

**JOIDES TECTONICS PANEL
 SPRING 1995 MEETING
 CalTech, 20-22 February 1995
 EXECUTIVE SUMMARY**

Attendees:

TECP Members: Susan Agar, Northwestern, Juichiro Ashi, Univ Tokyo, Kevin Brown, Scripps Institution, Yves Lagabriele, Univ Bretagne, Jian Lin, Woods Hole, Greg Moore, SOEST, Alastair Robertson, Univ Edinburgh, Carlo Doglioni, Italy, Garry Karner (alt for Mike Steckler), Lamont Docherty, Joanne Stock, CalTech, Phil Symonds Australian Geol Survey, Uri Ten Brink, USGS-WHOI Roland Von Huene, Kiel, An Yin, UCLA

Liasons: Brian Taylor PCOM; Carl Richer, TAMU; Doug Wilson, LITHP; Mike Underwood SGPP; Jian Lin, LITHP; Kevin Brown, SMP, Joanne Stock IHP, Sue Agar DMP

Host: Joanne Stock

1. Ranking of proposals.

Rank	Title	Proposal	Points
1	Woodlark	447 Rev	11.9
2	Iberia 2	461 Add	11.6
3	Taiwan	471	11.1
4	Romanche	468	10.6
5	Peru Tectonic Erosion	355 Rev	10.1
6	Mariana Back Arc	442 Rev	9.8
7	Nankai deformation and fluids	445	9.6
8	Tonga Forearc	451 Rev2	9.5
9	Physical prop. LWD	LOI 48	8.4
10	S Australia Continental Margin	466	8.2
11	Japan trench borehole obs	LOI 44	7.4
12	S'Reflector	334 Rev3	7.0
13	Stress-strain obs	LOI 41	6.4
14	Dipping reflectors (Argo)	469	6.1
15	W Pacific Seismic Net	431 Add2	5.1
16	Return to 735B	300 Rev	4.6

Note: Proposals were ranked that could reasonably be expected to be mature in time for scheduling during the present phase of the program (i.e. through 1998).

2. Recommendations.

TECP adopted the following 4 recommendations:

1.1 TECP recommend to PCOM that PCOM recommends to JOI Inc and that JOI Inc direct TAMU to ensure that every possible step is taken to ensure that the computerisation of both structural and lithological data is fully implemented during the computer data base upgrade project (JANUS).

Explanatory Note: In terms of TECP's thematic interests the new computerised data base system will be essentially useless unless primary lithology description and structural data are fully incorporated.

1.2 TECP recommends to PCON that PCOM recommend to JOI Inc that every effort be made to overcome funding constraints on further use of LWD. TECP further

recommends to PCOM that PCOM recommend to JOI Inc that TAMU be directed to put in place arrangements to allow LWD to take place on a leg, if necessary, without coring, should TECP rank a suitable proposal for LWD work sufficiently highly to allow implementation (assuming funding is available).

Explanatory Note: TECP notes that Logging While Drilling (LWD) offers essential opportunities for study of in situ physical properties to infer active tectonic processes. LWD is the only available tool that can provide essential physical property measurements. For example, conventional logging is often not possible in unstable accretionary prism holes. While recognising current financial constraints, TECP urges PCOM to be innovative and make every effort to enable further use of LWD in the near future.

- 1.3 TECP recommends to PCOM the development of integrated multidisciplinary observatories as a means of monitoring and experimenting on fundamental tectonic (and other) processes be highlighted in the new Long Range Plan.**

Explanatory Note: Development of the above observatories would be novel and innovative, likely to catch the attention of many others (e.g. politicians) and of obvious societal relevance (e.g. for seismic hazard assessment).

- 1.4 TECP recommends to PCOM that the new LRP also highlights the future importance of integrated continental land-sea drilling to help solve some fundamental tectonic processes (e.g. subduction/accretion).**

Explanatory Note: A focus on land-sea integrated drilling could lead to collaboration with the Continental Drilling Program and as a result greatly widen the earth science community interested in continental ocean drilling. Additionally, there is obvious societal relevance (e.g. assessment of seismic hazard).

3. Panel Replacements

The following names for a replacement for Sue Ager were suggested in priority:

1. Tim Burn, University of Connecticut (Convergent settings interest)
2. Sue Ager, (for continuity and link with SMP)
3. Dan Moos, Stamford University (Ocean-centred drilling; technical aspects)
4. Brad Hacker, Stamford University (ocean crust mechanisms, modelling)
5. Greg Harper, New York University, Albany (ophiolites, oceanic crust processes).

Other possible (lower priority) people could include: Steve Kirby (USGS, Menlo Park), and Greg Hirth (WHOI).

4. Next Meeting

Antalya, Turkey 19-21 October 1995
With three-day pre-meeting field trip

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Draft Minutes

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Host:

Joanne Stock

1. Introduction.

The meeting began with the customary welcome and round of introductions. The panel thanked Joanne Stock for acting as host, and An Yin for leading a most interesting and relevant fieldtrip to study strike-slip and extensional kinematic environments. Kevin Brown and his students were also thanked for logistical support during the fieldtrip.

2. Minutes.

The prior minutes were accepted without comment.

3. Liason reports.

i) PCOM

Brian Taylor noted that the TECP Revised White Paper had been accepted for publication in the JOIDES Journal. Also, TECP recommendations concerning inclusion of structural data in the data computerisation program (JANUS) and on collection and archiving of structural data had also been accepted. He noted that PCOM expected TECP to produce a structural data "cook book" for use at sea. Brian Taylor then went on to sketch the current financial constraints DDP was facing and the need for cuts. He referred to the current effort to reorganise and thus save money on publications (by $\frac{1}{3}$). Carl Richter also referred to the plans for the computerisation of data upgrade (JANUS) and for developing DCS. In the ensuing discussion, concern was expressed that so little progress had been made with DCS at this stage. DCS was still important to TECP's long-term interests. There was also some discussion of the future location of the JOIDES office.

ii) TAMU

Carl Richter briefly outlined the following aspects:

Data management upgrade (JANUS). A table was displayed showing priorities for work by the company, TRACOR. Sedimentary and structural data were in Group 4b, in the middle of the priority list. In the discussion, concern was expressed that structural data were not higher in the priority list and it was decided to return to this item (see Agenda Item 10).

DCS the TAMU rep. noted that there was current concern that a DCS "feasibility" might be more expensive than expected. TECP wondered if a University rather than a private company could do this work.

Navigation: an excellent real-time navigation system was now in operation at sea.

Staff Scientists: 2 positions remained open; interviews were in progress. More applications were desirable.

iii) **LITHP**

Doug Wilson and Jian Lin. As there had been no prior meeting there was nothing new to report. However, Jian Lin referred to information from Inter Ridge : a network of up to 100-200m deep holes was needed to characterise ocean crust architecture; there was still a long-term need for DCC.

iv) **SGPP**

Mike Underwood : No prior meeting; nothing new, other than to note SGPD's success at seeing supported proposals scheduled for drilling. There was now a need to develop a fresh set of innovative proposals. Meanwhile, there was still the intention to complete the New Jersey sea level transect. The Pressure Core Barrel would also be tested on an upcoming leg.

v) **SMP**

Kevin Brown discussed an important meeting he had participated in concerning long-term observatory studies (i.e. in and around wells). This was seen as a long-term objective needing new money (e.g. NSF). TECP strongly backs the initiative. Specific plans for what tools would be deployed, and where, are now needed.

vi) **LITHP**

No prior meeting, but Joanne Stock noted that she would not attend the next meeting at College Station. This was to be jointly with SMP and Kevin Brown would attend in a joint SMP/LITHP liaison capacity. This would be an important meeting, especially in view of TECP's concern that structural data were relatively low in the data management (TRACOR) priority list.

vii) **DMP**

Sue Agar reiterated there had been no meeting of the DMP since the last TECP meeting in Cyprus. Peter Lysne, chair of DMP requested that TECP consider carefully linking logging schedules with the scientific objectives during proposal evaluation. In particular, objectives of the BHTV would need to be identified well in advance as funds for this tool are not included in the BRG operating budget. DMP will be focussing this year on a review of the logging program in view of the budgetary restrictions, and a need to vitalize the program through a stronger tie to the overall scientific goals of the ODP. DMP will also be trying to maintain momentum in the area of high-temperature tools due to the long lead time for tool development.

4. **Recent Scientific results (including Leg 159 so far) Carl Richter**

Carl Richter outlined the trials and tribulations of the TAG leg. This had not been generally relevant to TECP, but lessons had to be learned about drilling oceanic crust and sulphides. The Motorised Core Barrel had proved effective, however.

Leg 159 (Equatorial Africa) was proceeding according to schedule, except that there had been some difficulties with logging, owing to poor hole stability. Leg 159 was a case where use of the BHTV could be useful. The stratigraphic resolution of deeper (Cretaceous) levels appears to be poor, this might be expected to improve with shore-based studies. (e.g. of palynomorphs). Small-scale structures were plentiful in deeper intervals, including evidence

of strike-slip. Structural data were being thoroughly recorded at sea, with the assistance of the TAMU Staff Scientist, Peter Clift.

5. Reviews of New and Revised Proposals and Letters of Intent

(SR Rev 3 Add) - Sedimented Ridges E Flank and Juan de Fuca (CORKs):

Although the CORK experiments for these areas are not a top priority for TECP, the Sedimented Ridges experiment addresses the relations of fluid circulation and deformation that are relevant to TECP interests. This experiment could yield valuable data on the state of stress in active rift zones. The panel had reservations concerning the assumption that faults at the CORKed sites are on the point of failure. What is the evidence for this? A further concern was whether or not it would be possible to seal the 858F hole adequately to prevent leakage from Hole 858D.

TECP considers the experiments for the eastern flank of the Juan de Fuca ridge as a lower priority than those on the Sedimented Ridges Leg but the panel strongly endorses the attempts to raise funds for CORK engineering developments. Even though this region does not have a well-defined structural framework at present, the data obtained, even from a more limited CORK experiment on the cellular convection site, will still provide a valuable base study for comparisons with other regions where fluid flow conduits are controlled by faulting or more rugged basement relief.

463 - Testing the plume-impact hypothesis at Shatsky Rise. By Sager et al..

