical of the lower crust or upper mantle, at very shallow crustal levels away from any major fracture zone, indicates that slow spreading ridges must be characterized by periods of very low magma supply and/or extensive tectonic thinning. The peridotites themselves have been extremely useful in studies of the compositional variability and melting history of the upper mantle beneath a slow spreading ridge.

The most exciting, and unexpected, lithospheric drilling result to date is unquestionably the 500 m of gabbro drilled at Hole 735B during Leg 118 on the Southwest Indian Ridge. Technically, this hole was a major triumph for the new bare-rock drilling techniques developed by ODP, as well as setting new records for both penetration (60 m/day) and recovery rates (95% over over the bottom 400 m; 87% overall) in a crustal drill hole. The gabbros obtained at this site represent the first coherent section of *in situ* Layer 3-type material ever recovered from the ocean basins. Studies of the geochemical and petrologic variations in this section will allow the magmatic evolution of a fossil oceanic magma chamber to be investigated in its true stratigraphic context. The logging and borehole experiments carried out in Hole 735B have also provided the first *in situ* information on the physical properties (porosity, permeability, seismic velocity, magnetism) of Layer 3.

Hot Spot Evolution and True Polar Wander - The floor of the central Indian Ocean is dominated by two prominent hot spot lineaments, the Ninetyeast Ridge and the Chagos-Laccadive Ridge. Drilling on Leg 115 investigated the poorly known Chagos-Laccadive Ridge and clearly established that the age of the volcanoes comprising this feature increase from south to north as would be predicted for a model in which the hot spot remains fixed in the mantle. Surprisingly, however, this hot spot, which is now located under Reunion Island, appears to have gradually moved northward relative to the earth's magnetic pole over the past 55 million years. This corresponds with a proposed southward motion of the Hawaiian hot spot, suggesting that the paleomagnetic reference frames for the Pacific and Indian Ocean mantle have moved in opposite directions over the same time period. These intriguing new results have lead to a revival of the old theory of "true polar wander" in which the whole outer shell of the Earth rotates with respect to the spin access, and caused renewed debate among geophysicists about the interaction between hot spots, the lithosphere and convection in the mantle.

B. *Practical spin-offs*

The hard-rock guide base, and associated drilling hardware, developed by ODP for ridge crest drilling also have potential applications in the exploitation of economically valuable, massive sulfide deposits in the ocean basins. The adaptation of high-speed, small-kerf, diamond-bit mine coring systems by ODP for ocean drilling is at the forefront of offshore technology, and is of considerable interest to both the petroleum and minerals industries. The oil industry is giving serious consideration to utilizing mining technology for drilling small diameter, low cost exploratory oil and gas wells both onshore and offshore. By drilling smaller diameter holes, there is potential for considerable savings in downhole equipment and operating costs. At the present time, several companies are field testing these same mining techniques for drilling ultradeep exploratory holes on land. In South Africa, for example, a mining company is currently drilling deep (>4000 m) exploration wells for the purpose of sampling specific ore bodies. There has also been limited deployment of mine coring systems from floating vessels for doing shallow soil studies and geological work.

III. Future Scientific Opportunities and Objectives

A. *Scientific Objectives defined by COSOD I and II*

In 1987 the accomplishments and future scientific objectives of ODP were discussed at the Second Conference on Scientific Ocean Drilling (COSOD II). The recommendations discussed at COSOD II, together with those included in the earlier COSOD I Report, can be used to construct the following set of major lithospheric drilling objectives for ODP (*not prioritized*):

- Determining the structure and composition of the oceanic crust, and its variation with age, tectonic setting and spreading history
- Investigating the magmatic and hydrothermal processes at mid-ocean ridges
- Characterizing the magmatic processes associated with the onset of the earliest phase of seafloor spreading
- Characterizing intraplate volcanism, especially that associated with seamount formation and the origin of oceanic plateaus
- Understanding the geochemical fluxes and magmatic processes at convergent margins
- Determining the state of stress, and thermal and mechanical evolution of the oceanic lithosphere

- Characterizing the dynamics, composition and geochemical evolution of the upper mantle

B. *Scientific Objectives Not Addressed by the COSOD Conferences*

One lithospheric drilling objective that was not specifically addressed in either COSOD Report, but that has been consistently ranked high by the Lithosphere Panel is the magmatic evolution of young hot spot volcanoes. The discovery of an early, alkalic phase of hot spot volcanism at Loihi was a milestone in the development of our understanding of mid-plate volcanism. It has had important implications for models of mantle plumes and their interaction with the lithosphere. However, the role of this juvenile alkalic stage in the formation of Loihi, and hot spot volcanism in general, remains controversial. Drilling a young hot spot volcano like Loihi or Mehetia could provide valuable, stratigraphically-controlled samples of this critical, early stage of hot spot volcanism. This type of drilling should be included in future plans for lithospheric drilling.

C. *Technical/Logistical Requirements*

Achieving the major scientific objectives of the lithospheric drilling community will require significant improvements in crustal drilling technology and borehole instrumentation. These requirements include:

- Penetration and sampling of young, highly fractured, extrusive basalts comprising the uppermost part of Layer 2
- Developing the capability of *routinely* drilling deep crustal sections (>3 km total penetration)
- Improved recovery rates for more representative sampling of the crustal section
- Drilling and logging equipment, and borehole instrumentation, capable of operating under sustained high-temperature conditions (up to 400°C)
- Improved methods of borehole fluid sampling
- Methods for long-term instrumentation and data recovery from boreholes

D. *Status of Scientific Objectives at the End of Phase I of ODP (1992)*

It is unlikely that any of the major lithospheric drilling objectives outlined above will achieved by the end of the first phase of ODP in 1992. However, depending upon the amount of time devoted to drilling in the Pacific during the next four years, and the success of ongoing engineering development efforts, substantial progress is possible in addressing several long-term lithospheric drilling goals.

