JOIDES TECTONICS PANEL MEETING, MARCH 21-23, 1991
DAVIS, CALIFORNIA

EXECUTIVE SUMMARY

1. 1992 SCHEDULE: TECP registered three concerns:

a. First, the 1992 drilling schedule allows only 39 days of drilling on the Chile Triple Junction (CTJ), which is 4 days less than the minimum expressed by the proponents and Co-Chief Scientist-designate Jan Behrman for an optimum leg. TECP requests that changes in the port locations be considered in order to squeeze a few days from the transit schedule to devote to CTJ drilling.

Second. the lack of site-survey information on the proposed Hess Deep leg, in addition to the fact that the two working cross-sections on which the drill-site may be based cannot be balanced, make it hard to predict what the drill will encounter. A serious mistake is unlikely, but MOHO penetration should not be the only objective of the 1992 leg.

Third, TECP is concerned about coral recovery problems and its potentially negative impact on 2-leg program of atolls and guyots.

2. TECP is finalizing a document, by former member Mike Etheridge, about proposal quality and the review process. It has prepared a draft checklist of items expected in proposals, site surveys, and core descriptions (APPENDIX 1).

3. Offset drilling--Improved structural information is critical--a working group or DPG is needed. Two tectonic themes are dominant--formation of lithosphere at spreading center, and its disruption. Drilling shoUld be one part of comprehensive geological/geophysical study

4. TECP concurs with NARM DPG that the two-traverse plan be considered as a package

5. GLOBAL RANKINGS:

TECP GLOBAL RANKINGS, MARCH 1991

RANKING	PROJECT/PROPOSAL (Proposal #'s in parentheses)	AV. SCORE	ACHIEVABLE IN NEXT FOUR YEARS
1.	North Atlantic DPG 4 of 7 legs	13.25	YES
2	Mediterranean collison zone 1 leg (323A, 330A, 379A, 383A)	10.92	YES
3.	Chile Triple Junction leg 2 (362-Rev2--pre and post collisional zones)	8.91	YES
4.	Equatorial Atlantic margin (346/A Rev.)	8.83	YES
5.	Hess Deep-2nd leg (A tectonic leg, as yet unsubmitted, not the one proposed in the East Pacific Prospectus)	8.08	
6.	Caribbean crust (343A, 384ARev)	6.33	
7.	Western Woodlark Basin (265D, Add)	5.83	

8.	Barbados next leg (378A Rev)	5.18	YES
9.	Galicia S reflector (334 Rev)	4.75	YES
10.	SE Newfoundland ridge (363)	4.67	YES
11.tie	Slow offset drilling (A not-yet-proposed leg emphasizing the drilling component of a comprehensive study of the tectonics of formation of offset drilling sites)	4.09	
12.	N. Australian collisional margin (340D)	4.09	
13.	Red Sea, Gulf of Aden (e.g. 119, 140, 219)	4.0	
14.	Cascadia (second leg of DPG proposal)	3.82	YES
15.	Tyrrhenian Sea (e.g. 12A)	3.58	
16.	Labrador Sea (366A)	3.33	YES
17.	Cayman Trough (333A)	3.0	YES
18.	Stress at hole 505 (373E)	2.33	YES
19.	South Atlantic margins (327, 381)	2.08	
20.	Old (south) Australia margin (e.g. 65B)	2.0	

6. STATUS OF TECTONIC THEMES:

Many themes have received relatively little attention. TECP feels that a number of OTR's (ODP TECP RFP's) may be called for.

a. Rifted margins--much interest, subject of DPG, many proposals
b. Sheared (translational margins)--relatively little attention paid so far to tectonic questions. Possible subject of RFP
c. Convergent margins--much interest, many recent legs. Need to finish work in Chile, assess status of Cascadia, Barbados. Oblique convergent margins possibly a subject of RFP
d. Divergent oceanic plate margins--tectonic themes largely missing from the 20 or so proposals. Need conjugate approach on slow-spreading margins, more tectonic/structural input on fast-spreading ridges, new attack on back-arc basins. Need RFP on these subjects.
e. Plateaus, microcontinents, aseismic ridges, and anomalous basins. Considerable recent activity. Possibly need RFP for joint land/sea/drilling attack on origin of Caribbean plate.
f. Driving forces (stress, intraplate deformation). Need to continue borehole televiewer as integral part of logging. TECP encourages development of slim-hole televiewer. Possibly need RFP on intraplate deformation in the NE Indian Ocean.
g. Plate history, sea level changes. Prime target for watchdogs, as no project is worth an entire leg. Need more attention on basement ages, Cretaceous quiet zone, Mesozoic and Pacific hot spot tracks, "regional" problems such as Caribbean, timing of initiation of first oceanic crust in rifted margins.
h. Collisional margins--complex subject difficult to formulate feasible drilling projects. Need combined land/sea/drilling studies. Foreland basins need more attention.

7. TECP watchdogs are:
1. Alistair Robertson--Transform Margins
2. Steve Cande, Tanya Atwater--Plate history, sea level change, magnetic questions
3. Dale Sawyer--Young rifted margins

4. Hans-Christian Larsen--Old rifted margins
5. Jeff Karson--Mid-ocean ridges
6. Yujiro Ogawa--Marginal basins
7. Casey Moore/Jan Behrman--Convergent margins (normal subduction)
8. Phil Symonds--Convergent margins (collisional)
9. Mark Zoback--Stress and mid-plate deformation

8. DEEP-DRILLING--Two model deep-drilling sites in volcanic-poor rifted margin proposals have been prepared and discussed with engineers. Model sites for a volcanic-rich rifted margin and accretionary prism are being prepared.

9. TECP recommends that proposals not renewed three (3) years after review shall be considered no longer active.

JOIDES TECTONICS PANEL MEETING, MARCH 21-23, 1991
DAVIS, CALIFORNIA

DRAFT MINUTES

PRESENT:
Eldridge Moores, UCD Chairman
Tanya Atwater, UCSB
Jan Behrmann, Germany
Steve Cande, Lamont-Dougherty
Jeff Karson, Duke U
Hans-Christian Larsen, Denmark
Alain Mauffret, France (substitute for J. Bourgois)
Casey Moore, UCSC
Yujiro Ogawa, Japan
Mike Purdy, WHOI
Alastair Robertson, UK
Dale Sawyer, Rice U
Phil Symonds, Australia
Mark Zoback, Stanford U.

LIAISONS
Shirley Dreiss SGPP
Laura Stokking, ODP
Brian Tucholke, ODP

APOLOGIES:
K. Klitgord, USGS
S. Cloetingh, LITHP Liaison

INTRODUCTION

Eldridge Moores opened the meeting and welcomed the panel to Davis. The panel welcomed new members Steve Cande, Jeff Karson, Phil Symonds, Alastair Robertson, and Mark Zoback. Moores outlined the Agenda.

AGENDA
Welcome and Introductions
Minutes of November 1-3, 1990 meeting in Paris
Report of PCOM Meeting
Report from Liaisons
Discussion of draft documents entitled "Discussion paper on proposal presentation and review processes in ODP" by Mike Etheridge, and "Information expected in drilling site proposals"
Discussion of draft document entitled "Tectonic features to be expected along mid-ocean ridges"
Watchdogs
Offset drilling
Discussion/ranking of new proposals
Global prioritization of all proposed ODP Programs
Location of Fall 1991 Meeting
Other?

REPORT OF PCOM MEETING

Eldridge Moores reported on the PCOM meeting, pending the late arrival of Brian Tucholke. TECP voting procedures will be changed to conform to PCOM regulations.

Regarding the 1992 schedule, TECP was pleased to see two of its highly-ranked Pacific legs---Chile I and Cascadia I included. TECP registered two principal concerns.

First, the 1992 drilling schedule allows only 39 days of drilling on the Chile Triple Junction (CTJ), which is 4 days less than the minimum expressed by the proponents and Co-Chief Scientist-designate Jan Behrmann for an optimum leg. TECP registered these concerns to PCOM Liaison Brian Tucholke after his arrival with the request that changes in the port locations be considered in order to squeeze a few days from the transit schedule to devote to CTJ drilling.

Second. the lack of site-survey information on the proposed Hess Deep leg, in addition to the fact that the two working cross-sections on which the drill-site may be based cannot be balanced, make it hard to predict what the drill will encounter. This issue was revisited later in the program (see below).