This paper aims to analyze a Large Igneous Province in the western Pacific ocean. The authors point out a series of objectives that have some interest for TECP, such to test the relationship of this LIP to a triple junction, to date the emplacement of the volcanic rise and to quantify its velocity of propagation, to study paleomagnetic evolution of the Pacific plate and the true polar wander path. The J/K boundary dating of the magmatic province seems to conflict with the much younger dating by Ozima et al. 1969.

The precise tectonic objectives remain unclear, and as written the the proposal appears more devoted to LITHP interests. This is unlikely to change..

Rating: A3, B1.1, B2.1, C1, D1, E, F

465 - SE Pacific Paleooceanography

Portions of this proposal address topics relevant to TECP, namely the responses of climate system to tectonic events, including closure of the Panamanian Seaway, Neogene uplift of the Andes, and opening of Drake Passage. However, proposed sites selected for paleoceanographic objectives are not most suitable for evaluating of tectonics-climate connections. TECP would require more quantitative discussion about crustal movements recorded in sediments. In any event this proposal is never likely to be of high thematic interest to TECP.

Rating: A5, F4

466 - Great Australian Bight Continental Margin

The panel was convinced by data presented in the proposal that a significant contribution to the study of divergent margin processes can be gained by drilling in this location. The panel, however, suggests that the scientific focus and the sites should be redefined. The proposal needs to show what new data would be added to that acquired through earlier passive passive margin drilling (e.g. Iberia)

We suggest that the proposal could focus on the following simple question: Why are there linear magnetic anomalies over faulted crust? If drilling results show the blocks to be continental crust, the results will imply that magnetic anomalies are not necessarily indicative of the presence of oceanic crust. If, on the other hand, the blocks are oceanic, then a new deformation style of oceanic extension will be demonstrated. Either way, the results will be highly significant. The panel's consensus is that this question alone warrants a drilling leg and there is no need to mention either metamorphic core complexes, the search for continent-ocean boundaries, or lower plate-upper plate conjugate margins. In fact, focus on these topics could be counter productive.

The general significance of the above question can be enhanced by bringing examples from other areas such as the southern Red Sea, where the margin is characterized by either stretched continental or oceanic crust (see papers by LeBrecque, Zittelini, Cochran, and Ron Girdler from 1980-1987).

In order to show the coincidence of rotated blocks and magnetic anomalies, the proposal should include a seismic profile showing the tilted blocks and the interpreted "sea floor spreading" magnetic anomaly. If possible, it should also include a structural map of the tilted blocks and a magnetic map of the same region. The structural map can be based on the old Eltanin survey identifying where the orientation of the tilted blocks and where they actually merge into "true" oceanic crust.

Satellite gravity data should be also shown.

The MCS survey planned in support of this proposal should be aligned perpendicular to the NW-SE spreading trend and away from the influence of major fracture zones. This is in contrast to Lines 65-14,15 which were aligned oblique to spreading and too close to a fracture zone. The survey should focus on a single area and include 2-3 parallel lines at close spacing (5-10 km) and 2-3 lines on either side of the closely-spaced lines with a spacing of 25-30 km. A tie-line along strike is desired. The survey grid should be designed to map the along-strike continuity of the tilted blocks along a width of 100-150 km. 1-2 of the lines should also be extended seaward until the tilted blocks are no longer observed. The drilling sites should be located along a single transect (unlike the current proposal) as follows:

2 holes along one tilted block around anomaly 33, the first aimed at the oldest syn-rift sediments, and the second, close to the crest of the block and aimed at penetrating basement.

1 hole to basement at the crest of the block that is farthest seaward.

1 hole to basement at the landward occurrence of normal diffractive oceanic crust. We are aware that sites may have to move or one of them be omitted if total penetration depth is too large.

The panel recommends that a plate kinematics person (e.g., Dietar Muller), a petrologist, and a biostratigrapher be added as proponents to strengthen the proposal.

In order to satisfy site survey requirements, the proponents should plan on collecting swath bathymetry and dredging off any basement blocks.

Ultimately any revised proposal will be judged in terms of its contribution to long-term TECP objectives (see New Whitepaper).

Rating: A1, B1.2, B2.1, C3, D1, E2, E5, E8, F2-3

Stratigraphic response to sea-level changes in the Western Mediterranean (Golfe du Lion and Ligurian Margin). By Droz et al..

This is a well formulated proposal, to test stratigraphic responses to fluctuating sea-level over siliciclastic passive margin in different morpho-structural environments, i.e. a flat wide platform with a flat backland versus a narrow or absent platform with a mountainous backland. Unfortunately the proposal is entirely devoted to problems more pertinent to the SGPP and makes little reference to tectonic objectives, including salt diapirism, and normal faulting that characterized the area during the Plio-Pleistocene. The authors recognize that in the Ligurian part of the proposal there could be effects due to the Alpine deformation and that the particular geologic and morphologic framework could mask the sea-level signal. If they could expand such a part, discuss how normal faults and salt diapirism may interfere with eustasy, the proposal would improve its relevance to TECP objectives. Moreover the tilted blocks buried by the Plio-Pleistocene sequence are interesting targets for the Oligocene extension of this basin. However, the proposal is never likely to be of great interest to TECP.

Rating: A5, B1.1, B2.1, C1, D, E, F4

469 - The Argo Abyssal Plain: A

The TECP is extremely impressed by the quality of the seismic reflection profiles from the proposed site. The quality of the data in conjunction with the existing data from the previous ODP drill hole aids the interpretation of the regional geology. The proposed objective of testing how oceanic crust was developed in the mid-ocean ridge via examining the structural framework of the Argo region is certainly very important. The panel understands that the current version of the proposal is still in its infancy and further site survey will be conducted. The main concern of the panel is that the selected site is adjacent to a subduction system and that the region has been deformed since the accretion as shown by the seismic reflection profiles. Thus, discriminating structures that formed during and after the accretion, needs to be clearly addressed in any revised proposal. Related to this concern is the question of why this particular site is so unique and appealing to testing the Mutter and Karson model. Could other locations be better?

Regarding the origin of the through-going reflector intended for drilling, the proponents may consider to design detailed seismological experiment (e.g., ray tracing?) by using experimentally determined seismic-velocity anisotropy. This could allow a first-order estimate of whether the reflections indicate the existence of preferred orientation. If the test is positive, one could be more confident about the proposed drilling. In addition, more detailed work on the structural setting, such as the three-dimensional geometry of the target faults/shear zones should be clearly defined in any future site survey.

Another concern is that the spreading rate of the selected site is between the fast and slow spreading (42-46 mm/year). Thus, the test result of favoring or rejecting the Mutter and Karson model may be ambiguous.

Despite the above concerns, the panel members feel that the quality of the reflection data is such of good quality that the superposed deformation may be distinguishable. Also, TECP believes that the origin of seismic reflections in the oceanic crust is of first-order importance.

Rating: A2, B1.2, B2.2, C2, D1, E4, F3.

470 - Oceanic drilling in the Atlantic II area (Red Sea)

The objective of this proposal pertinent to TECP is to test the hypothesized 3-stage accretion history of the Atlantis II deep in the Red Sea. By drilling, the proponents want to establish: (i) the cause of the magnetization contrasts, and (ii) the age and relatively timing of formation of the Wando and Atlantic terranes. Of key interest to TECP is the general rift to drift

transition in the Red Sea and how organized sea-floor spreading is established. Thus, there was a feeling from the panel that the objectives of the proposal were somewhat narrow and even if the objectives were realized, it is not clear how our tectonic understanding of the region would have been increased. However, interest was voiced with regards to the implicit idea in the proposal that the series of deeps, being pull-apart basins, need to coalesce to form a spreading centre. Thus, active continental strike-slip faults need to be associated with each of the deeps and the offset across the faults should equal the extension responsible for the pull-apart basins. Can this be demonstrated, at least qualitatively, using the swath-mapped bathymetry? Do strike-slip faults characterize the various deeps or is the Atlantis II area anomalous? Is there earthquake activity defining both the strike-slip and normal fault activity?

The panel recommended that the proponents attempt to place the structural evolution of the Atlantic II area into a more regional tectonic setting. Broadening the expertise of the proponents to cover the tectonic and seismogenic aspects discussed above might prove useful. Finally, the poor reproductive quality of the swath mapping bathymetry figures (in particular) does little to help the reviewers to assess the ideas being presented by the proponents. Care on this issue would be prudent. The proposers are also encouraged to be in contact with all others interested in Red Sea drilling.

Rating: A3,B1.2,C3,D1,E4(8),F3

447 - Rev, Active continental extension in the western Woodlark Basin

This revision to the highly ranked western Woodlark Basin proposal has the same scientific rationale and regional background information as the original proposal, but contains reprocessed geophysical data (acoustic imagery, magnetisation and reflection seismic) and a new drill site plan. The study area is rapidly becoming one of the best characterised regions of active continental breakup, even though data are still being processed and interpreted. New seismic data acquisition is planned for the area later in the year. The combination of metamorphic core complexes, seismogenic high and low-angle normal faulting and rift volcanism adjacent to an area of active seafloor spreading, makes the region an excellent place in which to investigate the physical processes and mechanics of lithospheric extension. The proposal clearly examines high priority TECP thematic objectives. The study of active systems such as this is a key part of the drilling strategy in TECP's new White Paper.

Overall, TECP felt 2 alternative approaches could be followed: i) Study of active detachment faulting in its regional tectonic setting. Thus if i) is the main objective then all the points listed below will need to be addressed before a mature proposal can emerge; ii) Focus on drilling and instrumentation of an active extensional fault. If this is the objective, then the regional setting may be less critical. However, it would be essential to explain exactly how drilling of the extensional fault would be achieved, what measurements would be made with what tools. How would possible alternative data be obtained (e.g. fluid flow, stress-strain etc) be analysed and modelled. What specific alternative models would be testable? On the whole TECP is more interested in approach ii), but recognises that this would require substantial revision of the proposal. Would a one-leg proposal to attack ii) be possible if there is not enough time for 2 legs?