LITHP has proposed that an additional 1-2 legs of drilling be spent at Hole 504B in the 1990-1992 time frame in order to deepen this hole into seismic Layer 3. Sampling of the Layer 2/3 boundary at this site, already the deepest crustal hole in the ocean basins, would be a major scientific achievement. However, even with this success we would still be far from reaching our long-term objective of drilling a hole through the entire thickness of the oceanic crust. The COSOD II Report proposed that a realistic goal for ODP by 1992 is *routine* drilling, with a minimum of 75% recovery, to depths of 1000 m below the basement/sediment interface.

The East Pacific Rise Working Group has proposed that four legs be devoted to drilling ridge crests in the eastern Pacific prior to 1992; two legs on the fast spreading East Pacific Rise and two legs on the sedimented ridge crests of the northeast Pacific. If this drilling is successful, a major step will have been taken toward the establishment of the "natural laboratories" envisioned in the COSOD I Report. However, this would only be the first phase in a much longer-term effort. At least an additional 2-4 legs of drilling would be required after 1992 to complete the East Pacific Rise program, and a minimum of 4-6 legs would be needed to establish a comparable suite of holes at one site along a slow spreading ridge.

There are other important lithospheric drilling objectives that could be addressed in the next four years, if the necessary drilling time is made available. For example, drilling in the western Pacific near the Bonin and Mariana arcs could provide the first constraints on geochemical fluxes at convergent margins, while a drill hole on Loihi could be used to investigate the recently discovered juvenile, alkalic stage of hot spot volcanism discussed above. However, in both cases these programs would represent only one part in a longer-term, global effort to understand the geochemical evolution of the oceanic crust and the underlying mantle. The concept of global geochemical mapping to investigate the composition and dynamics of the mantle as outlined at COSOD II entails a large number of drill holes on a variety of targets (seamounts, plateaus, hot spots, old crust etc.) that will require a decade-long program of drilling on a global scale.

Attaining the major scientific objectives of lithospheric drilling will require a two-fold commitment on the part of ODP: a long-term (5-10 yr) engineering development effort to improve crustal drilling technology, and the allocation of significant amounts of drilling time, including multiple legs to a single site. Without this two-fold commitment it is unlikely that any of the major scientific objectives of lithospheric drilling will be achieved in the foreseeable future.

IV Prioritization and Implementation of Objectives

A. *Scientific Prioritization*

The overall thematic objective of lithospheric drilling is to understand the origin and evolution of the oceanic crust, lithosphere and underlying mantle. Over the years, there has been a remarkable consensus within the lithospheric community on its drilling priorities. The two highest priorities have consistently been: (1) determining the structure and composition of the crust through deep crustal drilling, and (2) characterizing the processes of magma generation, crustal construction and hydrothermal circulation at mid-ocean ridges. Drilling can also provide important insights into the magmatic processes associated with the onset of sea floor spreading, mid-plate volcanism, convergent margin processes, the physical properties of oceanic lithosphere, and the composition and dynamics of the underlying mantle. We have not attempted a prioritization of these secondary objectives, since it was recognized that they are all components of a global system, and thus are all equally important. In this section we briefly abstract from the LITHP White Paper and the COSOD I and II Reports the goals, drilling strategies and technical requirements needed to achieve each of these drilling objectives.

Primary Objectives

The structure and composition of the oceanic crust

Goals We still have no direct knowledge of the structure, composition and physical properties of over two-thirds of the oceanic crustal section. Deep crustal drilling is essential for determining the bulk composition and physical properties of the oceanic crust, interpreting the geological significance of seismically-defined crustal layering, and understanding the alteration history of the oceanic crust. Deep crustal drilling can provide definitive answers to major outstanding questions such as: How do ophiolites compare with "normal" oceanic crust?, What are the compositions of primary mantle-derived melts and how are they modified by magma chamber processes?, and What is the depth and nature of hydrothermal interaction in the crust? Drilling deep crustal sections would produce a quantum leap in our understanding of oceanic crustal processes, and has been ranked a top priority by COSOD I, by WG-2 at COSOD II and by the JOIDES Lithosphere Panel.

Drilling strategy In terms of cost, required engineering development and long-term planning, deep crustal drilling is on an entirely different scale from the kind of drilling ODP has attempted in the past. The long-term objective is nothing less than a complete crustal section from the top of Layer 2 to Moho, although in the shorter term much can be learned from intermediate-depth holes (1-3 km deep) on crust of different ages in a variety of tectonic environments. At a minimum, holes should be drilled on crust at a slow and fast spreading ridge, since a comparison of the crustal structure for these two end members would resolve many outstanding questions concerning the significance of spreading rate on the crustal formation process. Two general drilling strategies have been discussed. The first involves drilling through layer 2 into the lower crust at sites considered "typical" of normal oceanic crust. This approach has the advantage of providing a complete crustal section at a single site, but it will be both time consuming and technically difficult. An alternative drilling strategy for reaching the lowermost crust and upper mantle is to locate holes in areas (e.g. proximal to fracture zones) where the plutonic foundations of the crust are exposed. Ideally, these holes should be located near sites which sample the upper crust so that the entire crustal section can be reconstructed.

Technical/logistical requirements Some progress can be made in achieving these objectives using existing drilling systems by locating holes in older crust where layer 2 is weathered and sealed, or by drilling in areas where massive layer 3-type rocks are exposed. However, our longer-term goal of complete crustal penetration will require new drilling systems capable of drilling 5-6 km into the crust in water depths of 5000-6000 m. Development of these systems will require a long-term (~10 yr) phased development effort, ship time for testing, substantial financial resources and close collaboration between scientists and engineers. Also needed will be new high-temperature, small-diameter logging tools and borehole instrumentation. Most importantly, successful deep crustal drilling will require patience, and a willingness to commit the drillship to a single site for a year or more of drilling (although this drilling would not have to be done as consecutive legs). Overall, we estimate the need for at least three holes 2000-3000 m below basement, with the hope of extending one of them to Moho by the year 2000. One of the shallower holes should be located on anomalously thin crust proximal to a fracture zone.