LIAISONS' AND OTHER REPORTS

ODP Laura Stokking reported on Legs 133 (also Phil Symonds), 134, 135, and 136. Many records fell on 133, resulting in flood of information. Leg 134 recovery was generally good, but poor in guyot. Leg 135 contained many surprises. Leg 136 was going well.

TECP expresses concern about coral recovery problems and its potentially negative impact on 2-leg program of atolls and guyots.

SGPP Alastair Robertson and Shirley Dreiss reported on the March, 1991 meeting from the minutes and their conversations with attendees SGPP held a 1 1/2 day workshop jointly with the Safety Panel on the problem of gas hydrates. We need a leg devoted to hydrates to make basic measurements, possibly in the Atlantic. Free gas is unlikely to be present in the hydrate layer, so it is not a serious safety issue with holes in such sites. With regard to global ranking, SGPP ranked 34 highly-rated proposals in five categories--sea level, material cycling, fluids, hydrothermal and metallogenesis, and paleogeochemistry. SGPP does not explicitly consider the tectonic aspects of sedimentation.

LITHP Jeff Karson (TECP liaison to LITHP) reported on the meeting the previous week. LITHP expressed its extreme dismay at the lack of appointment of a DPG for offset drilling. LITHP is interested in proposals on large volcanic provinces, the Red Sea, and deep drilling in oceanic crust in slow, fast, on-axis, and off-axis locations.

ATOLLS AND GUYOTS DPG Tanya Atwater reported on the recent meeting. The charge was to condense two proposals of 1 1/2 legs each into 2 legs; the process went surprisingly well. TECP's interests are in timing of hotspot tracks, tectonic nature of the south-central Pacific superswell, and origin of mid-late Cretaceous volcanic episode. Yujiro Ogawa mentioned the possible origin of seamounts southeast of Japan as reactivation of faults parallel to magnetic anomalies, rather than as hotspot tracks. The legs will be one in the Mid-Pacific Mountains, with a possible port in Majuro, and a second leg towards Japan. Included are two mixed pairs on atolls and aprons. Seamounts are of three types--planed volcanics, volcanoes with reefs, and true atolls. Drowning of Pacific atolls in Aptian-Albian time possibly correlates with abrupt increase in world-wide sea floor spreading activity and with dieoff of Tethyan rudists in Mediterranean--are they really synchronous? Site survey and

core recovery problems were discussed. Some new site survey data are available Possibly lagoonal sites just behind reefs are optimal for core recovery.

NORTH ATLANTIC RIFTED MARGIN (NARM) DPG Hans-Christian Larsen, NARM-DPG Chair, distributed its report. Proposals considered in planning include: 310-SE Greenland, 311-Rockall trough, 328 NE-Greenland, 334-Rev-Galicia S-reflector, 358-Vøring transect, 363-SE Newfoundland ridge, 365Rev-Non-volcanic margins. Not considered were 3902, 393, 394, 395, 396, 363-add. The DPG reduced 15-25 legs to about 7. A second meeting has been requested. TECP revisited this matter after proposal review.

DEEP DRILLING:

Dale Sawyer reported on discussions with engineers on his two model deep-drilling proposals from the North Atlantic non-volcanic margins proposal. The sites were : NB3 to penetrate substantial thicknesses of sediment to basement, and G1a to penetrate great thicknesses of basement. The NB3 model was in 4000 m water, and included 2260 m sediments and 40 m basement for a total of 6300 m. drill string. It would require about 46 days plus science plus logging plus contingencies. It requires new slimhole drilling capability, which should be tested soon. Continuous coring is impracticable; multiple casing is required. The G1a model includes 5180 m water. 1700 m sediments, and 1800 m basement, for a total of 8680 m drill string, which exceeds the weight capacity of the derrick in all be flat calm. It would require 35 days plus science plus logging plus contingencies to basement. The engineers cannot estimate basement penetration rate. Conclusion: not possible with current ship configuration. Deep drilling site possibilities are very site-dependent. We need to consider deep-penetration holes in shallow water, e.g. hole 735 B or on the Mediterranean ridge. Casey Moore will prepare a model site in an accretionary prism, for which closed circulation and pressure control is key. Hans-Christian Larsen will present a model deep volcanic margin site. TECP will explore the possibility of having an engineer at the next meeting to discuss engineering problems, and/or Dale Sawyer will prepare for TECP a report on deep drilling limitations.

OCEAN SEISMIC NETWORK (OSN)

Mike Purdy reviewed the objectives of the program. The first experimental site is being drilled. Instruments are still in developmental stage. There are three issues--data, power and timing. The latter two are in hand, but data recovery is a problem. Telemetering, satellite, and internal recording are the possibilities. There will probably be many failures. TECP's role with OSN is to identify holes that, if a re-entrycone and appropriate casing are left, can serve as an OSN site. There are areas on the sea floor that have been identified as high priority. There is now liaison between JOIDES and the Federation of Digital Seismic Networks, a committee that talks about network siting.

DISCUSSION OF DRAFT DOCUMENTS

A discussion of all three draft documents ensued. TECP decided to forward Mike Etheridge's to PCOM after he has a chance to review and revise it if he so desires. Chair will incorporate items from Etheridge's letter and other two documents into a TECP checklist to be forwarded to PCOM and Site Survey Panel. (SEE APPENDIX 1 FOR DRAFT CHECKLIST!)

"LETTER FROM FRANCE" BY YVES LANCELOT

TECP discussed the letter in terms of the future of ODP and the question of focused themes vs proposal-driven science. The project as a whole walks a thin line between seeing that major questions answered (central control) vs. diversification and democracy. TECP felt that it is not necessary that ODP should control everything--some diversification is inevitable and even desirable. The total effort should be cooperative, however. All representatives of non-USSAC organizations indicated that there is considerable support for continuation in ODP.

OFFSET DRILLING

At Moores' request, Jeff Karson discussed his analysis of the structural data available from Hess Deep, based in part on his participation in the Alvin dives. Karson described how little is known about the structure of the Hess Deep area--the published cross-sections reflect this. He described how he and his postdoctoral fellow, Steve Hurst, had constructed alternative balanced cross-sections that predict substantial differences in rocks to be expected in the various proposed drill sites. TECP concluded that a serious mistake is unlikely even without new site data beforehand, because the acquisiton of new information about the lower crust is fairly certain. The lack of predictability about what will be encountered in a given hole means, however, that at this time MOHO penetration should not be the only objective of the 1992 leg. Any future leg in this region should have a strong tectonics-structural input. Future drilling should be only one part of a comprehensive field structural/geophysical survey aimed at addressing 1) the tectonic development of the East Pacific Rise Crust exposed in the walls of the Deep; and 2) the nature of the aseismic extension giving rise to the Deep itself, and its relation to the Galapagos propagator. Karson agreed to prepare a draft paper on this subject for TECP to forward to PCOM.

Improved strructural information is critical for offset drilling; a working group or DPG is called for.. We discussed seismic strategies, including VSP; staffing requirements for structural geologists, and need for data acquisition for improving structural information. TECP will join LITHP in addressing a letter to PCOM about the need for an offset drilling working group or DPG. TECP emphasizes the need to address the two-fold nature of tectonic questions surrounding any such site or sites--1) the tectonics of the formation of the crust and mantle at the spreading center, and 2) the tectonic significance of the dismemberment and exposure in the proposed offset sites. Any drilling that addresses adequately these tectonic questions will be one part of a comprehensive geological/geophysical study of the whole region including the site or sites.

PROPOSAL REVIEW

(N.B. In conformity with PCOM guidelines, any proponents were absent from the room during all discussion and voting on a given proposal).

52 Add/rev. Continental margin sediment instability investigation by drilling adjacent turbidite sequences

This is a well-formulated proposal. Although the proposal does not test high-priority tectonic thematic objectives, TECP is interested in understanding turbidite-depositional signatures associated with sealevel changes. Specifically, we would be interested in verification of the hypothesis that large turbidites are emplaced during rising and falling of sea level as opposed to low stands. More consideration shold be given to the mechanics of triggering turbidites during changes in sea level and any possible distinction from seismic triggering.

Ranking: 2, mature.

323-Rev. The Alboran Basin and the Atlantic-Mediterranean gateway....

