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EXECUTIVE SUMMARY
INDIAN OCEAN PANEL MEETING
Rome (Italy), 21-23 October, 1987

1. Report of the **PCOM Meeting** in Nikko, Japan (26-28 August, 1987) was presented by U. von Rad.

- IOP strongly **recommends** that sufficient support exists at TAMU to enable all scientists to contribute to the Part B ODP volumes, specifically for drafting, illustrations, and editing.

- Regarding the general structure of the ODP advisory panels, IOP **supports** the intended changes toward a more thematically driven drilling program. If the regional panels are disbanded or greatly atrophy there is a danger that drilling will be focused only in the most familiar regions. IOP strongly **recommends** that the thematic panels be increased to include members with strong regional expertise and familiarity with data-sets. This membership may be tailored to true projected path of the drillship.

2. **Panel reports** were given from minutes (LITH, TECH) and presented by R. Schlich (SOP), I. Premoli-Silva (SOHP), and U. von Rad (SSP).

3. Drilling results for **leg 115** and **leg 116** were presented by R. Duncan and J. Cochran respectively.

4. Review of the **Kerguelen Drilling Program** (legs 119 and 120) : all the proposed sites, with the exception of site SKP-3, have been accepted by the Pollution, Prevention and Safety Panel. Site SKP-3 has been limited to a drilling depth of 800 m, this precludes the original SKP-3 scientific objectives (Mesozoic stratigraphy and tectonics). If KHP-3 (alternate site) is not drilled due to time constrain and SKP-3 is dropped for safety reasons, the corresponding information can be obtained by deepening sites KHP-1 and/or SKP-2 or by defining a new locality where the Mesozoic stratigraphy and tectonics objectives can be achieved. IOP **recommends** the second option.

5. Review of the **Broken Ridge Drilling Program** : IOP **endorses** the proposed program but suggests to shift site BR-1 further downslope to the north, to allow the determination of detrital remnants of the truncated section which might be incorporated in younger sediments.

6. Review of the **90°E Ridge Drilling Program** :

. IOP **recommends** for the northern (90°ER-1) Ninetyeast Ridge site the proposed composite hole (NNER-9 and NNER-10) which will sample the complete upper (Neogene) and lower (Paleogene) sedimentary sections, and penetrate the underlying basement (50 m).

. IOP **endorses** for the central (90°ER-2) and southern (90°ER-5) Ninetyeast Ridge sites the P. Newman and J. Sclater preferred options : central 90°E Ridge site at 17.08°S-88.11°E and southern 90°E Ridge site at 27.33°S-87.46°E.

. If time precludes drilling all three sites, IOP **recognizes** that the central and northern 90°E Ridge sites have the highest priority.

. IOP **recommends** HPC for the Neogene-Oligocene sedimentary sequence at all 90°E Ridge sites and double HPC (if time permits) at the northern and central sites.

. IOP **recommends**, that if drilling conditions permit, the 90°E Ridge sites be drilled to more than 50 m into basement ; the highest priority for deep penetration corresponds to the central 90°E Ridge site.

7. Review of the **Exmouth Plateau Drilling Program** : The discussion centered around the Southern and Western Exmouth Plateau sites with special attention to the merits of the new EP-12 site in comparison with the EP-6, EP-7, and especially EP-2A sites.

. IOP **accepts** the importance of the tectonic questions addressed by both EP-2A and EP-12 sites and does not consider them as alternates.

. IOP **considers** that the three sites EP-6, EP-7, and EP-12 could provide data relevant to the global sealevel curve.

. IOP **notes** some safety problems at site EP-12 and **considers** that a better formulated drilling proposal is essential to demonstrate a clear relationship between the anticipated stratigraphy and the postulated tectonic model.

. IOP **recommends** the following priorities (in that order) : EP-7, EP-10, EP-12 and EP-2A, if a more definitive EP-12 proposal is presented and if there are no safety concerns. If the tectonic-stratigraphic relationship cannot be demonstrated or safety considerations preclude drilling EP-12, the priorities should be EP-7, EP-10, EP-2A, and EP-6.

8. Review of the **Argo Abyssal Plain Drilling Program** :

. IOP **confirms** the priorities of drilling first site EP-9E on the Exmouth Plateau, followed by site AAP-1B with approximately 200 m of basement penetration.