The following comments refer to objectives as if i) is the written proposal:

The proposal presents a transect of five sites and alternates across a seismically active low-angle normal fault that is imaged on seismic data along the northern flank of the Moresby Seamount. The proponents recognise that this drilling will require two legs because one of the sites has a penetration of 2800 m. This fault appears to form part of a feature that extends for about 150 km to the east of Fergusson Is. The sites focus on three main aspects: i) testing whether the Moresby Seamount is a metamorphic core complex associated with a detachment

fault, or an upper crustal tilt block bounded by a low-angle normal fault, and determining its uplift/subsidence history ii) characterise and monitor the insitu properties of the fault by drilling through it at several locations, and installing a CORKED geochemical string iii) determine the nature and uplift/subsidence history of the hanging wall (upper plate).

The proposal is generally well presented, but TECP believes that there are aspects of it that require further consideration:

1. There was considerable discussion on Sites ACE-3a,3 on the Moresby Seamount and whether or not it is a metamorphic core complex. Caution was expressed in relying on P-T-t plots to examine uplift and unroofing history because of alteration of the 'basement' rocks. Can more information on the feature be obtained by further investigation of the metamorphic rocks dredged from the northern flank of the seamount, and is the assemblage of rocks obtained really very similar to associated with the metamorphic complexes of the adjacent islands? It may be useful to have a site on the southern flank of the seamount in order to sample an older part of the north-dipping sequence that forms the top of the seamount i.e. more towards the core zone and possibly beneath any mylonitic shear zone. What is the significance of the strong northward dipping reflector at about 1.8-2.1 sec TWT beneath the Moresby Seamount as seen on MW0304-50 line (Fig. 24)?
2. It was felt that there could be a better discussion of the sites with respect to other models of extension and a larger range of mechanical mechanisms.
3. More discussion is required on links between onshore/island geology and the proposed sites.
4. Comment was made about the onshore evidence for extension and whether the 'gneissic domes of the Papuan Peninsula are really core complexes unroofed by extension.
5. The proposal would benefit from a clearer discussion of the position of the sites within the full extensional terrane emphasising the regional significance of the fault on the northern flank of the Moresby Seamount, and the evidence for seismic activity along it. Questions were raised about evidence for the fault being currently active. Could other evidence for activity be obtained by say looking for seeps on the northern margin of the seamount using bottom cameras etc.
6. The main concern during TECP's discussion was the need for a more complete interpretation and presentation of the existing seismic data set. Very little of the Ewing (EW 9203) multichannel data is figured in the proposal, except for the seismic section on the drilling transect and a few schematic line drawings. This information is critical to being able to place the small proposed study area into its regional and extensional context, and will overcome questions on the wider significant are the features that are proposed for drilling.
7. A question was raised on the control that older collision and subduction-related thrust faulting may have on the development of the extensional terrane in the Woodlark region . Some consideration of this is required in the proposal - will it make the study area a special case and not a useful analogue to understanding old rifted margins?
8. The point was made that it is necessary for the proposal to contain quantitative models against which to judge the real physical property measurements etc. from the holes.
9. As mentioned in the previous review, further consideration of the penetration depths at the sites is necessary, particularly in light of further/continuing seismic processing.
10. Currently there are no crossing seismic lines at the sites. However, information was presented to TECP via the 'hero' indicating that a quite detailed seismic survey may be possible in the area in mid-1995. This is planned to provide the crossing lines as well as an

increased coverage around the proposed transect. TECP is very pleased to learn of this possibility as it is clear that crossing lines and further site definition will be required before drilling can proceed.

Overall TECP is very enthusiastic about the proposal and looks forward to seeing new data, processing and interpretations to further support drilling in this exciting area.

Rating: A1, B1.2, B2.1, C2, D1, E8

451 - Rev2. Ocean Drilling in the Tonga forearc

Proposal 451-rev is a combination of Proposals 451 (The Tonga Ridge longitudinal Island Arc transect, by Tappin et al.) and 446 (Ocean Drilling in the Tonga forearc. A test of models for the origin of supra-subduction ophiolites, early arc volcanism, subduction initiation and subduction erosion/accretion, by MacLeod and Bloomer).

The 451-rev proposal is based on TECP 93 fall meeting recommendation that proposals 446 and 451 be combined. It was of high interest for both the TECP and LITHP as it concerned interrelated problems of the dynamics of subduction, early and late arc volcanism and tectonic evolution of forearcs in an appropriate region.

This new version is a substantial revision of the previous proposal. The number of sites is reduced to 7; previous sites TR4 and TR5 located close to Eua Island have been removed. TECP agrees with this choice which does not alter the results proposed by drilling along the transect.

The objectives can be now achieved in a single leg. At each site, the authors propose to drill within the sedimentary section (ACB, XCB and RCB, 10 to 540 m) and within the basement, with penetrations of the order of 100-200 m.

The new proposal is now more mature and clarifies the scientific objectives by providing much more information and constraints on scientific points raised by the panels. It also includes more specific background information on the Tonga region (cross sections are now available) and along each drilling transect. However, a structural map derived from the Parson et al., (1993) bathymetric map should be incorporated, and its interpretation should be discussed.

The objectives now concern a wide range of tectonic and petrological problems such as :

- the origin of forearcs crust of the West Pacific
- the mechanism of tectonic erosion and the relative importance of steady-state versus catastrophic erosion due to the subduction of a topographic asperity,
- the timing and deep processes responsible for the splitting and the rotation of the Tonga platform,
- the characterization of the coupling between the down going slab and the upper plate and the possible effects of the subduction of the Louisville Ridge on stress orientations,
- the tectonic control, by forearc splitting and crustal thinning, of the nature of the melts produced in the arc,
- the regional control by the arc-forearc motion on possible flows of asthenosphere of Indian Ocean origin.

These objectives are now better formulated and appear to be enhanced by very recent results concerning the regional geodynamics as well as very detailed work on the data from Leg 135.

However, the text is confusing in some places and a better link between the items developed in the sections entitled 'scientific objectives' and 'scientific background', should be proposed.

The panel considers that most of the tectonic objectives can be achieved by drilling in the Tonga region along the proposed transects using available technology (FMS and BHTV are required). This proposal still lacks new data from bathymetric surveys over the principal targets, and TECP would like to see site surveys carried out, in particular the survey planned by Bloomer, as stated p. 37.

A final point is that the proposal is excessively complex with too many objectives. It should be streamlined by focussing on those aspects that drilling can rigorously test; aspects that cannot be constrained by drilling should be downplayed. TECP thinks that its interest could be ca. 40% of the proposal (LITHP 60%). The revision should take this into account.

Rating: A1, B1-2, B2-1, C2/C3, D1, E8 (add a structural map of the forearc), F2.

457 - Rev, Drilling on the Kerguelen Plateau and Broken Ridge - F. Frey et al. - see review of earlier version of this proposal at the fall meeting (last minutes)

This proposal will investigate various aspects of the origin, growth, and compositional variations of Large Igneous Provinces (LIPs) formed by the Kerguelen Plateau and Broken Ridge. Although much of the proposal focuses on problems more of interest to LITHP, there are some objectives within the mandate of TECP. These include the following objectives already noted in the proposal: resolution of the zero-age position of the Kerguelen hotspot via drilling on Skiff Bank, and the history of vertical tectonics (subsidence) of the southern part of the Plateau in Cretaceous time. An additional aspect of the proposal, which is especially interesting in light of TECP objectives, is the possibility of doing structural transects across some of the high-relief fault scarps and other tectonic features (e.g., 77°E graben) identified by Konnecke and Coffin [1994] within the southern (Cretaceous aged) part of the plateau. The present site plan does not specifically include any such transect, although the proposal does indicate that such a transect could be considered if further site survey data were first collected. TECP encourages the proponents to develop this aspect of the proposal further. The nature and age of the tectonism affecting the Kerguelen Plateau is a very important tectonic problem. The faults which affect the southern part of the Plateau are thought to be Cretaceous in age, although it is also possible that some of them might have younger movement (related to Eocene breakup of Broken Ridge from the Kerguelen Plateau?). Results from previous ODP/DSDP work on Broken Ridge, even in holes that did not penetrate basement, provide useful constraints on the Tertiary structural history of both Broken Ridge and the Kerguelen Plateau. This information could be more fully utilized in the present proposal.

Rating: A3, B1.1, B2.1, C1, D1, E8, F2.

355-Rev5 - Drilling the Peruvian Convergent Margin....

As a result of the most recent revision a significant number of the proposal objectives are now a high priority for TECP. In particular, the panel feels that this proposal can achieve the objective of constraining the uplift and erosion of the Peruvian margin, associated with the subduction of the Nazca Ridge. This is a mature proposal with good stratigraphic control in the Lima basin and needs only minor revision. The panel raised the question of whether any linkage between along strike erosional unconformity propagation, changing normal fault styles and the Nazca ridge migration could be observed both along and across the margin. Can these, for example, be related to the progressive migration of the uplift and subsidence patterns along the basin axis (i.e., parallel to the margin). Locally much of the necessary seismic data exists, a complete track chart should be included in the next revision with preferably an analysis of the tectonic component of regional stratigraphy. The panel was also interested in some analysis of the along strike variation in the pattern of normal faulting. How are the normal faults related or reactivated during underthrusting the progressive underthrusting of the Nazca ridge and what does this say about the nature of forearc/ridge

interaction? Overall the tectonic aspects of the proposal recieved a clear positive response from the TECP.

In any further revised version the proposers would be well advised to take careful account of the interest to be shown by SGPP. If this is not great, then the proposal would need to be as strong as possible from the purely TECP point of view to stand a good chance of being scheduled for drilling.

Rating: A1,B1.1,C1,D1,E3 & E8,F2

450 - Rev, Taiwan arc-continent collision

TECP finds this proposal to be highly relevant to thematic priorities, but considers it to be immature until the results of the 1995 MCS cruise are available. The proponents should clarify the global significance of the backthrusting boundary between the accretionary prism and the volcanic arc. Why was this area chosen over other parts of the collision zone? Is this a fundamental problem? If so, can other examples be cited?

The drill sites should be put into a regional crustal context. As currently written, this proposal for a characterisation of a collision zone - it must evolve into hypothesis testing. What might be expected to be drilled at each site?

TECP wishes to encourage the proponents to revise this proposal after the processed MCS lines are available.