This proposal to examine Neogene evolution of continental basement overthrusting and extension in the Alboran Sea addresses the general TECP theme of understanding deformation processes at convergent plate boundaries, as well as specific objectives such as the dynamics of interaction of extensional and collisional structures. The other part of the proposal on the development of the Atlantic-Mediterranean gateway, with its paleo-environmental goals, does not address high-priority TECP objectives, but recognises the influence of tectonics on the gateway and thus on sedimentary facies distribution.

TECP feels that the global significance of the collisional processes examined, and the reasons for studying them in this area, needs to be better argued within the proposal. This is a complex area, and clarification of the tectonic setting of each of the sites, along with a re-think of site seismic interpretations and their ambiguities, should improve the proposal. Clear links need to be made between the expected results of each site and the global themes. The proposal would benefit from the addition of subsidence curves from the existing shelf wells, particularly those in the Miocene grabens, and site prognoses containing explicit predictions of sediment types. This will give an indication of the extent to which drilling will be able to constrain the subsidence history of the grabens, and thus the relationship between collision and extension. Structure contour and isopach maps, showing the distribution of the major sequences between proposed sites, would improve the proposal, as would a simple figure illustrating the general setting and proposed evolution of the Alboran basin. Additional constraining data needed to achieve the objectives could be pinpointed, showing which of these data is existing, and what will come from ODP drilling. Is there a location within the Alboran Basin where the objectives of Site AL-1 could be better achieved (i.e. more substantial recovery of middle Miocene and early Miocene section in a clear syn-rift configuration) with less than the 3000m of penetration presently proposed? Given that the region has been explored for petroleum, has consideration been given to potential safety problems related to ODP drilling?

It is clear that important collisional tectonic objectives can be addressed in the Alboran Sea. TECP feels that consideration of the above comments will help the proponents to revise their potentially exciting proposal and produce a well-focused and achievable ODP drilling program.

Ranking: 4, Immature.

334-Rev. Galicia margin S reflector and ultramafic basement

TECP is very interested in drilling of the S reflector in a location where it is likely to represent a basement contact. We look forward to seeing seismic data, particularly velocity analyses, that are currently underway. We are especially interested in seeing drilling that will test the "shear zone" hypothesis for the Iberian margin. The correlation of S' to S (and other reflectors in the area) will help make a more convincing case for any of the drill sites.

Ranking: 4, mature.

363-Add. Paleoceanographic record at proposed drillsites NR1, NR2, and NR3.

This addendum to proposal 363 has little or no tectonic thematic interest. The original proposal continues to have high thematic interest. The addendum, which

addresses OHP and SGPP interests, does not degrade TECP interest in the original proposal.

TECP formally discussed the original proposal, and there were two suggestions to the proponents:

1) Why extend the longitudinal drilling mostly northward? The J-anomaly ridge appears simpler to the south.

2) One panelist asserted that the DSDP hole on the J anomaly missed the magnetic source region and, therefore, was not really viable as a part of a longitudinal transect.

Ranking: 1, no maturity box checked.

365-Rev Conjugate passive margin drilling--North Atlantic Ocean

The two proposed transects need to be presented (including cross-sections), taking into account the rift basins landward of the proposed study areas. It is pertinent to have a complete structural framework, including a proposed (semi-) balanced cross-section showing tectonic evolution, expected subsidence (amounts, lateral distribution, etc.). The structural interpretations shown on seismic profiles must be improved and associated with more rigorous seismic stratigraphic analysis, tieing into existing wells (commercial or scientific). Seismic imaging of deep targets on the Northern Newfoundland Basin part must be improved and data from the Iberia Abyssal Plain part migrated. Multi-channel seismic reflection data are needed for the North Flemish Cap part. Basement sampling in the northern Newfoundland Basin is important, and its feasibility must be documented

Ranking 4, mature.

389 Cretaceous N-S traverse in the western South Atlantic

As presently written, this proposal has no tectonic component. Furthermore, the proponent has not analyzed existing cores to demonstrate that the method works. If this proposal is rated highly by other panel(s) and is developed furthur, TECP requests that the proponent acquire a co-proponent with tectonics expertise, as several sites could be chosen to answer interesting tectonic questions, without detracting from the biological objectives

Ranking: 1, immature

390-Drilling in the Shirshov Region.

TECP welcomes this first proposal from our Soviet colleagues. The proposal, however, requires substantial development before TECP can carry out an effective review. Several important tectonic problems can be tackled by a Bering Sea drilling program. This proposal needs modification so that it effectively links the anticipated drilling results to process-oriented back-arc tectonics.

TECP encourages the proponents to develop this proposal by defining further exactly how the drilling will elucidate the origin and evolution of the Shirshov ridge. In addition, we encourage the proponents to establish contact with David Scholl of the U. S. Geological Survey, Menlo Park, who had a Bering Sea drilling proposal already pending with JOIDES. A combined proposal that addressed a suite of objectives in the Bering Sea would receive substantial attention from our panel.

Ranking: No ranking, too immature.

391. Depositional history and environmental development...sapropels in the eastern Mediterranean

This is an exiciting proposal to drill sapropels in the eastern Mediterranean with a view to testing alternative paleoceanographic hypotheses of organic matter preservation. As written, the tectonic objectives of the proposal are limited. In further planning and/or revision of this proposal, we ask that the following points be borne in mind:

1) The Eratosthenes seamount south of Cyprus may well have an intact Plio-Quaternary pelagic succession, with only minimal clastic input. Floyd McCoy, Hawaii Institute of Geophysics, is collating seismic and other data for this feature. If chosen for drilling sapropels, we urge penetration to basement to resolve the question of an oceanic versus continental origin of this important tectonic feature. Also, basal hydrothermal (Mn) deposits have been cored and reported by S. P. Varnavos (Patras, Greece), could be of interest to SGPP.

2) The sites drilled in the Mediterranean ridge could help document the vertical tectonic evolution of this important collisional/accretionary feature.

3) Other sites could be chosen to document a) the history of Aegean volcanism/arc development and b) uplift and erosion of Anatolia.

4) The proponents should consider combining the sapropels proposal with other tectonically oriented Mediterranean proposals--379A, 383A.

5) A. H. F. Robertson, Edinburgh, U.K. representative to TECP, and TECP liaison with SGPP, would be glad to assist the proponents in any way possible.

Ranking: 2, Immature

392. A mantle plume origin of the North Atlantic volcanic rifted margins....

This is a clean, compact, well-presented proposal. It is not yet mature, however. TECP suggests consideration of the following items to improve the proposal and to bring it to maturity:

1) Discuss in detail the reinterpretation of magnetic anomalies and structural interpretation along the continental margin;

2) Transverse seismic lines are needed to tie sites 3 and 4 to 1 and 2 in an integrated structural interpretation;

3) What is known about the conjugate margin (whether it is drillable or not) to fit the study into a larger context of models of VRM development?

4) What is chemistry and ages of the Thulean flood basalts?

5) Is hole LABS 2 needed? Should LABS 1 be deepened?

6) Is there a site where LABS 3 and 4 could be combined into one hole?

7) Is there any data that might suggest the composition of the possible peridotite ridge?

8) Is this the best place to try to correlate seaward-dipping reflectors with continental flood basalts?

Proposal ranking: 4 immature

393 Drilling the continent-ocean transition on the SE Greenland volcanic rifted margin...

The lack of seismic data in section B is a significant flaw in a proposal that intends to correlate the seaward-dipping reflectors with the continental flood basalts. Questions that need to be addressed are :

1) Why is this area better to study the SDRS-CFB correlation than the DPG high-priority transect?

2) How will the volcanic rocks be dated? Will the dating be precise enough to effect the intended correlation?

3) How will the drilled volcanic rocks be correlated with the CFB's?

4) What geochemical observations will be made?

5) What is the relation between the proposed drilling region and the conjugate margin; what is the nature of the latter?

TECP recommends that the proposal be sent to the NARM DPG for consideration in the context of the Volcanic Rifted Margin transect

Proposal ranking: 4 immature

394. Evolution of pre- and syn-volcanic extensional basins on passive volcanic continental margins

The tectonic/regional setting needs to be added. The correlation of volcanic unit 3 to the volcanic break-up sequence along the Hatton Bank margin (including SDR's) should be discussed and specifically demonstrated. TECP's view is that one hole should be sufficient to meet the major drilling objectives. The drilling objectives should be related better to the overall fundamental problems listed in the Introduction. TECP wishes to draw the proponents' attention to a rather similar proposal (311) and encourages contacts between the two groups holding data in the region.