Magmatic and hydrothermal processes at mid-ocean ridges

Goals Sixty percent of the earth's surface is created at oceanic spreading centers, as magmas generated in the underlying mantle are transformed into crust. In the most general terms, the goal of crustal drilling at ridge crests is to understand the complex and interrelated magmatic, tectonic and hydrothermal processes involved in the formation of the ocean crust. An example of one important focus for ridge crest drilling is the dynamic boundary between magma and cooled, fractured rock at the margins of a magma chamber. The physical and chemical interactions between rock and water at this boundary are almost completely unknown, yet it is at this boundary that the solid crust is formed. Other important objectives of ridge crest drilling include investigating temporal and spatial variations in magmatic activity, providing ground truth for geophysical horizons such as the pillow/dike or dike/gabbro boundary, and providing sites that can be used for a variety of down-hole experiments and long-term geophysical monitoring. Ridge crest drilling was the highest crustal drilling objective identified at COSOD I, and was highly ranked by WG-2, 3 and 4 at COSOD II, as well as by the JOIDES Lithosphere Panel.

Drilling strategy The East Pacific Rise Working Group has outlined a potential drilling strategy for fast spreading, unsedimented ridge crests involving a suite of eight holes. The highest priority site is a single deep (>1 km) hole near the ridge axis, outside the central zone of fissuring, that penetrates as close as possible to the top of the magma chamber. The second priority is a ~500 m deep hole in the axial fissure zone that penetrates far enough into the underlying dikes to characterize the temperature gradients and permeability structure of the shallow crust. A transect of three, relatively shallow holes (~300 m deep) across the rise axis and, and three holes along the rise axis toward the boundary of a spreading cell segment, were also proposed to investigate temporal and spatial variations in magmatic and hydrothermal activity. A somewhat different strategy might be appropriate at a slow spreading ridge or a sedimented ridge crest. For example, a shallow hole, or suite of holes, in an axial hydrothermal discharge zone is considered to be a very high priority, but was not recommended for the East Pacific Rise because the known vent sites are too small and immature.

Technical/logistical requirements None of the drilling described above can be attempted with present drilling technology. Especially critical is the development of a reliable technique for penetrating and stabilizing the upper 200-300 m of highly fractured extrusives present at ridge crests. High temperatures (>400°C) will be encountered at depth in many of the holes, and the mechanical and chemical consequences must be considered for drilling, fluid and rock sampling, and logging. A suite of holes, like that proposed for the East Pacific Rise, could require 8-12 months of drilling time. Individual legs should ideally be separated by 9-12 months to allow the engineers time to react to unanticipated problems. Drilling should, of course, be only part of a carefully co-ordinated and integrated program of multidisciplinary geological, geophysical, geochemical and biological investigations at each ridge crest "natural laboratory" as envisioned in the RIDGE Report. A major goal of ODP should be establishing three ridge crest "natural laboratories" by the year 2000: at both fast (EPR) and slow (MAR) spreading ridges, and at a sedimented ridge crest (Juan de Fuca/Gorda Ridge; Gulf of California).

Secondary Objectives

Magmatic processes associated with the initiation of sea floor spreading

Goal The transition from a continental to oceanic rift, and the initiation of sea floor spreading, is a fundamental geotectonic problem that is still very poorly understood. Variations in the response of the lithosphere to the rifting process provides an opportunity to examine the relative importance of brittle and ductile deformation, magmatism, and metamorphism on lithospheric evolution. Of particular interest is the nature and origin of the volcanism that accompanies early rifting, and the mechanisms that control the volume of rift-related volcanism. A better understanding of this magmatism is important to models of global crust-mantle interactions. At most margins the volcanic products of early rifting are buried under thick accumulations of post-rift sediments and drilling offers the only way of sampling this crust. Rift-related processes were identified as important secondary drilling objectives by both COSOD I and WG-4 at COSOD II.

Drilling strategy There are two different ways drilling can be used to address these problems. The first is to drill in young, active rifts like the Red Sea or Gulf of California. Both areas were drilled during the Deep Sea Drilling Project with considerable success, and further drilling in these areas is clearly warranted. A second approach is to drill relict rifts preserved in passive margins such as those bordering the Atlantic. 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.

Technical/logistical requirements Many of the drilling objectives outlined above are feasible using present drilling technology. WG-4 at COSOD II emphasized the need for deeper holes (3-4 km) into thicker sedimentary, igneous and metamorphic sections on conjugate margin pairs. On "volcanic" margins hard-rock penetration of 2-4 km is expected which will necessitate improved crustal drilling technology.

Intraplate volcanism

Goals 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 massive off-axis flood basalts or intrusive complexes. Studies of the products of mid-plate volcanism can provide important constraints on the composition and chemical evolution of the upper mantle. Three problems related to mid-plate volcanism are of particular interest: (1) the early magmatic evolution of hot spot volcanos, (2) the formation of near-axis seamounts and oceanic plateaus, and (3) the nature and origin of massive off-axis flood basalts or intrusive complexes.