Rating: A1, B1.2, C2, D1, F2

442 - N. Mariana back-arc rifting

The panel is satisfied by the proponents response to its comments. The inclusion of planned stress measurements and a structural geologist as a proponent were particularly welcomed. The following comments were raised during the discussion:

The benefits from drilling the proposed sites even if Martinez et al. propagation model proves wrong should be spelled out.

The panel considers the site survey to be only partly complete and hopes to see the the 6-channel high-resolution seismic survey funded. Furthermore, because Martinez et al. paper has not yet been published, many of the data (magnetization map, gravity, map with GSJ line coverage, and particularly, side-scan sonar) presented there were not available to the panel. We suggest including these data in the proposal.

Currently, the panel views the objectives as being 60% within LITHP mandate and 40% within TECP mandate. The panel hopes that TECP objectives can be even better focussed if deformation associated with the propagating back-arc can be clearly defined in the proposed MCS survey.

Rating: A1, B1.1, B2.1, C1, D1, E3, E8, F2.

452 - Rev, Antarctic Glacial History & Sea-Level Change

This proposal has only minor relevance to TECP objectives. For example, it is recognized that one (probably secondary) control on sedimentation along the margin of the Antarctic Peninsula may be the effect of flexural isostatic response to erosion and deposition, and to

cyclic ice loading. The variation in "effective lithospheric age" along the strike of the former trench, which depends on the age at which subduction ceased at each location, will be taken into account in comparing the results from different positions along the margin. In general, however, the strategy in this proposal is to obtain a well-constrained glacial and climactic history by carefully avoiding areas that may have been additionally complicated by tectonic effects. This is a suitable strategy, given the main objectives of the research, but makes the proposal of little relevance to TECP.

Rating: A5, F4.

435 - Add-2. Crustal fluxes into the Mantle at Convergent Margin. B : The Mariana- Izu Margin.

Proposal 435-Rev concerns an estimate of crustal fluxes being recycled in the mantle by addressing the mass balance of the inputs and outputs at the Mariana-Izu non accretionary convergent margin. Previous drilling in this region has already sampled most of the outputs, but the remaining components of the flux equation are still missing. The authors propose to sample these components in deepening hole 801C in the oldest crust in front of the Mariana Trench and in drilling Site BON-8, to sample the crust in front of the subduction zone.

This addendum is a response to a series of Spring meeting 94 Panel comments and questions. According to TECPs point of view, this addendum clearly shows that the present day available data are not sufficient to achieve the calculations of mass balance. Especially no data are available concerning the bulk chemical alteration of the ocean crust. They also confirm that the Mariana-Izu margin is a simplified case because, as shown by many authors, it lacks erosion or accretion during the Neogene.

TECP was mainly interested by the answer to question relative to the heterogeneity in the alteration status of the incoming plate, and agrees with the idea to consider the Mariana transect as an end-member case involving a (probably) strongly altered and old crust.

TECP points out that this proposal is of high interest in term of global tectonics and fluxes. Overall, the TECP is more interested in the Nicaragua crustal flux location.

Rating: A2, B1.1, B2.1, C4, D1, F4

448 - Add Origins and age and post-emplacement history

The structural geology of the proposed drilling region is much improved by making the detailed structural map. The panel members are very pleased with the effort. In particular, we consider that the description of structural characteristics are detailed and that the structural map itself is an important contribution to the regional tectonics of the region. Although the objectives of the proposed drilling of the Ontong Java Plateau is not our primary interest, we consider that if the drilling can be tied with the collisional tectonics, we would feel much more supportive.

Despite our general positive appraisal of the new structural efforts by the proponents, we are disappointed that the exact structural position of the proposed drill sites is not discussed at all. Further more, we found that our suggestion in the last review was ignored. We advised that the structural complexity such as tilted oceanic sections should be used as an advantage to minimize the drilling depth. This proposal is not likely even to be of primary importance to TECP but the panel is supportive of the tectonic objectives.

Rating: A3

431-Add2 Western Pacific Seismic Network

TECP retains its interest in seismic observations. The panel believes the need for emplacement into deep holes is not yet well established. TECP is supportive of deployment of borehole seismometers in carefully selected locations, to obtain much new data. TECP recognises the societal relevance of the proposal. TECP is less concerned with other aspects of the geology that could be understood by drilling these holes. However, could holes be used for additional purposes. (e.g. deployment of other tools).

In addition, the following more specific points can be made:

Although TECP highly supports the long-term observatories of the proposed work, there are still some remaining questions and requirements. TECP would demand a simple synthetic tomographic model to show why this location point is most suitable one; Using existing distribution of W. Pacific seismic stations/IRIS/WWSSN stations and regional earthquake sources, run synthetic tests showing resolution of tomographic images of the crust and upper mantle in the region. The proponents should compare these to the results of similar tests including stations at the locations of the two proposed borehole seismometers. If it can be shown that the installation of 2 permanent stations in these locations will improve the tomographic resolution, this will be an important point in favor of a seafloor and/or subsurface seismometer in these locations.

The proponents also need to consider what other instrumentation might be usefully installed in these holes, as well as just seismometers. If the holes are proposed as comprehensive observatories rather than just downhole seismometer installations they will be more globally relevant and more likely to receive support from the panels. Realtime retrieval of data would also be desirable and will allow more. For example, floating GPS receivers tethered to this borehole installation might be used for tsunami warning systems.

In order to justify the proposed drilling, it must be demonstrated that a borehole installation of the seismometers will have a higher signal-to-noise ratio than a sea bottom installation, for example, submersible deployment of instruments on the seafloor. Thus far, results from comparison tests are still inconclusive.

More generally, TECP believe that regional tomographic studies can be properly done only with a line (2-D) or areal coverage of many seismometers. This realistically can only be done with OBS. The redundancy achieved by these many instruments is essential for regional tomographic inversion as was shown for example in the Northern European array (NORSAR), even if the single to noise ratio is slightly less than at a downhole seismometer.

Rating A1, B1.1, C3, D3, E1, E4, E8, F2

Return to 735B

Even though the geological evidence that drilling in this region would penetrate a gabbro/peridotite section, TECP does not feel that the structural framework of this crustal block is sufficiently well-constrained at present to justify drilling for TECP objectives. TECP looks forward to seeing the analyses of recent and planned survey data, particularly the seismic reflection data, for this area. Drilling the gabbro-peridotite boundary is a thematic objective for TECP and with an improved structural framework this proposal could receive a higher ranking. The proposal currently lacks clear alternative hypotheses for the structural and lithologic data acquired from Leg 118 that can be tested by drilling. The panel doubts that the models for crustal architecture (fig. 2) can be distinguished by drilling. What is the evidence that shows that the structures in the 735B core are discrete features associated with major detachment faults as opposed to more distributed deformation throughout this region? The new seismic data may help to resolve this. While the surface mapping can help to locate

technically-feasible drill sites, the panel feels that the mapping objective are highly optimistic and that the sites must be constrained by the subsurface data.

Rating: A3, B1.3, B2.1, C2, D1, E8, F3

**445 - Rev Deformation and Fluid Flow Processes in the Nankai Trough Accretionary Prism
G.F. Moore, J.Morgan, B.Bekins, et al.**

The proposal was considered mature and relevant to the Long Range Plan. One question regards the detraction of not achieving full 1700 m penetration in hole WNT2A which is a first priority hole. What would happen if the hole reached only 1300 m depth with regard to fluid flow objectives? A more specific list of achievements for legs 1 and 2 would be helpful. Would 1 leg of drilling be viable, should there not be time allocated for 2 legs of drilling?

Rating:

**461 - Add Rift-to-drift processes within the ocean-continent transition west of Iberia
(NARM non-volcanic)**

TECP was pleased to see this addendum and to learn that the proponents intend to submit a new version of the proposal in time for the June 1995 deadline. The addendum also mentions new data, results and studies that have or are being undertaken, and will be included in the new version of the proposal. In particular, an Ar/Ar date for the Site 900 gabbro should be available in a few weeks, and further pre-stack migration for parts of existing data in the area is currently underway. TECP was particularly pleased to learn that multichannel seismic, wide-angle OBS and deep-tow magnetometer data will be acquired in the area in July-August 1995. These data will clearly further characterise the study area, provide the necessary crossings at some sites, and hopefully provide a much better 3D understanding of the basement highs that have been, and are proposed to be, drilled. The addendum also provides a preliminary response to TECP's October 1994 review - TECP welcomes this timely response. Several of these responses generated further discussion in TECP, and will be covered further here so that the proponents can consider them further in time for their next revision. 1. TECP still feels that on the basis of seismic character at least the top of the basement block at Site IAP-7 may be complicated by volcanism and if so may not satisfy the primary objective of the site. It could however, test for the presence of syn-rift magmatism. The lack of a magnetic anomaly associated with the block does not necessarily contradict the volcanic interpretation, as it would depend on the composition, thickness and type of magnetisation of the volcanics. Perhaps further seismic processing may help resolve this. 2. The issue of whether or not lateral movement along the Iberia margin might have complicated the structural setting of the study area was discussed. TECP has no firm view on this at this stage. It is likely that the extensional faults on any rifted margin will have some component of strike slip on them either during rifting and/or later post-breakup reactivation, and therefore the issue may be somewhat of a red-herring. However, the view was put by one TECP member that it is an important consideration. It would be helpful to further consideration of the proposal is rather than simply refute the suggestion, the proponents can respond to the issue by briefly referring to, and referencing, the kinematic evolution of the region. The proposal attacks high priority TECP thematic objectives in a very appropriate and well imaged area. TECP commends the proponents for their rapid response to our last review, and looks forward to seeing the revised proposal after June 1995, and future revisions incorporating the new Discovery data.

468 - (Bonatti et al.): Carbonate platforms at the Romanche and Vema

TECP was pleased to see that this proposal (#468) is now clearly focused on understanding the origin of transverse ridges commonly observed in slowspreading fracture zones. The new drilling strategy has followed a TECP recommendation made in our fall 94 meeting

when we reviewed an earlier proposal (376, Bonatti et al., Vema FZ). TECP is very interested in the origin of transverse ridges since it is a fundamentally important problem of the oceanic plate tectonics that remains poorly understood. As such this proposal is highly relevant to TECP thematic interests.