Ranking: 4 immature

395. Post-breakup compressional tectonics on a passive volcanic continental margin

The case for this proposal is not well made. It is not clear from the proposal that the feature is of local or regional significance. It could be a flower structure related to a strike-slip fault of limited extent The proposal objectives should be placed in the broader view of possible compressional deformation in the North Atlantic as a whole. The information presented on the sedimentary cover is inadequate.

Ranking: 2 immature

396. Testing of the hot-spot model for the origin of volcanic passive continental margins

This is a preliminary proposal addressing two objectives: 1) testing the hot-spot origin of volcanic passive margins; and 2) broadening the geochemical database in order to enable modelling of melt sources and to clarify the contribution of lithospher composition and continental crust contamination in volcanic passive margin evolution. TECP feels that existing geochemical data missing from the proposal could make the case stronger. The proposal does not consider the possibility of multiple melt sources. The geochemical rationale must be developed more explicitly and convincingly. The site survey information is incomplete.

Ranking: 3 immature

S-1. Documentation of lithofacies and depositional cyclicity, Navy deep-sea fan, California borderland.

This proposal essentially falls outside the mandate of the Tectonics panel. TECP does have an interest in the record of eustatic changes in sea level, and in other possible tectonic implications of deep-sea fan deposition. These interests are only indirectly addressed by this proposal, however.

Ranking: 2 immature.

NORTH ATLANTIC RIFTED MARGIN DPG REVISITED

Hans-Christian Larsen renewed the discussion of the North Atlantic Rifted Margin DPG by outlining the evolution of thought in the past 2-4 years about rifted margins. During this time it has become clear that approximately 50% of the world's rifted margins are volcanic-rich in nature. This surprising new insight means that we must revise our perception of how continental margins form, and what it is that initiates a Wilson Cycle. The existing volcanic-rich margins are related to the breakup of the Pangea supercontinent. Geographic and temporal relations imply that they form as a result of development within the mantle of hot regions, 100 times larger than plumes (in other words, structures that are reminiscent of the 800-1000 km diameter "corona structures" recently recorded in the Magellan radar data from Venus). A possible cause may be the thermal blanketing effect of large supercontinents.

The formation and development of volcanic-rich rifted margins seems to be very rapid, within 1-5 million years, in contrast to the development of volcanic-poor rifted margins,which develop slowly but continuously over tens of millions of years. These latter can expose the mantle without volcanism, possibly by some form of asymmetric rifting (simple shear?). Sheeted dikes within continental rocks are one feature that signals the copious igneous activity that marks the development of volcanic-rich margins.

Considerable discussion took place about the significance of these new results and their possible implications for tectonic history of other areas. Robertson observed that the Permo-Triassic margins in the Mediterranean region, subsequently caught up in the Alpine orogeny, seem more reminiscent of volcanic than non-volcanic margins. The specific sequences include the Verrucano (bimodal volcanism and associated sediments) of the western Mediterranean and the "Diabase-chert" assemblages of Yugoslavia and Greece. Moores wondered about the Triassic-Jurassic silicic "Tobifera-Choiyoi-Chonaiki" volcanism of southern South America, documented, among others, by former TECP Chair

Dalziel and co-workers, and posed the question as to the extent to which seaward-dipping reflectors are silicic in nature.

The ODP North Atlantic drilling has an unparalleled opportunity to investigate the contrast between volcanic-rich and volcanic-poor rifted margins. To do so, they propose to concentrate on two transects--a volcanic-rich margin transect eastward from southeast Greenland, and a volcanic-poor transect eastward from Newfoundland. Larsen expressed the DPG's hope that the two transects could be considered as a package, rather than as two competing projects. TECP endorsed this view, as reflected in the Global Rankings, outlined below.

GLOBAL RANKINGS

STATUS OF TECTONIC THEMES

Moores opened consideration of global assessment by outlining the major themes of concern to the Tectonics Panel, and calling for volunteers to assess the status of these tectonic themes in the context of existing proposals and recent drilling results Exciting aspects of oceanic drilling research include 1) the understanding active processes and 2) providing an actualistic anchor from which to develop a historical perspective about the evolution of the Earth in times prior to the preservation of oceanic crust and its well-known magnetic anomaly "road map" of plate motions. The discussants evaluated the status of their particular thematic area:

THEME	DISCUSSANT(S)
1. Rifted margins: volcanic-rich volcanic-poor	Hans-Christian Larsen
2. Sheared (translational) margins	Alastair Robertson
3. Convergent margins	Jan Behrmann
4. Divergent oceanic plate margins	Jeff Karson
5. Plateaus, microcontinents, aseismic ridges, anomalous basins (Caribbean, Scotia Sea)	Alain Mauffret
6. Driving forces, including stress, intraplate deformation	Mark Zoback
7. Collisional margins	Phil Symonds
8. Plate History, sea level changes and origin of magnetic anomalies	Tanya Atwater, Steve Cande

RIFTED MARGINS

Hans-Christian Larsen enlarged upon his earlier NARM DPG report and described how rifted margins have been the subject of many ODP proposals. The principal projects put forth are:

1. The North Atlantic transects embodied in the NARM DPG report
2. Basins marginal to volcanic-rich margins (proposals 310, 394)
3. Southeast Newfoundland (proposal 363)
4. Labrador Sea
5. Old Jurassic Atlantic margins (Proposals 326, 344, 74, 85)
6. South Atlantic margins (Proposals 381, 327)
7. Young rifted margins:
   Red Sea/Gulf of Aden

Bransfield Strait-Antarctic margin
Tyrrhenian Sea
(Proposals 351, 353, 140, 21, 219, 134, 119)

8. Other older margins:
   Antarctica
   Australia
   SE Africa
9. Western Woodlark Basin

SHEARED (TRANSLATIONAL) MARGINS

Alastair Robertson pointed out that these represent the third great category of plate boundaries. They have received relatively little attention in the past, but the rapid increase of information on the other boundary types has led to new attention devoted to these types. There are several categories:

1. Continental margin translational openings, e.g. equatorial Africa. One proposal is extant, and much recent work has gone into its revision. Issues here include crustal structure, subsidence history, and basement highs.
2. Oceanic fracture zones. Most proposals, such as those for the Kane Fracture zone and the Central Indian Ocean, have chiefly addressed igneous processes and have mostly ignored tectonic questions. Tectonic problems include the mechanics of uplift of mafic-ultramafic highs, such as the Vema fracture zone, and the swings into the transform of the spreading fabric, which has been ascribed to changes in regional stress pattern.
3. Transform continental margins--e.g. the southern California Borderlands. Existing proposals are entirely stratigraphic. Opportunity exists here for onland-offshore tieups. Many examples exist in places such as the western Indian Ocean, as well as in mountain belts (e.g. Alpine sector of the Gondwana-Laurasia opening).
4. Trench-trench transform faults. Examples include the South Sandwich, southern Caribbean, and western Aleutian margins. We know little about these features.

Few if any top-rated tectonic proposals exist in this theme. The most hopeful is the revised Gulf of Guinea proposal whcih should come to us soon. We should issue an RFP in this area.

CONVERGENT MARGINS

Jan Behrmann outlined the status of this theme. Many proposals and drilling legs have addressed issues related to this theme. Outstanding issues/proposals are:

1. Chile triple junction will be partly done in 1992. Issues that will remain include the longitudinal (time-transgressive) evolution and the question of subduction erosion.
2. Cascadia margin will be done in part in 1992. It is unclear what will be left over.
3. Barbados. The current proposal is too large. TECP suggests re-division into three aspects:
   a. Unanswered questions from Leg 110, principally instrument-accented fluid flow measurements.
   b. Southern Barbados, the Westbrook sector, focusing on questions of episodicity of accretion and growth kinetics of wedge.
   c. Forearc basin development in the northern sector.

In revision of the Barbados proposal(s), particular attention should be paid to focusing on questions of global significance, rather than area-specific problems.
4. Mediterranean Ridge (proposal 330 Add).
5. Kurile trench (old proposal of 1987 vintage)
6. Global issues include tectonic erosion (e.g.Chile, Puerto Rico, Mexico, Peru, Japan) and hydrogeology (e.g.Barbados, Cascadia II, other?). (Moores observed that resolving the issue of tectonic erosion will require combined onland/marine studies.).
7. Oblique convergent margins (e.g inner Caribbean margins) were the subject of a recent workshop in Jamaica. No proposal has been forthcoming. We should issue an RFP in this

DIVERGENT OCEANIC PLATE MARGINS

Jeff Karson observed that tectonic themes are largely missing from the approximately 20 proposals for drilling at mid-oceanic ridges, and the ubiquitous tectonic questions have simply been ignored.

