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Minutes
Western Pacific Panel Meeting
February 24-26, 1986
RSMAS, University of Miami

Contents

Western Pacific Panel Meeting
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Summary

The principal business of the meeting was to reconcile the thematic priorities of the Lithosphere, Tectonics, and Sediment and Ocean-History Panels with existing proposals and the Western Pacific Panel's previous recommendations, made at the August, 1985 meeting. The results are set out in Table 1 (overpage), which assigns priorities on the basis of 6-, 9-, or 12-leg options, and gives a summary of panel endorsements. Strong emphasis is given programs in island arcs, forearcs, and back arcs, with targets in the Bonins, Vanuatu, and the Lau Basin. These have strong thematic support from several panels.

Mixed thematic and regional objectives are the basis for the recommended programs in the Banda-Sulu region and for the Japan Sea. The Great Barrier Reef is the principal thematic objective of SOHP in this region. Thematic objectives are the basis for the recommended programs in the South China Sea (passive margin evolution) and at Nankai (accretionary problems). WPAC gives these higher thematic priority than TECP, which preferred more emphasis on collisional problems. However, the data sets and proposals dealing with the particular collisional problems favored by TECP (Ontong-Java Plateau and the Louisville Ridge - Tongan collision) <u>are not adequate</u> to formulate a drilling program.

The rationale for specific recommendations concerning programs and time allocations is spelled out in item 5 of these minutes.

WPAC also evaluated existing, pending, and proposed survey information and prepared some preliminary schedules for a 9-leg program commencing in 1988. To minimize transit, the preferred order is South China Sea, Japan Sea, Nankai, Bonins, Bonin-Mariana, Sulu-Banda, Great Barrier Reef, Vanuatu, Lau Basin. An early departure from the Indian Ocean is desirable to avoid the high-latitude winter problems in the Japan Sea (and Nankai Trough).

The rationale for a suggested rotation of panel membership (Appendix 1) is provided under item 10 of these minutes.

Table 1

Area[1]		Program Length (#Legs) 6	9	12	Thematic Blessings	Relevant Proposals	Site Survey Needs	Present Data Workup	Cruises Planned
Lau Basin	(8)	1	1	1	LITHP, TECP, Hawkins' workshop	HTB 189	zero-age survey	Integrate 5 recent cruises	--
Bonin-Mariana	(1) (13)	1	2	2	LITHP, TECP, Hawkins' workshop	83,171 /172	more MCS	JNOC MCS needed	ORI 7/86 Taylor MCS proposal ALVIN '87
Vanuatu	(6)	1	1	2	LITHP, TECP, Hawkins' workshop	187 190	more MCS	recent cruises	French MCS proposal
Sulu-Banda	(3)	1	1	1	SOHP, (TECP)	27,82 131,154	digital SCS (Banda)	✓	French MCS proposal Silver SCS proposal
Great Bar. Reef	(-)	0	1	1	SOHP, Carbonate Wkshop	206	✓	recent cruise	--
Japan Sea	(1)	1	1	1 1/2	SOHP, TECP= obduction	51+ JTB	✓	recent cruise	ORI 4-5/86 Shinkai'86
S. China Sea	(3)	?	1	1 1/2	SOHP	46,147 194,216	✓	recent cruises	--
[illegible]	(5)	?[1]	1	1		50 128/F	✓	JAPEX MCS needed	ORI 12/86 Shipley 2-ship prop
Sunda	(10)	0	0	?		80 127	more MCS	x	Gloria 87/88
Manila Trench	(15)	0	0	?[1]		218	Taiwan MCS migrate MCS	x	Taiwan MCS '86
Zenisu	(9)					163 177	more MCS		ORI 8/86
Sulu Transect	(-)					27,48 82	more arc MCS		French MCS Proposal
Tonga Transect	(8)					26, 67	more MCS		
Downhole Experiments	(17)				DMP	155	site-specific surveys		

Notes 1. Numbers in parentheses give WPAC ranking at August 1985 meeting; dash means no equivalent proposal at that time.

2. Palawan (48/D) dropped from consideration: very deep targets, safety problems. Okinawa (7) dropped from consideration: low thematic panel interest, political problems. Ontong Java not considered: no proposal.

1. INVOCATION, CAST OF CHARACTERS

The meeting was convened at 9:10 a.m. on February 24 in the Dean's Conference Room of the Rosenstiel School of Marine and Atmospheric Sciences, University of Miami, by Chair Brian Taylor. Present were Taylor, Silver, Schluter, Rangin, Hesse, Recy, Audley-Charles, Ingle, Leinen, Sarg, Nakamura, and Natland, with Taira and Hayes from PCOM, Garrison from ODP, and Brass from NSF. Present for portions of the meeting were host Keir Becker, representing DMP, and former panel member Langseth, representing kSP.

2. NEW MEMBERS

The panel welcomed the return of UK representation in the person of Mike Audley-Charles. His alternate is Dave Cronan. Also present for the first time was Rick Sarg, liaison with SOHP.

3. REPORTS

A. ODP: Lou Garrison reported the results of Leg 105 in the Labrador Sea, noting particularly the excellent performance of the vessel and heave compensator during high seas and heavy winds. He also reported on the successful installation of a bare-rock guide base at Site 648 on the Mid=-Atlantic Ridge during Leg 106, televised re-entry, coring with a mud motor, and unsupported bare-rock spud in, attempted several times during that Leg. He discussed the development of a mini re-entry cone, to be tested on a forthcoming leg. Then he presented the results of Leg 107 in the Tyrrhenian Sea, during which the Sardinian passive margin was drilled, and ultramafic rocks cored in the Tyrrhenian Sea Basin. Leg 108 is to core sites along the western African margin for paleoceanographic and paleoclimatic objectives.

B. PCOM: Dennis Hayes reported the deliberations of the January PCOM meeting, noting especially concerns about panel strucuture, inter-panel communications, and an orderly rotation of panel members. As paraphrased from a letter to the panel chairman by Roger Larson (Feb. 2, 1986), PCOM envisions a three-step process for each geographic area of planning:

a. First, thematic panels should specify the overall thematic objectives that can best be achieved in this geographic area; these objectives in a particular area are evaluated from a global perspective
b. Second, the relevant regional panel defines a specific drilling program <u>based on</u> and <u>within</u> the thematic constraints set forth by the thematic panels
c. Third, the proposed drilling program is reviewed by the thematic panels who comment on its adequacy in meeting thematic objectives
d. PCOM evaluates input from regional and thematic panels and finally plans a drilling program

Thematic panels should seriously de-emphasize the review of all specific drilling proposals and concentrate on long-term world-wide planning. Regional panels' prioritization of specific proposals and their subsequent proposed drilling programs will serve as initial screening processes for thematic panel review.

A new type of meeting was promulgated, wherein all the panel chairs would reason together. The first of these is to be held April 3 and 4 in Corvallis. The Indian Ocean legs are uncertain, and may succumb to political and site-survey problems. In this case, JOIDES RESOLUTION may leave the Indian Ocean early. Present plans call for approximately 3 years of drilling in the Pacific, to be divided roughly equally between the western Pacific and all points east. PCOM requests WPAC to develop a tentative 9-leg WPAC drilling program at this meeting, with 6- and 12-leg options. A second COSOD meeting is in the works, to be held next spring or summer, probably in Europe. J. Orcott (SIO) is the U.S. contact to volunteer to serve on the steering committee.

C. SOHP: Rick Sarg reported on the overall objectives of SOHP, and their preferences in the western Pacific. The three principal objectives concern:

1) response of sedimentation to fluctuations of sea level and subsidence, and to tectonic processes;
2) sedimentation in oxygen-deficient oceans, as a function of sea-level changes, variations in the carbon budget, etc.;
3) sedimentation on deep continental margins (the composition, lithology, and chemistry of sediments deposited in lower-slope regions).

Priorities in the western Pacific are 1) the Great Barrier Reef; 2) the Japan Sea; 3) the Bonins; 4) the South China Sea; and 5) the Banda and Sulu Seas.

Other Pacific objectives include the Bering Sea, sedimentation in the oldest parts of the Pacific Basin, atoll drilling, and the Ontong-Java Plateau.

D. LITHP: Margaret Leinen reported on behalf of LITHP. Their interests in the western Pacific are in:

1) magma processes and hydrothermal activity in backarc environments;
2) evolution of forearc crust and volcanics;
3) global mass balances (from a petrological and geochemical perspective, does what goes down a trench emerge in arc/backarc lavas?).

The first two have implications for ophiolites,. Pertaining to the third, the Chair noted receipt of a letter from Charlie Langmuir requesting that reference sites with significant basement penetration be cored adjacent to each arc system targeted in the western Pacific. Leinen and Langmuir are to prepare a specific proposal for such drilling for LITHP.

Specific areas of LITHP interest in the western Pacific are the Bonins and Mariana arc/backarc systems, the Tonga arc and Lau Basin, the Okinawa Trough, and the Coriolis Troughs. LITHP requests advice from WPAC concerning differences among these places, but notes a preference for geochemically simple systems (i.e. oceanic rather than continental arcs). LITHP is also aware of the unusual aspects of the Valu Fa "magma chamber" occurrence in the Lau Basin (andesites, failure to discern methane or other evidence for geothermal activity there).

E. TECP: Nakamura and Natland reported the results of the just-concluded meeting of TECP the previous week. TECP recognizes three global tectonic problems which can be best addressed in the western Pacific:

a) The evolution and constitution of arcs and fore-arc basement; the process of rifting in and near arcs; vertical tectonics in arcs

b) The origin and evolution of back-arc basins, including nascent and more highly evolved examples

c) The tectonics of collisions in the broad sense: The arrival of seamounts, aseismic ridges, plateaus, and continental plates and microplates at active convergent margins, and the possible accretion of these terranes. Natland presented a typewritten synopsis of the objectives of TECP in all these areas, and their summary recommendations, noting especially differences in their preferred targets and those recommended by WPAC at its August meeting. Broad correspondednce in targets for arc and backarc drilling exists between TECP and WPAC priorities, but TECP does not place high priority on either Nankai or the South China Sea, nor much priority on the Okinawa Trough (like LITHP, preferred simpler oceanic arcs). It wants more effort on collision problems, such as at the Louisville Ridge-Tongan forearc and the Ontong-Java Plateau--Solomon Islands.

There was much discussion on all these matters, later crystallized in a revision of WPAC recommendations which incorporated the interests of all the thematic panels, plus assessments of existing proposals. Panel sentiment was well summarized by Gary Brass who quoted the Regional Panels' mandate to "help thematic panels translate their broad thematic programs into concrete regional drilling plans" BUT ALSO TO "identify regional problems not covered by thematic panels," and, added Taylor, to respond to proposal pressure.

4. NEW PROPOSALS

The Panel then took up new proposals received since the last meeting. These included a proposal to drill near Papua New Guinea and the Bismarck Sea (forearc flood basalts and potential hydrothermal activity associated with an arc magma chamber), a Korean proposal to drill in the southern Japan Sea (Tsushima Straits), a revised South China margin propoal, summarized at the meeting by Hayes, a proposal to investigate the two-stage opening of the South China Basin, summarized by Rangin, a Manila Trench-to-Taiwan arc-continent collision proposal (S. Lewis et al.) and a proposal to drill an 85Ma passive margin setting in the Fairway Basin of the Lord Howe Rise, summarized at the meeting by Recy. Rick Sarg also provided an explanation for SOHP objectives for their highest priority in the western Pacific, the Great Barrier Reef-Queensland Plateau. SOHP views this as a good place for a carbonate platform study, one that is not deformed, yet has a clastic component similar to those in the geological record (ancient analogs abound!). The specific objectives are

1) late Paleogene/Neogene sea-level history
2) sea-level effects on sedimentation in a mixed epiclastic-carbonate regime;
3) plate motions tied to paleoclimate
4) tectonic cycles (lab to study cycles enhanced globally);
5) the comparative geological history of a continental margin with drowned reefs (Queensland Plateau), and active reefs;
6) sediment diagenesis; and
7) periplatform ooze cycles, their tie to sea-level fluctuations, which may be global (cf. Bahamas and edge of the Queensland Plateau).

The complete list of drilling proposals submitted to WPAC by February 24 is attached as Appendix 2.

This concluded the first-day's session.

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5. REVISED WPAC DRILLING PROGRAM

The second day's session was almost wholly devoted to reconciling the thematic priorities of the Lithosphere, Tectonics, and Sediment and Ocean History Panels with existing proposals and the Western Pacific Panel's previous recommendations, made at the August, 1985 meeting. The specific task set by PCOM was to recommend drilling programs for 6, 9, and 12 legs. The results are set out in Table 1, which gives the number of legs to be apportioned among the various programs under the three options, plus a summary of principal panel endorsements.

The list is divided into two principal groupings: those dealing largely with tectonic and lithospheric priorities, separated by the Great Barrier Reef (which is the principal priority of SOHP in the region) from those of mainly WPAC priority. The group of four above the GBR consists of objectives and targets which not only can be done well in the western Pacific, but can only be done in the western Pacific. The first three of these have strong thematic endorsements from LITHP and TECP, and are highly regarded by WPAC (Lau Basin, Bonins/Marianas, and Vanuatu). The fourth of these (Sulu-Banda) is a regional thematic problem (trapped marginal basins and fragmentation of those basins), but it has a strong endorsement from SOHP (silled basins and closure of the Pacific-Indian seaway) and has the advantage of sound proposals and a good foundation of survey data. WPAC advocates this program because the Sulu-Celebes-Banda area is a critical link between the Australian-Indonesian-Philippines collisions.

Below the Great Barrier Reef on the list is a group of which each has either strong regional or thematic interest, or both, but none of them have the out-and-out thematic endorsement of other panels. Of these, those which appear strongest on the basis of existing proposals, survey information, and thematic or regional interest are the Japan Sea, the passive-margin problem in the South China Sea, and the accretionary-wedge problem at Nankai. The problem of arc-continent collision may potentially be well addressed in the Manila Trench-Taiwan and the Sunda/Sumba areas, but the proposals for both of these areas now focus on the accretionary-wedge problem more than arc-continent collision. These conclude the list of programs allocated any time under the 6-, 9-, or 12-leg formats in Table 1.

Below these in Table 1 are a series of four unranked alternates, which could be incorporated into the program at the 12-leg level if one of the more highly ranked programs is not done for any reason. These are the Zenisu collision zone of Japan, a transect of holes across the Sulu Basin, Sulu arc, and Celebes Sea, a Tonga arc-forearc transect, and the four-plate downhole-instrumentation proposal off Japan.

Finally in Table 1 are programs excluded or dropped from consideration for lack of an adequate proposal or a combination of survey/political complexities. These include the Okinawa Trough, and a deep Palawan objective (both discussed below), and two collision-related problems strongly endorsed by TECP, the Ontong-Java Plateau, and the Tongan forearc-Louisville Ridge collision zone. Concerning collision-related problems, WPAC considered that only one of the three programs advocated by TECP, namely the collision zone of the d'Entrecasteaux Ridge with Vanuatu, has an adequate proposal and suite of survey data on which to plan a drilling program. There is no existing proposal to drill on the Ontong-Java Plateau proper, as advocated by TECP, and there is no site-specific proposal to drill the lower slope of the Tonga Trench to ascertain the mechanism or even verification of Louisville Ridge seamount accretion.

The apportionment of time under the 6-, 9-, and 12-leg formats proceeded in the following way. The first four regions on the list (above the Great Barrier Reef), and the Japan Sea (below it) should be allocated one leg apiece in a minimal (6-leg) western Pacific Program. One of the South China Sea passive-margin program or the Nankai accretionary program should have the remaining leg, but the Panel left it for future thematic/regional/survey considerations to judge which. In a 9-leg program, all 7 of these objectives plus the Great Barrier Reef should receive time, with an additional leg allocated to the multi-thematic Bonin/Marianas forearc-diapirs-arc-backarc complex of problems (including a deep penetration hole in at least one of these settings). This latter we believe is in accord with the strong thematic endorsement of this region from LITHP and TECP, as well as WPAC's thematic assessment.

In a 12-leg program, WPAC considers that additional time should be added to certain programs, rather than adding many additional programs. A leg should be added to the Vanuatu program (allowing time for both the collision problem and Coriolis trough backarc problem, as well as the arc-reversal problem, to be addressed). A half-leg addition apiece would ensure full value from the Japan Sea and South China margin programs. One additional program should be added, concerning the arc-continent collision problem at either Manila-Taiwan or Sunda-Sumba.

In reaching the above series of recommendations, some very specific endorsements and deletions require amplification.

1). The Great Barrrier Reef is a special category in that it is the foremost priority in the region for one panel (SOHP), but has no other thematic endorsements. The proposal at this stage is adequate as to sites proposed, but is weak in thematic documentation, which was provided at our meeting orally by Rick Sarg.

2). The Okinawa Trough was deleted from further consideration because the existing proposal calls for several very deep holes, additional site survey is required but probably will not happen, and there are political (EEZ-type) problems. The entire program seems too much to justify, and is not likely to happen. Apart from WPAC's interest, thematic endorsements are weak (both LITHP and TECP prefer simpler oceanic arc-backarc systems).

3). The South China Sea program endorsed here combines both the passive-margin objectives, and some of the targets in the basin. Lack of TECP endorsement was discussed extensively. WPAC concluded that the margin problem here offered a unique opportunity to evaluate subsidence/flexure/

thermal models of passive margin evolution, and asks TECP to consider this again in light of the recently submitted proposal by Hayes and others.

4). The Nankai proposals endorsed here include a combination of those dealing with the physical processes accompanying development of a decollement, and the more regional pattern of deformation associated with the entire accretionary complex. Advantages are that this may be the only place where a decollement can be reached in a turbidite sequence, and a truly superior set of MCS and other survey information has been obtained. Lack of endorsement by TECP (and their preference for Makran) is surprising. WPAC requests TECP to re-evaluate Nankai carefully in terms of their global perspective on accretionary problems, giving due weight to the survey information available, and the likelihood that coring/recovery and other technical advantages of JOIDES RESOLUTION will radically improve drilling results at Nankai compared with previous experience.

5). The Manila-Taiwan (newly submitted) and Sunda-Sumba proposals were evaluated particularly with regard to the thematic problem of arc-continent collision. TECP's recommendations focused on collisions involving seamounts, aseismic ridges, and large oceanic plateaus, but did not deal specifically with arc-continent collisions, which are as well represented in the western Pacific as the other types. WPAC asks TECP why arc-continent collisions are not more conspicuous in their thematic priorities. The two sets of proposals dealing with this problem actually focus more on deformation processes and fabric development in accretionary wedges. They need some re-direction. WPAC asks TECP to evaluate the existing Manila trench and Sumba proposals with respect to Nankai and other accretionary complexes in terms of thematic priorities. Silver, meanwhile, with a contribution from Audley-Charles, will revise the proposal for Sunda to focus more on the collision aspect. Regarding the Manila-Taiwan proposal, the tie to Taiwan is exciting, geophysical work to make that tie stronger is anticipated, and needs to be factored into a revised proposal. WPAC requests that this be done by Lewis, Hayes, Suppe et al. WPAC expects that one full leg will be needed to do either Manila-Taiwan or Sunda/Sumba.

6). Proposals concerning the possible overthrust of an arc onto a continental margin in the Palawan-Sulu Sea region were discussed. The problem has no thematic endorsement from other panels, hence has to be advocated from a regional perspective only. Excellent survey data exist, but the heart of the proposal concerns a very deep hole (>2,200 m) to penetrate an entire accretionary complex and reach a hoped-for carbonate platform. Given the restricted-basin setting of this hole, safety problems are such that a riser would probably be required for this drilling. Moreover, the presumed deep carbonate reflector on existing MCS data does not have the impedance contrast expected (although time-equivalent clastic sedimentary rocks are not precluded). WPAC finally considered this too dubious a prospect to endorse, with no one (in a vote) in favor of the 2-km deep hole proposed at SULU-1. As for the broader-brush Sulu transect (other, shallower holes across the Sulu arc and into the Celebes Sea), this was split out from SULU-1 and placed as a possible alternate in Table 1.

7). A similar status was accorded the Zenisu project, which consists of drilling a complex arc-like ridge colliding with Japan (and causing Recent, even contemporary, deformation in the central part of Honshu). The principal objective is timing of deformation. Others include 1) evaluation of a new, nascent, subduction zone in the collision region; 2) the physical properties of deformed sediments; 3) the timing of tilting with respect to accretion; 4) the nature of the Zenisu Ridge; and 5) the transition in crustal types along the ridge (approaching Japan), and the different responses of those crustal types to collision. An ancillary objective is the history of the Kurishio current. WPAC asks TECP to give a reading on Zenisu. The principal argument for going there is that there appears to be an intracrustal thrust related to subduction, i.e. a thematic objective.

8). The Downhole-instrumentation project involves 4 holes, serviceable from Japan, perhaps even hardwired to Japan, to monitor plate deformation and seismicity in an area of multi-plate interaction. All four holes would have to be drilled substantially into basement. WPAC endorsed this as an alternate, provided a site-specific proposal can be generated, incorporating some of the sites (or proximity to sites) in the Nankai and Zenisu programs. An option (suggested by Langseth) is that a one-hole operation be considered as a start-up for this project.

9). Specifically concerning TECP's endorsements, WPAC emphasizes that most of the collision problems they favored cannot be approached at the present time through drilling, not only because pertinent proposals do not exist, but because present survey information does not lend itself to preparation of such proposals. Specifically, an adequate survey program for the Ontong-Java collision would have to include careful imaging of the sea-floor in the collision region (Sea-Beam or SeaMARC), as well as extend MCS coverage from the Plateau into the Solomon Islands region. Similarly, deformation (uplift) of the Tongan forearc, or portions thereof, by seamount accretion, would have to be documented more fully by a careful survey, including extensive dredging of relevant portions of the trench slope. Apart from that, there is little assurance that drilling into seamounts in a trench-slope setting is technically feasible, or would prove much.

Partly in place of such objectives, WPAC argues that outstanding thematic problems can be addressed in the South China Sea and at Nankai, and requests that TECP reconsider these, and in light of the above comments concerning inadequacy of proposals and surveys dealing with collision processes. (Point, Game, perhaps Set. Match still pending.)

10. One additional matter came to a vote. The question was, Should the Great Barrier Reef program be removed from the 9-leg format in order to include the presently proposed drilling at either Manila-Taiwan or Sunda-Sumba? The vote was: in favor, 2; opposed, 6; abstain, 4. Motion denied.

This concludes the summary of deliberations pertaining to Table 1.

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6. SITE SURVEY PANEL AND ODP DATA BANK

The only other item considered during Day 2 was a presentation by Mark Langseth concerning site surveys and the Site Survey Panel. Mark outlined SSP priorities and procedures, the role of individual panel members as "assessors", the place of the ODP data bank, and of SSP in supervising or at least monitoring input and output from the Data Bank. A more "activist" role for SSP was outlined, in comparison with times past. Mark specified that contacts are needed to be designated by WPAC for each identified Leg or program. Now is the start-up time for SSP and ODP Data Bank involvement with western Pacific objectives.