Drilling strategy The range of products of mid-plate volcanism (seamounts, plateaus, flood basalts, etc.) require different drilling strategies and technical capabilities. One of our highest priorities is a characterization of the magmatic evolution of young hot spot volcanoes. Loihi is a particularly attractive drilling target; it is already extremely well-mapped and studied, it is located in relatively shallow water (~1500 m), and it is logistically convienent to Hawaii for permanent instrumentation. A single, relatively deep hole (>500 m) near the summit of this volcano could provide valuable, stratigraphically controlled samples of the juvenile alkalic phase of Hawaiian volcanism and its transition to the main theoleiitic shield-building stage. It could also serve as a permanently instrumented "natural laboratory" on an active, submarine volcano. Similarly, drilling a small near-axis seamount is necessary for an understanding of the internal structure and composition of these features, the most abundant volcanoes on earth. Drilling is the only method of unambiguously determining the age and composition of oceanic plateaus, and of sampling the mid-Cretaceous flood basalts and intrusive complexes found in the western Pacific. For this type of drilling, modest basement penetration (100-500 m) is adequate at a few carefully chosen sites

Technical/logistical requirements Drilling young hot spot volcanoes or near-axis seamounts will be technically difficult and will require both a bare-rock drilling capability and improved techniques for drilling in young, fractured basaltic rocks. However, drilling of older seamounts may be feasible with present technology. Multiple legs may be necessary at a single site, although one logistical advantage of seamount drilling is the relatively shallow water depths of some of these targets. Drilling oceanic plateaus and mid-

Cretaceous flood basalts and intrusive complexes is technically feasible with present drilling technology, although penetration of overlying cherts may be a problem in some areas.

Geochemical fluxes and magmatic processes at convergent margins

Goals It has long been clear that the subduction of the lithosphere is intimately connected to volcanism at convergent margins. What remains unclear is to what extent subducted crust, and the overlying sediments, contribute to the source of these volcanics. Some workers have suggested almost no input from the downgoing plate, others maintain the downgoing plate is *the* major source of arc magmas, and still others have argued that the subducting plate contributes material primarily through metasomatic transport caused by dewatering of hydrous phases. A quantitative evaluation of the geochemical fluxes at convergent margins is critical to an understanding of crust-mantle interactions on a global scale. The main goals of this work are thus twofold: (1) characterizing the geochemical input (sediments and crust) from the downgoing plate, and (2) estimating the crustal output in the form of arc and back-arc volcanism on the overriding plate. Neither of these first order fluxes are well-known and both require drilling as one means of study. This program was ranked highly by WG-2 at COSOD II and has been endorsed by both the JOIDES Lithosphere and Tectonics panels.

Drilling strategy In order to evaluate the geochemical fluxes at convergent margins, drilling will be required on the downgoing plate, and in the forearc and backarc environments. Quantifying the input fluxes will require sampling of the three major components being subducted: (1) a normal, marine pelagic sequence, (2) oceanic crust, and (3) ocean-island lavas and volcanogenic sediments (in some areas off-axis flood basalts and intrusive complexes may also be important). Multiple holes will thus be required at any given arc. They should be located on older crust, comparable in age to the crust presently being subducted, adjacent to well-studied island arcs. Since a significant portion of the input from the downgoing slab may come from the uppermost crust, only moderate basement penetration (~300 m) will be necessary. There are two ways of obtaining a more complete and representative record of arc output through drilling. One approach is to drill directly into basement on the arc or in back-arc basins. An alternative strategy is to drill in the clastic aprons adjacent to the arc which should record a history of the arc's evolution. Ideally, the clastic apron drilling would be co-ordinated with deeper basement drilling on the arc itself. A transect of comparatively shallow basement holes across an arc-back-arc transition, carefully sited near one or two deep holes on the arc itself, would provide good constraints on the output flux. In the longer term, arcs in a variety of geologic and tectonic settings with different geochemical signatures should be investigated.

Technical/logistical requirements Most of the drilling described above can be accomplished using the conventional technology now employed by ODP. Basement drilling in the arc and outboard of the trench would benefit from better crustal drilling techniques and improved capabilities for drilling through chert and in volcaniclastic sediments. Basement re-entry holes will be necessary in some cases, but many of the sites can be single-bit holes. Logistical considerations (weather, proximity to good ports and other drilling targets) will be important in choosing candidate arcs since the feasibility of multiple legs over a period of several years is desirable.

Physical state and evolution of the oceanic lithosphere

Goals A knowledge of the thermal and mechanical evolution of the oceanic lithosphere, and the stresses acting on the plates, is important for an understanding of a number of fundamental problems including the subsidence history of oceanic crust, the kinematic evolution of plate boundaries (spreading centers, transforms, convergent margins), and the coupling between lithospheric and asthenospheric processes. While these problems can be approached with a variety of different techniques (satellite geoid and gravity studies, high-resolution sea floor mapping, earthquake seismicity studies, seismic reflection and refraction investigations, heat flow measurements, etc.), drilling represents a potentially valuable, and often neglected, tool. A drilling program addressing these problems could have several different components. One high priority focus for this work should be to determine the stress and deformation history of the lithosphere in the critical tectonic regimes that characterize mid-ocean ridges. A program of this type could be closely integrated with the ridge crest drilling described above, and would complement the activities of RIDGE. It was ranked a top priority by WG-4 at COSOD II.

Drilling strategy. Reliable *in situ* stress measurements can now be made in ODP boreholes using stress-induced wellbore breakouts and acoustical imaging logging tools. Determining the stress regime at a mid-ocean would involve drilling a series of holes that penetrate 100-200 m into basement located in a number of relatively closely-spaced (<1 km to tens of km) arrays or transects along and across the ridge crest.. Spreading ridge segments with contrasting opening rates (2-16 cm/yr), ridge-transform intersections, and transforms with variable slip rates and strike-slip geometries should be studied. The *in situ* stress measurements should be augmented with detailed physical property and borehole studies which would help define the kinematics of brittle crustal deformation and the physical properties of the crust. Beyond this immediate goal, other lithospheric properties can be investigated as well. One drilling objective that is technically feasible, and addresses a scientifically mature problem, is flexural moat drilling. The volcanoclastic sediments filling flexural moats adjacent to mid-plate volcanoes potentially contain a valuable record of the mechanical response of the lithosphere to volcanic loading. This information will better constrain models for the mechanics of flexure, not only for oceanic volcanoes, but in other tectonic settings such as the sedimentary basins that form along passive continental margins and in front of orogenic fold/thrust belts.