. IOP **favors**, if time is available, double-coring of the critical Upper Jurassic-Neocomian section in a second Argo Abyssal Plain site (AAP-2).

9. **IOP Membership changes** : D. Falvey, W. Prell, and J. Cochran will rotate off in 1988.

10. **Next meeting** : Perth (Australia), or Montreal (Canada) or Corvallis (Oregon) in November 1988, after completion of the Indian Ocean drilling program.

MINUTES OF THE INDIAN OCEAN PANEL MEETING
21-23 OCTOBER, 1987
ROME, ITALY

Members Present :

R. Schlich (Chairman)
H. Baecker
A. Baxter (alt. for R. White)
A. Bosellini
J. Cochran
T. Davies
R. Duncan (Secretary)
D. Falvey
J. Ludden
I. Premoli-Silva (SOHP)
E. Vincent
U. von Rad (PCOM)

Absent :

W. Prell
J. Segawa
C. Langmuir (LITHP)
A. Watts (TECP)

R. Schlich opened the IOP meeting on Wednesday, 21 October, with a special welcome to new members E. Vincent and T. Davies, A. Baxter (alternate for R. White) and I. Premoli-Silva (the new liaison from SOHP). Thanks were given to A. Bosellini and the Consiglio Nazionale delle Ricerche for hosting the meeting.

I. PREVIOUS MINUTES

The minutes of the previous IOP meeting (LDGO, 31 March-1st April, 1987) were adopted without changes.

II. REPORT OF THE PCOM MEETING IN NIKKO, JAPAN (26-28 AUGUST)

U. von Rad (PCOM liaison) reported on several issues of concern to us :

. Publications : IHP has presented some substantial changes in preparation and publication of the ODP Proceedings Parts A and B which are aimed at cost savings. We discussed these and IOP applauds most of these changes, but strongly recommends that sufficient support exists at TAMU (Publications) to enable all scientists to contribute to the Part B volumes, specifically for drafting, illustrations, and editing.

. The Navidrill system will be undergoing further testing on land and should be ready for submarine engineering tests on Leg 120.

. A proposal from ODP Logging (LDGO) to modify a logging instrument, the formation microscanner, was discussed.

. Indian Ocean Program :

Leg 118 : Following a proposal from the co-chiefs to change the drilling plan, PCOM reiterated that 10 days were added to this leg for engineering tests of the guide base and the top priority will continue to be to set the guidebase and drill a single deep hole into the central peridotite ridge, if weather permits.

Leg 119 : Co-chiefs will be J. Barron and B. Larsen.

Two days have been added for setting a re-entry core at KHP-1 to have the option to return if time allows (Legs 119 or 120). Prydz Bay drilling has a 500 m maximum penetration depth (set by Safety Panel) ; there will be a program of sediment trap deployment using the Maersk Master to be coordinated with Leg 119 scientific party.

Leg 120 : Co-chiefs will be R. Schlich and S. Wise.

Site SKP-2 has been reestimated at 1000-1300 mbsf. If site SKP-3 is dropped for safety reasons, a re-entry cone will be set at site SKP-2.

Leg 121 : Co-chiefs will be J. Pierce and J. Weissel.

There will be sufficient time to drill all three 90°ER locations as well as the Broken Ridge sites, in this leg. The final port is now likely to be Singapore.

Leg 122 : Co-chiefs will be U. von Rad and B. Haq.

Leg 123 : F. Gradstein will be one co-chief, the other yet to be determined. Site EP-9B has been changed to EP-9E (yet to be precisely located) at the suggestion of SSP.

. Panel structure :

Based on submissions from the COSOD II meeting and the thematic panels, PCOM recognizes that the science advisory structure should be more "thematically driven rather than proponent driven". Hence, thematic panels will have more influence in prioritizing and evaluating drilling programs in light of previously defined thematic objectives. Regional panels may be dissolved or be called for logistical advice. Thematic panels should have members, however, with specific regional experience and members familiar with regional data sets. A subcommittee has been charged with making specific recommendations to PCOM on a new advisory panel structure and proposal evaluation system.

III. REPORT OF SOP MEETING AT WOODS HOLE (2-3 April, 1987) : R. SCHLICH

With regard to Legs 119, 120, SOP favors SKP-6B as the top alternate if the Prydz Bay sites cannot be drilled.