This prompted discussion concerning WPAC's immediate tasks, beginning next meeting. These will involve much more emphasis on site-by-site evaluation, and a focus on survey data. Interactions among site proponents, assorted panels, and potential cruise co-chief scientists will take place, and final site recommendations will have to be made. Mark urged that WPAC not get into the position of synthesizing survey data; rather the emphasis should be on the evaluation of pre-filtered data for the selection of optimum sites.

This concluded the second day's session.

7.DOWNHOLE INSTRUMENTS, LOGGING, EXPERIMENTS

The third day's session was devoted to a thorough presentation by Keir Becker concerning downhole instruments, logging, and experimental tools, evaluation of existing and pending site surveys for the program outlined in Table 1, suggestions for a drilling schedule for the 9-leg option of Table 1, and some housekeeping matters.

Becker's presentation resulted in much interested discussion, and the realization that other things will and should be done besides coring in the Western Pacific. The Panel thanked Keir for his presentation and for graciously hosting our meeting.

8. EVALUATION OF SITE-SURVEY STATUS

A synopsis of existing, pending, and proposed site-survey information is included in Table 1. Existing coverage seems adequate to support drilling programs through most of the 9-leg option. Additional surveys would be useful in the Bonins, Vanuatu, Banda Sea, near Taiwan, and in the Sunda-Sumba region. A site-specific survey (not to mention a proposal) will be necessary to target a bare-rock re-entry guide-base in any of the arc or backarc targets preferred by LITHP. Most bodies of survey data need to be entered into the ODP Data Bank. Results of recent cruises of 5 institutions in the Lau Basin need to be integrated, and an updated drilling proposal for the Lau Basin needs to be prepared before the next WPAC meeting. Additional cruises will provide information for the Bonin/Marianas diapirs, the Japan Sea, Nankai, the region near Taiwan, and the Zenisu collision region. Additional proposals are promised for the Bonins forearc (Taylor, MCS), Vanuatu (French MCS), the Banda Sea (Silver; digital SCS), Nankai (T. Shipley; 2-ship experiment), and Sunda-Sumba-Timor (GLORIA survey of Wetar Straits, possibly too late in 1988).

9. SOME TENTATIVE SCHEDULES

Possible schedules for the 9-leg program were considered, with due attention to high-latitude winter monsoons (Dec.-Feb. in South China and Japan seas), and typhoons (late July-Sept. in north, late Dec.-Feb. in south). Early departure from the Indian Ocean (western Pacific drilling to begin in May, 1988), as well as western Pacific drilling beginning in September, 1988, was considered. In all cases, the preferred order (to minimize transit) was South China Sea, Japan Sea, Nankai, Bonins, Bonin-Mariana, Sulu-Banda, Great Barrier Reef, Vanuatu, Lau. An early departure from the Indian Ocean is desirable to avoid the high-latitude winter problems in the Japan Sea (and Nankai Trough). Given possible schedule interactions with objectives in the western Central Pacific (atolls, Cretaceous guyots, old ocean crust, volcanogenic sediments, etc.), we carried this exercise no further.

10. ROTATION OF PANEL MEMBERSHIP

The Panel considered the rotation of its members. Each panel member was requested to supply the chairman with his or her preferred time to rotate off the panel, together with suggestions for his or her replacement. All the U.S. members provided specific times and suggestions for their replacements, whereas almost all of the foreign members deferred decisions to their national ODP panels, and none present volunteered to rotate off this year. Nevertheless, several guidelines for panel membership replacement were agreed on:

a) The panel should have a liason with each of the thematic panels
b) The panel should have a broad cross-section of thematic expertise, with at least 2 petrologists, 2 sedimentologists/ paleooceanographers, 1 structural geologist and 1 member familiar with downhole instruments/experiments.
c) As our panel evaluations will become increasingly site specific, familiarity with primary data sets will be an important asset for panel members.

The chairman incorporated these guidelines into his preferred schedule of panel rotation (see Appendix 1), which was developed following the meeting.

11. ASSIGNMENTS FOR DRILLING-PRIORITY SUMMARIES

At PCOM's request, WPAC is to provide short summaries (with location maps) of the Table 1 sequence of priorities. Those responsible for write-ups are 1) Lau Basin - Natland; 2) Bonins/Marianas - Taylor; 3) Vanuatu - Recy; 4) Sulu and Banda - Silver; 5) Great Barrier Reef - Sarg; 6) South China Sea - Hayes; 7) the Japan Sea - Nakamura; 8) Nankai - Taira; 9) Manila-Taiwan - Hayes and Lewis; 10) Sunda-Sumba - Silver; 11) Zenisu - Rangin; 12) Downhole Experiments - Natland; 13) Sulu Transect - Rangin and Schluter; 14) Tonga - Natland; with Ingle contributing sections on SOHP objectives in the Sulu, South China and Japan Seas. The write-up is to provide a table of sites, site locations (lat., long.), water depths, sediment thickness, anticipated basement penetration, and type of hole (HPC, re-entry, etc.). Deadline of write-ups to Taylor is March 15.

12. FUTURE MEETINGS

Given the scheduled or planned sequence of TECP, LITHP, and PCOM meetings, plus the April meeting of panel chairs, WPAC reluctantly gives up its August meeting in Singapore in favor of an earlier (June 19-21) meeting in Chambery, Hanover, or Kingston, R.I. (URI), in diminishing order of preference, and a meeting following AGU in San Francisco (December 13-15).

13. SINGAPORE POSTER SESSION

The panel reaffirms the importance of maintaining and increasing communications with scientists and government representatives of countries in whose waters/region we wish to drill. To this end, the Circum-Pacific Congress to be held in Singapore in August provides an excellent opportunity, and a WPAC poster display there remains a high priority. A rapidly diminishing rump group of WPAC members who did not have to catch planes discussed the contents of the poster session. Reduced seismic sections and other figures that could illustrate key drilling themes and sites were requested to be brought to the June meeting. These could be located with respect to a large map of the region and combined with posters of the drill ship, etc., to form the poster display. The guides to the Ocean Drilling Program (yellow book) and Lab Stack should be made available for hand out at the Singapore meeting.

At 4 p.m., Chair Taylor adjourned this meeting of the Western Pacific Panel.

(Minutes prepared by J. Natland)

Action List

1. LITHP requests WPAC to spell out differences among backarc systems in the Bonins, Marianas, Tonga-Lau, and Coriolis Troughs.

2. Sarg is to follow up with Australian proponents and SOHP panel concerning preparation of a more focussed, thematically justified Great Barrier Reef proposal.

3. Taylor is to contact Darrel Cowan, TECP Chair, with request to reconsider the South China Sea, Nankai and Zenisu proposals.

4. Hayes is to contact S. Lewis, J. Suppe, et al., concerning shifting emphasis of Manila-Taiwan proposal from the accretionary problem to the arc-continent collision problem.

5. Silver is to work with Audley-Charles to shift emphasis of Sunda-Sumba proposals to the problem of arc-continent collision.

6. Taira is to request proponents of downhole instrumentation proposal to provide a revised proposal giving detailed site specifications, and ideally making use of sites in other possible programs (Nankai, Shikoku Basin, Zenisu Ridge, etc.).

7. Taylor is to assign contacts on WPAC and/or among proponents to work with Site Survey Panel and the ODP Data Bank.

8. Taylor is to write to the 5 institutions with recently acquired data in the Lau Basin, requesting that they integreate their results and a revised Lau Basin proposal, in time for our June meeting. Natland is to act as prod.

9. Panel members are to prepare short write-ups, giving principal objectives of each drilling program in Table 1, together with a site location map, and a table of site data. Assignments are 1) Lau Basin - Natland; 2) Bonins/Marianas - Taylor; 3) Vanuatu - Recy; 4) Sulu-Banda - Silver; 5) Great Barrier Reef - Sarg; 6) South China Sea - Hayes; 7) the Japan Sea - Nakamura; 8) Nankai - Taira; 9) Manila-Taiwan - Hayes and Lewis; 10) Sunda-Sumba - Silver; 11) Zenisu - Rangin; 12) Downhole Experiments-Natland; 13) Sulu Transect - Rangin and Schluter; 14 Tonga - Natland. Deadline is March 15.

10. Taylor is to write to Roger Larson requesting that our next meeting be held in Chambery on June 19-21. The second choice of location is Hanover. The third choice is URI.

11. Involved parties get items to Taylor concerning Singapore poster session by June meeting.

Appendix 1: Chairman's recommended schedule of WPAC membership rotation.

5/86 1) Roy Hyndman (P.G.C., member at large) or other downhole specialist to replace M. Langseth (12/85).

2) Kensaku Tamaki (ORI, Japan, Marine Geophysics) to replace H. Kagami as Japanese representative.

3) Rick Sarg (Exxon, seismic and carbonate stratigraphy) to become SOHP liason.

4) Steve Scott (U. Toronto, Canada, Economic Geology) to replace R. Hesse.

9/86 5) Jim Gill (U.C.S.C., Petrologist) or other arc specialist (Bob Stern, U.T. Austin) to be added to panel and to become LITHP liason on Margaret Leinen's replacement in 1987.

1/87 6) Greg Moore (U. Tulsa; MGG, structure) to replace E. Silver --alternates Steve Lewis (LDGO) or Neil Lundberg (Princeton)

4/87 7) Bob Thunnel (S. Carolina) or M. Lagoe (U.T. Austin), paleo-oceanography, sedimentologist, to replace J. Ingle

8) Margaret Leinen to be replaced as LITHP liason. New U.S. member?

9) Kazu Nakamura to be replaced as TECP liason.

9/87 10) Don Tiffin (CCOP/SOPAC) or Neville Exon (BMR) to replace J. Recy as SW Pacific member-at-large.

1/88 11) Claude Rangin to be replaced as French representative

12) Hans Schluter to be replaced as German representative

13) Jim Natland to be replaced by U.S. petrologist (e.g., Jim Hawkins, SIO)

4/88 14) Mike Audley-Charles to be replaced as British representative

15) Brian Taylor to be replaced as chairman

Appendix 2

JAPAN SEA AND TRENCH (NORTHERN REGION)

REGION	PROPONENT	NUMBER
Japan Sea Tectonics	Tamaki et al.	51/D
Japan Trench (TTT)	Ogawa/Fujioka	132/D
Hokkaido Forearc	Seno et al.	144/D
Japan Sea (Ryukyu Arc)	Ujiie	145/D
Japan Sea (Toyama Fan)	Klein	146/D
Sagami Trough	Ogawa et al.	148/D
Japan Sea Active Spreading	Kimura et al.	149/D
Japan Sea Mantle Plume	Wakita	151/D
Japan Sea Downhole	Suyehiro et al.	155/F
Japan Sea Massive Sulphide	Urabe	156/D
Japan Sea Paleoceanography	Koizumi	157/D
Japan Sea and Forearc Sediments	Matsumoto/Minai	158/D
Japan/Kurile Trench	Jolivet et al.	164/D
Japan Sea Opening	Tatsumi et al.	166/D
Japan Sea Sediments (SiO_2)	Iijima et al.	168/D
Japan Trench Forearc	Otsuki	174/D
Japan Trench Inner Wall	Niitsuma/Saito	175/D
Japan Trench Triple Junction	Niitsuma	176/D
Japan Sea (Tsushima Basin)	Chough, et al.	198/D

NANKAI TROUGH TO MARIANAS

REGION	PROPONENT	NUMBER
Okinawa Transect	Letouzey et al.	29/D
Nankai Trough	Kagami/Taira et al.	50/D
Izu-Bonin Transect	Okada/Takayanagi	83/D
(Nankai) Fabric	Karig	128/F
Ryukyu Arc	Ujiie	145/D
Downhole Transect	Kinoshita et al.	159/F
442B Downhole	Kinoshita et al.	161/F
Zenisu Ridge	Rangin et al.	163/D
Shikoku Basin	Chamot-Rooke/Le Pichon	165/D
Okinawa Trough	Uyeda et al.	167/D
Bonin System	Taylor	171/D
Mariana Backarc	Fryer	172/D
Zenisu Ridge	Taira et al.	177/D
Nankai Trough	Shiki/Miyake	178/D
Daito Ridges	Tokuyama et al.	179/D
Kita-Amani Basin	Shiki	180/D
Ogasawara Forearc	Ishii	181/D
Northern Marianas	Flower/Rodolfo	HTB

INDONESIA - PHILIPPINES (CENTRAL REGION)

REGION	PROPONENT	NUMBER
Sulu Sea/Negros Trough	Rangin	27/D
South China Sea	Letouzey et al.	28/D
Sunda Straits	Huchon et al.	42/D
South China Sea	Hayes et al.	46/D
Manila Trench	Lewis/Hayes	47/D
Palawan	Hinz et al.	48/D
Eastern Banda Arc	Schluter et al.	49/D
Sunda/Banda Arc	Karig/Moore	80/D
Sulu Sea	Thunell	82/D
Sumba Transition Zone	Reed et al.	127/D
Banda Sea	Silver	131/D
South China Sea	Wang et al.	147/D
Banda/Celebes/Sulu Seas	Hilde et al.	154/D
South China Sea	Liu et al.	194/D
South China Basin Axis	Pantot et al.	216/D
Manila Trench/Taiwan	Lewis et al.	218/D

NEW ZEALAND TO PAPUA NEW GUINEA (SOUTHERN REGION)

REGION	PROPONENT	NUMBER
New Hebrides	Recy et al. (ORSTOM)	25/D
Tonga/Kermadec	ORSTOM	26/D
Southwest Pacific	Falvey	43/D
Solomon Sea	Milsom	52/D
Tonga/Lord Howe Rise	Falvey et al.	67/D
Australasia Super Proposal	Crook et al.	126/D
Northern New Zealand	Eade	130/D
Valu Fa Ridge, Lau Basin	Morton et al.	170/D
Papua New Buinea/Bismarck Sea	Exon et al.	184/D
New Hebrides	Taylor/Lawver	187/D
Tonga/Lau	Stevenson et al.	189/D
Vanuatu Collision	Fisher et al.	190/D
Solomon Intra-arc Basin	Vedder/B[illegible]s	191/D
Great Barrier Reef	Davies et al.	206/D
Northern Lord Howe Rise	Mauffret/Mignot	217/D
Lau Basin	Hawkins et al.	HTB

ATTACHMENT 1

86/378

RECEIVED MAY 12 1986

A FIRST PROSPECTUS FOR WESTERN PACIFIC DRILLING

At the February 1986 meeting, the western Pacific Panel formulated a regional drilling program (see below) based on global thematic objectives which may best be achieved in the western Pacific. This report provides summaries of most of the priority drilling legs. Following evaluation by the thematic panels and PCOM, the drilling program and this report will be revised at the June WPAC meeting.

Area[1]		Program Length (#Legs) 6	9	12	Thematic Blessings	Relevant Proposals	Site Survey Needs	Present Data Workup	Cruises Planned
Lau Basin	(8)	1	1	1	LITHP, TECP, Hawkins' workshop	HTB 189	zero-age survey	Integrate 5 recent cruises	--
Bonin-Mariana	(1) (13)	1	2	2	LITHP, TECP, Hawkins' workshop	83,171 /172	more MCS	JNOC MCS needed	ORI 7/86 Taylor MCS proposal ALVIN '87
Vanuatu	(6)	1	1	2	LITHP, TECP, Hawkins' workshop	187 190	more MCS	recent cruises	French MCS proposal
Sulu-Banda	(3)	1	1	1	SOHP, (TECP)	27,82 131,154	digital SCS (Banda)	✓	French MCS proposal Silver SCS proposal
Great Bar. Reef	(-)	0	1	1	SOHP, Carbonate Wkshop	206	✓	recent cruise	--
Japan Sea	(1)	1	1	1 1/2	SOHP, TECP= obduction	51+ JTB	✓	recent cruise	ORI 4-5/86 Shinkai'86
S. China Sea	(3)	?	1	1 1/2	SOHP	46,147 194,216	✓	recent cruises	--
Nankai	(5)	?[1]	1	1		50 128/F	✓	JAPEX MCS needed	ORI 12/86 Shipley 2-ship prop
Sunda	(10)	0	0	?		80 127	more MCS	x	Gloria 87/88
Manila Trench	(15)	0	0	?[1]		218	Taiwan MCS migrate MCS	x	Taiwan MCS '86
Zenisu	(9)					163 177	more MCS		ORI 8/86
Sulu Transect	(-)					27,48 82	more arc MCS		French MCS Proposal
Tonga Transect	(8)					26, 67	more MCS		
Downhole Experiments	(17)				DMP	155	site-specific surveys		

Notes 1. Numbers in parentheses give WPAC ranking at August 1985 meeting; dash means no equivalent proposal at that time.

2. Palawan (48/D) dropped from consideration: very deep targets, safety problems. Okinawa (7) dropped from consideration: low thematic panel interest, political problems. Ontong Java not considered: no proposal.

SUMMARY OF LAU BASIN DRILLING PROPOSALS: THE WPAC PERSPECTIVE

Introduction

At its February meeting, the Western Pacific Panel considered the several proposals extant for drilling in the Lau Basin and accorded such drilling a high priority. The following summarizes what has been proposed for the Lau Basin, and how the Western Pacific Panel currently perceives the objectives of a possible drilling program there.

A total of six sites have been proposed, five of them in "A Science Plan for Drilling in Western Pacific Arc, Trench, and Backarc Systems" compiled by J. W. Hawkins (hereafter Conference Report), and a sixth additional site as a result of a recent cruise by Hawkins in a new proposal which also amplified the objectives of two targets in the Conference Report.

The central problems addressed by the sites are 1) the petrological development of the Lau Basin, particularly the evolution of the basin's basalts from having a significant island-arc geochemical signature to having virtually none at all; 2) the place of silicic magmatism in certain parts of the basin; and 3) backarc geothermal and hydrological processes. The sites proposed are listed in Table 1, together with a summary of their objectives, and their locations are shown in Figure 1.

Petrological Development

The sites proposed to deal with the petrological development of the Lau Basin are LAU-2, on the western edge of the basin, where an angular unconformity in the sediment column may date the opening of the southern part of the basin but where basement also can be reached. Nearer the center of the basin is target L-7, where basaltic rocks having a significant arc-like geochemical signature (Mariana-Trough-type) are expected on the basis of dredge results. Finally, Site L-11 is proposed as a bare-rock site in the central Lau Basin, where basalts having primarily N-MORB characteristics have been dredged. Both Sites L-7 and L-11 are designed to provide the detail of controlled stratigraphy through sequences of these basalt types, to compare with each other and with basalts of the major oceanic spreading ridges.

Silicic Magmatism

One aspect of petrological diversity in the Lau Basin is the occurrence of silicic lavas (andesites and dacites) at three of the targets proposed for drilling. Two of these are evidently in similar structural situations, namely L-12 in the NE Lau Basin, and L-9, Valu Fa Ridge in the southern part of the Basin. Both of the two principal basalt types in the Lau Basin have been dredged near L-12, as well as ferroandesite and dacite. Similar andesite has been dredged from Valu Fa. Both places have been interpreted as types of propagating rifts within the backarc setting. Valu Fa is also the place where a deep magma chamber has been imaged using multichannel seismic techniques. One final target, L-10, Zephyr Shoal, is near the location of a dredged dacite vitrophyre. L-12 is specifically proposed by Hawkins to replace L-10.

Geothermal and Hydrological Objectives

All the sites proposed for drilling in the Lau Basin have explicit or implicit geothermal/hydrological objectives. Hydrothermal sulfides have been dredged near target L-12 (NE Lau Basin) and methane plumes found in the waters above it. Elevated particulate and total dissolvable Mn has been found in the water column above Valu Fa Ridge (L-9), but no methane plumes. However, FeMn crusts up to 10 cm thick coat some of the dredged andesites. Near Site L-10, Zephyr Shoal, high heat flow values have been measured in sediments up to 400 m thick.

With the exception of target L-12, NE Lau Basin, where hydrothermal sulfides have been dredged, none of these has been proposed as a primary target for evaluating backarc geothermal processes.

Deliberations of the Western Pacific Panel

WPAC is cognizant that no fewer than three of the targets proposed for drilling in the Lau Basin are bare-rock targets (L-9, Valu Fa; L-11, Central Lau Basin; and L-12, NE Lau Basin). There is no formal Lithosphere Panel endorsement for any of these as a major bare-rock target at the present time.

Strictly considering the themes outlined above and as stated in the proposals, WPAC views the first, the matter of petrological diversity as reflecting a fundamental change in the composition of mantle sources, to be the best-founded basis for a drilling program in the Lau Basin. Considering that backarc basins are fundamentally basaltic provinces, this question of mantle sources seems more important than questions of derivation of silicic magmas by either shallow magmatic differentiation or assimilation of high-level arc crust or sediments. Moreover, propagating rifts are intrinsically complex places tectonically, and perhaps should be studied in a simpler, oceanic setting before they are approached by drilling in a backarc basin.

The geothermal objectives so far stated are really just incidental to the petrological themes outlined in the Conference Report and the Hawkins proposal. Until a more specific program is formulated and proposed, WPAC will continue to view the geothermal and hydrological aspects of drilling in the Lau Basin as having lower priority than the petrological objectives.

For these reasons, WPAC advocates devoting a single leg to the Lau Basin, to concentrate on targets L-11 (although perhaps a nearby target with a sediment pond would get at the petrological objectives better and more quickly than at a bare-rock site) and L-7, on the western side of the Lau Basin. We note further that a target such as LAU-2, on the far western side of the Lau

Basin, has been strongly endorsed by the Tectonics Panel as a means of determining the mechanism of the early stages of backarc rifting. A transect, involving these and perhaps intermediate targets, is thus recommended by WPAC as the program for a single leg of drilling in the Lau Basin.

The results of four late '85/ early '86 Seabeam and bottom sampling cruises will need to be evaluated before final sites are chosen.