Technical/logistical requirements A program of systematic mapping of *in situ* stress in crustal boreholes can begin immediately. In many cases, the same holes drilled for studies of paleoclimate change, extinction events or crustal geochemical variability can be used for *in situ* stress measurements, provided the hole is deepened 100-200 m into basement. The ridge axis stress studies will require improvements in drilling capabilities in young crust, but they can be closely co-ordinated with other ridge crest drilling.

Mantle chemistry and dynamics

Goals Long-standing questions of mantle composition, heterogeneity and dynamics are of fundamental importance to our understanding of the differentiation of the mantle, plate driving forces, and the evolution of the ocean basins and continents through geologic time. The geochemical and isotopic composition of lavas erupted along ocean ridges, at seamounts and hot spots, and on oceanic plateaus contain unique information on the chemistry and dynamics of the mantle. Radiogenic isotope ratios and related information on parent/daughter element ratios are particularly useful for identifying different mantle reservoirs, their mean ages, mixing of reservoirs, and the importance of crustal recycling. Major element variations in crustal and ultramafic rocks may also be useful for inferring mantle temperatures, and, with less certainty, the major element composition of the mantle source itself. A complementary perspective on mantle dynamics has come from recent three-dimensional seismic imaging of the mantle. These "tomographic" images of the earth's mantle are showing large regional variations in the seismic velocity of the upper and lower mantle that can be related to patterns of mantle convection. Integrating these geophysical observations with a global program of geochemical mapping holds great promise for revolutionizing our understanding of the earth's mantle over the next decade. ODP can make two unique contributions to these studies: (1) expansion of the Global Seismic Network to include ocean-bottom seismic stations located in drill holes to substantially improve the spatial resolution of mantle tomographic studies, and (2) systematic sampling of older, sedimented crust, seamounts, oceanic plateaus and hot spot volcanoes to improve constraints on the global geochemical variability of the mantle over time scales of 10^6-10^8 yrs.

Drilling strategy To accomplish the objective of improving mantle tomographic imaging, we propose the goal of establishing 15-20 sea floor seismic observatories by the year 2000. These stations should be located in crustal holes 100-200 m deep (placing the instruments in boreholes significantly reduces noise levels), and should include both short-period and long-period, broad-band seismometers. The observatories should be located in all the major ocean basins in such a fashion so as to complement the land-based stations of the Global Seismic Network. Auxiliary studies, including seismic investigations, tilt and strain measurements and electromagnetic measurements may be desirable at many of these sites. Global geochemical mapping will entail a large number of drill holes on a variety of drilling targets including old sedimented crust, seamounts, oceanic plateaus, hot spot volcanoes and linear island chains. Typically the holes need to have only limited (50-100 m) basement penetration, although some deeper penetration holes would be desirable, especially on seamounts and plateaus. In general, these holes should be located on crust encompassing a range of ages in all the major ocean basins.

Technical/logistical requirements A program of global geochemical mapping will only be feasible if it is possible to drill shallow basement holes rapidly so that over the course of a decade or so a large number of holes (on the order of a hundred or more) can be completed. Given the competing programs for the use of the drillship (including the primary lithospheric drilling objectives summarized above), this will only be possible on a large scale if a second drilling vessel is available to ODP.

Before a global network of sea floor seismic observatories can be established, a number of pilot experiments will have to be carried out to: (1) better understand the sources, propagation mechanisms and environmental controls on ocean floor noise in the 3 mHz- 50 Hz band, (2) determine the dependence of noise spectra on the depth of burial of the sensor below the sea floor, (3) compare signal and noise data from sea floor observatories with nearby island stations, and (4) prove the operational reliability of sensors, data recording and/or telemetry schemes, power sources and timing systems for long-term (>1 year) deployments. Development of a routine wireline re-entry capability is critical to being able to carry out these pilot experiments in an efficient and timely fashion.

B. Implementation Plan

1. Needed Technological Development

Perhaps more than any other group in ODP, success in achieving the major scientific objectives of lithospheric drilling will require major new technological developments in drilling systems, logging equipment and borehole instrumentation.

Drilling In terms of drilling systems, three major problems must be overcome: (1) penetration and sampling of young, highly fractured, extrusive basalts comprising the uppermost part of Layer 2, (2) low penetration rates, short bit life, hole instability and incomplete flushing of cuttings in deeper crustal holes, and (3) low recovery rates. Solving these major engineering problems will require a commitment on the part of ODP to:

- Develop a long-term plan for improving crustal drilling technology
- Assign a senior ODP engineer (and staff) permanently to this project.
- Give this group an adequate development budget that is independent of leg-to-leg operating expenses.
- Devote ship time exclusively to testing new drilling equipment on a regular basis.
- Maintain close liaison between ODP engineers and scientists within the JOIDES panel advisory structure.

While it is impossible to predict with any confidence the pace at which this engineering development effort can proceed, we recommend that the following goals be established for the program:

By 1992: Routine drilling, with a minimum of 75% recovery, to depths of 1000 m below the basement-sediment interface

By 1996: Drilling to 2000-3000 m, well within Layer 3

By 2000: The capability of drilling through the entire crustal section to Moho

Logging and borehole instruments Improvements in logging equipment and borehole instrumentation will be required as well. Both ridge crest drilling and deep crustal boreholes are likely to encounter high temperatures, up to and possibly exceeding 400°C. These high temperatures will necessitate special temperature-resistant logging tools and borehole instruments. A collection of slim-line logging tools may also be needed since the experimental mine coring systems will probably drill a hole with a maximum diameter of only about 4". A second major need is for improved borehole sampling techniques. A reliable side-wall coring technique could significantly improve the representativeness of the material recovered from crustal holes and reduce the need for very high recovery rates when drilling. New methods of borehole fluid sampling are critical for many hydrothermal and pore-water geochemistry studies. Techniques need to be developed for sealing boreholes after drilling and logging operations are completed, with some method of access for later work, Finally, ODP needs to improve the utilization of drill holes for a variety of possible hole-to-hole experiments, sea floor experiments and long-term measurements and sampling. Of particular importance is developing methods for remote data storage and retrieval from borehole emplaced, long-term instrumentation.