The proposal at its present form is, however, immature and may possibly encounter technical feasibility problems for drilling. Thus an ad-hoc committee was formed at TECP spring 95 meeting to assist the proposal proponents in coming up with a mature proposal before the 1995 deadlines. The committee includes TECP members Gary Karner, Yves Lagabrilie, Carlo Doglioni, Jian Lin, and Uri ten Brink; ten Brink, who is currently TECP watchdog on vertical tectonics, will chair the committee. TECP asked that the following questions be addressed in the revised proposal:

- (1) The proposal proponents and ad-hoc committee should seek the advise of an experienced sedimentologist to address feasibility of drilling into carbonates or sedimentary apron before proceeding with the revised proposal.
- (2) The panel complimented the proposal proponents on their effort in developing conceptual thrust faulting models to explain vertical tectonics (Bonatti et al., JGR, 1994). It is essential that the revised proposal address explicitly what specific parts of the thrust model may be better constrained by the drilling results. Gravity profiles across the uplift blocks, where available, should be incorporated in modeling thrust faults.
- (3) It was suggested by panel members that sedimentary formations adjacent to limestones may contain valuable information on the subsidence history of the uplift blocks. The proposal proponents and ad-hoc committee are encouraged to explore the possibility of using conjugate sequences recorded in limestone and adjacent sediment drill holes to work out the uplift-subsidence history.
- (4) Questions remain unanswered regarding whether the observed uplift features near Romanche and Vema FZs were caused by same past episodes of changes in Atlantic plate motion directions or the features near the Romanche and Vema were controlled by unrelated local tectonic events. The proposal proponents and ad-hoc committee are encouraged to consider a drilling strategy that will address this potentially important problem relating to plate kinematics of the north Atlantic.

A1, B1.1, B2.1, C1, D3, E8, F2

Letters of Intent

LOI 40, ODP Drilling in the Banda Sea, Indonesia - E. Silver and D. Snyder

TECP views the Banda Sea area as a key one for studying many problems of importance related to microplate tectonics and triple junction evolution. We strongly encourage the submission of a more detailed drilling proposal for this region.

Rating: A1.

LOI 41, A stress/strain observatory system: Costa Rica

TECP is highly enthusiastic about this proposal and encourages the proponents to proceed with the necessary technological developments. Siting the observatory will clearly require a well-constrained structural framework to ensure, for example, that measurements are not recording movements in a slump in the hangingwall of the targeted fault. The panel suggests that the proponents include a detailed discussion of the rationale for the location of the site and why this margin is the best place to locate this observatory. What are the alternative sites?

LOI 43, Drilling of the Rodriguez Triple Junction - by Tamaki & Fujimoto

To drill the Rodriguez triple junction may bring new data on one of the most intriguing points of plate tectonics, i.e. triple junctions, and in particular a triple junction where every plate diverge (R-R-R). The RTJ is the point where Africa, India and Antarctica plates meet. A better knowledge of the kinematics of this area may contribute substantially to understanding of plate tectonic processes by focusing on the amount of relative rotation and consequent transtension among plates that allows contemporaneous divergence between three plates. Drilling in this area can also contribute a lot to the study of oceanic ridges, particularly in a point where join together ridges of different morphology and expansion rate. An interdisciplinary approach with the LITHP would be expected. being the nascent proposal also addressed to basalts composition. The sites proposed appear to be appropriate at this stage. Any proposal will need to demonstrate what can be learnt that is specific to the triple junction processes, as opposed to slow spreading ridges in general.

Rating: A1

LOI, 44 Japan Trench downhole observatory

TECP is supportive of this LOI and recognises the societal relevance. This would appear to be an excellent utilization of a single downhole observatory. It has a great potential for impact on both basic scientific questions and seismic risk assessment. If technical problems can be overcome, this proposal could be championed by ODP and would help with public relations. TECP expects the technical requirements to be explained and justified clearly in any new proposal.

Rating: A1

LOI 47, Scientific Drilling in the Red Sea - J. Ludden et al.

TECP would like to note first of all that the Red Sea has many unique characteristics which make it attractive as a potential drilling destination, in order to study a variety of tectonic problems related to crustal architecture and processes of early rifting and transform fault development. Thus, in general, we welcome proposals that are focused in this region. This LOI seems to be a very general expression of interest in the region on the part of the proponents (Ludden et al.) and alludes to a few of the interesting scientific problems which

could be targeted in this area. We encourage more detailed development of scientific ideas and the submission of a more detailed drilling proposal focusing on one or several questions of fundamental tectonic importance. However, because there are presently two active ODP proposals dealing with the Red Sea: #086 (Bonatti et al) and #470 (Sichler et al), TECP suggests that Ludden et al. coordinate with the proponents of these other two proposals in order to design a viable and coherent drilling program based on their mutual interests.

TECP also notes that previous versions of proposals to work in the Red Sea have run into difficulties not just because of politics but also because of the presence of salt layers at depth and the difficulty in imaging through these and dealing with them during drilling. Another presently active LOI (#33) proposes to avoid this problem by working in the Gulf of Aden, where many of the same tectonic questions can be addressed but where salt is not present. Proponents of any Red Sea proposal should be prepared with a well-formulated strategy for dealing with salt and should also consider alternative locations such as the Gulf of Aden, if appropriate.

Rating: A1.

LOI 48, Physical property variations across convergent margins

The TECP is very keen on this proposal and strongly encourages the proponents to submit a full proposal for the July 1995 deadline. The tectonic/physical property themes are of direct relevance to TECP objectives. Detailed objectives, tectonic relevance, time/cost estimates should be furnished for each of the transects. Given the cost of the LWD system, the proponents are strongly encouraged to focus on only the most significant tectonic aspects of this system. The possibility of coupling this proposal to the stress/strain observatory system in Costa Rica (LOI 41) was raised as a possible route the proponents could investigate. This could be put forward as a unique and possibly revolutionary style of ODP leg.

Rating:

LOI 51, Deep drilling near Site 504 - Pezard et al.

TECP rating for this letter of interest is A3 (Portions are relevant). TECP considers this LOI to address primarily LITHP interests. The LOI has some limited TECP relevance regarding fault micro-structures.

6. Watch Dog Reports

Large-scale Ocean-Continent Integration - An Yin

The existing proposals related to ocean-continent integration fall into two topics: continental-margin divergence and continent-arc collision. The objectives of the Taiwan and Iberian proposals are highly relevant and important to improving our understanding of how the continental and oceanic lithosphere interacts. I would like to point out that the community of continental tectonics are focusing efforts in the area of interactions between global tectonics and climate changes. In particular, the origin of the Himalayas-Tibetan plateau system and its relation to the initiation of the Asian Monsoon have been intensely discussed recently. There are several projects are either supported or being considered to be funded by the NSF Continental Geodynamics Program (e.g., INDEPTH in southern Tibet, a Dartmouth project in northwestern Pakistan). These topics are very fitting to the thematic interests of the ODP TECP in that they are processes-oriented and deal mostly with active or Late Cenozoic tectonics. With this common interest in mind between the two communities, we should encourage or help initiating new proposals in this direction.

Transform Margins - Uri Ten Brink

Following the Fall94 meeting, TECP noted both formally and personally to E. Bonatti its strong desire to see the the transform ridge drilled and dated. As a result a new proposal (#468) has now been submitted, which follows his prior proposals (the engineering leg on the transverse ridge of the Vema F.Z, and #376 - Vema F.Z). However, the proposal is still immature and may possibly encounter feasibility problems for drilling (e.g. drilling shallow water carbonates). Hence, an ad-hoc sub-committee was organized to encourage a mature proposal to be submitted for the 1st July 1995 deadline. A mature proposal would only be produced if i) the present proponents agree; ii) the proposal is technically feasible in terms of the required data. The sub-committee will be chaired by Uri Ten Brink and with members, Gary Karner, Yves La gabrielle, Jian Lin, Carlo Doglioni, and Uri ten Brink. The committee will seek the advise of an experienced sedimentologist to address feasibility of drilling into carbonates, or sedimentary apron before proceeding with a full proposal

Scheduled legs

Leg 159 -Equatorial Atlantic - The first drilling in translational setting - completed.

386 - California margin, scheduled. for 1996. It is a paleoceanographic leg but with secondary benefits to the study of the transpressive (and previously transtensive) plate boundary between Mendocino and Baja California.

Pending proposals not discussed in this meeting

333- Cayman trough. No new revisions at this time.

458 - Southern Ocean Transect. A paleoceanographic leg which includes site TSO-2 on the Agulhas Ridge with plans to drill to basement. This site bears directly on the origin of transverse ridges.

Convergent Collisional Settings - Roland van Huene, Greg Moore

There are currently two proposals in the JOIDES system that deal with collisional settings: one to study the northern Australia-eastern Indonesian collision and one to study the Taiwan collision zone. The Australian/Indonesia proposal (#340) was last reviewed at the spring 1993 meeting and has not been revised. Revision awaits a future site survey. The Taiwan proposal (#450-rev) was reviewed at this meeting and received a high ranking. These two proposals represent the best areas to study arc-continent collisions, so further proaction on the part of TECP is not necessary.

Oceanic Lithospheric Processes - Jian Lin

1. Proposals that are related to oceanic lithosphere and ranked by this panel

- 300-Rev (Natland and Dick): Return to Site 735; reviewed by this panel
- 376-Rev3/468 (Bonatii et al.): Carbonate platforms at Romanche/Vema F.Z.s; reviewed by this panel; TECP suggested a working group (ten Brink, leader) to work with Bonatii to explore the feasibility of coming up a much specific plan
- Genetic proposal on reflecting interfaces on oceanic crust, which combines the following two proposals:

469 (Stagg and Symonds): The Argo abyssal plain: A proposal to drill reflecting interfaces within oceanic crust; reviewed by this panel

438 (Mutter and Karson): Test of reflecting interfaces in oceanic crust; last reviewed by Spring 94 panel

2. Proposals that are related to oceanic lithosphere but not ranked by this panel

- 426 (Christie et al.): Australia-Antarctic discordance; last reviewed in 1992; additional site survey data will be collected in 1996
- 425-Rev (Casey): Mid-Atlantic Ridge offset drilling; last reviewed in 1993
- 413 (Murton): Reykajanes Ridge; last reviewed in 1992
- 420 (Purdy): The evolution of oceanic crust; last reviewed in 1992
- LOI 43 (Tamaki and Fujimoto): Drilling of the Rodriguez Triple Junction; reviewed by this panel
- LOI 51 (Pezard et al.): Deep drilling near Site 504; reviewed by this panel

3. Recommendations by the Sept. 1994 US RIDGE "RISES" workshop

The RIDGE Design Workshop for Experimental Approaches to Ridge Segment Structure and Dynamics (RISES) was held 26-27 September 1994 in Wakefield, Massachusetts and was attended by more than 50 scientists from 20 U.S. institutions and two InterRidge observers. The principal objective of the workshop was to design a set of coordinated hypothesis-driven experiments that will help to define the direction of the Crustal Accretion Variables (CAV) element of the RIDGE program over the next 3-5 years.