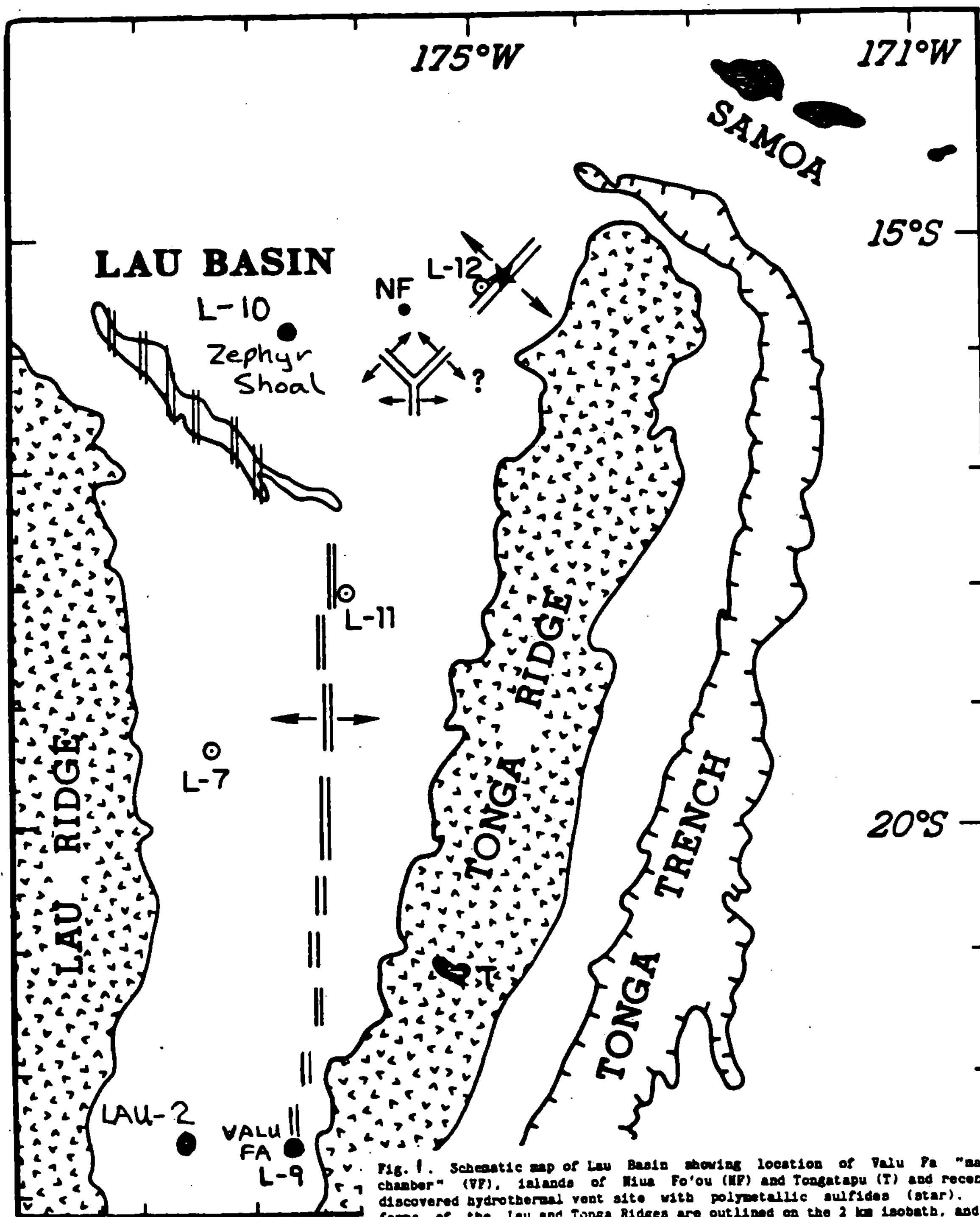


Fig. 1. Schematic map of Lau Basin showing location of Valu Fa "magma chamber" (VF), islands of Niua Fo'ou (NF) and Tongatapu (T) and recently discovered hydrothermal vent site with polymetallic sulfides (star). The forms of the Lau and Tonga Ridges are outlined on the 2 km isobath, and the axis of the Tonga Trench is shown by the 6 km isobath. The orientation of well defined spreading axes is shown schematically. A Ridge-Ridge-Ridge triple junction is inferred in the northeastern part of the basin, but its location and geometry is not well constrained at this time. Peggy Ridge (PR) is an inactive ridge probably formed of offset segments of ridge with a N-S trend. Proposed drill sites L-7, L-11, L-12, L-10, L-9, and LAU-2 are shown.

TABLE 1

Summary of Lau Basin Drill Sites

Site	Lat.	Long.	Water Depth	Sediment Thickness (m)	Proponent's Preferred Basement Penetration	Time to do	Objectives	Proponent
L-7*	19°14'S	177°37'W	2200-2300	400-500	100-200 m	∿ 1 week	Older basaltic crust in the Lau Basin	J. Hawkins
L-11*	18°S	176°W	2200	0 (could shift to sediment pond)	500	majority of 1 leg	Axial crust, center of Lau Basin	J. Hawkins
LAU-2	22°10.6'S	177°40.9'W	2700	680	100?	∿ 1 week	Oldest sediments, crust in Lau Basin; date opening of southern Lau Basin	A. Stevenson
L-12	15°20'S	174°40'W	2200	0	100 to 500	majority of 1 leg	Reasons for silicic volcanism; metallogenesis	J. Hawkins
L-10	15°53'S	176°42'W	2200	400-500	500	majority of one leg (could shorten to 2 weeks with less basement)	Sedimented version of L-12 (Zephyr Shoal)	J. Hawkins
L-9	22°15'S	176°37'W	1700	0	1500	(surely you jest!) 3-4 legs	Valu Fa magma chamber; crustal structure, hydrothermal process	J. Morton

TOTAL: 5½-6½ legs

SUMMARY OF THE TWO-LEG BONIN-MARIANA DRILLING PROGRAM

TECTONIC SETTING

Subduction of Pacific lithosphere beneath the West Philippine Basin began in the Early Eocene, and through the Early Oligocene formed an intra-oceanic volcanic arc and a 200-km-wide forearc of arc volcanic material (tholeiites and boninites), possibly superimposed on previous oceanic crust. Mid-Oligocene rifting split the arc and late Oligocene-Early Miocene back-arc spreading in the Parece Vela and Shikoku Basins isolated the remnant arc (Palau-Kyushu Ridge) from the active Bonin-Mariana arc and forearc. The rifting and initial spreading was time transgressive, starting in the center of the Parece Vela Basin and at the northern end of the Shikoku Basin, resulting in the bowed and V'd shape of those basins, respectively. This process is being repeated. The southern part of the arc split again in the Late Miocene, and 6 to 8 my of seafloor spreading in the Mariana Trough has isolated the active Mariana arc from, and increased its curvature with respect to, the remnant West Mariana Ridge. Spreading in the Mariana Trough may be propogating to the north. In contrast, the Izu-Bonin arc is still in the rifting stage of backarc basin formation and is undergoing extension along most of its length. The major zone of rifting is immediately west of the active volcanic chain, but some arc volcanoes near 29°N are surrounded by grabens. Volcanism is continuing along both the active and "remnant" arcs. Volcanic centers have also developed in the rift basins. Their chemistry indicates a basalt-andesite-rhyodacite association, with the basalts having similar major and trace-element compositions to Mariana Trough tholeiites. The backarc rifts are semi-continuous along strike, being segmented by structural highs and chains of submarine volcanoes extending westwards from the island volcanoes.

The difference in arc/back-arc evolution between the Mariana and Bonin systems has produced corresponding differences in their forearcs. The Bonin forearc has experienced little structural disruption since its inception. A broad forearc basin has accumulated volcaniclastic and hemipelagic sediments behind an outer-arc high. The onlap of strata onto this high, together with Eocene shallow-water fossils found on the Bonin islands, indicates that it has been a relative structural high since early in the history of the arc. A mature, dendritic, submarine canyon system has developed by mass wasting and headward erosion, incising many deep canyons across the forearc, cutting as much as 1 km into the 1.5 to 4 km thick sedimentary section. In contrast, the Mariana forearc has not behaved as a rigid plate, but has undergone extension tangential to its curvature. This has produced radial fractures and, together with the disruption caused by numerous seamounts on the subducting plate, easy pathways for diapiric intrusions of serpentinised mafic/ultramafics of arc affinity. Eruption of these diapirs onto the seafloor, together with uplift of forearc material due to their subsurface intrusion, has formed a broad zone of forearc seamounts (up to 2500 m high and 30 km in diameter) 50 to 120 km from the trench axis. In the Bonins chloritised/serpentinised mafic/ultramafics occur along a narrow zone which controls the location of a lower-slope terrace. This zone appears to be the oceanic forearc analog of overpressured dewatering zones in accretionary sedimentary wedges. Possibly because most of the sediment has slumped off the trench inner wall, the large forearc canyons die out on the middle slope and do not cut across the lower-slope terrace. Only very minor, and probably ephemeral, accretionary complexes occur at the base of the inner wall of both the Bonin and Mariana trenches.

SITE RATIONALE

Investigating the processes of intra-oceanic arc-trench development in the same region has obvious logistic and scientific benefits. Several factors combine to make the Bonins the best of all the western Pacific locations in which to address these processes. They include (1) the present density of marine geological and geophysical information, (2) the prospects for additional multidisciplinary surveys, (3) certain unique geological factors such as the presence of large submarine canyons and the Bonin Islands (a subaerial outer-arc high), and (4) the inherent simplicity of the system (continuous subduction since the Eocene without major collisions or arc reversal). However, the largest and best studied serpentinite diapirs occur in the Mariana forearc, and two sites in this two-leg drilling program are included there.

BONIN SITES 1 and 2 are located in the graben and on the bounding horst, respectively, of the active Sumisu rift, and seek to determine the:
1) differential uplift/subsidence history of the central graben and bounding tilted arc block, and whether this is compatible with stretching or detachment models of extensional tectonics.
2) duration of rifting
3) nature of syn-rift volcanism and sedimentation, whether arc volcanism is continuous or interrupted by rifting, and when the extrusion of back-arc type basalts began.
4) extent and chemistry of hydrothermal circulation in a tectonic setting similar to that of Kuroko-type massive sulphide deposits
5) nature of the rift basement
6) nature of the arc basement between (and isolated from the pyroclastic deposits of) major arc volcanoes. [Consider the limitation to our knowledge of continental arcs if we were restricted to exposures in the top 1000 m of only the largest stratovolcanoes.]

BONIN SITES 3-6 are located in the forearc near 32°N; BON3 on the frontal arc high, BON4 on the inner and BON5 at the center of the upper-slope basin, and BON6 on the outer-arc high. These sites were chosen to determine the:
1) uplift/subsidence history across the forearc (using backstripping techniques on cored/logged holes and seismic stratigraphic analysis of interconnecting MCS profiles) to provide information on forearc flexure and basin development, as well as the extent of tectonic erosion. We do not know whether the frontal arc and outer-arc high develop by igneous construction or differential uplift, whether the upper-slope basin between them is due to forearc spreading or differential subsidence, or whether flexural loading by either arc volcanoes or by coupling with the subducting plate is an important process. For example, the seismic stratigraphy laps onto and reverses dip over the frontal arc high. Is this due to an original Eocene volcanic high. to mid-Oligocene rifting of the arc, or to Plio/Pleistocene volcanic loads on the fractured (by rifting) edge of the forearc?
2) forearc stratigraphy, to ascertain (a) the sedimentology, depositional environment and paleoceanography, and (b) the variations in intensity and chemistry (boninitic, tholeiitic, calc-alkaline, rhyo-dacitic, alkaline) of arc volcanism over time, and the correlation of these variations with periods of arc rifting, backarc spreading and varying subduction rate.

3) nature of igneous basement forming the frontal arc, outer-arc high and beneath the intervening forearc basin (which has never been sampled) to answer questions concerning the initial stages of arc volcanism and the formation of a 200 km wide arc-type forearc massif (were the frontal arc and outer-arc high formerly contiguous and subsequently separated by forearc spreading, were they built separately but near synchronously on former West Philippine Basin oceanic crust, or are they part of a continuous Eocene arc volcanic province, possibly with overprints of later forearc volcanism?).
4) micro-structural deformation as well as the large scale rotation/translation of the forearc. Paleomagnetic studies of the Bonin Islands suggest 90° clockwise rotation and 20°N translation since the Eocene, which has major implications for reconstructions of the Philippine and surrounding plates.

BONIN SITE 7 & MARIANA SITES 2 & 3 are located on forearc seamounts; BON7 on the flank of a dome along the Bonin lower trench-slope terrace, MAR2 on the flank of Pacman seamount near the Mariana trench slope break (a large diapir which has breached the surface and erupted serpentinite flows), and MAR3 on a nearby conical seamount interpreted to represent an updomed forearc sequence resulting from subsurface emplacement of a diapir.

Forearc diapirs were first recognized AFTER the last round of western Pacific drilling. The proposed drill sites, in three different structural settings, seek to determine the
1) timing of emplacement: ongoing, dormant, Oligocene? -- from the stratigraphy of the flows and intercalated sediments on the flanks of the seamounts, and from the history of tectonic uplift above the subsurface intrusion.
2) emplacement mechanism: diapirs of serpentinite with entrained wall rock in the Marianas vs. completely remobilized outer forearc in the Bonins?; and the internal structures (fracture patterns, flow structures) of the seamounts.
3) extent of fluid circulation through the outer forearc and the chemistry of the fluids (from the subducting plate, overlying lithosphere, circulating seawater?).
4) conditions at depth in the outer forearc from the igneous and metamorphic petrology of the lower crustal rocks.

Forearc diapirism may provide a model for emplacing some alpine-type ultramafic bodies common in accreted terranes pre- rather than syn/post-collision.

BONIN SITE 8 is located on the outer trench flexural bulge of the Pacific Plate near magnetic anomaly M15. Drilling objectives include:
1) a reference site for geochemical mass balance calculations: to what extent does subducted material influence the chemistry of arc and rift volcanism?
2) to determine changes in the Tertiary bottom currents, whether these caused the regional hiatuses in NW Pacific sedimentation and, by comparison with the Bonin arc/forearc sites, to what extent the Bonin-Mariana arc served as a barrier to divide the bottom currents.
3) to determine the earliest Cretaceous stratigraphy and crustal petrology (i.e., to penetrate the late Cretaceous cherts for the first time).

SITE SUMMARY

The sites that we propose to be drilling in the Bonins represent a compromise between deep basement and complete stratigraphic objectives. They were chosen from an extensive data base that needs some additional close-spaced MCS profiles. Additional surveys should be able to identify sites where shorter holes can meet the objectives (especially for forearc sites 4 and 5). The Mariana sites are extensively surveyed but need better seismic reflection data. This should be collected using the ATLANTIS II during the ALVIN dive cruises scheduled for spring 1987. Nine of the twelve holes are in water depths less than 4000 m (average - 2400 m) which should result in very good biostratigraphy. The principal proposals on which this summary is based are #171 for the Bonins, with sections on paleoceanography from #83, and #172 for the Marianas.

Site #	Lat. (°N)	Long. (°E)	W.D. (m)	Penetration Sed.	Bsmt.	Site Time* (Days)
BON1	30°55'	139°53'	2270	850	50	8
BON2	30°55'	140°00'	1100	500	200	8
BON3	31°22'	140°17.4'	1250	600	50	6
BON4A	32°26.5'	140°22.5'	1820	700	—	6
BON4B	32°28.6'	140°22.5'	2420	950	50	9
BON5A	32°26'	140°47'	2700	950	—	8
BON5B	32°23'	140°48'	3400	900	50	10
BON6	31°54'	141°06'	2850	950	150	12
BON7	30°58'	141°48'	4650	500		8
BON8	31°18'	142°54'	6000	500	100	12
MAR2	19°20'	146°54'	3700	700		8
MAR3	19°30'	146°41'	4200	700		9
						104

*Time estimates assume APC/rotary coring, with mini-cones but not major re-entry cones, and are based on Figure 15 in JOIDES J., v. XI (4), plus basement drilling at 2 m/hr.

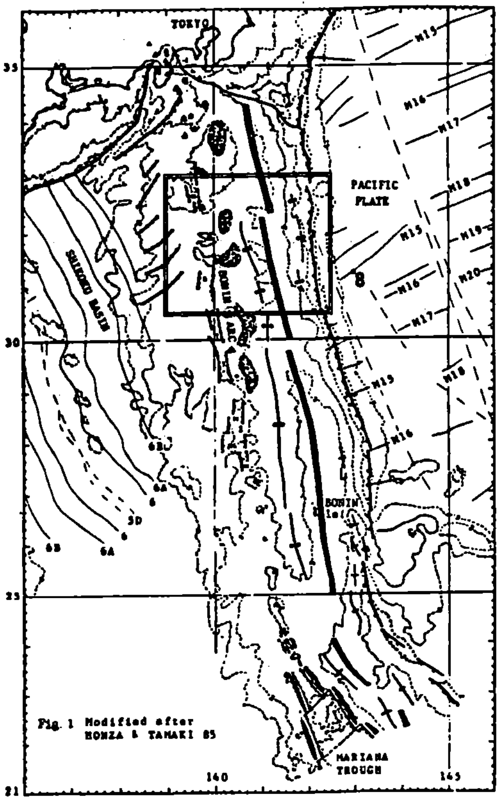


Fig. 1 Modified after HONZA & TAMAKI 85

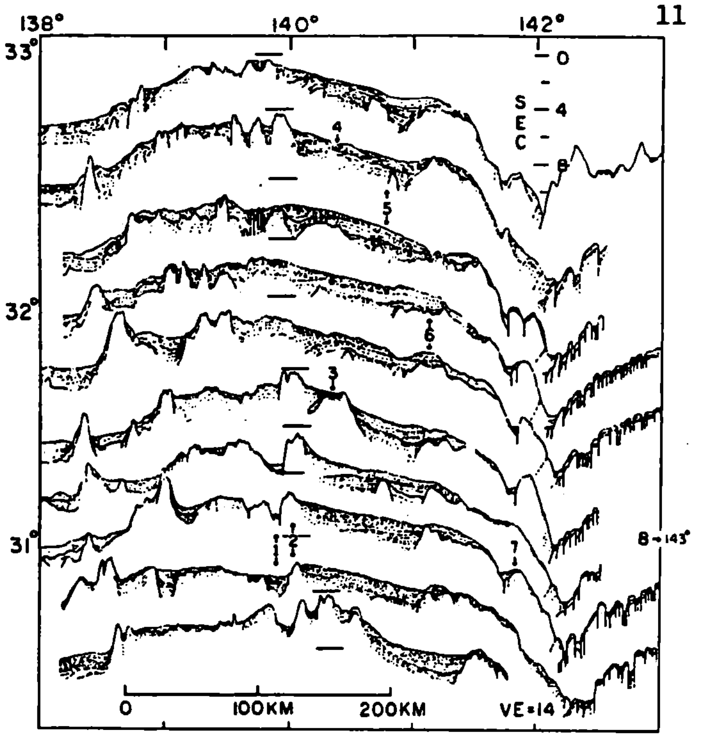
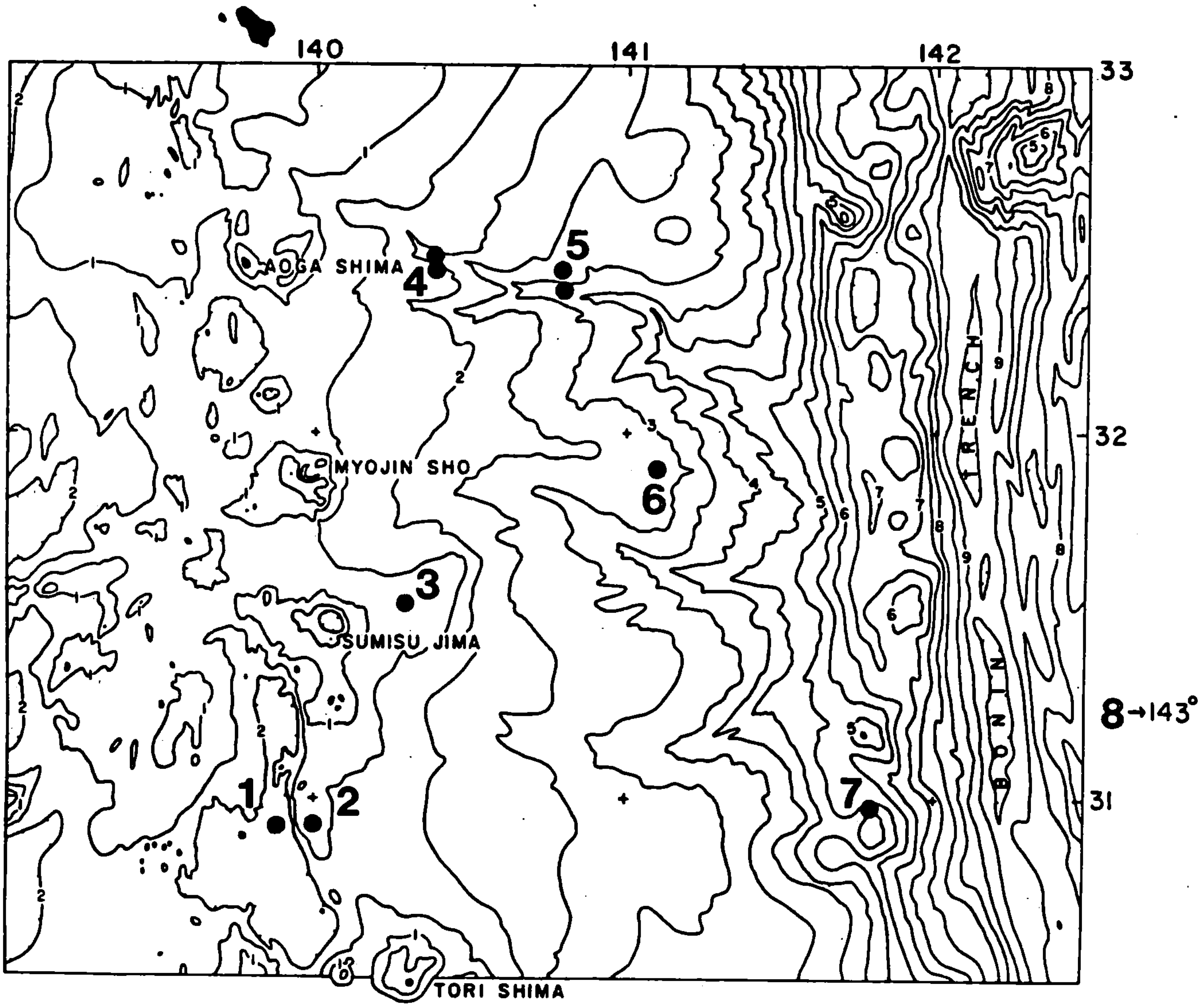
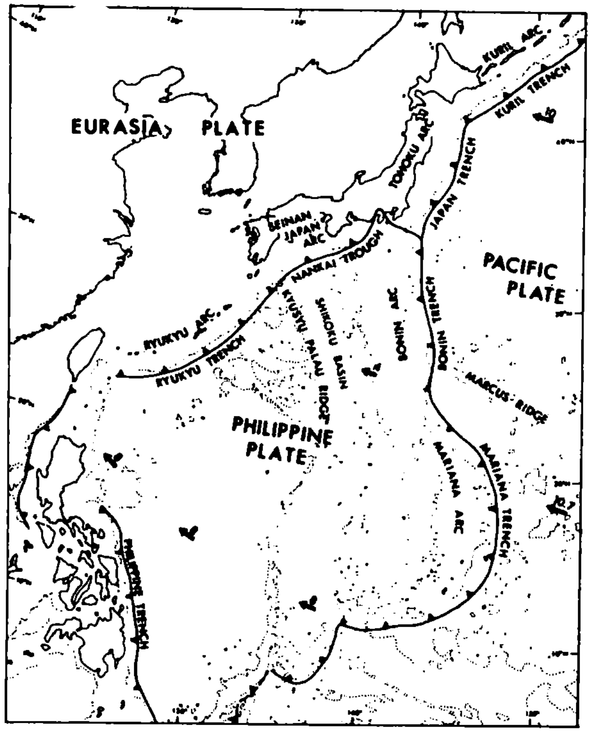
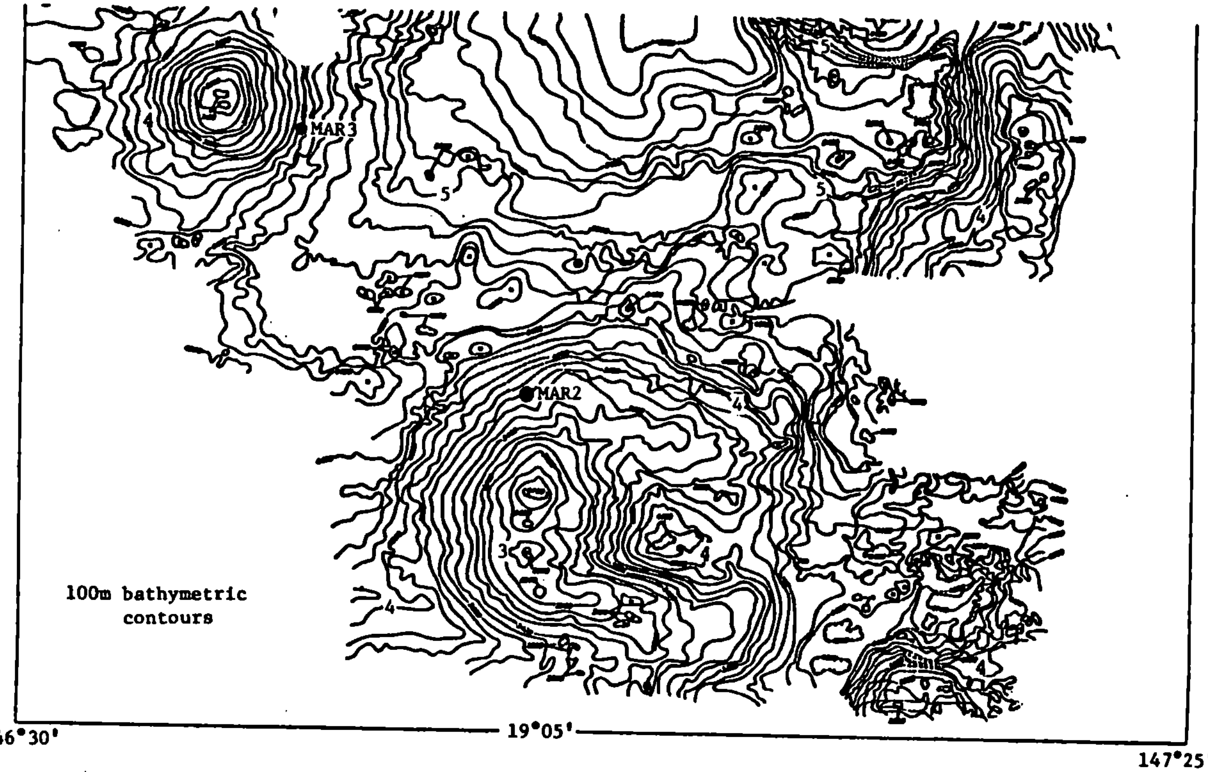