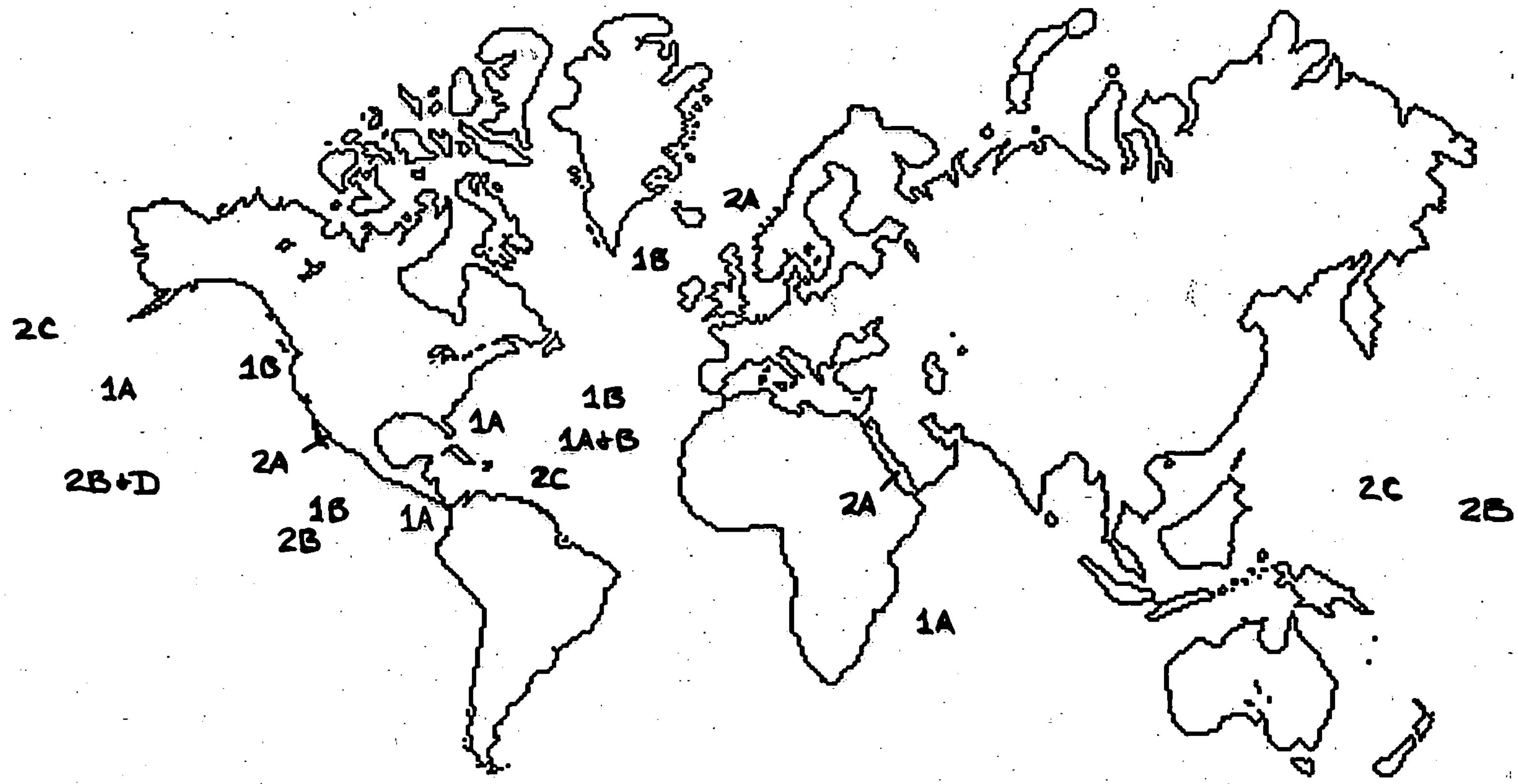
Ship facilities Our highest priority objectives of deep crustal and ridge crest drilling require a vessel with at least the capabilities of the present *JOIDES Resolution*. Logistically, these objectives will involve drilling a few (~ 30 total) technically difficult, time-consuming holes in a few carefully selected and intensely studied areas. However, some of our secondary objectives (e.g. geochemical mapping, global stress measurements) involve a large number of shallow basement holes, widely distributed throughout the ocean basins that could potentially be drilled with a vessel with much more modest capabilities. Such a vessel could also re-enter holes previously drilled by *JOIDES Resolution* for logging, downhole experiments and deployment or recovery of downhole instruments. It is probably fair to say that *without* an alternate vessel, it will not be feasible to achieve both our primary objective of drilling deeply into the crust and at ridge crests, and many of the secondary drilling objectives outlined above.

2. Drilling Areas and Required Pre-Drilling Data

The site survey requirements and selection criteria for our two highest priority objectives, deep crustal drilling and ridge crest drilling, have been discussed in the COSOD II and East Pacific Rise Working Group Reports. For both kinds of drilling, sites should only be selected after exhaustive site surveys. Regional bathymetric, side scan, magnetic and gravity surveys will be required to unambiguously define the tectonic setting of candidate sites. The crustal structure near drill sites should be determined using multichannel seismic reflection techniques (CDP and expanding spread profiles), OBS seismic tomography studies and medium-scale electromagnetic sounding experiments. Near ridge crests this work should be accompanied by detailed surficial mapping and sampling to characterize the petrologic and geochemical diversity of the area, and water column geochemistry studies to define the distribution of hydrothermal vents and constrain the advective heat output from the ridge. This site survey work should begin as soon as possible to develop the necessary databases for at least 6 candidate sites for deep crustal drilling and 4 sites for ridge crest observatories so that site selection can proceed in a timely fashion. In addition, pilot experiments should be carried out at selected boreholes (e.g. near Hawaii), to begin to address the technical issues related to the establishment of sea floor seismic observatories and global stress mapping.