Slow spreading ridges have major fault escarpments parallel to the ridge, which commonly are simply viewed as "giant road cuts" for lithospheric sampling, but which are instead an integral and poorly-understood tectonic component of lithospheric development. The "surprises" encountered in many holes in slow-spreading ridges point to the lack of structural and tectonic control on these sites, and to the lack of understanding of the development or even the nature of oceanic lithosphere. Most median valleys that have been surveyed in detail are asymmetrical, rather like conjugate continental margins. Brian Tucholke observed that hole 735B contained very exciting structural information, and a lot more could be done in this regard on this and other cores. In response to a panelist's query, Karson observed that a good target for drilling would be major reflectors in the oceanic crust. He suggested a two-part approach to attack this problem: 1) someone should be commissioned to collate the structural information in older DSDP/IPOD/ODP cores; and 2) we should issue an RFP for conjugate drilling across the median valley.

Fast-spreading ridges are more problematic because the structures are not so well-exposed obvious. Nevertheless there is need for more tectonic/structural input here, as well. The tectonic information from hole 504B is understudied. Hess Deep constitutes a unique opportunity to extract tectonic information about the development of fast-spreading East Pacific Rise crust, but the existing drilling proposals are essentially petrologic in nature. Tectonic/structural considerations were not a part of the East Pacific Rise DPG. A related question is the nature of amagmatic spreading such as that which formed Hess Deep at the western end of the Galapagos propagator.

Back-arc/marginal basins have been the subject of a number of proposals, most of which have tectonic objectives. Examples mentioned included the Tyrrhenian and Aegean Seas and Bransfield Strait. These examples provide good opportunities for land/sea tieup. All proposals are good, but the Aegean is immature.

Ophiolite analogues would be helped by any oceanic crustal drilling. Questions of the initiation of subduction and ophiolite emplacement have not been addressed (except for the minor consideration of the Taitao Ridge in the Chile Triple Junction proposal). A further issue is the high temperature metamorphic soles of ophiolite complexes--where are they forming today. Proposals to drill the Aoba basin and the Woodlark basin bear on the ophiolite analogue. It would be nice to see a proposal address the initiation of subduction in the Macquarie Island region.

During discussion, several veteran panel members expressed considerable frustration about TECP's repeated revisiting this topic without coming up with concrete objectives. Perhaps what is needed is a different approach. Instead of trying to piggyback tectonic objectives on existing oceanic spreading center proposals, one should develop a tectonic proposal from scratch, in which drilling objectives are only part of a comprehensive geologica/geophysical/drilling project addressing the question of the tectonics of development and/or preservation of oceanic lithosphere.

PLATEAUS, MICROCONTINENTS, ASEISMIC RIDGES, ANOMALOUS BASINS (CARIBBEAN, SCOTIA SEA)

Alain Mauffret summarized a few principal regions of this category--Kerguelen, Ontong Java plateaus, the Pacific volcanic province, Agulhas plateau, Caribbean, etc. Some of these have been drilled, and some are the subject of proposals of varying status. The origin of the Caribbean, for example, is related to the question of the origin of anomalous volcanic provinces. Drilling in these regions for tectonic objectives is difficult and requires careful geophysical constraint and possibly close coordination with on-land studies. Phil Symonds suggested an RFP for a combined land-sea study of the Caribbean region aimed at formulating questions that could be answered by drilling.

DRIVING FORCES, INCLUDING STRESS, INTRAPLATE DEFORMATION

Mark Zoback mentioned that the borehole televiewer for stress determination is a standard down-hole logging tool for rotary core bit holes. For this aspect we need only to encourage its continued routine use. The borehole televiewer is not yet available for the smaller diamond coring system holes. Can we encourage its development?

The intraplate deformation in the NE Indian Ocean (southeast of Sri Lanka) is possibly a nascent subduction zone and is a prime candidate for possible study.

COLLISIONAL MARGINS

Phil Symonds summarized the status of this subject. There are nine proposals since 1987 on this theme, principally in the Mediterranean and in the Australia-Indonesia-New Guinea collision zone. The complex nature of these systems makes it difficult to formulate well-focused drilling proposals especially with the present state of knowledge. Collisional systems, however, offer an opportunity to meld ODP research with land geology. There are many significant questions to be answered, such as the nature of extension in collisional systems. For example, the continental crust of the Alboran Sea appears to have thinned from 40 to 14 km in a few million years. The Aegean Sea has a similar history. Foreland basins represent relatively neglected regions. They are of economic importance and are a key element in the interpretation of collisional mountain systems. The east Indonesian-Papua-New Guinea foreland basin is an example, as well as being an important area in which to study terrane accretion processes. Collisional accretionary prisms are present in the Mediterranean and in eastern Indonesia--these features clearly are related to active margin accretionary prisms.

PLATE HISTORY, SEA LEVEL CHANGES,

Tanya Atwater noted that the tectonic aspects of these subjects generally are not worth a whole leg. She and Steve Cande volunteered as "Watchdogs" to be alert for possible addition of tectonically oriented drilling in this regard to other proposals. There are several subjects that command attention:

1. Basement ages are not known in some places. This lack of knowledge could be addressed by selective deepening of holes drilled for other purposes.

2. The Cretaceous quiet zone needs more work. There have been a few suggestions of "wiggles" in the magnetic field during this zone, but we need more information about the nature of the magnetic record in the oceans to correlate with land studies.

3. Hot spot tracks and absolute plate motions are not well known in the Pacific and in the Mesozoic everywhere.

4. There are several "local" or regional problems that we tend to lose sight of, such as the Caribbean and the Indian Ocean soft plate boundary. There may be other soft plate boundaries, as well.

5. We need to know the time of initiation of the first oceanic crust in passive margins, in order to properly understand the nature of the continental margin magnetic features.

ORIGIN OF MAGNETIC ANOMALIES

Steve Cande mentioned that the question remains as to the location of the magnetic anomalies. There are a number of contradictory observations:

1. There is considerable extensional rotation in slow-spreading oceanic crust, which doesn't always seem to be reflected in some magnetic anomalies.

2. The magnetization is low in layer 2, suggesting that the source is deeper.

3. The magnetic anomalies are skewed in some cases more that would be predicted from structural information, and less so in others. For example, the M0-M10 sequence in the central Atlantic displays perfect unskewed magnetic profiles, whereas Anomaly 34 is highly skewed. The slow spreading rate would seem to be compatible with fault-block rotations and skewed anomalies. The M0 anomaly has been drilled, so it would be interesting to drill Anomaly 34 for comparison purposes. This might be a fruitful subject for an RFP, perhaps for the transect south of the Kane Fracture zone.

WATCHDOGS

TECP watchdogs have the following responsibilities:

1. To keep track of their individual themes and to have the most up-to-date information necessary to evaluate and rank proposals or themes within the system.

2. Monitor proposals on a given theme from birth through adolescence to maturity. Make sure that detailed information gets back to proponents on what is necessary for greater applicability to TECP themes. Keep TECP informed of status of proposals within their individual theme.

By consensus of the panel, the following watchdogs were appointed for the indicated areas:

1. Alastair Robertson--Transform Margins

2. Steve Cande, Tanya Atwater--Plate history, sea level change, magnetic questions

3. Dale Sawyer--Young rifted margins

4. Hans-Christian Larsen-Old rifted margins

5. Jeff Karson--Mid-ocean ridges

6. Yujiro Ogawa--Marginal basins

7. Casey Moore/Jan Behrmann--Convergent margins (normal subduction)

8. Phil Symonds--Convergent margins (collisional)

9. Mark Zoback--Stress and mid-plate deformation

GLOBAL RANKINGS

Global rankings were made by listing 25 outstanding thematic issues and/or proposals on the screen and each person ranking 20 in order. Proponents agreed not to vote on their own proposals and to indicate on their ballot that they had a conflict. Scores were tallied, and averages computed by dividing total scores by the number voting minus the number of conflicts (12 or 11 in every case).

Rankings were further qualified by indicating which ones were achievable in the next 4 years, according to TECP consensus. Explanatory discussions follow the rankings.