Figure 2. Line drawings of GH79 seismic reflection profiles across the Izu Arc-Bonin Trench system between 30.5° and 33° N(Honza and Tamaka, 1985). From east to west, the characteristic structural elements of this active margin include: (a) a lower slope terrace on the trench inner wall, (b) a thick forearc basin sequence which laps onto and thins over an outer-arc structural high, and (c) a broad arc platform with active volcanoes and rift basins on the east and older volcanic cross chains on the west. The eight proposed ODP sites on or between the seismic lines are indicated by single or double arrows respectively.

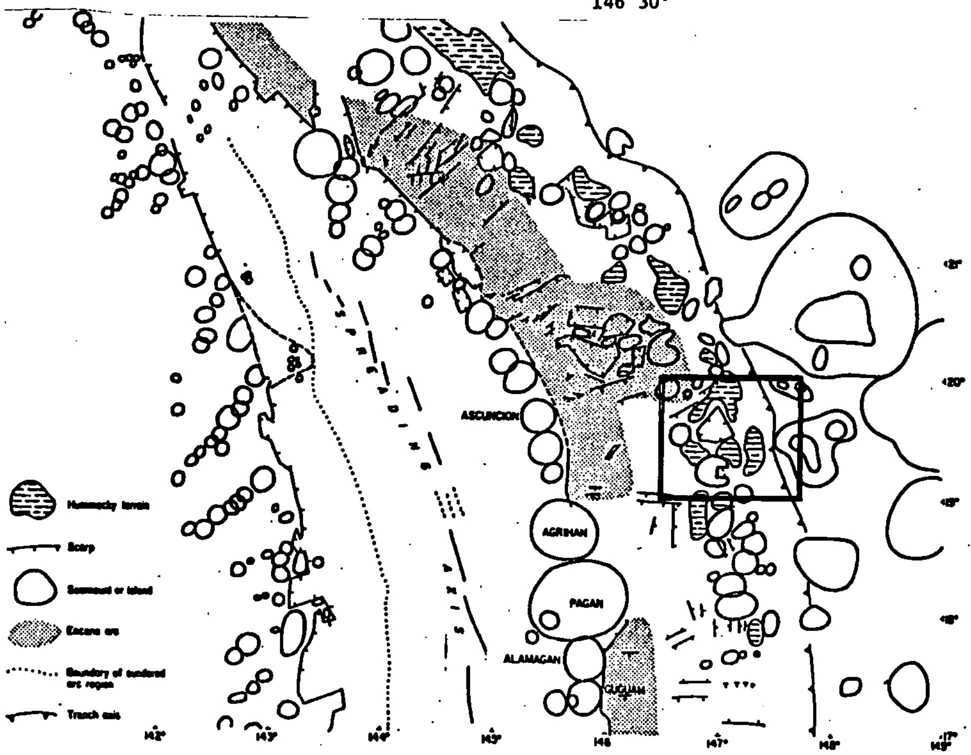




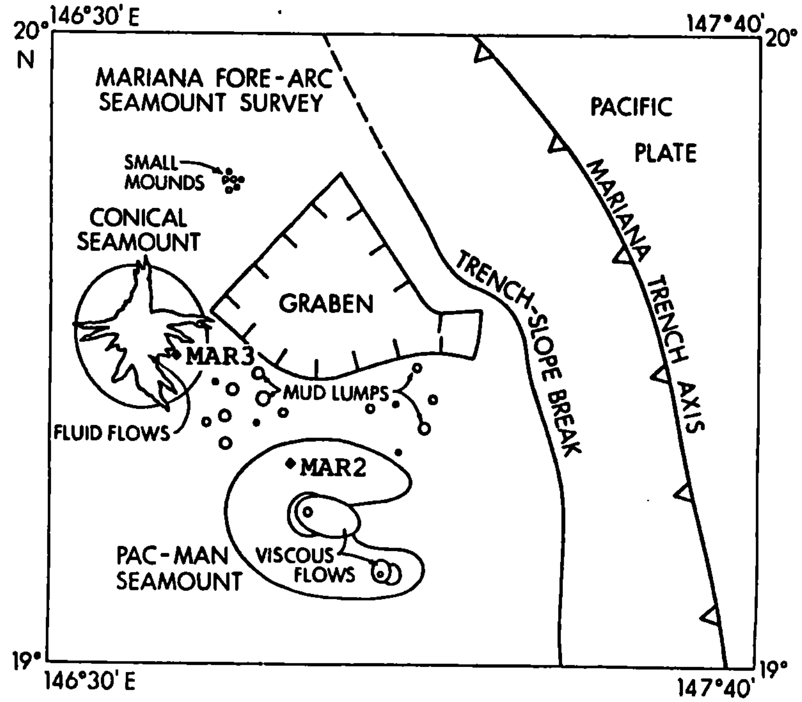
EURASIA PLATE
PACIFIC PLATE
PHILIPPINE PLATE
KURIL ARC
KURIL TRENCH
TOHOKU ARC
JAPAN TRENCH
SEINAN JAPAN ARC
NANKAI TROUGH
RYUKYU ARC
RYUKYU TRENCH
KYUSHU PALAU RIDGE
SHIKOKU BASIN
BONIN ARC
BONIN TRENCH
MARCUS RIDGE
MARIANA ARC
MARIANA TRENCH
PHILIPPINE TRENCH



MAR3
MAR2
100m bathymetric contours
146°30'
19°05'
147°25'



ASUNCION
AGRIHAN
PAGAN
ALAMAGAN
GUGUAN
SPREADING AXIS



20° N
146°30' E
147°40'
20°
MARIANA FORE-ARC SEAMOUNT SURVEY
PACIFIC PLATE
SMALL MOUNDS
CONICAL SEAMOUNT
GRABEN
MAR3
FLUID FLOWS
MUD LUMPS
TRENCH-SLOPE BREAK
MARIANA TRENCH AXIS
MAR2
PAC-MAN SEAMOUNT
VISCOUS FLOWS
19°
146°30' E
147°40'
19°

SUMMARY OF THE NEW HEBRIDES (VANUATU) DRILLING PROGRAM.

This drilling program is based principally on USGS/ORSTOM proposal together with TEXAS proposal.

TECTONIC SETTING.

In late Miocene early Pliocene time the New Hebrides arc apparently underwent arc-polarity reversal after which the Indian plate has underthrust the arc from the west at a rate of at least 10 cm/yr. The d'Entrecasteaux zone (DEZ), a linear aseismic ridge on the Indian plate, began to collide with the central New Hebrides arc by roughly 2 my ago. Troughs formed in the back-arc both North and South of the collision zone and may represent an early stage of back-arc rifting initiated since arc polarity reversal. The Aoba basin centers on the volcanic arc directly east of the DEZ collision and may be a result of subsidence between rapidly uplifting forearc and back arc blocks. We believe that distribution and initiation of both the back-arc troughs and the Aoba basin are strongly influenced, if not directly controlled by collision of the DEZ with the arc. It is clear that much of the unusual morphology, pattern and rates of vertical deformation, and even historical seismicity patterns have been strongly influenced by collision of the DEZ. Arc polarity reversal, the collision process, and basin formation can be investigated in a small geographic area with a combination of drill sites that have interlocking objectives and most sites will address at least two of the three principal objectives.

OBJECTIVES.

Arc-Ridge collision.

The DEZ-Arc collision is the most event influencing central New Hebrides structure and tectonics and is the principal objective of our proposal. DEZ 1 will drill into the interplate thrust zone where relatively strong rocks of the North ridge of the DEZ are in contact with probably indurated rocks of the upper plate such as are seen on Santo. Other sites are chosen to allow us to sample an interplate thrust in sediments(DEZ 4) and in a collision zone (DEZ 3), to test the bloc accretion theory (DEZ 5) and to determine the minimum age of collision (DEZ 2,4,6) and the history of uplift of the submerged part of the western Sant block which emerged reefs have a holocene uplift rate exeeding 5mm/yr (DEZ 3,5).

The back arc troughs.

The Coriolis troughs lie behind the volcanic line, yet fresh basalt and glass have been dredged from them. The troughs occur along much of the length of the arc except directly behind the DEZ collision where we suspect that the collision process is suppressing formation of back-arc rifting. We propose to drill sites BAT 4 and 5 in the troughs to sample the range of igneous rocks compositions and its evolution. We also aim to sample sediments in the graben to determine the timing of rifting and its relationship to other events in the arc including the DEZ collision (BAT 3). A reference hole, BAT 1 or 2 on the west side of the rifts will also be useful for comparison with the vertical deformation history of the DEZ collision.

The__Aoba__Basin-magma evolution following arc polarity reversal and subsidence history related to collision of the DEZ.

The Aoba basin is a second type of intra-arc basin in the New Hebrides whose origin appears to contrast with that of the Coriolis troughs. It may be the result of tectonic subsidence related to collision of DEZ with the central part of the arc. Extremely rapid uplift of Santo and Malakula Islands at the extreme western edge of the arc and uplift of the back arc islands of Pentecôst and Maewo on the eastern edge is consistent with contemporary subsidence of the intervening Aoba Basin. Drilling sites IAB 1 et 2 is to investigate the history of this basin and to compare with sites IAB 3 and BAT 1 outside the DEZ collision zone; this should provide a detailed history of the timing and amount of collision tectonics. By drilling sites IAB 1 and 2 in the sediments of the Aoba Basin we expect to observe a record of the supposed arc polarity reversal reflected by the evolution of ash chemistry in the basin.

SITE SURVEY DATA-existing and planned.

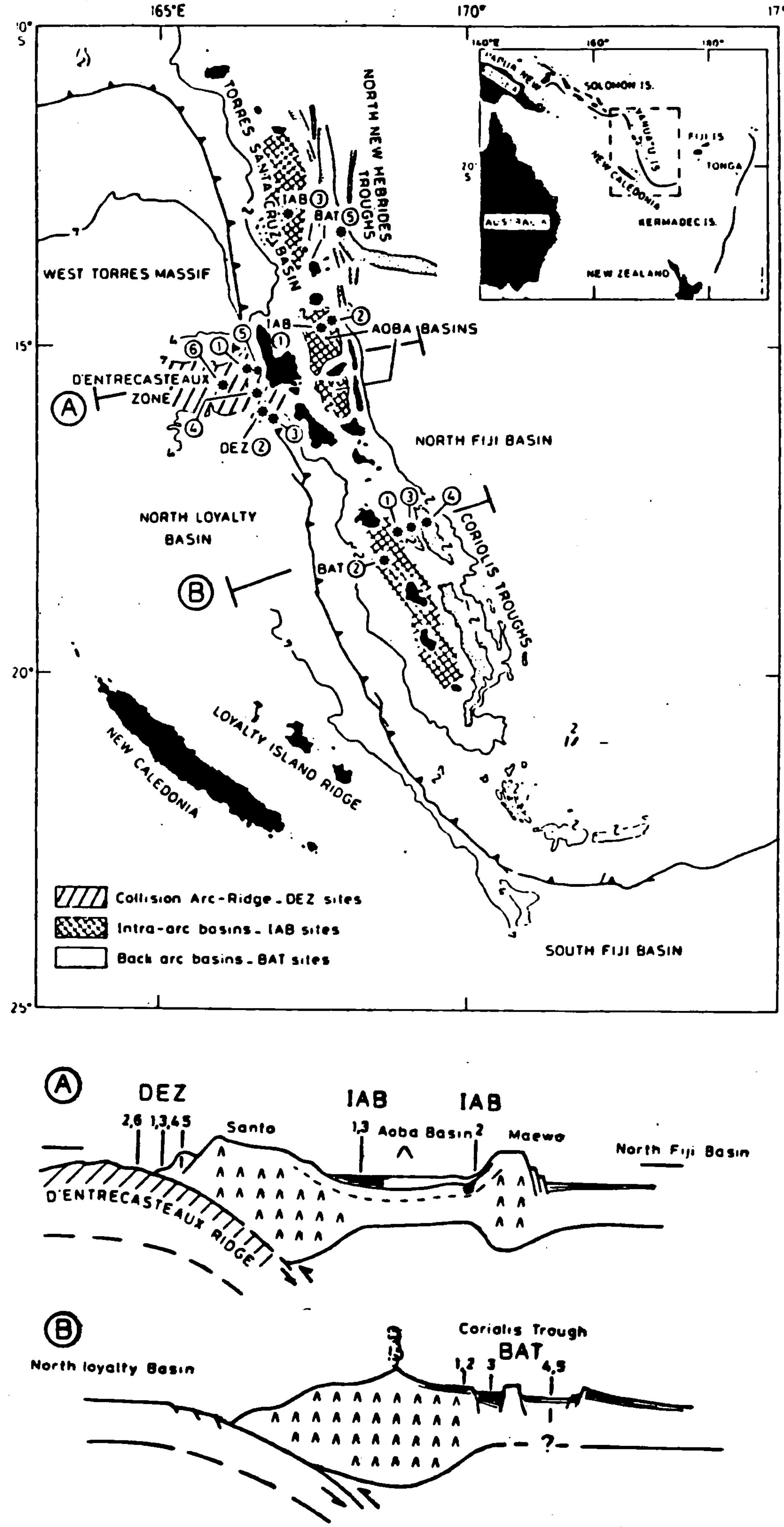
A large data base applicable to the proposed sites has been assembled by ORSTOM and includes single and multichannel seismic profiles, refraction profiles, magnetic, gravity, dredging, bathymetry, and island geological and geophysical data. Recent MCS profiles from the 1982 and 1984 USGS cruises have helped locate ideal sites in the DEZ and Aoba basin. Late 1985, seabeam, seismic and dredging data from the R/V J. Charcot provide excellent bathymetric control and insights for choosing sites on the DEZ collision zone and in the back-arc troughs. ORSTOM and Texas will conduct OBS refraction surveys in the Coriolis troughs and on the DEZ in late 1986. ORSTOM has requested support for additional MCS surveys in the Coriolis Troughs. Site control is already quite adequate, but we are trying to achieve most future programs in time to bear on final site selection.

SUMMARY OF PROPOSED SITES.

Site#	LAT (°S)	LON (°E)	W Depth(m)	Penetration	Drill Days
DEZ 1	15°19.2	166°21.7	2500	1300	11
DEZ 2	16°01	166°40.5	1100	750	5-6
DEZ 3	15°54	166°45	700	1000	6
DEZ 4	15°42.1	166°35.5	3000	1500	14
DEZ 5	15°19.5	166°26	500	800	5
DEZ 6	15°32.1	165°57.5	3400	1000	10
BAT 1	17°57.5	168°52	1000	1500	8-9
2 *	18°16	168°39.5	1000	"	"
BAT 3	17°54	169°05.5	2100	1500	11
BAT 4	17°49.8	169°20.5	2600	500-1000	6-8
BAT 5	13°15	167°57	2550	500-1000	6-8
IAB 1	14°47.5	167°35	3075	1000	9
1A*	14°44	167°4.1	"	"	"
IAB 2	14°38.3	167°55	2600	1000	8
IAB 3	12°51.6	167°04.7	1900	1500	11

Total: 110-116 days without alternate sites.

* indicates alternate sites.
Drilling time estimates are based on Fig. 15 in JOIDES J.,vXI (4).


165°E
170°
175°
10° S
15°
20°
25°
TORRES SANTA CRUZ BASIN
NORTH NEW HEBRIDES TROUGHS
WEST TORRES MASSIF
AOBA BASINS
D'ENTRECASTEAUX ZONE
DEZ
IAB
BAT
NORTH FIJI BASIN
NORTH LOYALTY BASIN
CORIOLIS TROUGHS
NEW CALEDONIA
LOYALTY ISLAND RIDGE
SOUTH FIJI BASIN
SOLOMON IS.
FIJI IS
TONGA
AUSTRALIA
KERMADEC IS.
NEW ZEALAND
Collision Arc-Ridge - DEZ sites
Intra-arc basins - IAB sites
Back arc basins - BAT sites
DEZ
IAB
IAB
2,6
1,3,4,5
Santo
1,3
Aoba Basin
2
Maewo
North Fiji Basin
D'ENTRECASTEAUX RIDGE
Coriolis Trough
BAT
North loyalty Basin
1,2
3
4,5

THE BANDA SEA AND SULU SEA MARGINAL BASINS

The Banda Sea lies within the hub of the complex collision zone between Australia, SE Asia, and the Philippine Sea plate. Knowledge of the kinematic evolution of the Banda Sea will provide a crucial constraint on the development of this complex collision zone, a region that has been compared with the evolution of the ancient Cordillera mountain system of western North America.

Proposals for the origin of the Banda Sea include the range of origins proposed for marginal seas elsewhere, namely back arc spreading, entrapment of older ocean crust, or plate edge processes. Recent geophysical and geological studies of the Banda sea suggest that its origin may be a combination of entrapment of several small basins and slivering of a contintental borderland derived from Irian Jaya into the region. Such slivering would be consistent with the presence of subaerial fragments of Irian Jaya surrounding the Banda sea, such as the Sula platform and parts of the islands of Buru, Seram, Buton, and Sulawesi. This proposed model of a constructional origin of a marginal sea through strike-slip faulting of continental and oceanic crustal fragments, provides a new modern analog for rock associations in ancient mountain belts and a system for understanding possible histories of amalgamation of tectonostratigraphic terranes.

The north and south Banda basins (Fig. 1), attain water depths in excess of 5 km, have low average heat flow, and have up to 1 km of sediment cover, making them prime candidates for trapped, older oceanic crust. The northeast part of the Banda Sea, however, has shallower water depths, thinner sediment cover, high heat flow, and complex NE trending ridges, called the Banda Ridges. Dredging of these ridges yielded continental margin rocks that can be correlated with those of northern Irian Jaya. Geophysical studies of the ridges indicate that they are cut by a series of NE trending faults. The basins between the ridges may be young rift basins, and drilling there could record their rift history.

The drilling program consists of sites in the north and south Banda Basins and the Lucipara basin to determine the age and stratigraphic history of each region. Stratigraphy of the lower sections in the north and south Banda basins will test for similarity or difference in origin, and will be compared with the site in the Sulu sea, described below. The Neogene sections will provide a wealth of information on changes in paleoceanography as the Indian and Pacific ocean circulation systems were isolated, on the volcanic history of the eastern Sunda arc, and on the timing and history of rifting and emplacement of the ridges.

Recent models relating the Banda, Celebes and Sulu basins as fragments of a once continuous Indian ocean plate can be tested by drilling at least one site in the Sulu sea, in conjunction with the sites in the Banda sea. If the basins were once part of a larger, continuous plate, the stratigraphy in the basins should be similar prior to plate breakup. Alternatively, the Sulu sea may be related to either the South China sea or the Philippine sea plate, and the stratigraphies in each case should be distinguishable. In addition, the stratigraphy of the Sulu sea may contain the best record of the collisional events inferred for the Palawan and Sulu archipelagos, as well as providing a unique paleoceanographic record of the western boundary circulation pattern during the Neogene. Thus, a well-placed site within the Sulu sea, in conjunction with one or more shallow HPC sites, will provide a highly valuable geological reference site for unraveling western Pacific tectonics.