The SOP priority in drilling objectives is :

1. Neogene latitude and depth transect : KHP-1, SKP-2, SKP-1, SKP-4A, SKP-6A, SKP-8 ;
2. Basement : SKP-1, SKP-4A, SKP-6A ;
3. Mesozoic stratigraphy and tectonics : SKP-3, KHP-3.

IV. THEMATIC PANEL REPORTS

. LITHP (29 Sep-2 Oct, 1987). No liaison present ; indirect report from minutes.

. TECP (28-30 Sep, 1987). No liaison present ; indirect report from minutes.

. SOHP (31 Aug-2 Sep, 1987). Report by I. Premioli-Silva.

Leg 119 : In the case that the Prydz Bay sites cannot be drilled, KHP-3 is considered the alternate (by SOHP) in view of sampling the lower (Mesozoic-Cenozoic) sedimentary section !

Leg 122 : EP-12 (Mutter and Larson proposal) is preferred over EP-2A.

Leg 123 : AAP-1B is the top priority, with full logging.

V. REPORT OF SITE SURVEY PANEL (30 Jun-3 Jul, 1987) : U. VON RAD

Leg 118 : Site survey data have not yet reached the Data Bank.

Legs 119 and 120 : Final seismic data for SKP sites requested ; all sites now OK.

Leg 121 : Broken Ridge and 90°ER site surveys prepared and sent to SSP for review.

Legs 122 and 123 : All sites reviewed ; further data requested for ODP Data Bank. Final processing will be done by BMR prior to final safety review.

VI. REPORT OF LEG 115 : R. DUNCAN

Leg 115 was successful in achieving its principal objectives of investigating the history of hotspot volcanism associated with the Reunion hotspots and Neogene carbonate production and dissolution in tropical Indian Ocean waters. Specifically :

- Basaltic rocks were successfully recovered at four basement sites (706, 707, 713, 715) and biostratigraphic age estimates established the reality of age-progressive volcanism consistent with the hotspot model.
- Shipboard petrochemical studies (XRF) on the basalts identified several magma types at each site and revealed that several mantle source regions (hotspot, MORB, sub-continental mantle) have contributed to melting along this volcanic lineament.
- True polar wander of 8° since 35 Ma is inferred from paleolatitudes of the basaltic rocks ; this is consistent with results from the Pacific.
- The carbonate production/dissolution studies were based on calculated mass accumulation rates for both carbonate and non-carbonate fractions over 1 m.y. time increments at each of five sites located at depths between 1540 and 4430 mbsl.
- The later part of the lower Miocene and most of the middle Miocene were periods of intense carbonate dissolution ; pronounced CCD excursions also occurred at about the middle/upper Eocene boundary. These may eventually be linked to large scale changes in climate (such as glacial episodes in Antarctica) and circulation (Australia-Antarctica spreading).
- There appears to be carbonate content oscillations of a quasi-cyclical nature (0.4-0.5 m.y. period ?).
- There were a number of problems with magnetostratigraphic analyses, due to weakly magnetized sediments and magnetic overprinting by the APC core barrels; meaningful results were obtained at 710 and 711 only. Major changes in the calibration between zonal schemes and the geomagnetic polarity record are required in the middle Miocene.

- A continuous sequence of upper Miocene to Pleistocene aragonite-bearing periplatform oozes were recovered at site 716. In addition to a high-resolution history of aragonite production/dissolution at this carbonate bank site, there is a fascinating record of diagenetic processes.

Observations/Recommendations :
- From the clearance problems encountered in Mauritius and initially with the Maldives it is clear that ODP must have a full-time, high-level position devoted to clearances and liaison with scientists in non-member countries (with territorial jurisdiction over proposed drilling sites).
- ODP should have a person knowledgeable about leg objectives and operations at each port call. This could be the same person identified above.
- Communications to and from the shipboard scientists and their home institutions should not ve impeded by TAMU. This link is important in maintaining other research commitments of participating scientists.
- The technical support was superb but any further reduction in technicians (115 was one "short" of normal) would cause large problems in handling core and maintaining work stations.
- The geochemical labs were used heavily and performed well, in particular XRF and XRD.
- The petrographic microscope situation needs attention and maintainence ; the fancy microscopes could be exchanged for simpler student microscopes ; the SEM was not used.