The ocean drilling program (ODP) was identified by the workshop as an integral component of the intra-segment experiments to directly constrain the structure of lower crust and upper mantle at both slow- and fast-spreading ridges. Specific drilling strategies for slow-spreading intra-segment experiments includes: (1) Drilling old crust along an isochron paralleling the ridge segment to determine if present day along-axis patterns of geochemical variability mirror those of paleo-spreading centers and to detect systematic correlation of geophysical and geochemical anomalies; and (2) drilling a series of 10-15 shallow 100-200 m holes into a serpentine belt flanking a ridge segment to allow direct sampling of an along-axis section of the mantle. The lithologic heterogeneity of the mantle rocks and the rock fabrics observed would then directly constrain the processes of shallow mantle flow and melt transport on the scale of a single segment. To address the problem of magma plumbing system beneath fast-spreading ridges, the workshop endorsed a second leg of drilling at Hess Deep Rift to more fully determine the distribution and variability of lower crustal and mantle rocks formed at a fast-spreading ridge. Ocean drilling is thus an important, integral component of the RISES experiments.

The above drilling strategy, which consists primarily of shallow holes of few hundred meters deep, was formulated as realistic goals given the currently demonstrated capabilities of ODP. The workshop emphasized, however, that the least ambiguous means of determining the causes of crustal thickness variations along spreading centers is by drilling deep (full crustal) holes to enable direct correlation of full subsurface rocks units with gravity and seismic measurements. Therefore developing capabilities of drilling deep holes in young oceanic crust near spreading centers must remain a pressing, high-priority goal of the ODP.

Back-arc basins and forearc domains - Yves Lagabrielle

A relatively large number of revised proposals and unrevised, but still active, proposals relate to problems of back-arc spreading and arc-forearc geology. All of these, except one (453), concern the West Pacific region.

The proposals often refer to transects of holes designed to constrain dynamic models, such as rift propagation, spreading axis propagation and progressive splitting of arcs. Some proposals also focus on problems of the origin and nature of forearc crust and to construction of early arc volcanic provinces.

The active geodynamical systems which are proposed for drilling are :

- the north of the Mariana trough (442-Rev: study of rift and back-arc spreading propagation),
- the tip of the Woodlark spreading axis (447-Rev: study of continental extension and transition to oceanic spreading),
- the Lau-Havre system has 2 different proposals focusing on (1) processes of oceanic spreading in the back-arc basin (437--), (2) north-south evolution of arc activity with time and the nature and tectonic processes of the forearc region in relation with the subduction of a topographic ridge (451-Rev2).

One other proposal concerns the Ontong-Java plateau whose post emplacement evolution has had considerable influence on the geodynamics of the SW Pac region (448-Rev).

Other revised proposals concern the general problem of inputs and outputs at convergent margin without accretionary complex (435-Rev2), and the origin of silicic rocks in the forearc (421-Rev).

Proposal 453 (Fisk et al.) concerns the geology of arc and back-arc regions, north of the Antarctica peninsula. This multiple objective proposal addresses problems of global tectonics, of magma genesis and of paleoceanography.

447-Rev. Active continental extension in the western Woodlark basin - Taylor and others.

This is a totally tectonic-oriented proposal. The 3 sites include objectives of high priority for TECP. The question is how oceanic spreading in the Woodlark basin passes into continental stretching in the Papuan Peninsula. The objective is to test a model of asymmetric rifting of the crust. It is specifically interesting to test whether the inferred detachment fault evolves from high angle to low angle and to test the mode of emplacement of a metamorphic core complex.

Drilling is essential to test the interpretation that Moresby Seamount is a lower plate metamorphic core complex. A transect of sites is proposed and two different models of faulting are proposed with two different geometries.

442-Rev The magmatic and tectonic evolution of rift initiation in back-arc basins : drilling in the northern Mariana trough - Stern et al.

The problem concerns the way in which continental, or arc crust is stretched before oceanic spreading.

The TECP is mainly concerned with 3 objectives that are:

- style of initial rifting of arcs,
- timing of rifting and evolution with time,
- modes of propagation of rifting and then of spreading into a new region.

The remaining objectives are of interest for LITHP.

Mariana trough is spreading at a half rate of 1.5-2.2 cm/yr. The spreading regime passes progressively into amagmatic deeps (with gabbros and peridotites exposed) and then to

grabens and volcanoes. The main question is to know how far to the north does crust formed by seafloor spreading extend.

437-- Lau-Havre-Taupo: Convergent margin, spreading to rifting transect - Parson and others.

This is an "immature" drilling proposal. The aim is to study a geological evolution through time from the attenuation of continental or arc crust to the spreading and the accretion of new oceanic crust. The Lau-Havre-Taupo back-arc basin is shown as a modern example of where propagating oceanic spreading is succeeding to propagating rifting. They propose to drill 7 sites along strike of the back-arc basin.

451-Rev2. Ocean Drilling in the Tonga forearc: subduction geodynamics, arc evolution, and deformation processes at non-accretionary convergent margins - MacLeod and others.

Proposal 451-Rev2 is of high interest for both TECP and LITHP but unfortunately lacks complete site survey data.

This proposal addresses crucial questions of tectonic evolution in a region of interest, characterized by a relatively simple geodynamic situation and the fastest subduction and absolute plate velocity ever recorded. Detailed objectives are :

- to know the exact timing of uplift-subsidence in the external forearc and rifting-spreading in the internal forearc,
- to be able to discriminate between steady state subduction erosion and catastrophic event,
- to have constraints from paleomagnetic data on forearc rotations allowing to test very recent models of asthenospheric flows beneath slabs.

421-Rev. Investigation of section age and formation conditions of the acidic volcanic layers in the ocean slope of the volcano Trench.

This proposal relates to the general topic of forearc settings as it concerns the study of acidic rocks discovered in the volcano trench (at the Junction between the Mariana and Izu-Bonin trenches). The objectives are mostly petrological and geochemical objectives but the problem which is debated is close to the question arising from the Arculus proposal.

435-Rev2. Crustal fluxes into the mantle at Convergent margins. B: the Mariana-Izu Bonin Margin - Plank et al.

This revised proposal concerns the domain of forearc. They propose to drill 2 sites in the incoming plate in front of the Bonin-Izu and Mariana trenches to determine the net crustal fluxes being recycled in the mantle by mass balance of the inputs and outputs of the arc-forearc system.

453 Bransfield Strait, Antarctica: marginal basin formation, timing of rift volcanism, mantle geochemistry, and Antarctic glaciation - Fisk et al.

This new proposal partly addresses questions of rifting and back arc spreading. The study area is the Bransfield Strait located at the extreme north of the Antarctica Peninsula. The strait corresponds to a back arc basin that opened behind the now inactive South Shetland Islands Arc.

The objectives concern geodynamics, tectonic and paleoceanography. They propose to drill 10 holes. About 5 holes have clear tectonic objectives.

Microstructural Watchdog Report - Sue Agar

In convergent margin proposals, drilling in Nankai (445) presents a good opportunity for a detailed study to look at the early microstructural evolution of accreted sediments that is obliterated in exhumed accretionary complexes and constrain the conditions of formation of distinct microstructures that characterize this stage of accretion. Core investigations should include mapping the distribution of the dominant deformation mechanisms that can be linked to strain modeling and physical property studies. In the Peru margin (355 rev 5) measurements of the hydraulic properties combined with studies of sediment fabrics associated with gas hydrates could provide some useful insights to the controls on slope failure and possible structural fabrics associated with the BSR. The Taiwan proposal (450) recognizes the potential for microstructural indicators of kinematics, deformation mechanisms, stress evolution, strain paths and the importance of linking these to physical property measurements and FMS logging.

Several proposals include *in-situ* stress measurements (e.g., Tonga forearc (446), Red Sea (470), Cayman Trough (333), the Northern Mariana Trough (442-rev)) but none of them delivers a clear explanation of how the stress measurements would be interpreted within the tectonic framework. How will they relate the stress measurements to local-scale structures and fabrics?; What is the significance of stress measurements in relatively shallow holes?

In several proposals, evaluations of PTt paths are proposed as a means to determine the exhumation history. The proposals need to state the resolution of the geobarometers and geothermometers they anticipate using. Is this resolution adequate to distinguish PTt paths? What alternative methods could be used?

Proposals to drill rheological boundaries (e.g., 735B, 15° 37' MAR, Vema) would provide an opportunity to examine the microstructures and inferred deformation mechanisms across lithological transitions. These studies are important for understanding strain localization in the oceanic lithosphere. Proposals that address drilling seismic reflectors in oceanic lithosphere (Argo Abyssal Plain (469), Reflecting interfaces (438)) could provide an excellent opportunity to calibrate core microfabrics with acoustic signatures. Microstructural evidence for the reactivation of the Argo abyssal plain structures would need to be addressed.

Plate Dynamics - Watchdog report by C. Doglioni

As in the past meetings, very few proposals in the system are devoted or even marginally interested to plate dynamics. Moreover none of the proposals takes into account global constraints as for instance the "westward drift" of the lithosphere which has evident consequences in the polarity of the subduction zones. Also, the relative "eastward motion" of the mantle has been seen in the literature as a mechanism for back-arc spreading. Nevertheless proposals continue to ignore completely this information and its consequences as the decollement between lithosphere and asthenosphere, which is never included in all the kinematic models that claim to be tested in proposals dealing with rifting processes, both in back-arc settings and in classic rift zones.