The accompanying map indicates the regions that are likely targets for future lithospheric drilling. As noted above, there is an obvious division between those objectives that require drilling a few technically difficult, time-consuming holes at a few carefully selected sites, and others that involve a relatively large number of shallow holes spaced widely across most of the major ocean basins. The most likely areas for drilling deep crustal holes, given the criteria discussed above, are in the central and western North Atlantic, in the eastern Pacific (Hole 504B), or in the north-central Pacific. Potential sites for a deep crustal hole proximal to a large-offset fracture zone include the Atlantis II fracture zone on the Southwest Indian Ridge, the Oceanographer or Kane fracture zones in the central North Atlantic, or one of the large equatorial Atlantic fracture zones. Likely locations for the ridge crest "natural laboratories" include the East Pacific Rise between 9ºN and 13ºN, the Juan de Fuca/Gorda Ridge system, the MARK/TAG area in the central North Atlantic, and possibly the Reykjanes and Southwest Indian Ridges, or the Guaymas Basin in the Gulf of California.. Other second priority lithospheric drilling targets exist in all the major ocean basins, although most are concentrated in the Atlantic and Pacific Oceans. None are located at high latitudes.

Finally, it is important to note that all of the highest priority lithospheric drilling requires multiple legs at individual sites or in the same area. Thus it is **critical** that the drillship be scheduled so that it can reoccupy drill sites at intervals of 9-12 months. All of these considerations suggest that the circumnavigation philosophy that has driven the first eight years of ODP planning is **not** the optimal strategy for lithospheric drilling. Instead, we would favor a plan in which ship scheduling is driven not by regional political interests,



Likely Targets for Future Lithospheric Drilling

1A - Deep crustal drilling; 1B - Ridge crest drilling; 2A - Young oceanic rifts;
2B - Intraplate volcanism; 2C - Convergent margins; 2D - Lithosphere stress/flexure;
Global distribution: sea floor seismic stations; mantle geochemical mapping

but by the longer-term thematic drilling objectives outlined above.

3. Implementation plans at different levels of effort

Addressing the major lithospheric objectives outlined above during the coming decade will require a focussed, interdisciplinary drilling effort with the following major goals:

- By 1996 drill at least three holes 2000-3000 m into the oceanic crust, with the prospect of extending one of these holes to Moho by the year 2000. One of these holes should be located on anomalously thin crust proximal to a fracture zone, the others on crust formed at fast and slow spreading ridges

- Drill arrays of shallow (~300 m) and intermediate (1-1.5 km) depth holes in several locations along the mid-ocean ridge system, including fast, slow and sedimented ridge crests. One of these areas should be permanently instrumented to establish a sea floor "volcano observatory" by the year 2000.

- Establish 15-20 sea floor seismometer observatories by the year 2000 throughout the major ocean basins in 100-200 m deep crustal holes instrumented with short and long-period, broad-band seismometers

- Complete 50-100 shallow (<100 m deep) holes in crust of various ages, on seamounts, aseismic ridges, oceanic plateaus and across convergent margins to investigate intraplate volcanism, constrain global geochemical fluxes, and determine the state of stress of the lithosphere.

The following implementation plan gives a rough estimate of the activities and level of effort that might be required to achieve these lithospheric drilling objectives in coming decade:

Phase 1 (1989-1992)

- Establish detailed planning groups (DPGs) on "Deep crustal drilling", "Ridge crest drilling", "Sea floor seismic observatories", and "Global geochemical and stress mapping"
- Develop a long-term engineering development plan to improve crustal drilling technology, including cost estimates, manpower needs, and test-leg requirements
- Begin site survey work for at least 6 candidate sites for deep crustal drilling, 4 sites for ridge crest drilling, and 5-10 seismic observatories

- Complete 2 legs of deep crustal drilling at Hole 504B, or at another suitable deep crustal drill site
- Complete 4 legs of drilling on sedimented and unsedimented ridge crests of the eastern Pacific
- Carry out recommended pilot experiments for the establishment of a sea floor seismic observatory, probably at a site near Hawaii

Phase 2 (1993-1996)

- Complete site survey work for deep crustal holes, ridge crest drilling and seismic observatories
- Drill two or three holes 2000-3000 m into the crust (1 leg/yr for four years), including one hole near a large fracture zone (SWIR or North Atlantic)
- Begin Mid-Atlantic Ridge drilling; complete second phase of EPR drilling (1 leg/yr for four years)
- Establish 5 sea floor seismic observatories and drill 25-50 shallow crustal holes for global geochemical/stress mapping (2 legs/yr for four years)

Phase 3 (1997-2000)

- Extend one crustal hole to Moho (1-2 legs/yr for four years)
- Complete second phase of MAR drilling (2 legs)
- Establish a sea floor volcano observatory on a volcanically active part of the mid-ocean ridge system (1 leg/yr for four years)
- Establish 15 sea floor seismic observatories and drill an additional 25-50 shallow crustal holes for global geochemical/stress mapping (2 legs/yr for four years)

In this scenario, 4-5 legs (8-10 months) of drilling would be required per year to complete the four highest priority lithospheric drilling objectives by the end of the next decade. However, it is important to note that there is significant overlap in the interests of the Lithosphere and Tectonics panels, especially in the programs for global stress mapping and the establishment of sea floor seismometer stations. With careful co-ordination and planning this drilling may also satisfy some objectives of the paleoceanographic and paleontological communities.

The optimal situation for carrying out this program would the case in which a second drilling platform is available to carry out drilling (e.g. hydraulic piston coring, shallow basement penetration) that does not require the advanced capabilities of the *JOIDES Resolution*. This would probably require a substantial (~50%) increase in the level of funding for ODP, but would make it possible to drill the technically difficult, time-consuming deep crustal holes that are the highest priority of the lithospheric community without compromising other drilling programs, including some with lithospheric objectives, that require a large number of shallow holes distributed throughout the major ocean basins.