EXISTING DATA BASE AND REQUIREMENTS

Abundant analog single channel seismic profiles have been taken by a number of institutions, but very few digital single channel or multichannel lines are available. The existing single channel data are sufficient to define the basement problems (where drilling could answer the questions of the age and origin of the basins), but they are insufficient for establishing regional stratigraphies and for imaging the structure of the Banda ridges. We clearly need site surveys within the Banda Sea to maximize the utility of the drilling ship here.

Abundant geophysical information is available for the Sulu sea, and these appear sufficient for site selection and interpretation.

SUMMARY OF PROPOSED SITES

SITE #	LATITUDE	LONGITUDE	WATER DEPTH	SEDIMENT THICKNESS	BASEMENT PENETRAT.	HOLE TYPE	# OF DAYS
BNDA 1	6°30'S	128°00'E	4600M	800M	25M	S	10
BNDA 2	4°25'S	125°12'E	4800M	800M	25M	S	11
BNDA 3	5°00'S	127°00'E	3400M	500M	200M	S	11
SULU 5	7°45'N	121°11'E	4300M	1200M	200M	S	17
							49

PROPOSAL LISTINGS

NO.	PROPONENTS	REGION
27/D	RANGIN	SULU SEA
48/D	HINZ ET AL.	SULU SEA
82/D	THUNELL	SULU SEA
131/D	SILVER	BANDA SEA
154/D	HILDE ET AL.	BANDA AND SULU SEAS

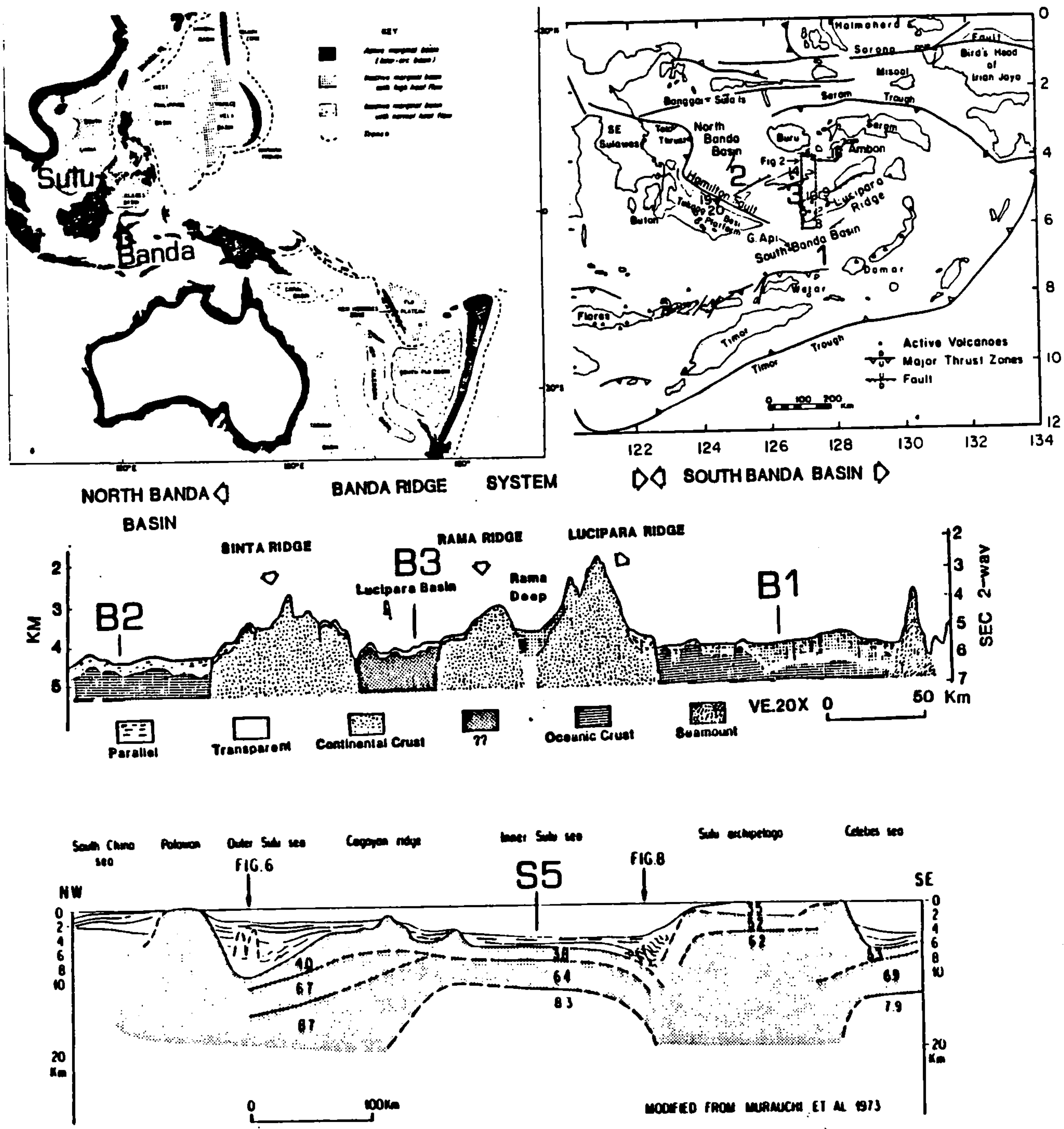


Figure 1. a) Western Pacific basins. b) Banda sea, showing proposed drill site locations. c) Composite cross section across the Banda sea, showing proposed drill site locations. d) Generalized section across the Sulu sea, showing proposed drill location.

Great Barrier Reef - Queensland Trough ODP Leg Summary

The Great Barrier Reef - Queensland Trough province is composed of mixed reefal carbonate/siliciclastic shelf sediment thought to be principally controlled by climate, and relative sea level. During periods of low sea level deltaic progradation occurred at the shelf edge accompanied by fan deposition on the mid- and lower slope. The oldest sedimentary sequences beneath the shelf occur eastwards of a major fault zone lying beneath the middle shelf, and forming the western boundary of the Queensland trough rift basin. An interpreted basal Late Cretaceous rift-fill sequence containing volcanics is overlain by a marine onlap facies interpreted to be Paleocene to Late Eocene in age. These strata are in turn overlain by oblique, complex sigmoid-oblique and sigmoid progradational facies of probable Late Oligocene, Late Miocene, and Plio-Pleistocene ages (Symonds, 1983).

Along the continental margin the Central Great Barrier reef facies was established during the Pleistocene. The reefs grew on siliciclastic fluviatile and deltaic sediments during periods of high sea level, and were subaerially eroded during the intervening periods of low sea level. There is clear latitudinal variation in the nature and timing of reef growth. The reef is thicker in the north and has a multi-phase growth. In addition, side scan sonar profiles of the upper slope of the Great Barrier Reef have identified shelf parallel drowned reefs which are, apparently, low sea level analogues of the present outer barrier (P. Davies, written pers. comm., 1986). The earliest reef growth in the region probably began on basement highs on the Queensland Plateau in the Early to Middle Eocene (Pinchin and Hudspeth, 1975) although some consider that reef growth did not commence until the Late Oligocene and Early Miocene following stabilization of an equational circulation pattern (Taylor and Falvey, 1977). Reef growth today covers almost one-quarter of surface of the Queensland Plateau and the areas of buried reefs indicate this may have been even greater in the past.

In the Queensland Trough distinct seismic packages are identified and tied to major sea level oscillations. The eastern margin of the Queensland Trough is carbonate dominated and sediments have two sources: reef derived material from the Plateau area and planktonic material. Dredging of a series of seamount-like features in the Trough at depths down to 1200 m indicate a shallow water reefal origin for the seamounts and rapid subsidence rates (Plio-Pleistocene rates of 100-500 m per MY) for the Queensland Trough (P. Davies, written pers. comm., 1986).

The Great Barrier Reef area is an excellent example of a mixed carbonate/siliciclastic province in a passive margin setting. This area can provide important facies and stratigraphic models for understanding ocean history, the evolution of passive margins and ancient carbonate depositional systems. The following objectives have been identified and would be addressed by ODP drilling on the slope of the Great Barrier Reef and in the Queensland Trough:

(1) Sea level controls on sedimentation,
(2) the effect of plate motions and subsidence cycles on sedimentation and paleoceanography,

(3) an understanding of tectonic cycles in relation to sea level cycles,
(4) changes in paleoclimate related to plate position and the effect on sedimentation,
(5) slope/basin sedimentation - fans and lowstand deposits.
(6) basin fill history,
(7) Late Paleogene-Neogene paleoceanography,
(8) diagenetic history in a stratigraphic framework, and
(9) comparison of the history of a continental margin and an isolated plateau (Queensland Plateau).

In addition, a transect in this region would be able to be tied to a shallow-water continental shelf drilling program.

The immediate goal is one transect of four holes. One hole would be in the slope area to drill the paleoshelf deposits and toe-of-slope carbonate detritus. One hole would be at the paleo shelf margin for sediment history and slope deposition. A third hole would be at the toe-of-slope to basin transition to drill this transition, and the older Queensland Trough sediments. The fourth hole would be drilled on the eastern side of the Trough near the southern margin of the Plateau for a basinal reference section, paleoceanography, basin history, and periplatform sediment cycles.

Site Summary Table

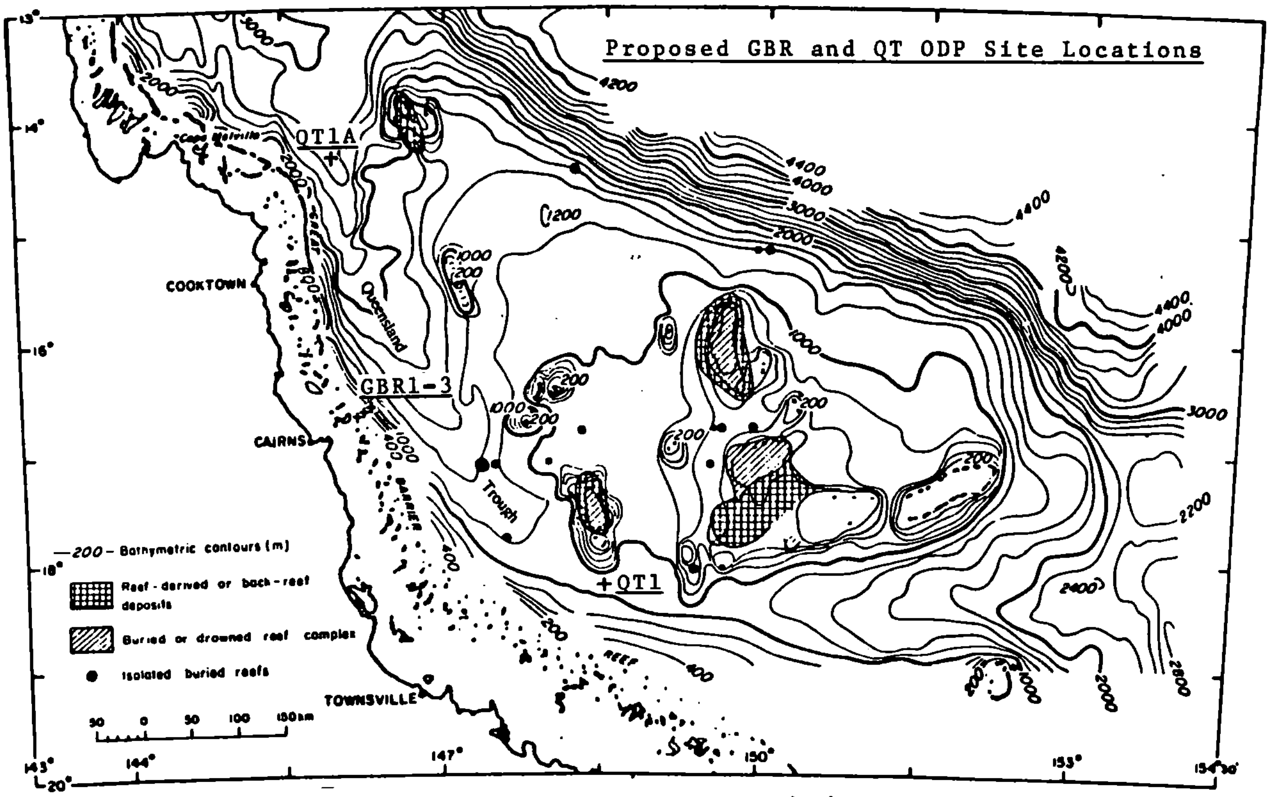
Proposed Holes	Relative Priority	Approx. Location	W.D. (m)	Penetration (m)	Est. Time Required On-Site
GBR1	2	16°38.7'S,146°17.5E	150	1000	10-12 days
GBR2	1	16°38.2'S,146°18.5'E	315	1000	10-12 days
GBR3	1	16°37.2'S,146°19.5E	863	1000	10-12 days
QT1	1	18°S,148°30E	1100	1500	15 days
QT1ALT	2	14°19.2'S,146°8'E	2475	2200	(20 days)
					51 (56) days

References

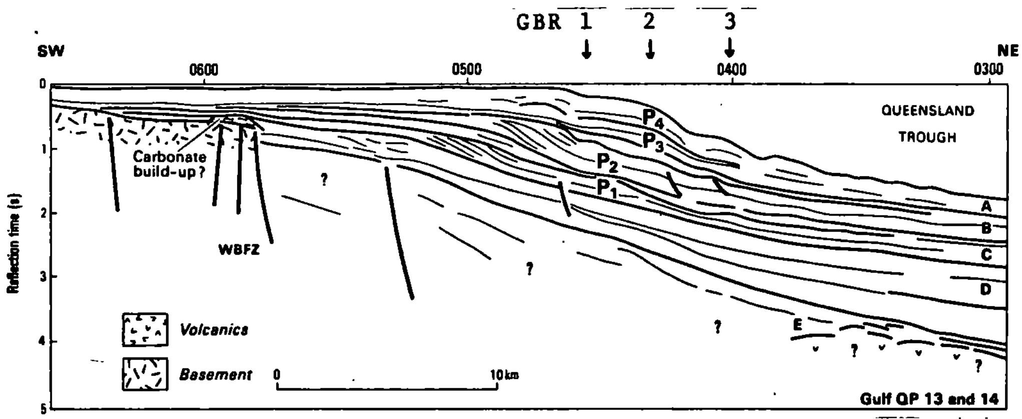
Pinchin, J. and Hudspeth, J.W., 1975, APEA Jour., v. 15, p. 21-31.

Symonds, P.A., 1983, in Baker, J.T. et al. (eds.), Proc. Great Barrier Reef.

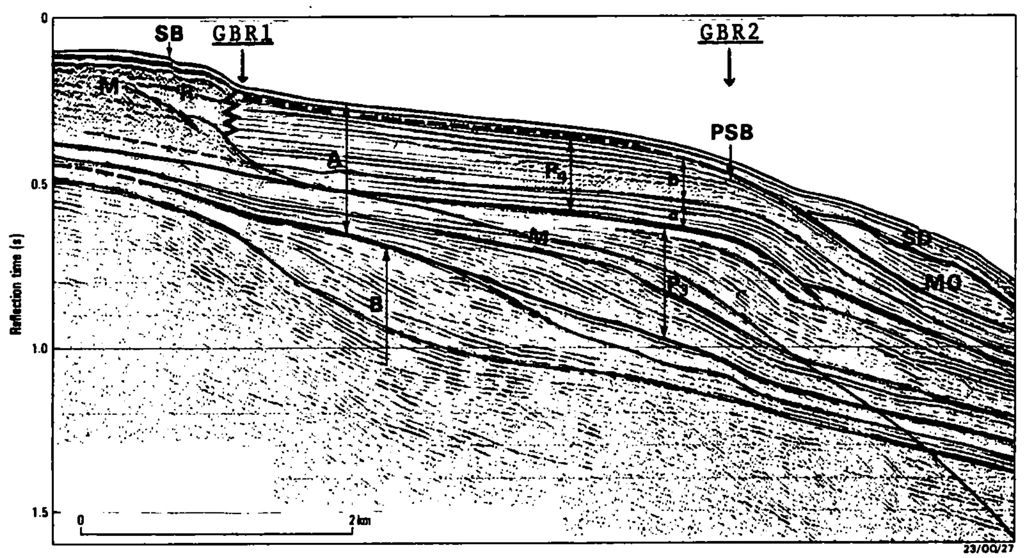
Taylor, L.W.H., and Falvey, D.A., 1977, APEA Jour., v. 17, p. 13-29.



Distribution of buried and drowned reefs



Interpretation of processed Gulf seismic profile: Grafton Passage transect. The major seismic sequences (A.B.C.D.E). and progradational phases (P1, P2, P3, P4) are labelled. WBFZ is the western boundary fault zone of the Queensland Trough rift basin.



Sparker profile at the eastern end of the Grafton Passage transect.
Amplitude-corrected, 12-fold stacked section. Shows prograding, mounded onlap (MO), sheet-drape (SD) and reef facies (R). Note the amount of shelf out-building and the relative positions of the present-day shelf break (SB) and the Pleistocene palaeoshelf break (PSB). Major seismic sequences (A, B) and progradational phases (P3, P4) are labelled. P4 has been subdivided into seismic facies units 4a and 4b. M is the first water-bottom multiple.

SUMMARY OF THE JAPAN SEA DRILLING PROGRAM

Introduction

Japan Sea is one of the western Pacific back-arc basins and is believed to have been formed by multi-axial rifting of the continental arc, much different from the rifting of the oceanic arc. Proposed drill holes reaching basement that was not achieved by DSDP Leg 31 can organize a large amount of geological and geophysical data of the Japan Sea to reconstruct the complex Neogene tectonics of East Asia.

Objectives

The drilling program for the Japan Sea is based principally on Tamaki et al's (1985) proposal together with ten proposals from many disciplines.

Tectonics

1. *Tectonics:* Back-arc rifting and spreading tectonics of the continental arc
   Back-arc extension tectonics of the continental arc, associated with multiple rifting, continental crustal extension, anomalous oceanic crustal structure, disorganized magnetic anomaly lineations, and contamination of MORB volcanism and arc volcanism, is comparatively studied with the Atlantic type extension tectonics.
2. *Tectonics:* Age of the spreading of the Japan Sea
   To constrain the age of the formation of the Japan Sea is critical for the regional tectonic reconstruction in East Asia. Recent paleomagnetic study on Japanese islands demonstrate extremely rapid bending of the Honshu island suggesting the Japan Sea generated in only 1 m.y.
3. *Tectonics:* Shift of plate boundary and obduction of oceanic crust
   The EURA-NOAM plate boundary shifted to the eastern margin of the Japan Sea in the Quaternary accreting NE Japan to NOAM. Obduction as well as subduction of the oceanic crust is ongoing along the new plate boundary.

Geochemistry and lithospheric study

4. *Metallogeny:* Ore genesis in the back-arc failed rifts
   Occurrence of shale-hosted massive sulfide and Kuroko-type sulfide deposits is predicted from the study of ore deposits on island arcs. This problem strictly constraints ore genesis of island arc-type ore deposits.
5. *Geochemistry:* Geochemistry of hydrothermal activity buried by sediments
   Geochemical interaction of hydrothermal activity and rapid sedimentation in the back-arc basin is comparatively studied with the case of mid-oceanic ridge.
6. *Petrology:* Origin of BABB (back-arc basin basalts)
   BABB and MORB are comparatively studied to constrain the geodynamism of the mantle wedge beneath the arc, especially under extremely rapid spreading condition.
7. *Sedimentology:* Diagenesis of siliceous back-arc basin sediments

8. *Crustal study:* Logging in basin holes
   Down hole seismometer measurements are carried out for studying detail structure of Layer 2 with anomalous velocity of 3.5 km/sec and acoustic emission measurements for resolving stress history.

Paleooceanography

9. *Paleoenvironment:* Opening of marginal sea and its effect to oceanographic and climatic environments
   Well preserved sediment sequence on rises above CCD in the Japan Sea is studied by standard environment analyses.
10. *Micropaleontology:* Study of fresh-water diatom fauna
   Fresh-water diatomite which was sampled by piston core at only one location in the basin area.

Proposed sites

9 principal sites and 8 alternate sites are proposed. Most of proposed sites are common through multiple proposals. All the sites are carefully selected not to meet gas production. Estimated drilling days for principal sites are 50.5 days which are good fit for a single leg. Extended drilling days of 72.5 days that fit for 1.5 legs can drastically improve paleooceanographic study.