The North Australian proposal dealing with the origin of foredeeps origin has unfortunately not yet been resubmitted.

The letter of intent 43 to drill the Rodriguez triple junction might have important feedback on plate kinematics and dynamics of triple junctions.

Divergent margins - Phil Symonds

As of February 1994 there were 9 active divergent margin proposals as follows: 086-REV2 - Red Sea (Bonatti) - addresses high priority TECP objectives in an area of interest, but story complicated by salt. Very immature at present. 333-REV2 - Cayman Trough (Mercier de

Lepinay) - of interest to TECP, but needs considerable further action. Note new proposal reviewed at Oct. 94 meeting.334-REV3 - Galicia S' reflector (Boillot) - TECP questioned the scientific feasibility of the proposal, but considered it to be mature.432 - Galicia deep hole, S reflector (Reston) - of high interest to TECP, but considered technologically unfeasible due to the more than 3000 m of penetration required.447 - Western Woodlark (Taylor) - high priority proposal examining aspects of continental extension in an active rift environment. Ranked no. 1 by TECP at last Spring global rankings, but does require further work and probably data collection. Further processing tests have now been carried out on the seismic data and considerable improvement was obtained. A new seismic crossing of the sites is being planned.NARM-DPG (Larsen) - the full volcanic/non-volcanic rifted margin proposal for the North Atlantic advocating many drilling legs. Addresses high priority objectives, but as presented it contains deficiencies and is immature. Several aspects of this proposal have been re-submitted in revised form as mentioned below.NARM-Add Newfoundland non-volcanic (Austin) - considerable improvement on original NARM-DPG proposal but problems with sites remain. Has high priority objectives.NARM-Add2 (Larsen) - E. Greenland volcanic margin following on from Leg 152 - concentrates more on feather edge of seaward dipping volcanic sequence and has important pre-volcanic rift-related objectives. New proposal reviewed at Oct. 94 meeting.NARM-Add3 (Reston) - West Iberia non-volcanic margin (Iberia II) - proposes follow-up drilling to Leg 149 in ocean/continent transition zone. High priority objectives but only preliminary until Leg 149 results better understood. New proposal reviewed at Oct. 94 meeting.LOI-31 (Stagg) - Lower plate rifted margin, southern Australia - of considerable interest to TECP but only preliminary at this stage.Of the 10 proposals (9 active and one letter of intent) above, two relate to Galicia margin S or S' objectives, and one other proposal (NARM-Add3) includes a Galicia sub-set. Six of the above proposals attack NARM-type objectives and build on the NARM-DPG report.During the March 94 global rankings divergent margin proposals ranked as follows:West Woodlark - 1, Iberia II - 4, E Greenland II - 7, Cayman Trough - 8, S. Australia LIO - 11, NARM- Newfoundland - 14, Galicia deep S reflector - 15. That is, there were 7 divergent margin proposals in the top 15 of the global rankings.At the Oct. 94 TECP meeting the following divergent margin proposals were reviewed and the comments are included within these minutes:333-Add2 - Cayman Trough update - focuses more on transform aspects of the feature, but still of considerable interest to TECP.460 - E. Greenland transect - formerly NARM-Add2. Has important TECP pre-volcanic rift-related objectives, following on from Leg 152.461 - W. Iberia margin - formerly NARM-Add3. Follow up to Leg 149. LIO 33 - Gulf of Aden (Cochran) - TECP is very interested in drilling in this area, where both volcanic and non-volcanic margins are represented, and the exact conjugate is easily defined.Thus only 1 letter of intent and no new divergent margin proposals were added at the Oct. 94 meeting resulting in a total of 9 active proposals and 2 letters of intent with objectives that relate to divergent margins.The Prospectus for fiscal year 1996 contained two divergent margin proposals - SE Greenland II volcanic margin and Iberia II non-volcanic margin - both of which are follow-ups to previous drilling legs. This indicates that the drilling order proposed in the NARM-DPG report has now changed as the second volcanic leg will not be on the Vøring margin, and the second non-volcanic leg is unlikely to be in the Newfoundland Basin. It seems that although the conjugate margin drilling approach adopted by the NARM-DPG is still valid, it is unlikely to be achieved in the foreseeable future because of feasibility problems related to both the scientific objectives and the deep drilling capability of the JOIDES Resolution. This opens the question that if this conjugate strategy is starting to fall apart with respect to the North Atlantic, are there other rifted margin provinces that offer better conjugate drilling possibilities? In the short term the answer is probably no. However, younger rifted margins with readily identifiable conjugates and less sediment cover, such as the Gulf of Aden region, which was proposed in a recent Letter of Intent, and active extensional provinces such as the West Woodlark Basin, offer very interesting drilling possibilities in the future. Another drilling strategy that could be followed is to drill specific features imaged on seismic data that are geophysically well constrained within their rift margin setting and are considered to be globally significant in terms of rifting processes, no matter what margin they occur on. Although the preferred method of studying such features is on a conjugate margin drilling transect, experience has shown that this is rarely practicable. Examples of such features that

are the products of important extensional/rifting processes are possible detachment faults, metamorphic core complexes etc. In line with TECP's new focus on the study of active or recently active processes there are three areas that have been proposed for divergent margin studies - the West Woodlark Basin, the Red Sea and the Gulf of Aden. Of these the West Woodlark, which examines the mechanisms of extension in an actively propagating rift environment, is the most mature. The Gulf of Aden appears to offer better possibilities for conjugate margin studies than the Red Sea, because it has no thick evaporitic sequences. It also offers well constrained conjugate margin pairs; the possibility of studying an along-strike transition from a volcanic margin associated with the Afar hotspot to a non-volcanic margin; sufficient sediment to record the tectonic evolution of the rift, but not so thick that it will preclude drilling into the oldest synrift sequences; and the possibility of examining the influence of reactivation of older structures on rift development because the younger Oligocene rifting cuts across older (Late Jurassic - early Cretaceous) extensional deformation features. This area requires considerable seismic acquisition before a formal proposal can be submitted.

(2) transect drilling across young or active features; and (3) drilling of specific features imaged on seismic data that are geophysically well constrained within their extensional settings, and which are considered to be globally significant for rifting processes. The currently active drilling proposals fit into these categories as follows: (1) 461-Iberia, NARM-ADD- Newfoundland; (2) 447-West Woodlark; (3) 334 - Galicia S', 432-Galicia S, 466-Great Australian Bight. Of these the two Galicia proposals and the Newfoundland proposal involve very deep holes varying from 1800-3100 m of penetration and are considered by many to be at or beyond current JOIDES Resolution drilling technology. It is considered possible that the other three proposals could be brought to maturity in time for drilling in 1997, and certainly by the end of the current program period (1998). Thus given the current status of active divergent margin proposals there may be only three that have any real chance of being drilled before the end of the current program. Near mature proposals requiring deep drilling will have to be very well focussed on only the highest priority thematic objectives (e.g. detachment drilling) if they are to stand any chance of success. They will also need to be aimed at targets that are not too far beyond current drilling depths, say 2000 m or less, to be seen as plausible proposals. For divergent margins the only potential high priority deep drilling proposed so far is probably the S' reflector on the Galicia margin (about 1800 m); however, for this to proceed further a convincing argument will need to be made for it being a detachment fault that can be linked unambiguously to the S reflector that underpins tilt blocks on part of the margin.

7. Global Ranking of Proposal

The Panel discussed the list of "active proposals" and ensured that all were considered for global ranking. Of these only OCT-Iberia (461-Rev) had not been discussed in detail this time; a brief summary was given by Hero, Phil Symonds.

TECP decided to include in the global ranking only those that could reasonably be expected to be drillable by the end of the present phase of ODP - 1998. In practice, this means proposal revisions submitted by the July 1st 1996 deadline. TECP decided to rank the S'Reflector proposal, in the knowledge that a new improved proposal could be submitted by 1st July 1995.

TECP then voted, as in the past, with Proponents not voting. The results were as follows:

Rank	Title	Proposal	Points
1	Woodlark	447 Rev	11.9
2	Iberia 2	461 Add	11.6
3	Taiwan	471	11.1
4	Romanche	468	10.6
5	Peru Tectonic Erosion	355 Rev	10.1
6	Mariana Back Arc	442 Rev	9.8
7	Nankai deformation and fluids	445	9.6
8	Tonga Forearc	451 Rev2	9.5
9	Physical prop. LWD	LOI 48	8.4
10	S Australia Continental Margin	466	8.2
11	Japan trench borehole obs	LOI 44	7.4
12	S'Reflector	334 Rev3	7.0
13	Stress-strain obs	LOI 41	6.4
14	Dipping reflectors (Argo)	469	6.1
15	W Pacific Seismic Net	431 Add2	5.1
16	Return to 735B	300 Rev	4.6

Note: Proposals were ranked that could reasonably be expected to be mature in time for scheduling during the present phase of the program (i.e. through 1998).

8. Shipboard Structural Science

Following PCOM's endorsement, structural data were now being collected effectively at sea and would be archived by adding a column to the Barrel Sheets and by publication of VCDs and other data (e.g. drawings) on CD-Rom. There was still a need to produce the "Cook book" for use at sea. A meeting of a small group (up to 5) to finalise this had been included in the plan adopted by PCOM. Peter Clift had sent an e-mail recommending that such a meeting be held in East Coast USA (WHOI?) in late spring-summer to finalise the cookbook. The PCOM rep suggested some of this could be done by e-mail. Also progress could be made on Leg 160. However, TECP is still of the opinion that a small group meeting is needed, with additional e-mail input from others.

9. Computer database upgrade (JANUS)

TECP were very concerned that in the event only a start might be made on the priority list. Might funds/time run out before Group 4b (structural data) were incorporated. Groups 1-3 were seen as effective parameterisation for data needed for interpretation of lithological and structural data. It was accepted that computerisation of essential numeric data (groups 1, 2 at least) was probably essential. TECP felt that the numerical data computerisation was, in principle, relatively straightforward and should not take up much time, allowing for rapid moving in to Computerisation of Structural and Lithological data. The following recommendation was adopted.

Recommendation 1

TECP recommend to PCOM that PCOM recommends to JOI Inc and that JOI Inc direct TAMU to ensure that every possible step is taken to ensure that the computerisation of both structural and lithological data is fully implemented during the computer data base upgrade project (JANUS).