TECP GLOBAL RANKINGS, MARCH 1991

RANKING	PROJECT/PROPOSAL (Proposal #'s in parentheses)	AV. SCORE	ACHIEVABLE IN NEXT FOUR YEARS
1.	North Atlantic DPG 4/7 legs	13.25	YES
2	Mediterranean collison zone 1/2 legs (323A, 330A, 379A, 383A)	10.92	YES
3.	Chile Triple Junction leg 2 (362-Rev2--pre and post collisional zones)	8.91	YES
4.	Equatorial Atlantic margin (346/A Rev.)	8.83	YES
5.	Hess Deep-2nd leg (A tectonic leg, as yet unsubmitted, not the one proposed in the East Pacific Prospectus)	8.08	
6.	Caribbean crust (343A, 384ARev)	6.33	
7.	Western Woodlark Basin (265D, Add)	5.83	
8.	Barbados next leg (378A Rev)	5.18	YES
9.	Galicia S reflector (334 Rev)	4.75	YES
10.	SE Newfoundland ridge (363)	4.67	YES

11.tie	Slow offset drilling (A not-yet-proposed leg emphasizing the drilling component of a comprehensive study of the tectonics of formation of offset drilling sites)	4.09	
12.	N. Australian collisional margin (340D)	4.09	
13.	Red Sea, Gulf of Aden (e.g. 119, 140, 219)	4.0	
14.	Cascadia (second leg of DPG proposal)	3.82	YES
15.	Tyrrhenian Sea (e.g. 12A)	3.58	
16.	Labrador Sea (366A)	3.33	YES
17.	Cayman Trough (333A)	3.0	YES
18.	Stress at hole 505 (373E)	2.33	YES
19.	South Atlantic margins (327, 381)	2.08	
20.	Old (south) Australia margin (e.g. 65B)	2.0	

Comments on Rankings:

1. TECP has confidence in the NARM DPG, and is willing to trust their judgment as to which of the proposed legs should have priority.

2. This ranking is based on increased TECP interest in the concept of collisional processes. Two proposals (Alboran Sea and Mediterranean ridge) are well enough developed to be brought to maturity in time to be included in the next four years. The proponents should be encouraged to come up with the needed new data and analysis in time to meet the schedule.

3. New site survey information has been accomplished to sharpen focus of second leg. Ranking is consistent with TECP's previous global ranking.

4. New site surveys have been completed in the Gulf of Guinea. New submersible data will be available soon. The proponents should be encouraged to revise proposal in time for the next four years' program.

5. TECP is interested in a tectonically focused leg, perhaps as a substitute or complement for a lithospheric focus. New site survey information is crucial. It is unlikely that adequate survey information will be available in time for the next 4 years.

6. In TECP's view the Caribbean presents exciting problems related to the origin of oceanic plateaus, the possible emplacement of an exotic plate from the Pacific. We note, however, the deficiencies of existing proposals, and we do not believe that any will achieve maturity within the next several years.

Rank 7 and below. Proposals achievable in four years are indicated. The other proposals in this category are not yet mature from a tectonic perspective. The items are rated chiefly as topics, rather than as ratings on individual proposals.

PROPOSAL "SHELF LIFE"

In its global rankings, TECP has wrestled with the dilemma of which proposals are still active. **Accordingly, TECP recommends that proposals not renewed three (3) years after review shall be considered no longer active.**

NEXT MEETING

The next meeting will be in Cyprus, tentatively scheduled for October 9-11, after a 3-day field trip to the Troodos complex to be offered by PCOM member John Malpas, TECP Chair Eldridge Moores, and TECP UK representative Alastair Robertson.

APPENDIX 1

SUGGESTED CHECKLIST OF FEATURES OF TECTONIC SIGNIFICANCE FOR ODP PROPOSALS, SITE SURVEYS, AND CORE DESCRIPTIONS

The Tectonics Panel of the Ocean Drilling Project (TECP) has been concerned for some time with the breadth and universality of tectonics in questions of ODP drilling. It has spent considerable effort in the review process trying to suggest ways in which proponents could enhance the tectonic value of (and TECP's interest in) their proposals. In this process it has found that many proposals lack the items detailed below. TECP offers this checklist of features to be expected in proposals and site surveys, as well as in cores, as a means of saving time as the proposal matures, and of increasing the scope of the scientific results of each drilling site.

CHECK LIST FOR PROPOSALS and SITE SURVEYS

1. Does the proposal narrative recognize and adequately address the tectonic significance of the proposed drilling?

2. Does the proposal team include appropriate experts in tectonics?

3. Is the structural and tectonic setting of each proposed hole clearly outlined? Items include:

--Geophysical data

--Seismic refraction data?

--Seismic reflection data
--multichannel?
--migrated?

--Structural information
--fault scarps--attitudes, fault plane features, etc?
--igneous rocks--types, distribution, attitudes
--sediments--types, distribution, attitudes,
--breccias--tectonic or sedimentary
--projection of surface information to depth?

--predicted level of intersection of surface features in hole?
--accurate scaled cross-sections (no vertical exaggeration)?
--balanced?
--drill sites located on cross-sections?
--objectives of site discussed in context of inferred structure at depth on balanced cross-sections
--seismicity?
--maps
--focal mechanisms

4. Is the tectonic setting adequately incorporated into the objectives of the proposed drilling site?

--Offset sites
--are the local variations of structure and lithology of single site clearly documented?
--variations in structure and lithology between sites clearly documented?
--tectonic rationale for use of proposed sites in composite clearly documented?
--tectonic questions to be answered by site clearly formulated and adequate?

HOLES AND CORES

1. Are the following feature ---predicted?---observed?
--breccias:---tectonic? ---sedimentary?
--matrix vs clast supported??
--clast composition
--clast shape, surface features (striations, etc)?
--non-horizontal dips on sediments or lavas?
--non-vertical dips on dikes
--faults?
--dimensions of zone?
--recovery?
--slickenlines? useful for stress determination?
--juxtaposition of different magnetic polarity? --chemistry?--petrography?
--abrupt changes in magnetic inclination?
--ductile shear fabrics?
--porphyrblasts?

--S/C fabrics?
--tension gashes?
--offset markers?
--syntaxial or antitaxial growths?
--metamorphic features?
--duplicated or missing metamorphic zonation?
--mineralized faults or fractures?
--same or different from host rocks away from faults?
--straight or curved?
--if curved, S- or Z-shaped?
--stress field inferrable? inferred?
--vein mineralogy? comparison with host rocks?
--fluid inclusion microanalysis
--igneous contacts
--any independent means of determining paleo-horizontal and azimuth constraints in addition to magnetic vectors?

2.--Does the proposed shipboard scientific staff include the requisite expertise to identify and interpret the predicted structural features in cores?

Duke University
DURHAM
NORTH CAROLINA
27706

DEPARTMENT OF GEOLOGY
OLD CHEMISTRY BUILDING

TELEPHONE (919) 684-5847

April 4, 1991

Dr. James A. Austin
Institute for Geophysics
University of Texas at Austin
8701
Mopac Blvd.
Austin, TX 78759-8345

Dear Jamie,

The enclosed document is meant to be included with the TECP minutes and report sent to you separately by Eldridge Moores.

Cheers!

Jeffrey Karson

ODP TECP Interest in Proposed Drilling at Hess Deep

Tectonic Studies at Hess Deep

During the March 1991 meeting of TECP at Davis, CA, the panel discussed scientific problems to be addressed by drilling near Hess Deep in scheduled and future ODP programs. The panel is very interested in this area, but would like to see a much broader approach to drilling than presently expressed in available proposals. TECP members expressed interest in two general types of information: structures related to fast seafloor spreading and structures related to mechanical extension of oceanic lithosphere away from a spreading center.

The definition of the internal composition of oceanic crust created at fast-spreading ridges is a longstanding goal of LITHP. However, deformation structures produced during fast spreading are also of interest. Evidence of substantial faulting and plastic deformation is well documented in many ophiolites and also in outcrops and samples from fast-spread (135 mm/yr) East Pacific Rise crust exposed near Hess Deep. *Nautile* and *Alvin* submersible studies have shown that upper crustal structures can be studied directly in major escarpments in this area,. However, middle and deep crustal units appear to be rather poorly exposed at the surface but are anticipated at relatively shallow depths (< 1 km ?). TECP would like to see proposals include studies of deformation fabrics in both crustal and mantle lithologies that will help elucidate the kinematics and dynamics of deformation at these structural levels. These objectives can easily be appended to existing proposals and will be in accord with LITHP thematic interests.