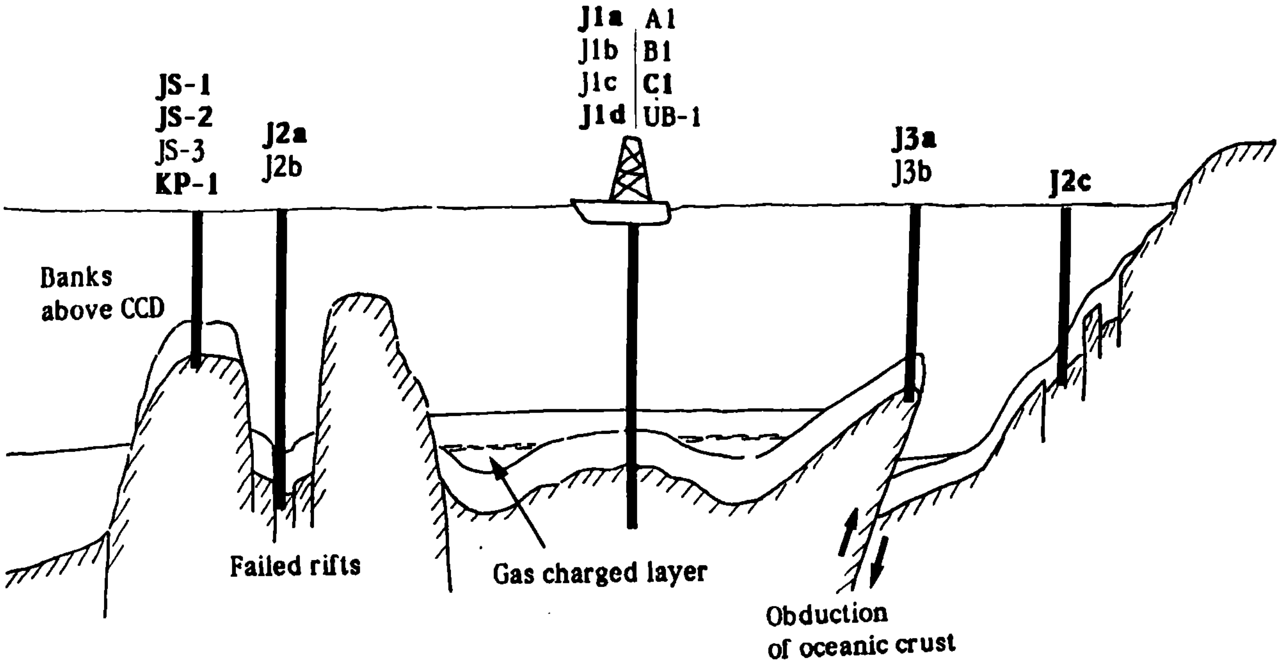
List of proposed sites

Site	Water Depth(m)	Hole Type	Reentry	Drill Days	Penetration (m)	Related Objectives
J1a	**2530**	**Rotary**		**6**	**550**	**1,2,5,6,7,8**
J1b	2780	Rotary	x	9.5	700	1,2,5,6,7,8
J1c	2400	Rotary		6	550	1,2,5,7,8
J1d	**3170**	**Rotary**		**6**	**350**	**1,2,5,6,7,8**
J2a	**2050**	**Rotary**	**x**	**12.5**	**1370**	**1,2,4,5,6,8**
J2b	2065	Rotary	x	10.5	1050	1,2,4,5,6,8
J2c	**1270**	**Rotary**	**x**	**9.5**	**1020**	**1,2,5,6,8,9**
J3a	**2040**	**Rotary**	**x**	**8.5**	**700**	**1,2,3,5,6,9**
J3b	1480	Rotary	x	8.5	870	1,2,3,5,6,9
KP-1	**1400**	**Rotary**	**x**	**8**	**1100**	**1,2,9**
				Sub total: 50.5 days (excluding alternate sites)		
JS-1	**2338**	**Rotary,HPC**		**7**	**500**	**9,10**
JS-2	**998**	**Rotary,D-HPC**		**4.5**	**600**	**9**
JS-3	1200	Rotary,D-HPC		4	400	9
A1	3225	Rotary	x	9	600	1,2
B2	1400	Rotary	x	8	1000	1,2
C3	**2928**	**Rotary**	**x**	**10.5**	**1000**	**1,2**
UB-1	2500	Rotary,HPC		11	1400	1,2,8

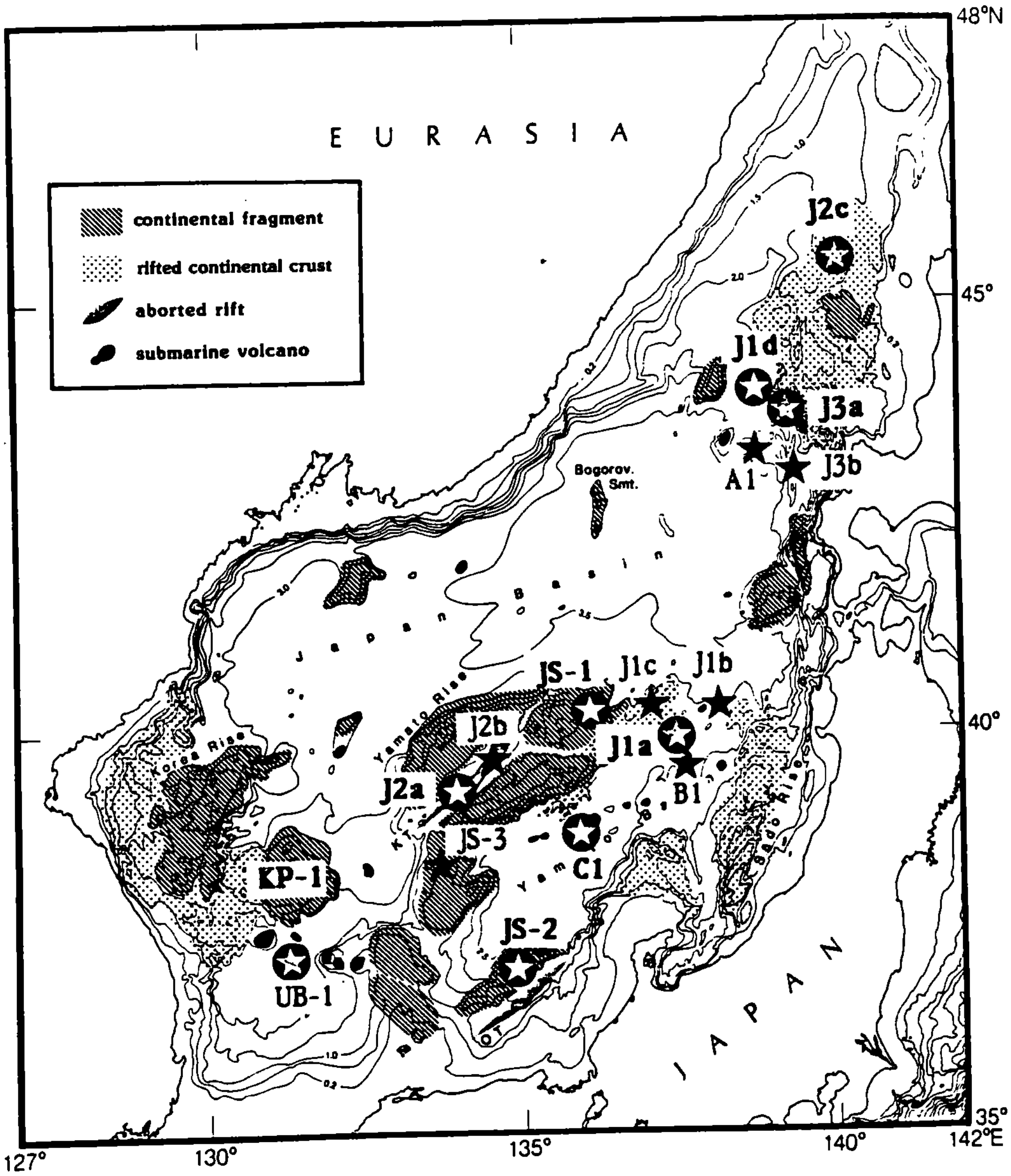
Thick: Principal site

Total: 72.5 days (excluding alternate sites)

Proposed drilling sites on a cartoon profile of the Japan Sea



Proposed drilling sites (thick:principal, thin:alternate)



WESTERN PACIFIC PANEL

Summary of South China Sea Proposed Drilling:
The Northern Rifted Margin and Deep Basins

Part I - Rifted Margins

The South China Basin is an "Atlantic-type" marginal basin, bounded by passive continental margins to the north and south. Opening of the basin moved microcontinental blocks (including northern Palawan and Reed Bank) southward from their original Paleogene positions adjacent to the China mainland. East trending magnetic lineations identified in the eastern half of the basin, date seafloor spreading as mid-Oligocene through Early Miocene (32 to ~17 m.y.B.P.); Figure 1.

The South China Sea is particularly well suited for studying passive margin stretching models because: A) it is probably old enough not to be effected by the complex, unquantifiable initial stretching processes and tectonics B) it is young enough to still exhibit observable differences in its subsidence and associated thermal history predicted by different crustal extension models.

The South China Sea is also an excellent place to: 1) investigate the processes of early rifting and subsidence of passive continental margins in general 2) to examine the validity of existing thermo- mechanical models of rifting in a place where the parameters of such models either have been or can be measured directly 3) to provide tectonic constraints to help isolate the effects of rifting from subsequent collisional processes that also occurred to the south 4) to obtain valuable ground truth on the sediment history (including effects of changing sea level), the paleoenvironment, and the petrology of the crystalline basement in a Western Pacific "marginal sea basin".

In the South China Sea all of the crucial pieces of supporting geophysical data have been collected to test passive margin models that predict the relationships between continental rifting, subsidence, drifting, sediment deposition, thermal history, and hydrocarbon maturation. They include: good regional MCS coverage of the margin, excellent single channel seismic and underway geophysics for the deep basin, deep seismic crustal thickness data and detailed heat flow measurements along selected margin transects.

Our principal drilling goal involves one transect of 4 ODP holes (near ~116°-118° E) in the region best known by the existing geophysical data base, and tied to additional commercial bore hole data from the inner shelf along the landward side of this margin transect.

One hole would be in the deep basin, two holes on the broad continental rise/slope, and one hole on the deep outer shelf/slope (See Figure 1 and table 1).

Part II - Deep Basin Holes

The final phase drifting history of the South China Sea remains open to interpretation. One model suggests a late change in spreading direction from N-S to NW-SE accompanied by coeval opening of the southwestern sub-basin of the South China Sea. Another model requires a late phase or oblique spreading for portions of the basin. A third more radical hypothesis postulates that the southwest sub-basin is much older (Cretaceous) than the eastern basin (Oligocene - Mid Miocene). Because these basins are relatively small, the conventional method of determining crustal ages from seafloor spreading magnetic lineations does not provide an unequivocal answer. Knowing the timing of key spreading events is important in evaluating their relationship to apparent regional pulses of tectonic activity and to possible regional/global plate reorganizations.

A number of similar proposals were received, each designed to resolve one or more aspects of the unknown late spreading history of the central and southwestern portions of the South China Sea basin. The holes shown in Figure 1 - SCS 5-8 represent "generic holes" defined from the ~15 holes proposed for the deep basin. They will answer questions regarding the age and rates of spreading in key parts of the basin, and will investigate the paleoenvironmental/ sedimentary conditions for this enclosed marginal sea. Each hole can be sited to minimize the required penetration and still solve the problems posed. While a minimum of 3 holes is required to answer all the key questions, even 1 or 2 basin holes would solve some of the problems.

Table 1

	Proposed Holes	Relative Priority	W.D.	Sed. Thickness	Penetration	Est. Time required On-Site*
Rifted Margin Sites	SCS 1	2	3650 m	1200 m	1250 m (into basement-oceanic crust)	12-13 days
	SCS 2	1	3150 m	~1000 m	(into basement-transitional crust)	9-10 days
	SCS 3	1	2060 m	~1200 m	(into basement-transitional crust)	9-10 days
	SCS 4	2	750 m	2000 m	(to 1000* m, to basement would be best)	7*-20 days
Deep Basin Sites	SCS 5	2	4000 m	<200 m	~250 m (into oceanic crust)	6 days
	SCS 6	3	4300 m	~400 m	~450 m (into oceanic crust)	7 days
	SCS 7	3	4200 m	~600 m	650 m (into oceanic crust)	9 days
	SCS 8	4	3480	200 m	250 m (into oceanic crust)	6 days

All estimates derived from JOIDES JOURNAL, v. xi, N. 4, 1985, Fig. 15.

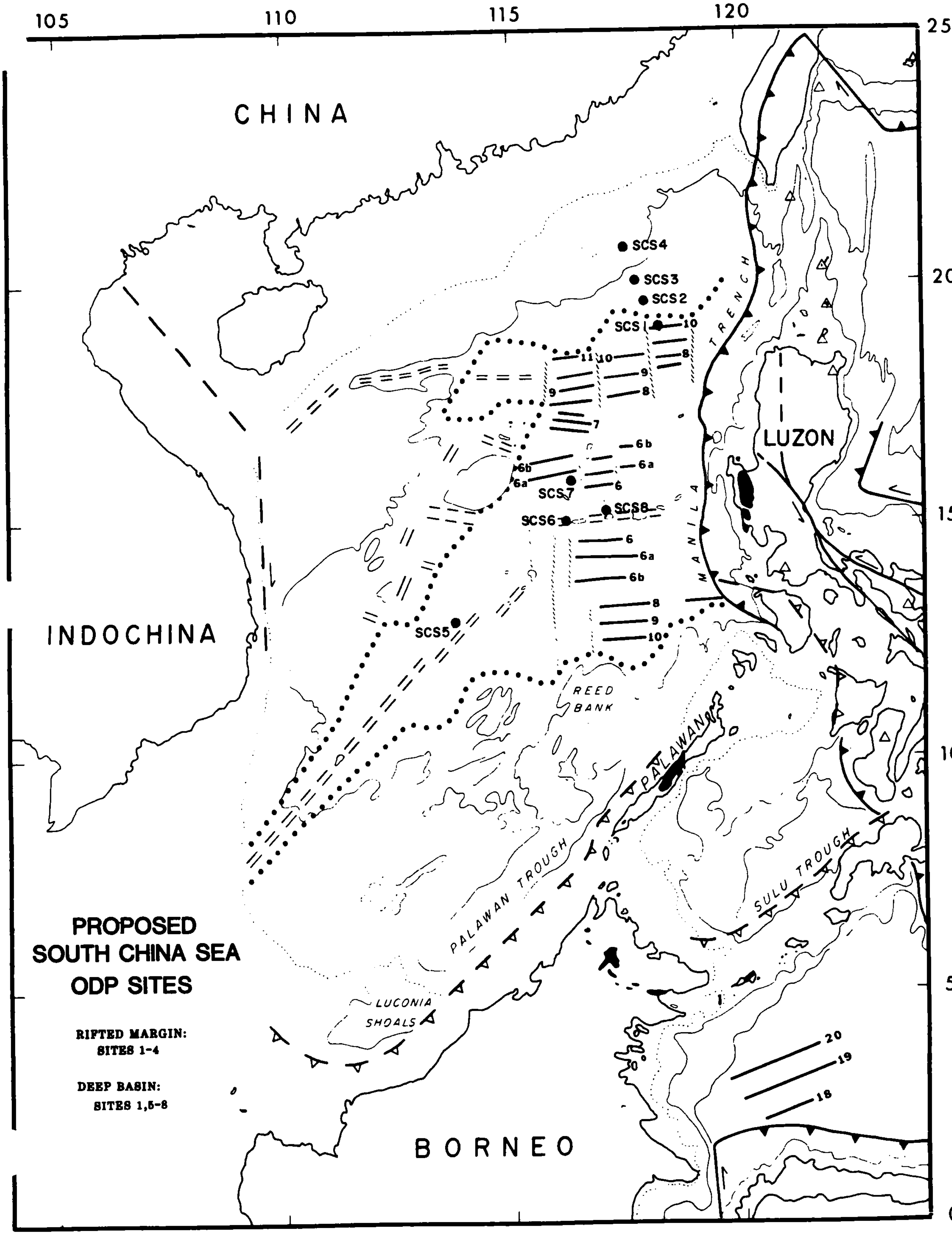

105
110
115
120
25
20
15
10
5
0
CHINA
INDOCHINA
BORNEO
LUZON
MANILA TRENCH
PALAWAN
PALAWAN TROUGH
SULU TROUGH
REED BANK
LUCONIA SHOALS
SCS4
SCS3
SCS2
SCS1
SCS5
SCS6
SCS7
SCS8
PROPOSED SOUTH CHINA SEA ODP SITES
RIFTED MARGIN: SITES 1-4
DEEP BASIN: SITES 1,5-8

Figure 1

SUMMARY COMMENTS ON OCEAN HISTORY DRILLING OBJECTIVES IN WPAC MARGINAL BASINS

SOUTH CHINA SEA

Paleoceanographic and sediment history objectives in the South China Sea derive from (1) the ideal passive margin record known to exist along the northwest continental margin of the sea, (2) the multiphase water mass and faunal history thought to have accompanied the episodic tectonic and eustatic history of the South China Sea basins, and (3) the importance of the sea as a model for a number of Paleozoic and Mesozoic basins thought to have formed in similar back arc settings.

The proposed transect of sites in the South China Sea offers the possibility of repeatedly tracing faunal and sedimentary response to major Neogene eustatic events from the shelf to deep basin floor in a relatively confined basinal setting as opposed to an open ocean configuration. We anticipate that these studies will be enhanced by the availability of data from commercial drill holes in shelf and shelf-edge areas thus allowing a uniquely complete spectrum of shelf, slope, and deep basin depositional facies to be defined and integrated with seismic profiles. In short, we see an opportunity to document the evolving depositional architecture of this passive margin in a manner allowing well contrained tests of proposed subsidence models in a setting where sedimentary and tectonic parameters can be judged in relation to overall basin history.

The stratigraphic records to be recovered in the South China Sea will provide evidence of (1) varying paleobathymetry at each site and hence documentation of rates and modes of margin and basin subsidence including age contraints on key unconformities, (2) variations in the composition, rate of accumulation, and modes of sediment transport during each phase of rift history reflecting both eustatic control of terrigenous sediment, paleoceanographic and climatic control of pelagic materials, and sedimentary evidence of volcanic events accompanying collision events to the east. We are particularly concerned about documenting any anoxic phases in the evolution of the South China Sea and the possible control of of oxygen deficient water masses by eustatic and tectonic manipulation of basin configuration, existance and position of shallow sills, and the interplay between global and climatic control of surface and deep circulation. Significantly, the South China Sea serves as the only source of well oxygenated water for the adjacent Sulu Sea basins with all this implies for the history of anoxia and resulting faunal and geochemical affairs in both basins. ODP drilling in both the South China Sea and Sulu Sea will thus provide a special opportunity to compare and correlate paleoceanographic histories of two adjacent but contrasting marginal basins during a period of major global climatic change associated with mid Miocene Antarctic cooling. Isotopic and faunal analysis of HPC cores from the South China Sea will provide detailed recordes of deep, intermediate, and surface circulation and productivity as well as supplimentary evidence of the separation of Indian Ocean and Pacific influences on faunal and water mass history as collision, back arc spreading, and basin formation accelerated throughout this region in mid Miocene time.

SULU SEA BASINS

Paleoceaographic objectives in the Sulu Sea basins are focused on the anoxic and suboxic sedimentary record known to exist in this silled marginal sea. A proposal by Thunnel details the importance of this setting for yielding an ultra high resolution stratigraphic record of variations in basin circulation and productivity tied to global climatic and eustatic events and to the tectonic and depositional history of the basin. Incites into the depositional and paleoceanographic evolution of the Sulu Sea basin gained via ODP drilling will have important implications for the interpretation of analogous Mesozoic and early Tertiary silled basins common to the meridial Tethys Sea and which evolved in similar carbonate-rich equatorial settings.

Specifically, faunal and stable isotopic analysis (C^{13}, O^{18}) of the Sulu Sea sequence will provide unusually detailed records of basin response to Quaternary and late Neogene glacial and interglacial climatic cycles manifested by eustatic sea level fluctuations as well as changes in surface circulation in this region. Much of the Neogene record in the Sulu Sea basin is expected to consist of laminated organic-rich sediment reflecting deposition under anoxic and suboxic subsill water which excluded larger infaunal invertebrates allowing preservation of individual laminae. Infact, the laminated character of the subsill sequence may well allow identification and analysis of six month (e.g. seasonal) events and annual cycles in the paleoceanographic evolution of the basin as well as a complete spectrum of longer term climatic and depositional cycles tied to the eustatic control of critical sill depth. We anticipate that benthic faunal analysis will demonstrate threshold effects between the anoxic and suboxic states induced by these events as well as cyclic control of fine grained turbidite deposits in the basin center. Variations in planktonic and benthic foraminifera in these sediments will allow analysis of both deep and shallow circulation in the basin with distinctive benthic biofacies demarking evolution of anoxic, suboxic, and oxic phases in water mass history.

Our proposed site in the west central area of the Sulu Sea basin was chosen to recover the least disturbed deep basin record. Available seismic lines indicate this area is relatively free of coarse turbidite deposits common to the steep eastern flank of the basin, Our second proposed site on the basin flank will yield a less continuous but neverless valuable paleoceanographic and eustatic record with carbonate anticipated to be well preserved in both sites despite the oceanic depths in the basin proper. Finally, it is important to point out that an independent piston and box core transect will likely be completed across the Sulu Sea basin and into the adjacent South China Sea prior to ODP drilling providing especially valuable background information on Recent sediment and faunal relationships in these adjacent seas and aiding in the interpretation of the Neogene sequences anticipated in this area.

SEA OF JAPAN

Sediment history objectives in the Sea of Japan take advantage of the relatively large body of knowledge available on sedimentary, faunal, and oceanographic patterns and processes in the modern sea and the substantial incites into Neogene events gained via concentrated study of Miocene, Pliocene, and Pleistocene marine sequences exposed along the eastern and southern margins of the sea. Major goals include (1) faunal and isotopic analysis of the unusually dynamic mid and high latitude paleoceanographic and climatic history experienced by the Sea of Japan which is known to have involved a major change from subtropical to subarctic character in late Miocene time and repeated alternations of anoxic and oxic phases as a function of both tectonic and climatic events in this region, (2) documentation of the age and character of the well established three-fold sedimentary history experienced by this sea and the relative roles of volcanic, eustatic, tectonic, and paleoceanographic events in producing these widespread lithofacies patterns, (3) detailed analysis of the origin and diagenesis of the distinctive and ubiquitous diatomaceous sediments characterizing mid and late Miocene phases of basin evolution, and (4) the origin, development, and sedimentary architecture of major late Neogene and Quaternary submarine fan systems now filling the eastern portions of the sea.

Although the Sea of Japan constitutes one of the best studied of all back arc basins key facts concerning the age, depositional history, and paleoceanographic development of the sea remain obscure or unanswered. For example, Leg 31 drilling failed to penetrate prelate Miocene sediments leaving questions about mid and early phases of basin history unanswered and equivocal. Thus, establishment of the age of earliest marine sediments in the sea constitues a major question to be addressed by ODP drilling. Study of onshore sequences on Honshu has revealed that subsidence in the eastern portion of the sea began in early Miocene time with rapid acceleration of subsidence in mid Miocene time. Although seismic and magnetic evidence tend to support this picture for others areas in the sea hard evidence is lacking with the age of older sediments in the deepest portions of the sea surmised but not fixed. The rapid spreading and subsidence in the Sea of Japan in mid Miocene time is known to have been followed by widespread deposition of largely biogenic diatomaceous sediments representing a response both to a lack of diluting terrigenous debris and relatively high productivity in surface waters during later Miocene time. Recovery of HPC cores in these latter deposits will allow an unusually detailed paleoceanographic history to be reconstructed and enhanced by the abundance of environmentaly sensative diatom floras. These analyses will also sheld light on the relative influences of the warm Kuroshio and cold Oyashio currents in this history with distinctive floras and faunas allowing these patterns to be traced and correlated with both global paleoclimatic trends and the tectonic emplacement of sills and island barriers.

Emplacement of extremely shallow sills at the major gateways of the Sea of Japan in Pliocene time set the stage for control of basin circulation, geochemistry, and productivity during later Pliocene-Pleistocene and Holocene phases in basin evolution. Piston cores and limited data from Leg 31 drilling have provided scant but dramatic evidence of alternating periods of severe anoxia and oxic circulation of the sea as eustatic sea level changes alternatingly isolated the sea from the Pacific Ocean and re-established marine circulation across the shallow sills. The severity of these events is evidenced by the presence of fresh water diatom floras in uppermost Miocene and younger sediments recovered from the sea. Furthermore, it is known that anoxic phases have been accompanied by unusual metal anomalies in deep sediments and that an unusually shallow CCD is present during oxic phases of basin history including the Holocene. Proposed ODP sites in the Sea of Japan are positioned to address each phase in the complex paleoceanographic history of the sea including detailed analysis of pre-sill and post-sill phases of basin evolution. The eustatic control of terrigenous sedimentation in the eastern sub-basins should be clearly displayed within the Toyama Deepsea Fan with the parallel objective of deciphering the depositional architecture of fan systems in confined marginal basin settings as developed in a proposal by de V. Klein.