VII. <u>REPORT OF LEG 116 : J. COCHRAN</u>

Leg 116, in the Central Indian Ocean basin 600 km south of Sri Lanka, was designed to investigate both tectonic and sedimentary processes recorded in the sediments of the distal Bengal Fan in a region that has undergone significant intraplate deformation.
The drilling objectives were :
- to determine the age of onset of intraplate deformation and subsequent history of motion on faults ;
- to investigate the possibility and nature of hydrothermal circulation suggested by site survey heat flow ;

- to determine distal Bengal Fan lithofacies and to characterize depositional and diagenetic processes responsible ;
- to determine provenance of sediments to document uplift history of the Himalayas.

A total of ten holes were drilled at three sites. Site 717 was a reference hole in the thickest sedimentary section on a fault block. Site 719 was drilled further up the same block. Site 718 was drilled on a heat flow high on the next block south to investigate hydrothermal circulation and the influence of high heat flow on diagenesis. It also took advantage of a condensed post-Miocene section to penetrate earlier history of the fan. Two of the three holes (718 and 719) were logged to total depth.

The drilling determined that intraplate deformation began to affect the region about 7 mybp and that motion on the faults has continued at a fairly constant rate since then.

The history of the Bengal Fan in this region dates at least from the lower Miocene and the fan sediments are at least 1.3 km thick some 2500 km from the Ganges Delta. The oldest sediments penetrated were 17 Ma silty turbidites which imply that major uplift of the Himalayas occurred well before that date. The major source of sediments has been the Ganges-Brahmaputra delta front, but there has also been a significant input from the continental margins of the western Bay of Bengal, particularly during sea level highstands and a lesser but distinctive contribution from local seamounts. The uplift history of the Himalayas and sealevel variations can be shown to be the major influences on sedimentation. Local tectonic activity and normal fan processes such as channel migration have exercised local control. An active hydrothermal circulation system was documented in the upper sedimentary section by temperature and geochemical measurements.

Observations/Recommendations :
- An effort should be made to develop methods of improving recovery of silt and sand sediments and of stabilizing hole conditions when drilling such sediments.
- The problem of magnetic overprinting of the sediments by the core barrel should be investigated.

- Technician support was excellent but should not be jeopardized by further reductions.

VIII. REVIEW OF THE KERGUELEN-PRYDZ BAY DRILLING PROGRAM

Leg 119 and leg 120 scientific prospectus have been finalized and the safety review for the Kerguelen and Prydz Bay sites has been done at the last PPSP meeting at College Station on 6-8 October, 1987.

Leg 119 will drill site KHP-1 (Neogene latitudinal and depth transects) to a depth of 910 m, site SKP-6A (basement and latitudinal and depth transects) to a depth of 550 m, and the Prydz Bay sequence of sites (latitudinal transect) with drilling depths limited to 500 m. Site SKP-6B is the first priority alternate to the Prydz Bay sites if drilling in Prydz Bay is impossible due to ice conditions. The sediment section at this site is expanded compared to the nearby SKP-6A site and will likely contain a more complete Cretaceous to Cenozoic section (SOHP recommended KHP-3 as an alternate to Prydz Bay sites but SKP-6B, initially proposed by the Kerguelen Working Group, is clearly preferable considering the latitudinal transect objective).The possibility of setting a re-entry cone at site KHP-1 so as to have the option to return, if time allows, to get a deeper section which will not otherwise be recovered on the northern Kerguelen Plateau has been endorsed by PCOM (site KHP-3 is an alternate and will probably not be drilled).

Leg 120 will drill site SKP-1 (basement and latitudinal and depth transects) to a depth of 450 m, site SKP-2 (Neogene latitudinal and depth transects) to a depth of at least 1100 m, and SKP-4A (deep basement and latitudinal and depth transects) to a depth of 500 m (200 m into basement). Site SKP-3 (Mesozoic stratigraphy and tectonics) has been limited by the PPSP to a drilling depth of 800 m, this clearly precludes the original SKP-3 scientific objective. If site SKP-3 is dropped it has been suggested, and accepted by TAMU, either to set a re-entry cone at site SKP-2 for further penetration or to define a new locality with thinner Neogene section (if possible) for the Mesozoic stratigraphy and tectonic objectives. IOP strongly recommends the second option as the best strategy for sampling the important Mesozoic sediments on the plateau.