With a 10% increase in funding for ODP, a second drilling platform would probably not be feasible. In this case, the global geochemical and stress mapping programs might have to be drastically scaled back or eliminated altogether, except as done on an opportunity basis in conjunction with other drilling. The establishment of sea floor seismic observatories would probably still be practical if they could be co-ordinated with other drilling, but the number of stations might have to be reduced. If a substantial portion of the 10% budget increase is devoted to engineering development, then the deep crustal and ridge crest drilling programs should still be feasible.

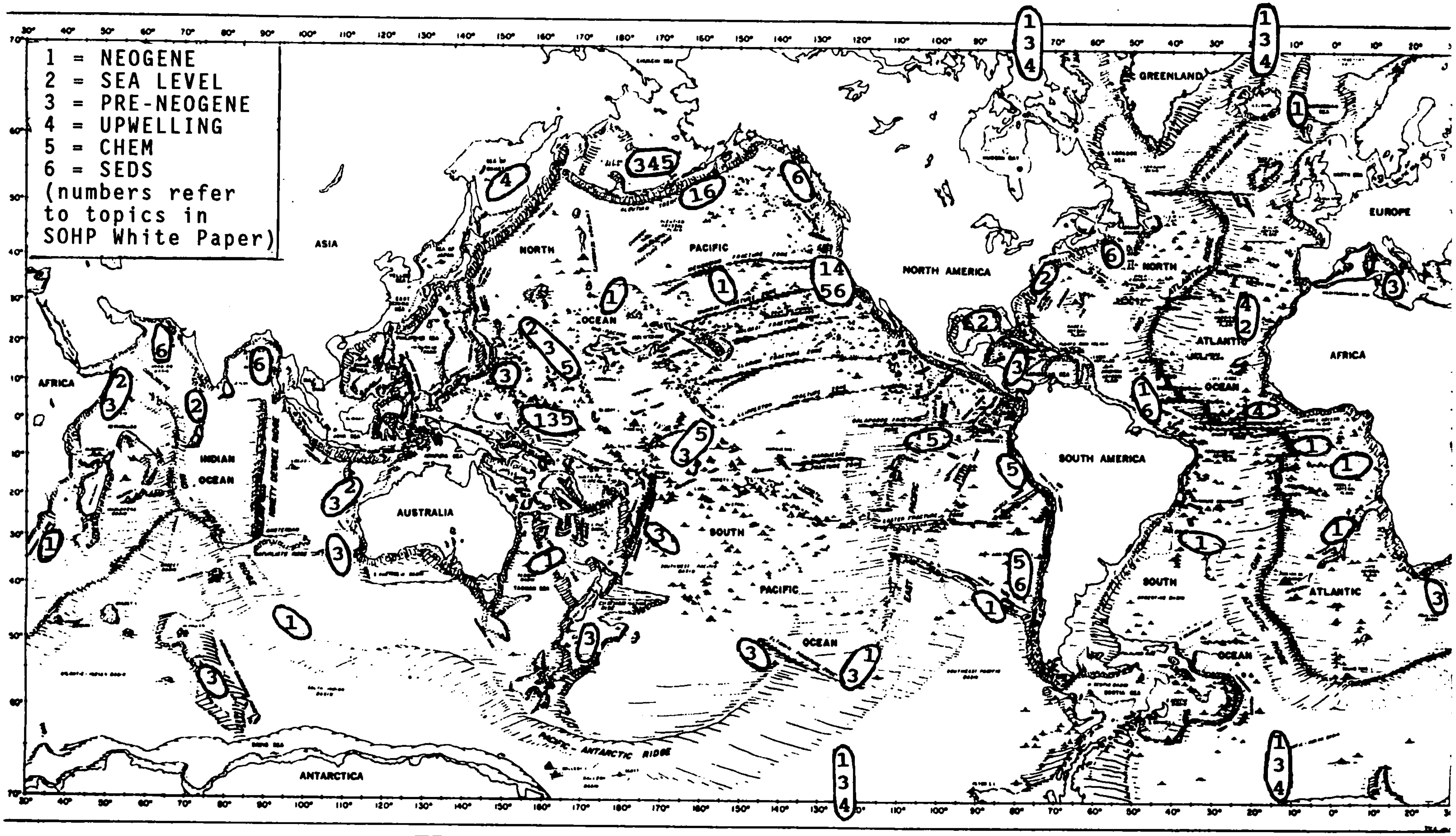
With a steady-state effort, and only inflationary increases in the ODP budget, it might be difficult to mount the major engineering development effort needed to improve crustal drilling techniques. If this occurred, even the two highest priority lithospheric drilling objectives might not be achievable by the end of the next decade. However, even with level funding a more thematically-focussed, problem-oriented drilling program could make more progress in achieving long-term lithospheric drilling objectives than has been the case so far during the first phase of ODP.

V. Relationship between ODP and other Global Initiatives

The goals of the lithospheric drilling program outlined above are compatible with a number of international research initiatives that are in progress, or are planned. Our proposals for deep crustal drilling and ridge crest drilling are closely linked with RIDGE (Ridge InterDisciplinary Global Experiments), a major new global initiative which has the unifying goal of understanding the physical, chemical and geological processes involved in the formation of oceanic crust. Drilling is an important component of RIDGE plans for the establishment of one or more sea floor volcano observatories by the end of the next decade. Our proposal to establish 20 sea floor seismometer stations in boreholes would expand efforts already underway to establish a Global Digital Seismographic Network. The plans for global stress mapping would enhance an ongoing project to create a world stress map that is being compiled under the auspices of the Inter-Union Commission of the Lithosphere. Finally, our proposals to drill on seamounts and young hot spot volcanoes complement a proposal to DOSECC for a deep drill hole on Hawaii.

SOHP

AREAS WHERE SOHP'S HIGH-PRIORITY THEMES CAN BEST BE ADDRESSED



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