SUMMARY OF THE DRILLING PROGRAM FOR NANKAI TROUGH AND SHIKOKU FOREARC TRANSECT

Introduction

Accretion of trench-fill turbidites is one of the fundamental processes of orogenic belt evolution. However, the mechanism of formation and deformation of accretionary wedges, including the origin of such chaotic rock facies as melanges or broken flysch formations, is controversial. In particular, there is a large gap in the scale of structural information acoustically imaged at the toes of accretionary wedges and the observed structures of onland examples. Drilling is the only way to narrow this gap.

The Nankai Trough convergent margin is one of the best studied examples of turbidite-filled trenches and active accretionary wedges. The data set is substantial and includes migrated MCS profiles, SCS profiles, abundant geophysical data (including one of the best heat-flow data sets for any trench or accretionary prism), Seabeam mapping, and submersible diving results. All these data indicate that the deformation of trench turbidites and fluid circulation (accompanied by vent ecological systems) are quite active at the toes of accretionary wedges. In contrast to this strong data set, drilling results have been quite incomplete (although as pointed out by Coulbourn, 1986, drilling here should be very rewarding, because of the stable hole conditions and because the gas problem is minor compared to other convergent margins). Parts of two legs (31 and 87) have been devoted to drilling in the Nankai Trough at three sites, but inadequate data was obtained due to shortage of time and misfortunes such as derrick problems and typhoon weather.

Objectives

The overall tectonics and sedimentation in the Shikoku forearc region are controlled by the collision of the Izu-Bonin arc against the Honshu arc. The turbidites come from the "Japanese Alps" through the Suruga Trough. Two broad tectonic objectives can be addressed in the Nankai Trough-Shikoku forearc transect drilling plan: the toe and outer forearc processes of accretionary prisms, and the vertical tectonics of the forearc, particularly in response to the collision event.

1. Toe and Outer Forearc Processes

Several important processes of accretionary wedge evolution are the objectives of Nankai Trough drilling. They are:

(a) the deformation, structural fabric development, lithification, and diagenesis of trench-fill turbidites.
(b) the role of porewater (from both turbidites and oceanic sediments) in accretionary wedge deformation and diagenesis.
(c) the mechanism and conditions of melange formation.
(d) the mechanism of vertical and horizontal growth of accretionary wedges.
(e) the structural and sedimentological evolution of slope basins.
(f) Sedimentary facies of trench turbidite, channel environments.

2. Vertical Tectonics of Forearcs

It has been assumed that the southwestern Japan arc has been deformed, due to the Izu-Bonin collision, since Pliocene time. The consequences are: (a) the uplift of the Japanese Alps, (b) the westward migration of the forearc region, accompanied by the right-lateral strike-slip movement of the

Median Tectonic Line, and (c) E-W compression of the volcanic arc and NW-SE compression of the forearc. The objectives addressed in this program are related to this broad arc deformation phenomena. The drilling plan focuses on the vertical tectonics and formation of forearc basins related to the NW-SE compression. Objectives are: (a) timing and rate of forearc basin subsidence, (b) history of the vertical motion of the outer ridge, and (c) long-term vertical tectonics of accretionary wedges since middle Miocene time, for comparison with presumably drastic Plio-Pleistocene events.

Proposed Sites

The strategy of drilling in accretionary wedges is similar to that of the Barbados leg (Leg 106) — a reference hole at the trench and a series of holes at different tectonic levels of accretionary wedges, emphasizing logging and porefluid sampling.

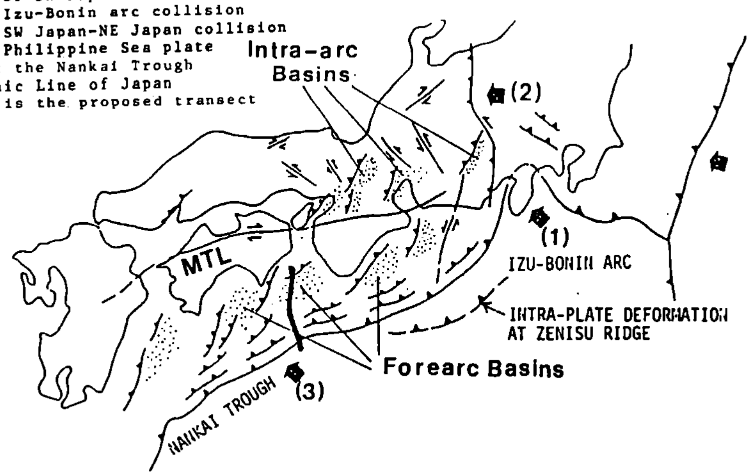
Drilling at the forearc basin sites focuses on the determination of stratigraphy, sedimentary environments, and paleo-waterdepths.

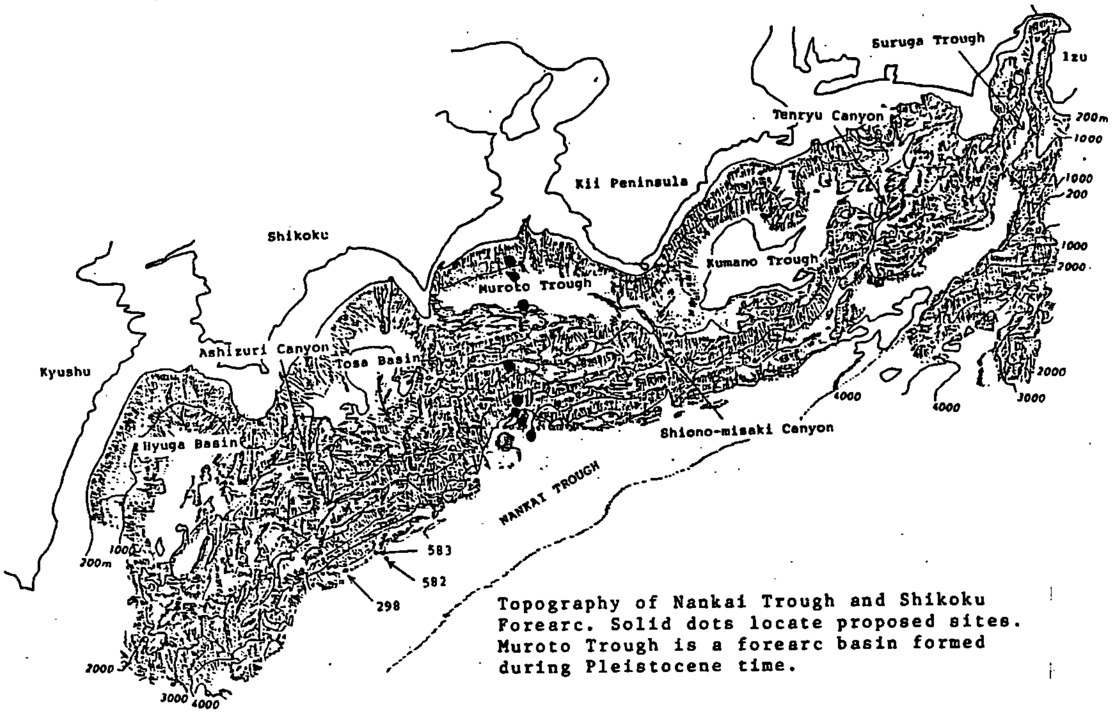
Other objectives which can be investigated in this region include paleoceanography of Kuroshio current, turbidite sedimentary facies of the slope and of the trench channel environments, and paleoseismicity using turbidite frequency.

LIST OF PROPOSED SITES

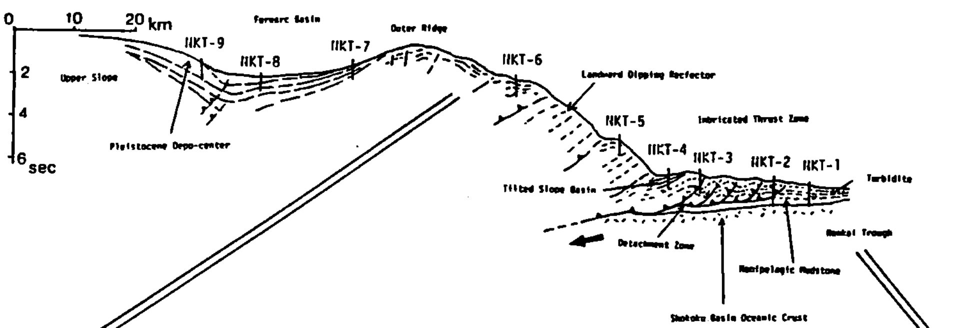
#	Lat	Long	Water Depth	Drill. Days	Penetration	Hole Type
NKT-1	32N	135E	4750m	14	1200m	HPC, Rotary Reentry
(Reference hole at the undeformed trench-fill. Penetrate through Pleistocene turbidites, Plio-Miocene hemipelagic mudstone and oceanic crust).						
NKT-2	32N	135E	4580m	23	1700m	HPC, Rotary Reentry
(Toe of prism to penetrate through decollement to the oceanic crust)						
NKT-3	33N	135E	4280m	9	700m	HPC, Rotary
(Nature of major imbricated thrust zone and porefluid evolution)						
NKT-4	33N	135E	4280m	9	700m	HPC, Rotary
(Slope basin structure and stratigraphy to calibrate tilting history and age of accretionart wedge)						
NKT-5	33N	135E	3530m	9	800m	HPC, Rotary
(Nature and lithofacies of landward dipping reflector sequence)						
NKT-6	33N	135E	1650m	8	700m	HPC, Rotary
(Structure of folded slope basin and vertical tectonics of upper slope)						
NKT-7	33N	135E	1050m	8	800m	HPC, Rotary
(Stratigraphy of forearc basin-fill)						
NKT-8	33N	135E	1320m	7	600m	HPC, Rotary
(Investigation of the subsidence of forearc basin)						
NKT-9	33N	135E	820m	7	700m	HPC, Rotary
(Vertical tectonics of upper continental slope)						

Active Tectonics of SW Japan
(1) direction of Izu-Bonin arc collision
(2) direction of SW Japan-NE Japan collision
(3) direction of Philippine Sea plate subduction at the Nankai Trough
MTL=Median Tectonic Line of Japan
Thick solid line is the proposed transect

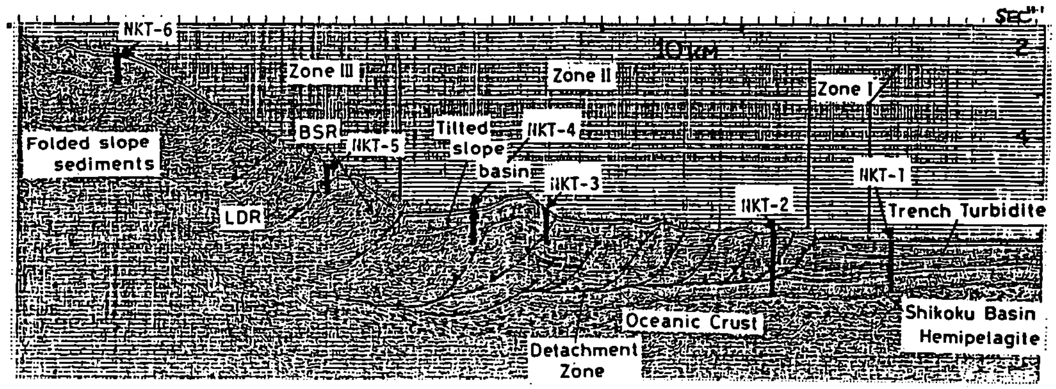




Topography of Nankai Trough and Shikoku Forearc. Solid dots locate proposed sites. Muroto Trough is a forearc basin formed during Pleistocene time.



Illustrations showing the locations of proposed sites along the Nankai Trough-Shikoku Forearc seismic cross sections.



Summary: Taiwan Collision Zone/Manila Trench Drilling Objectives

Proposed drilling along the Manila Trench/Taiwan collision zone convergent plate margin is based on the theme of *collision tectonics*. Specific goals are: 1) to gain new understanding of the processes by which an oceanic subduction zone evolves into an island arc-continent collision by investigating the Taiwan arc-continent collision zone, and 2) to investigate a zone of trench-seamount collision offshore of western Luzon. The Manila Trench/Taiwan collision system represents one of the best locales in which one can move along structural strike of a single continuous plate boundary and pass from a region characterized by the subduction of oceanic lithosphere into a region where transitional crust is being subducted, and then to a zone of active collision between a passive continental margin and an island arc. Because of the unique and well-quantified oblique collision geometry between the island arc of eastern Taiwan and the Asian continental margin, the temporal evolution of the collisional orogeny can be accurately documented. The rate of southward propagation of the collision with respect to the arc is about 85 km/my; hence, to move 85 km southward along Taiwan and the northern Manila Trench is equivalent to moving to a stage 1 my earlier in the development of the collisional orogeny. This relationship between the temporal evolution of the arc-continent collision and position along strike of the convergent plate margin allows questions about both the temporal and spatial evolution of the collisional orogeny to be addressed by drilling.

Drilling would ideally take place along three or four transects, each consisting of four or five holes (Fig. 1). The objectives of the southernmost transect, located along latitude 18° 50' N., are to quantify the structure and stratigraphy of sediments involved in oceanic crust subduction prior to arc-continent collision. The results of this transect will serve as a "baseline" for comparison to drill results from within the actual collision zone. The central drilling transect, located at about 20° 15' N., will investigate the sedimentary and structural consequences of the earliest stages of arc-continent collision, including sampling underthrusting continental crust, determining the rates of tectonic uplift during the early stages of the collision, and documenting the involvement of arc and/or continental basement in thrust faulting. The northernmost drilling transects, located southwest and southeast of Taiwan, will investigate the sedimentary record of the arc-continent collision. Questions to be addressed here include: How does the nature and distribution of sediment reflect the geometry of the collision? What are the differences and/or similarities in sedimentation between the forearc basin and the foreland basin during arc-continent collision?

A narrow zone is present further south along the Manila Trench where a collision between the trench inner wall and the Scarborough Seamount chain is occurring. The trench-seamount collision is restricted to a small region of the trench because the plate convergence direction is nearly parallel to the trend of the seamount chain. Hence, the effects of episodic collisions of individual seamounts are repeated in a small segment of the forearc rather than being distributed over a large part of the forearc, as is the case during oblique collisions of linear seamount chains. This serves to amplify the tectonic consequences of the attempted subduction of large topographic features on the oceanic plate. This target region represents a unique opportunity for the investigation of trench-seamount collisions. Five drill sites to investigate this problem are identified using CDP reflection data from the collision zone (Fig. 2). Sampling data from these sites will be directly comparable to hypothesized seamount fragments now exposed within subduction complexes on land.

Detailed information about the onset and evolution of arc-continent collision is difficult or impossible to obtain from ancient examples exposed on land due to the intense deformation that accompanies the terminal stages of collision. However, by moving along strike of the Manila Trench toward the Taiwan arc-continent collision zone one can sequentially investigate 1) the subduction of oceanic crust ("B-subduction") immediately prior to the involvement of continental crust, 2) the transition zone between oceanic and continental subduction, and 3) the early stages of underthrusting continental crust ("A-subduction"). Processes related to subduction can be directly compared to those of collision along the same convergent plate margin, where variables such as convergence rate and direction are constants. The Manila Trench is likely one of the best natural laboratories available in which to identify, isolate, and contrast the processes active during subduction, arc-continent collision (terrane accretion!?), and trench-seamount collision events along a single, continuous plate boundary.

Site Summary

Site	Latitude	Longitude	Water Depth (m)	Penetration (m)	Hole Type
Arc-continent Collision-Early Stage Sites					
MTT-1	20° 15'N.	120° 20'E.	4000	1100	Rotary
MTT-2	20° 15' N.	120° 25'E.	3750	1600	Rotary
MTT-3	20° 15' N.	120° 37' E.	2650	700	Rotary
MTT-4	20° 16'N.	120° 47'E.	2750	700	Rotary
MTT-5	20° 16' N.	121° 08' E.	3150	600	Rotary
Pre-Collision Sites					
MTT-6	18° 50' N.	119° 41' E.	4100	1200	Rotary
MTT-7	18° 50' N.	119° 50' E.	3780	1100	Rotary
MTT-8	18° 51' N.	120° 01' E.	2850	900	Rotary
MTT-9	18° 52' N.	120° 18' E.	2075	800	Rotary
Trench-Seamount Collision Sites					
MTT-10	15° 59' N.	119° 11' E.	3875	500	Rotary
MTT-11	15° 59' N.	119° 15' E.	4580	600	Rotary
MTT-12	16° 00' N.	119° 19' E.	2000	500	Rotary
MTT-13	16° 00' N.	119° 25' E.	1400	800	Rotary
MTT-14	16° 01' N.	119° 33' E.	1810	900	Rotary
Mature Arc-Continent Collision Sites					
MTT-15*	22° 15' N.	119° 35' E.	1650	--	Rotary
MTT-16*	21° 45' N.	119° 50' E.	2350	--	Rotary
MTT-17*	21° 20' N.	120° 00' E.	2900	--	Rotary
MTT-18*	22° 25' N.	121° 20' E.	2250	--	Rotary
MTT-19*	21° 55' N.	121° 20' E.	3050	--	Rotary
MTT-20*	21° 45' N.	121° 12' E.	2770	--	Rotary

* Approx. locations; site surveys for Taiwan Collision targets will be conducted in 1986.

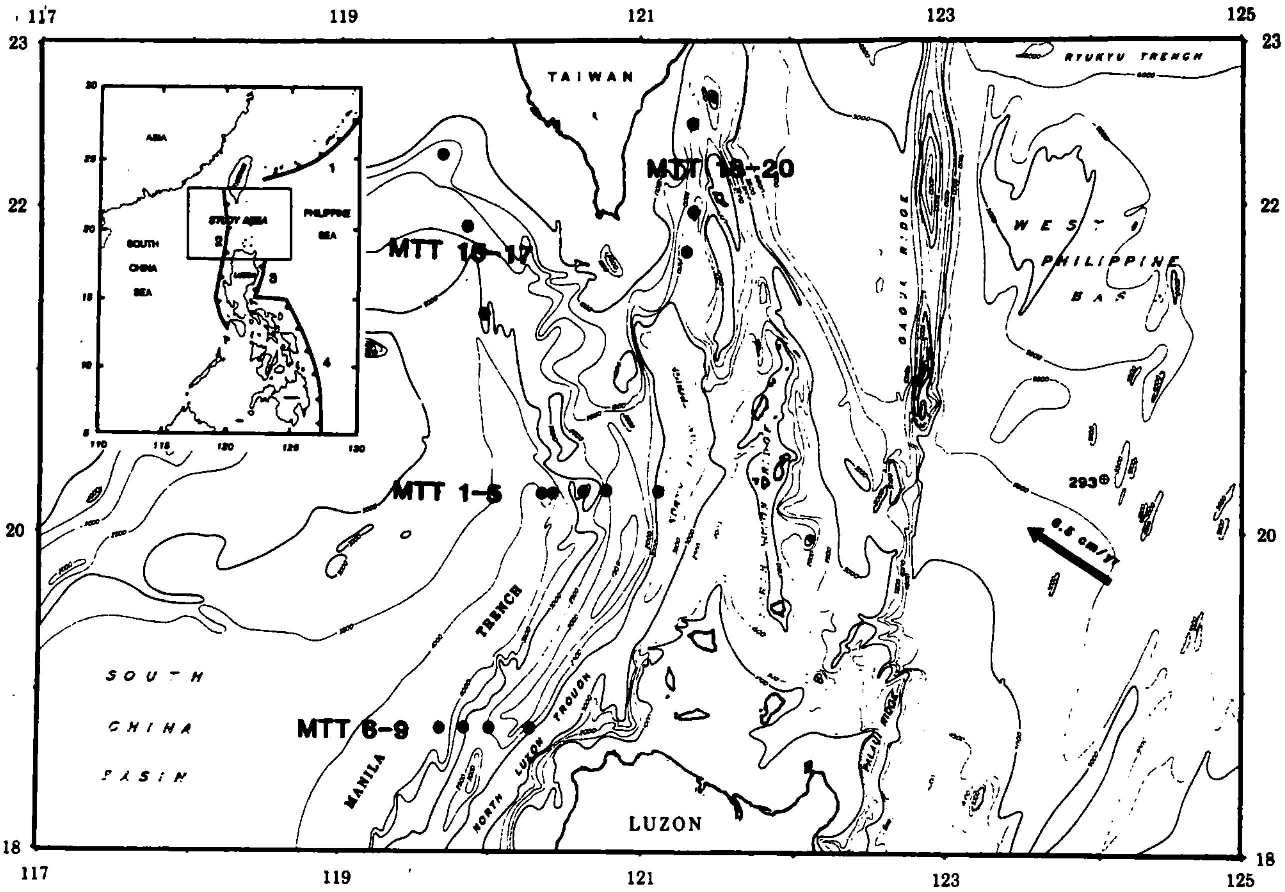


Figure 1

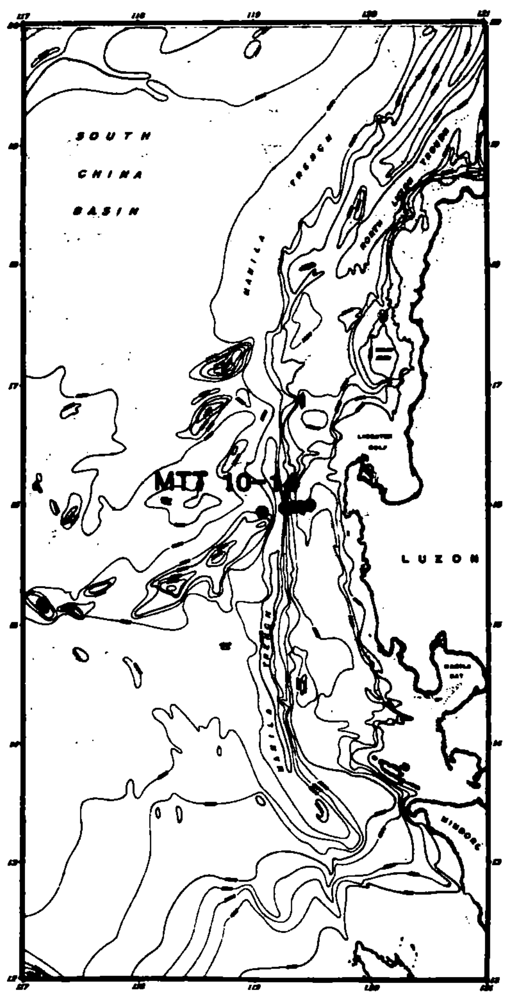


Figure 2

INTRAPLATE DEFORMATION ALONG : ZENISU RIDGE JAPAN

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General objectives

Intraplate of a young marginal basin by thrusting of the oceanic crust seaward of a subduction trench.