Mechanical rifting of oceanic lithosphere away from an established spreading axis occurs at Hess Deep, but also at other propagating rift tips ranging in scale from those at overlapping spreading centers, to microplate boundaries to major propagating systems. Understanding the geometry and kinematics of this type of rifting is not considered in the present drilling objectives at Hess Deep. While there are obvious applications to the study of lithospheric extension in general, several specific areas of interest appear to be available for study in this region. These include the development of low-angle (detachment) faults, flexural response to footwall unloading in a region of large extension, vertical partitioning of strain during extension, serpentinite diapirism, rift propagation kinematics, and stress distribution near a propagating rift tip. Proposed drilling is not designed to address these questions and TECP would like to see additional proposals in these areas. These types of studies cannot be accomplished with a single deep hole in the rift floor. Drilling transects and carefully sited holes in various parts of the rift valley would be required. Some of these types of objectives could be accomplished as part of an offset drilling program designed to ultimately recover a composite section through the entire thickness of the crust.

Concerns Regarding Proposed Drilling

Despite the initial enthusiasm of LITHP and PCOM for drilling a deep hole in Hess Deep that might penetrate deep crustal rocks and perhaps even the geological expression of the Moho discontinuity, TECP is very concerned about the lack of a sufficient data base with which to adequately plan a drilling program. In addition, there has been an inadequate consideration of the available data. In particular, there is concern that drilling of mainly lithologic targets is presently based on highly suspect preliminary geological cross sections of the rift structure. The cross sections used in the present proposal of Gillis and others (ODP Proposals 375/D and 387/E Rev) and published by Francheteau and others (1990) have problems both with basic assumptions regarding the pre-rift

crustal structure and with the geometry of.tectonic features in the sections. Both of these factors have a major effect on the inferred geologic structure of the Hess Deep Rift and on strategies for drilling to any particular structural level of the crust including the potential for offset drilling.

The seismic thickness of the crust in the area is not well constrained at present. In the proposed cross sections the thickness is taken as only 4 km, substantially less than the more typical 5-7 km found in other parts of the Pacific Ocean crust. This figure is apparently based on the results of multichannel seismic reflection data (Zonenshain and others, 1980) for which there is no velocity control. Reflections at about 1.3 s are taken as the Moho, however, this is at best the reflection Moho and need not correspond to the depth of the velocity increase to >8.0 km that would correspond to anhydrous olivine-rich rocks of the mantle. The presence of a substantial thickness of ultramafic cumulates cannot be ruled out. In fact, samples interpreted as cumulate ultramafics were recovered in the Hess Deep Rift with *Nautile*. Thus, the depth to a family of interesting reflectors may have occurred at 4 km depth in the pre-rift crustal structure but, the depth to the cumulate/residual mantle contact ("petrologic Moho") may be substantially deeper.

Geometric problems with the proposed cross sections of the Hess Deep Rift are evident from elementary line-length balancing or cut-and-paste reconstructions (figures 1 and 2). Making simple assumptions concerning area conservation and faulting in the crustal units, neither of the proposed sections cannot be restored to a continuous layered structure and therefore are unlikely candidates for the present geologic structure of the rift valley. From the presently known surface geology of the rift a family of balanced (restorable) cross sections can be constructed. Many possibilities arise depending upon the details of fault geometry in particular. Because no unique section can be drawn at this time, the roles of several major types of features are unclear. These include low-angle normal faults, high-angle normal faults, broad serpentinite uplifts, and flexural uplifts. The geometry of these structures dictates the distribution of rock types across the rift and at depth. Thus, a detailed knowledge of the structure of the Hess Deep Rift in cross section is required if any drill hole is to be placed in the proper geological context. This is perhaps most critical for any attempt at the construction of a composite section from a series of offset drill holes. This is illustrated by the very different offset drilling strategies that might be proposed for the different cross sections shown in Figure 1.

With these considerations in mind, it should be noted that drilling on the Intra-Rift Ridge of Hess Deep should have a high likelihood of penetrating layered cumulate rocks that are known to crop out there. It is less clear if major low-angle detachment faults will cut-out part of the pre-rift vertical sequence at depth. Restorable cross sections of rifted crust with pre-rift thickness of 6 km can be constructed to place the (paleo-) Moho at depths of 1-2 km beneath the top of the Intra-Rift Ridge, possibly within the range of present drilling techniques (?). Although it is difficult to account for the present elevation of this ridge, many structural models of the rift generally include very deep crustal rocks in this location.

Recommendations

Drill site selection should be based on restorable, cross sections with no vertical exaggeration.constructed on the basis of the most complete geological and geophysical data available. In the case of Hess Deep, site survey work will almost certainly have to be done after initial drilling has begun.. In order to provide additional constraints for cross sections in the area we suggest the following types of site survey work.

1. **Both regional and local, high-resolution seismic studies that include seismic reflection and refraction.**
2. **Collection and analysis of gravity data across the rift valley.**
3. **Near-bottom sampling.**
4. **Collection of detailed structural data including the strike and dip of geological contacts and paleomagnetic studies.**
5. **Collection and analysis of earthquake seismic data.**

In addition, TECP would like to see additional proposals for studies that could be carried out in the vicinity of Hess Deep either in conjunction with or separate from the existing proposal and proposals for offset drilling.

1. **Investigations of deformation structures in the lower crust and upper mantle associated with fast seafloor spreading**
2. **Investigations of extensional deformation associated with the opening of Hess Deep Rift.**

References

Francheteau, J., Armijo, R., Cheminee, J.L., Hekinian, R., Lonsdale, P. and Blum, N., 1990, 1 Ma East Pacific Rise oceanic crust and upper most mantle exposed by rifting in Hess Deep (equatorial Pacific Ocean): Earth and Planetary Science Letters, v. 101, p. 281-295.

Karson, J.A., Hurst, S.D., and others, 1991,Cross sections of Hess Deep Rift: a critical analysis: unpublished manuscript.

Zonenshain, L., Kogan, L.I., Sovostin, L.A., Golmstock, A.J. and Gorodnitskii, A.M., 1980, Tectonics, crustal structure and evolution of the Galapagos Triple Junction: Marine Geology, v. 37, p. 209-230.

Figure Captions

Figure 1. Cross sections of the Hess Deep Rift structure. Sections (a) and (b) from Francheteau and others (1990) are not restorable to a continuous layered crustal sequence by dip-slip displacements on faults striking at right angles to the section planes.. Section (c) is a nearly restorable section based on a modification of (b). Section (d) is a restorable section using only planar detachement and high-angle faults. See figure 2 for restored sections.

Figure 2. Restored cross sections of the Hess Deep Rift (Karson and others, unpublished data). (a)-(d) correspond to the sections in Figure 1. Note that large gaps (black) and overlaps (stippled) are present in sections (a) and (b), that is, they are not balanced and are therefore unlikely candidates for the geologic structure of this area. Many other possible solutions exist.