Explanatory Note: In terms of TECP's thematic interests the new computerised data base system will be essentially useless unless primary lithology description and structural data are fully incorporated.

10. Draft Long Range Plan

The Chair summarised that status of the LRP in terms of TECP's interests. It was noted that an early version had suggested effectively combining TECP, LITP and SGPP with a new effectively OHP being allocated up to 50% of drill time. This had been vigorously opposed by PANCH, as reported to PCOM, November 1994. USAC had subsequently rejected this approach. However, TECP wishes to reaffirm that there remains a clear need for a thematic panel similar to TECP in any revised LRP. Collaboration with other panels is effective and if possible could be strengthened. The Chair noted that input to the future plans section of the draft LRP was sent to Brian Lewis in early January and this document had been circulated to TECP for comment at the present meeting. The Chair also pointed out that future plans needed to be innovative and catch the eye of the community, science planners and politicians alike. Also, it was assumed that societal relevance would figure in the LRP. The document was intended to be written in simple language, although it was possible that an additional version might be produced in more technical language. The PCOM rep noted that any further input was needed at once. Roland von Huene stressed the importance of societal relevance.

A discussion ensued as to what TECP initiatives should be highlighted in the LRP. The main suggestions were:

1) Study in situ physical properties

Great advance had been made with obtaining good data by conventional logging, limited by problems such as hole stability. Logging While Drilling (LWD) was a spectacular advance and offered great opportunities. LWD could be more valuable than recovery of additional core, for example in already well studied accretionary settings. Funding was clearly a problem, but ODP could take the bold and innovative step of sanctioning a LWD leg without coring in an already well drilled area.

Recommendation 2

TECP recommends to PCOM that PCOM recommend to JOI Inc that every effort be made to overcome funding constraints on further use of LWD. TECP further recommends to PCOM that PCOM recommend to JOI Inc that TAMU be directed to put in place arrangements to allow LWD to take place on a leg, if necessary, without coring, should TECP rank a suitable proposal for LWD work sufficiently highly to allow implementation (assuming funding is available).

Explanatory Note: TECP notes that Logging While Drilling (LWD) offers essential opportunities for study of in situ physical properties to infer active tectonic processes. LWD is the only available tool that can provide essential physical property measurements. For example, conventional logging is often not possible in unstable accretionary prism holes. While recognising current financial constraints, TECP urges PCOM to be innovative and make every effort to enable further use of LWD in the near future.

2. Monitoring Active Systems (i.e. Observatories)

TECP believes that the LRP should flag the importance of developing integrated interdisciplinary observatories, for the study of long-term tectonic (and other) processes. This would include long-term monitoring and experimental work (e.g. as part of an oceanic seismic network), or for study of hydrothermal and/or biological processes. Development of such observatories will allow quantification of fundamental tectonic processes, a key aim of TECP. Use of "observatories" also clearly has great societal relevance (e.g. assessment of seismic hazard) and might command new, additional funding. TECP adopted the following recommendation:

Recommendation 3

TECP recommends to PCOM the development of integrated multidisciplinary observatories as a means of monitoring and experimenting on fundamental tectonic (and other) processes be highlighted in the new Long Range Plan.

Explanatory Note: Development of the above observatories would be novel and innovative, likely to catch the attention of many others (e.g. politicians) and of obvious societal relevance (e.g. for seismic hazard assessment).

3) Land-Sea Integration

Solution of some fundamental tectonic problems require integration of tectonic information between land and sea (e.g. subduction - accretion). The advent of the Continental Drilling Programs offers an obvious opportunity for collaboration that could greatly increase the size of the Earth Science community with an interest in continental ocean drilling. The following recommendation was adopted:

Recommendation 4

TECP recommends to PCOM that the new LRP also highlights the future importance of continental land-sea drilling to help solve some fundamental tectonic processes (e.g. subduction/accretion).

Explanatory Note: A focus on land-sea integrated drilling can lead to collaboration with the Continental Drilling Program and as a result greatly widen the earth science community interested in continental ocean drilling. Additionally, there is obvious societal relevance (e.g. assessment of seismic hazard).

The discussion of the new LRP concluded with an emphasis on the need to continue to seek answers to fundamental tectonic processes; the development of observatories that was not an end in itself. It was agreed that the Chair would revise the existing TECP input to the future LRP and send it to Brian Lewis and TECP would be further consulted if time allowed.

11. Panel Replacements

US rep Sue Ager was rotating off, as was ESCO rep. Carlo Doglioni. In view also of forthcoming losses to the Panel, priorities were: i) to maintain a balance, as members with interest in convergent kinematic environments would decrease by 2 by the end of 1995; ii) to maintain continuity especially with respect to liaisons with the service panels; iii) to increase the number of panel members with recent ODP shipboard experience.

12. Next Meeting

Alternatives Edinburgh (UK), Brest (France), Antalya (Turkey).

The Panel chose Antalya (Turkey) since this would allow a field trip to take place focusing on active fault processes, a key TECP interest.

Dates: Field trip 16-18 October
Meeting 19-21 October.

13. Prior to concluding the meeting the Chair expressed TECP's thanks to Sue Ager and Carlo Doglioni who were rotating off. Sue had brought much greater appreciation to TECP of the importance of study of small-scale tectonic structures, in particular. Her role as liaison to DMP had been particularly useful. At the other end of the "size scale", Carlo had particularly kept in front of the Panel the importance of study of large-scale tectonic processes, including plate dynamics and sub-crustal effect.

Appendix: Information for Deformation of the Earth section of the Long Range Plan by Alastair Robertson, Chair TECP, released in the light of TECP input (Feb. 1995)

Dynamic systems have sculptured the earth at geologic time-scales and they periodically impact the cultural infrastructures of civilisations. Ocean Drilling provided an unparalleled opportunity to understand dynamic earth systems in the world's oceans. Continental drilling complements ODP objectives, but many tectonic processes require investigation in the marine environments.

The Earth is an integrated system with numerous feed-back mechanisms between solid earth processes, climate and biosphere. The strength of the lithosphere in all tectonic environments is controlled by the physical and chemical conditions of deformation and the properties of the deforming materials (i.e. sediments and rocks). The forces that uplift large tracts of the earth many kilometres or depress it down into the earth's interior are understood as a function of crustal strength. Changes in the environment such as pressure, stress, temperature, pore fluid pressure and chemistry, for example, determine how rocks are deformed (e.g. faulted). The timing, nature and distribution of deformation is therefore a key aspect for understanding the dynamics of the earth.

Quantification of tectonic systems : We are at a stage where ocean drilling has probed many, but by no means all of the main plate global tectonic settings. We have gained a basic understanding of these systems from which we can try to understand the fundamental processes. However, to progress, a more systematic approach is needed to the study of large-scale tectonic processes operating in :

i) Extensional; ii) Contractual; iii) Translational; and iv) Vertical tectonic settings.. This approach recognises that fundamental tectonic processes operate globally and transcend the conventional division into plate tectonic settings. For example, extensional processes operate to some extent in each of the above kinematic environments, notably at rifted margins and divergent margins (spreading axes). focus on such large-scale tectonic environments encourages the collection of appropriate data sets that, in turn, facilitate the development of comprehensive theory. To achieve these aims (especially quantification) it will be necessary to maintain and enhance systematic acquisition and archiving of shipboard structural data. It is also intended to achieve close correlation between recovered core, borehole imaging and logging. Drilling will be carefully planned to allow our coordinates to help solve outstanding tectonic problems (e.g. origin of deep seismic reflectors in rifted margins and oceanic lithosphere. In addition we also intend to retain selected exploratory-type drilling, as some very important settings of earth deformation remain virtually unstudied (e.g. transform). Also completely unpredictable discoveries concerning tectonic processes must remain to be made in the oceans.

We also aim to achieve a quantum leap forward in the understanding of tectonic processes by introducing the following novel, innovative studies that involve ocean drilling :

Study of in situ physical properties : Development of an underlying theory to explain tectonic processes depends critically on the measurement of physical properties at and around boreholes. Measurement by conventional logging of boreholes are often limited by problems such as poor hole stability. The application of logging While Drilling (LWD) technology represents a spectacular recent advance in ocean drilling. In future, Logging While Drilling should be used, both as an adjunct to drilling and coring, and also as a means of obtaining essential physical property information from cores that have already been drilled, but not logged (e.g. some convergent margins). Further core recovery may not be

necessary in such settings. Improved physical property information is essential to shed light on tectonic processes of societal relevance (e.g. seismic hazard).

Monitoring Active Systems - Development of multi-disciplinary observations : To improve understanding and qualification of dynamically active tectonic processes it is essential to develop integrated multi-disciplinary observations capable of recreating three-dimensional tectonic effects in and around boreholes. In future, it will be essential to develop comparable packages of instruments capable of recording and monitoring processes. These should include a stress tool to detect active deformation. Instruments to record temperature variation, fluid flow and fluid pressure changes (i.e. fluid fluxes) through time, and (if required) seismometers to track active faulting. Suitable setting for such instrumentation include active extensional (i.e. modern rifts) and contractional (e.g. thrust plains and decollement zones) locations. Such studies of active processes will focus locally around an active fault system. However more regional-scale experiments are envisioned that link *in situ* observations of fluid, temperature, stress and pressure systems in active fault zones with seismicity that allows coupling of these parameters in numeric models. Such development would attract the attention of the wider scientific community (e.g. biologists) and interest funding agencies and politicians, also bearing in mind the obvious societal relevance (e.g. assessment of seismic hazard)

Land-Sea Integration of tectonic processes : The solution of some fundamental tectonic processes requires the integration of tectonic information gained by drilling, both on land sea. A good example is the study of convergent margins where the plate subduction effects both onshore and offshore areas.

Continental Drilling Program offers the obvious opportunity for collaboration between the marine and land communities. For example, a transect of holes needs to be drilled from coastal to offshore along the western USA and Japan continental margins to provide basic data needed for earthquake hazard assessment (e.g. knowledge of integrated fault patterns, *in situ* pressure variation, fluid fluxes *in situ* stress). Such drilling would also greatly widen the earth science community interested in ocean drilling.

In summary, it is obvious that the study of fundamental tectonic processes remains a key objective of future ocean drilling.