I. Geodynamic setting

The Zenisu ridge is a WSW-ENE trending linear structure located seaward of the Nankai trough, at the western edge of the Izu-Bonin (Iwo-Jima) active arc.

From the morphological point of view, this ridge trending N-50 E is vanishing progressively to the west, where it disappears within the Shikoku basin. Eastward this ridge connects progressively with the Izu-Bonin ridge.

It is a NW dipping monoclinal, fault bounded on its southeastern flank, itself bordered by a sediment filled trench, called the Zenisu basin. The sediments covering the ridge correspond generally to transparent seismic sequences, suggesting an hemipelagic origin, and are very similar to the seismic sequences recognized westward on top of the oceanic crust. Magnetic anomalies trending NW-SE were recognized across the ridge, suggesting an oceanic origin for this western part of the ridge. This NW-SE direction is fairly consistent both with the magnetic lineations related to the first stage of Shikoku basin opening, and with the topographic grain of the eastern wall of Suruga trough.

The tectonic framework of this ridge is controlled by N-60 E trending low dipping faults and associated folds are concentrated along the steep SE ridge slope and into the Zenisu basin. Here, sediments (partly trench fill sediments and partly hemipelagic sequences) are folded and accreted by thrust faults to the base of the ridge. The structures of the steep southern flank display a thrust and fold pattern with thrust bounded folds, very similar to the Nankai accretionary prism.

Zenisu ridge appears as an oceanic crustal slab, dipping to the NW, accreting clastic sediments as its base, and accomodating part of the convergence motion between Japan and the Philippine

Sea plate. It can be considered as a classical example of intraoceanic accretion.

II. Drilling objectives.

Zenisu ridge is a quite unique example of intra-oceanic plate deformation largely documented by MCS, SCS, Seabeam and manned submersible observations.

Complementary data in this area could provide important informations about such intra-oceanic deformation processes, marked by intense dewatering of sediments, water diagenesis, organic matter maturation and development of benthic communities.

Various objectives are presented here :

1. Study the deformed sediments present along the south-eastern slope of Zenisu ridge and their dewatering stage. Three sites are proposed in the place where benthic communities were encountered during Kaiko diving project :

2. To check the nature of the basement of western Zenisu ridge, supposed to represent the oldest part of Shikoku basin.

3. Testing the age and rate of tilting along the Northwestern slope of Zenisu ridge, by dating the observed unconformity.

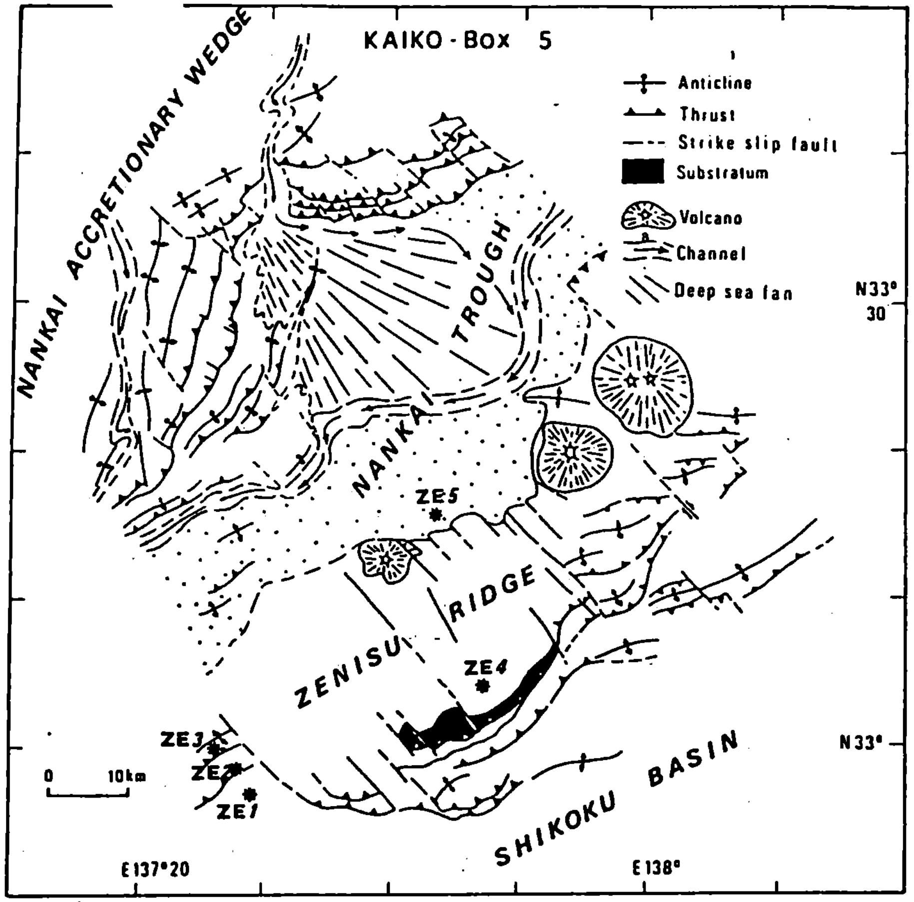
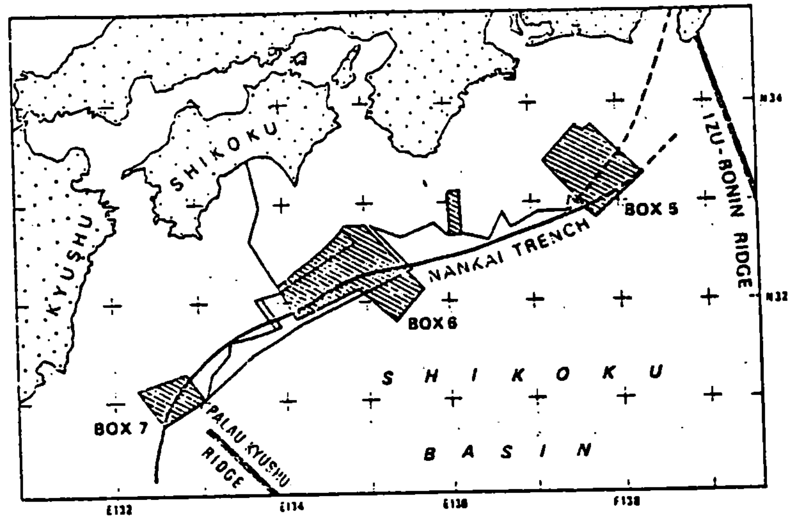
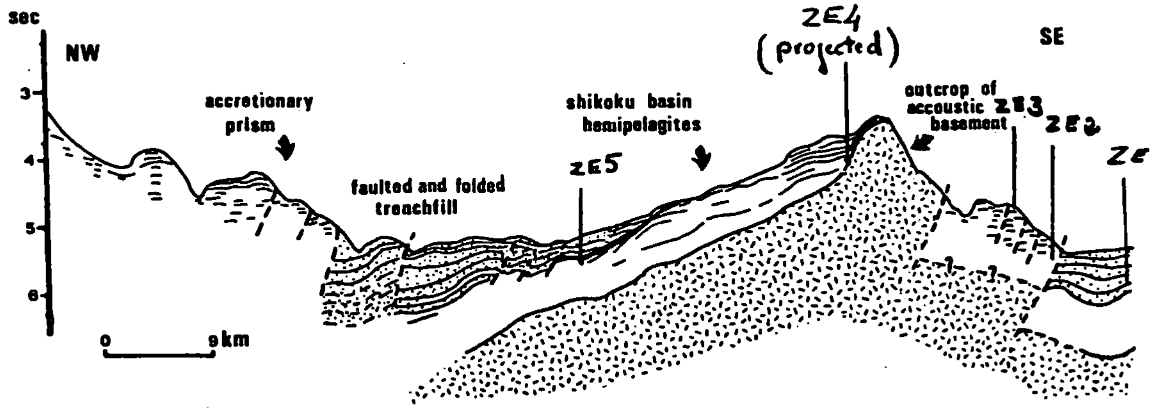


FIGURE 3 Structural sketchmap of BOX 5 showing the superficial deformation of the eastern part of the Nankaï accretionary wedge and of the Zenisu ridge. Stars locate the proposed drilling sites.



Location of the three boxes surveyed during Leg 1 of KAIKO project, June 1984. Zenisu Ridge lies over BOX 5, seaward of the Nankaï Trough.



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SITE	OBJECTIVE	OPERATIONAL CONSIDERATIONS
ZE1	To establish the nature and age of the "trench-fill like" basin, South of Zenisu. Reference site for ZE2 and ZE3	Water Depht : (m) 4250m Sed. Thickness : (m) 450m Total penetration : (m) 450m Single Bit : Nature of sediments/rocks anticipated : turbidites and hemipelagites Weather conditions/window : May-July Territorial juridiction : Japan
ZE2	(1) In situ pore-water sampling for inorganic and organic analysis expected results : water diagenesis and organic matter maturation, upward flux of connate waters in relation with dewatering processes. (2) Deformation processes into sediments at the base of Zenisu Ridge.	Water Depth : (m) 4200m Sed. Thickness : (m) 400m Total penetration : (m) 400m HPC : Single Bit : Nature of sediments/rocks anticipated ; turbidites and hemipelagites. Weather conditions/window : May-July Territorial juridiction : japanese
ZE3	In situ pore water sampling for inorganic and organic analysis. Expected results : water diagenesis and organic matter maturation, upward flux of connate waters in relation with dewatering processes, at place where biological communities have been discovered during Nautile diving in June 1985.	Water Depth : (m) 4100m Sed. Thickness : (m) 450m Total penetration : (m) 450m HPC : Single Bit : Nature of sediments/rocks anticipated: inurated hemipelagic muds Weather conditions/window: May-July Teritorial juridiction : Japan
ZE4	Etablish the nature and age of the crust of the western Zenisu ridge and document the stratigraphy of sedimentary sequence covering it, supposed to be the oldest sediments in the Eastern half of the basin.	Water Depth:(m) 3150m Sed. Thickness:(m) 400m Total penetration: (m) 420m HPC : Single Bit : Nature of sediments/rocks anticipated: Hemipelagites, turbidites (or tuffaceous layers and lavas (oceanic basements) Weather conditions/window: May-July Territorial juridiction : Japan
ZE5	(1) to determine the age and the rate of basement tilting of oceanic crustal slab, along the northern slope of Zenisu Ridge. (2) To determine the age change of sedimentation between hemipelagites covering the ridge and the ovelying turbidi- of Nankai Trough deposited in onlap.	Water Depth: (m) 4100 Sed. Thickness: (m) 650m Total penetration: (m) 650m HPC : Single Bit : Nature of sediments/rocks anticipated: Turbidites and thin hemipelagites Weather conditions/window: May-July Territorial juridiction: japanese

PROPOSAL FOR DRILLING : SULU SEA MARGINAL BASIN TRANSECT

C. RANGIN, UA 215 C.N.R.S. - France.

H. SCHLÜTER, B.G.R. Hannover RFA.

The Sulu sea is a small basin located between two main marginal basins, the South China Sea to the North, and the Celebes sea in the South. It is bounded from the first one by the Calamian cuyo platform and the Palawan ridge in the North, and from the second one by the Sulu ridge, in the South. This Sulu basin is marked in its axial parts, by a major bathymetric high, the Cagayan ridge.

- The Dangerous Ground platform, belongs to the southern continental margin of the South China Sea and has been colliding with the philippine arc along the Palawan trench, active until 15 Ma. ago (Holloway, 1981).

- The Palawan ridge corresponds to a wide accretionary prism formed by mesozoic ophiolitic and clastic sequences highly deformed during middle Miocene thrusting, disconformably covered by lower middle Miocene (Langhian) clastics deposits.

- The Cagayan ridge is accepted as a remnant volcanic arc related to the Palawan subduction zone;

_ The Sulu ridge is characterized by a very recent volcanic chain, built above a complex basement including undated melanges. Along its northern flank, this volcanic ridge is bordered by the Sulu trench, and along its southern flank by steep escarpments, separating this ridge from the Celebes Sea basin considered as Eocene in age. The Sulu volcanic arc and associated melanges, are testifying for two distinct subduction episodes, the firth one would have been related to the northward subduction of the Celebes Sea, and the last one, to the southward subduction of the Sulu sea along the Sulu trench.

Two deep sub-basins elongated ENE, are present between these ridges :

- The Northern Sulu basin, is characterized by an upper sequence lying disconformably on top of highly deformed sediments.

- The Southern Sulu basin is characterized by a relatively flat acoustic basement interpreted as an oceanic crust of undefined age.

Drilling objectives :

1) Collision processes : timing of propagation of deformation along the Palawan-Northern Sulu basin Neogene orogenic belt.

2) Nature, age and deformation style of an Island arc (Cayagan ridge), involved into this collision (see detailed objectives proposal by BGR).

3) Nature and age of Southern Sulu Sea basin (trapped or intra-arc basin).

4) Sedimentation into a silled oxygen deficient basin.

5) Incipient subduction on back arc side and related dewatering processes.

6) Timing for arc reversal on both flanks of Sulu Ridge.

Proposed BGR site Sulu-2 on the W-flank of the Cagayan Ridge as part of the Sulu-Transect for ODP-Drilling

The NE-SW striking Cagayan Ridge divides the Sulu Basin into the NW Sulu-Subbassin and into the SE Sulu-Subbasin. The tectonic domain of the western/northwestern Cagayan Ridge is characterized by rather uniform sediment thicknesses of assumed Early Miocene to Holocene age overlying shingled acoustic basement reflections that are interpreted as basalt flows. Although pieces of 14 my old arc-basalt were recovered (BGR SONNE cruise SO-23) the nature and age of the Cagayan Ridge remain controversial in the context of the geodynamic evolution of the South China Sea/Sulu Sea areas.

Opening of the South China Sea was counterbalanced by subduction of Mesozoic oceanic crust, hitherto assumed along the NW Borneo-Palawan troughs (Hamilton, 1979; Taylor & Hayes, 1980, 1982) and completed around 15 my ago. But there is strong evidence that subduction occurred further to the east, somewhere along the NW Sulu Basin (Hinz & Schlüter, 1985). In both cases, the Cagayan Ridge represents a remnant volcanic arc, related to this subduction and the NW Sulu Basin a deformed forearc basin due to arc-continent collision causing overthrust of the forearc onto the Palawan microcontinent.

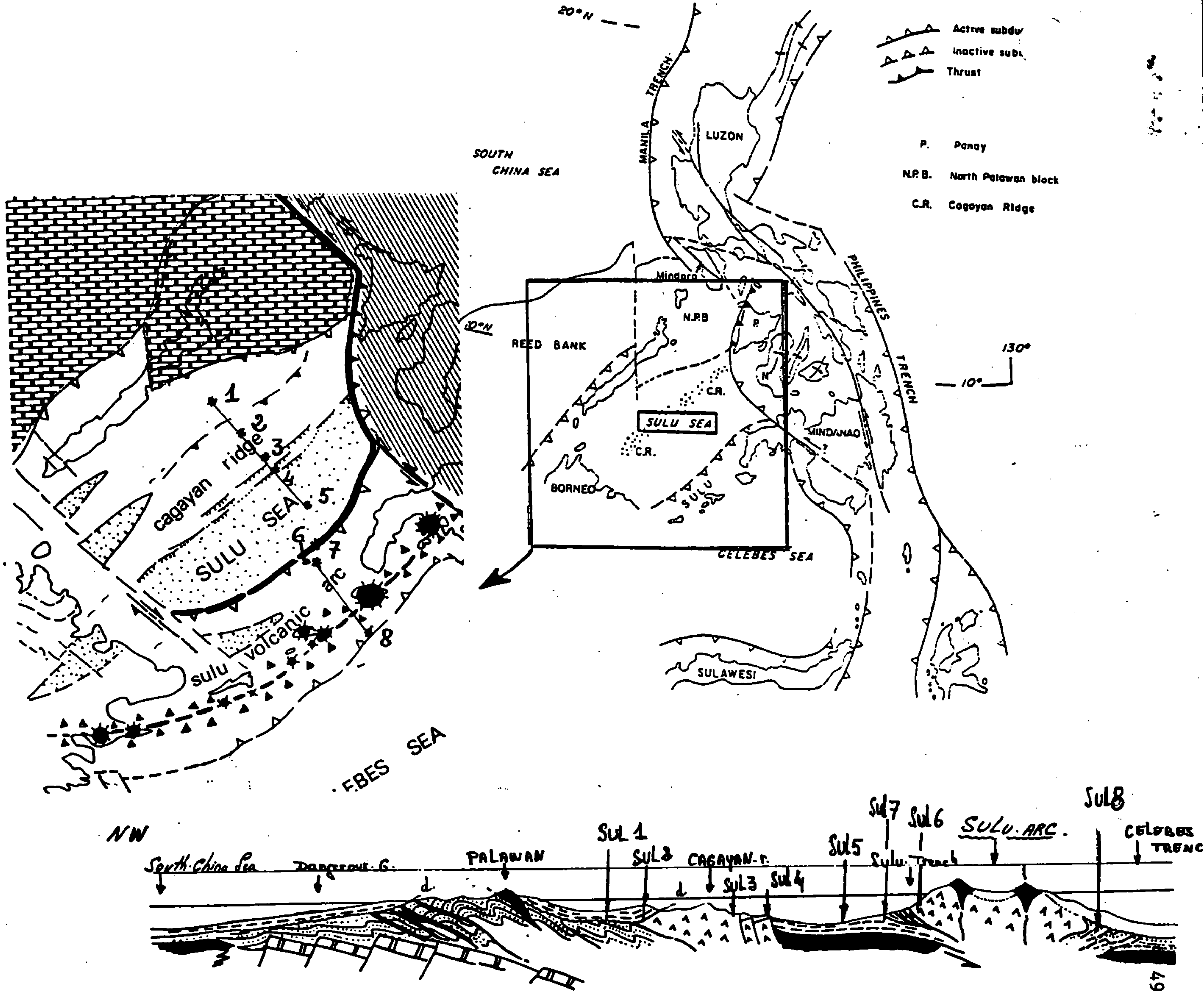
A different hypothesis explains the Cagayan Ridge as the remnant of a rifted volcanic arc system left behind, when the SE Sulu oceanic basin opened in Eocene ? (Hilde et al., 1985)/Oligocene ? (Rangin, 1985) times. Drilling site Sulu-2 on the western terrane of the Cagayan Ridge has a direct feed-back to geodynamic concepts developed for the Sulu Sea and for the southeastern parts of the South China Sea as well as for the Palawan terrane. Main objectives of site Sulu-2 are:

- Determination of age and nature of the sedimentary sequences and their bounding unconformities in comparison to the SE Sulu Basin and to the NW Sulu Basin/Palawan terrane.

- Determination of nature and age of pre-Early Miocene anticipated basalts, in particular their petrologic-geochemical signature.

- Penetrate the underlying basement of unknown nature and age
  Sulu-2: 9°23'N/120°12.5'E, WD: 1748 m, Sed. Thickn.: 550 m,
  T.Penetr. 1000-1200 m
  Special Require: Re-entry, logging, heat flow, paleomag. sedimentology, igneous petrology

SITE	SPECIFIC OBJECTIVE	LARGE THEMATIC OBJECTIVE
SUL 1	Age of regional disconformity , to be compared with some disconformiyy on top of Palawan accretionnary wedge, and Palawan Island. Possible extension of Palawan accretionnary wedge into Sulu Sea. Water Depth: (m) 1500 Sed. thickness : (m) 1200 Total penetration: (m) 1200	Contrain the amount time necessary for Collision processes at large scale. Instantaneous deformation versus propagating deformation into Collisional belts.
SUL 2	Age and nature of deformed Northern Sulu basement : proximal fore arc deposits or volcanic arc terrane. Water Depth: (m) 1500 Sed thickness: (m) 500 Total penetration: (m) 600	Age and nature of Cagayan Ridge. Deformation style and coeval metamorphism on Island arc terrain involved in Collision. Intermixing magma processes between starved Island arc, and incipient marginal opening.
SUL 3	Age and nature of acoustic basement of Cagayan Ridge. Reference site for SUL 4 Water Depth: (m) 1650 Sed. thickness: (m) 200 Total penetration: (m) 300	
SUL 4	Petrology and sedimentation history of rifted arc basement Problem of the transition between last stage of arc magmatism in Cagayan Ridge and first stage of oceanic basement in inner Sulu Sea. Water Depth: (m) 3300 Sed thickness: (m) 450 Total penetration: (m) 600	Development of an intra arc oceanic basin in Neogene time. Fast subsidence history, evaluate the effect of late Cenozoic Sea level fluctuations on sedimentation in a shallowly silled, oxygen deficient basin.
SUL 5	Age and geochemistry of Southern Sulu basin basement considered as oceanic young evolution stage of a possible intra arc oceanic basin to be compared with sites SUL 3 and 4. Water Depth: (m) 4500 Sed thickness: (m) 550 Total penetration: (m) 700	
SUL 6	Nature and age of upper part of Sulu Sea Inner wall, remnant arc drifted Cagayan Ridge after intra-arc Sulu Sea openning. Water Depth: (m) 1500 Sed thickness: (m) 250 Total penetration: (m) 400	
SUL 7	Age, facies, tectonic style of deformed sediments along a incipient subduction zone. In Sulu pore water sampling for inorganic matter maturation, upward flux Connate waters in relation with shallow dewatering processes. Date subduction reversal along Sulu arc. Water Depth: (m) 3900 Sed thickness: (m) 350 Total penetration: (m) 350	Evaluate processes of incipient subduction on back arc side. Evaluate time necessary for flipping of subduction zone from southern side to Northern side of Sulu arc ridge.
SUL 8	Age of disconformity suspected at base of Celebes trench wall. Infilling of the trench after cessation of subduction. Date subduction reversal. Water Depth: (m) 4200 Sed thickness (to be defined by Site Survey)	


20°N
SOUTH CHINA SEA
MANILA TRENCH
LUZON
Mindoro
N.P.B
P.
REED BANK
10°N
C.R.
SULU SEA
BORNEO
SULU
MINDANAO
PHILIPPINES TRENCH
130°
10°
CELEBES SEA
SULAWESI
Active subdu
Inactive sub
Thrust
P. Panay
N.P.B. North Palawan block
C.R. Cagayan Ridge
1
2
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8
cagayan ridge
SULU SEA
sulu volcanic arc
CELEBES SEA
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South China Sea
Dangerous G.
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Sul 5
Sul 7
Sul 6
Sulu Trench
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Sul 8
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