ADDENDUM TO TECP MINUTES

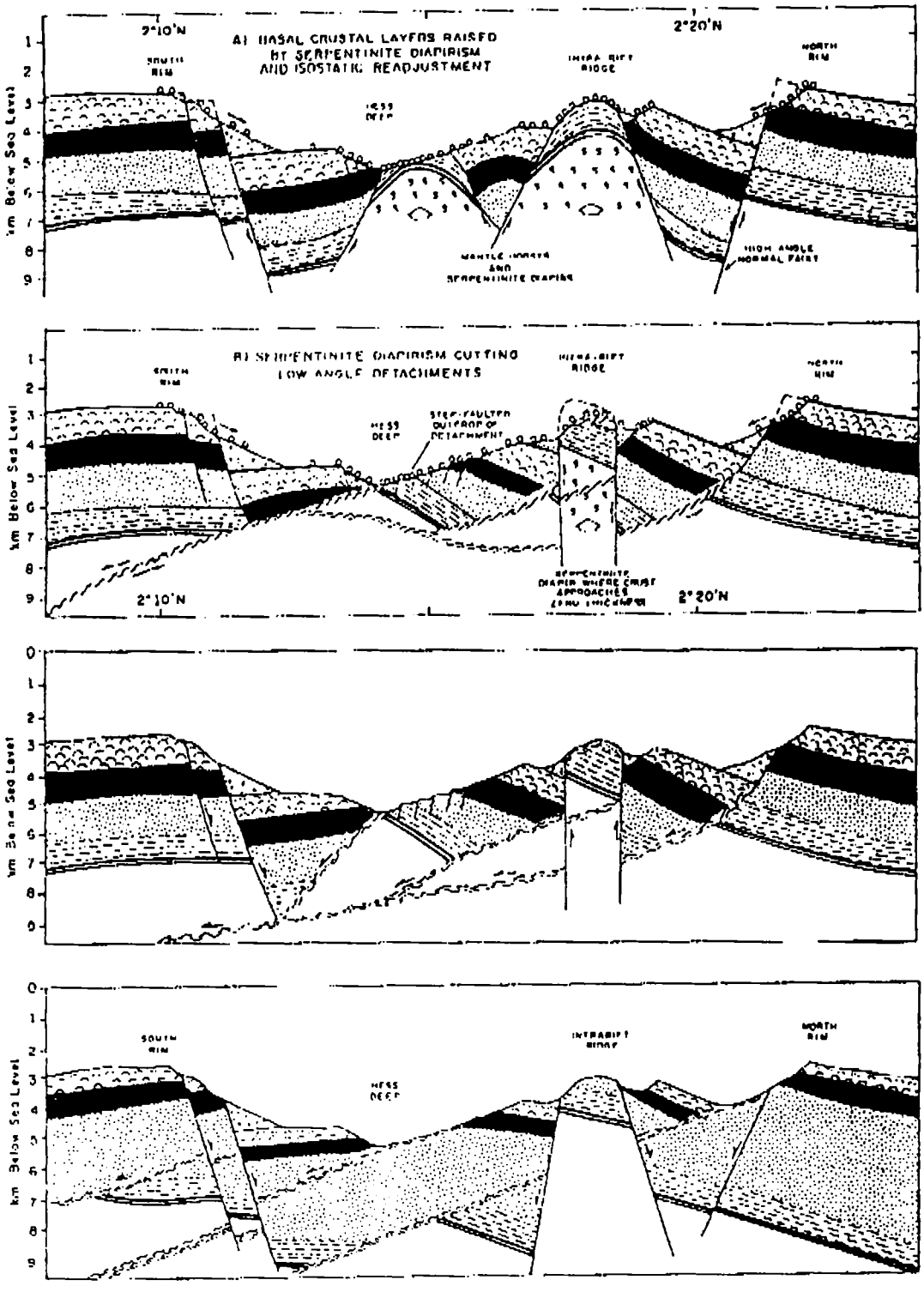
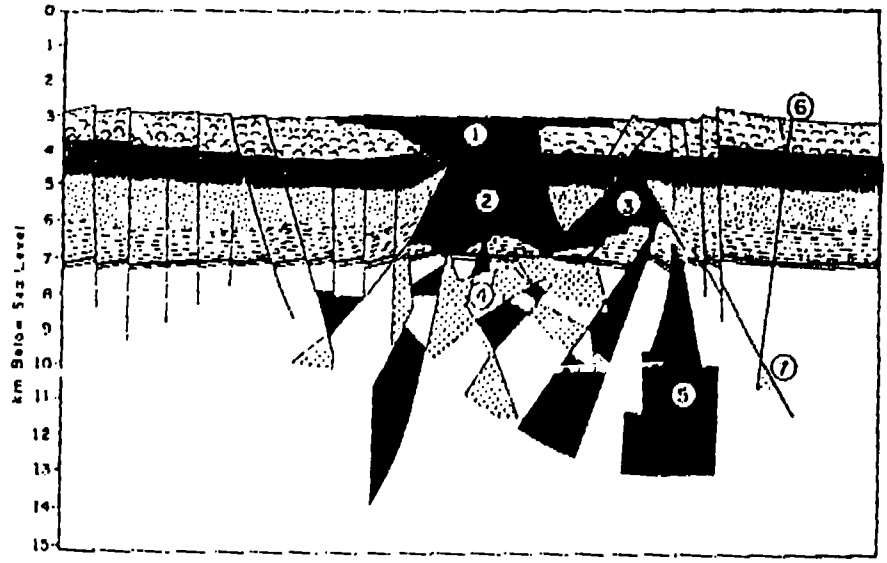
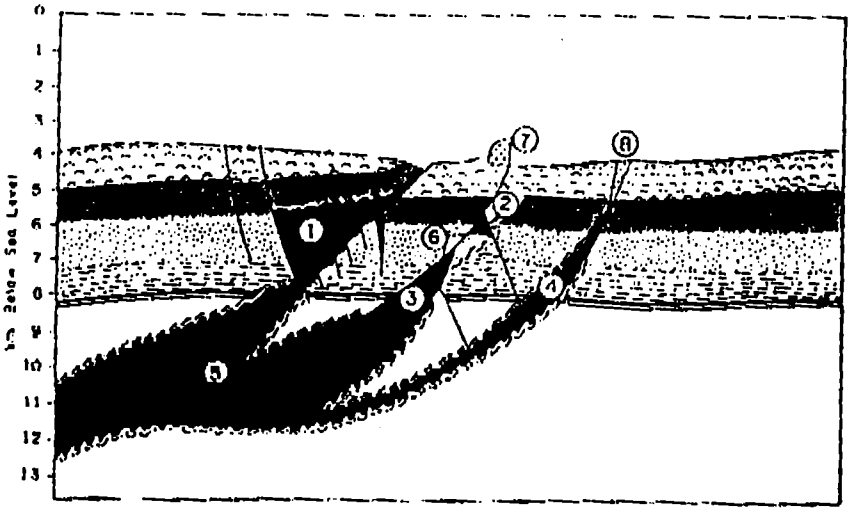
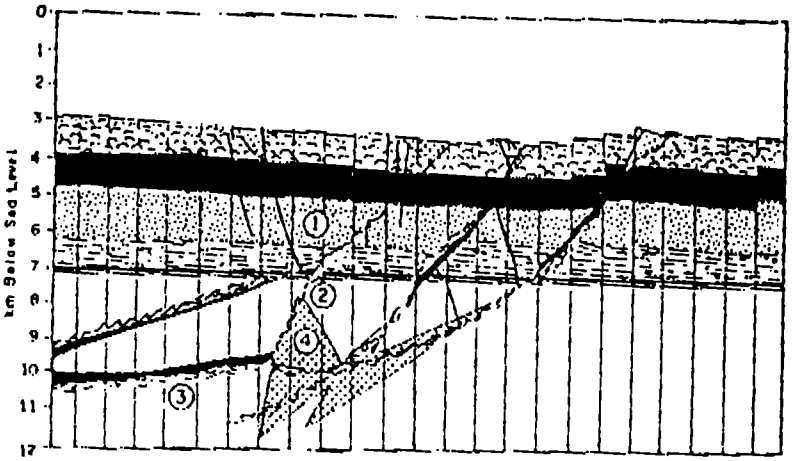


Figure 1


km Below Sea Level
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
1
2
3
4
5
6
7


km Below Sea Level
0
1
2
3
4
5
6
7
8
9
10
11
12
13
1
2
3
4
5
6
7
8


km Below Sea Level
0
1
2
3
4
5
6
7
8
9
10
11
12
1
2
3
4

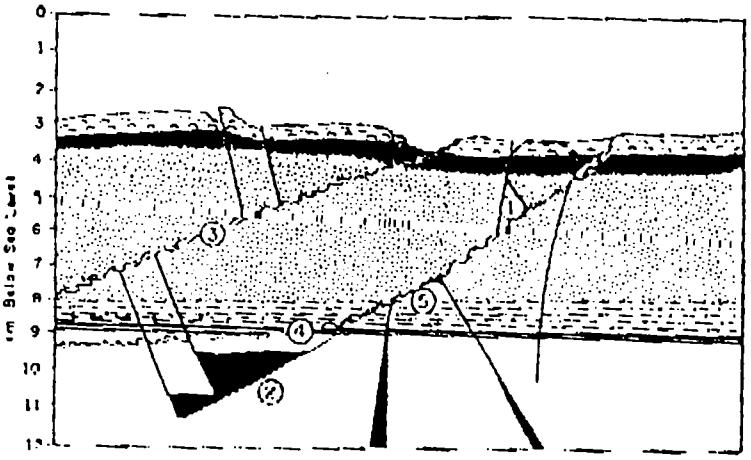

km Below Sea Level
0
1
2
3
4
5
6
7
8
9
10
11
12
1
2
3
4
5

Figure 2