IX. REVIEW OF THE BROKEN RIDGE DRILLING PROGRAM

The discussion was based upon the preliminary prospectus of J. Weissel, dated August 13, 1987 (Appendix A). Four holes are proposed (BR-1 to BR-4), each showing 450 m penetration which corresponds to about 15 days.

The stratigraphic sections of the four holes sum up to the nearly total coverage of an inclined sequence truncated by an unconformity which is overlain by horizontal strata.

The IOP endorses the proposed program suggesting the following minor modifications :

- Site BR-1 should be shifted further downslope to the north to allow the determination of detrital remnants of the truncated section which might be incorporated in younger sediments. This clastic wedge should be bracketed between pelagic sediments of pre-uplift age and those capping the ridge top (post-unconformity).
- Consequently the position of the other holes should be re-arranged in order to ensure a complete stratigraphic coverage.

X. REVIEW OF THE 90°E RIDGE DRILLING PROGRAM

The objectives of ODP drilling sites on the Ninetyeast Ridge are to better constrain the age progression along the ridge and to obtain basement samples to further characterise the basalt geochemically. There is also an excellent opportunity to obtain high resolution Neogene sections to complement material recovered in the Western and Central Indian Ocean in order to achieve paleoceanographic reconstructions of the entire Indian Ocean.

The northern 90°E Ridge site at about 6°N was surveyed by J. Curray and reported in the previous IOP meeting. To achieve the objectives two holes were proposed at this locality. Site 90ER-1A (redesignated NNER-9) will sample the well developed upper sedimentary section, but thin lower section, to assure optimum basement penetration. Site 90ER-1B (redesignated NNER-10) will sample the lower section and would be carried as deeply as time and bit life permit into basement (Appendix B1).

The Central and Southern 90°E Ridge sites at 17°S and 27°S were surveyed by Conrad and the data processed and analysed by J. Newman and J. Sclater at UTIG. Within each survey area several possible sites were suggested, with one identified as the preferred option (Appendix B2).

The panel examined the seismic records for the northern, central and southern sites and made several recommendations :

- IOP recommends for the northern 90°E Ridge site a composite hole : NNER-9 to be drilled to 400-500 mbsf to recover the upper section (Neogene and Oligocene ?) and basement (50 m) and NNER-10 washed down to just above the contact with the lower section and then cored to recover the lower section (Paleogene) and basement (50 m).
- IOP also recommends, on the basis of experience of shorter than expected basement drilling times in the Western Indian Ocean (Leg 115), that if drilling conditions permit, these 90°E Ridge sites be drilled to more than 50 m into basement. In particular IOP recommends that the Central 90°E Ridge site be extended to 100 m into basement.
- If time precludes drilling all three sites, the central and northern 90°E Ridge sites have highest priority.
- IOP recommends HPC for the Neogene-Oligocene sedimentary sequence at all 90°E Ridge sites. Double HPC is recommended (if time permits) at the northern and central sites. These sections will complement those obtained on Leg 115 and those already available from DSDP sites 216, 214, 255 and 254.

XI. REVIEW OF THE EXMOUTH PLATEAU DRILLING PROGRAM

U. von Rad presented the objectives, priorities and new drilling time estimates of Leg 122. A document with drilling time estimates and diagrams for the predicted stratigraphy and lithology of sites EP2A, EP12, EP7, EP6, and EP10 was distributed (Appendix C).

The main drilling objectives of the leg are :

- test of the Jurassic, Cretaceous and Tertiary sea level curve,
- study of differential subsidence and paleobathymetric development,
- study of early-rift history and subsidence/stretching models,
- study of post-breakup evolution (juvenile to mature ocean stage).

The main discussion centered around the Southern and Western Exmouth Plateau sites EP-6, EP-7, EP-12 (a new proposal by Mutter and Larson) and EP-2A ; the merits of the new EP-12 site were discussed in comparison with the other Southern Exmouth Plateau sites EP-6, EP-7, and especially EP-2A. The EP-12 proposal addresses the tectonic problem of deformation of the whole crust at a passive margin by brittle fracture. In this respect the proposal is consistent with COSOD-II emphasis on thematic goals, specifically the fundamental mechanisms of rifting. U. von Rad had sought comments on this proposal from interested parties :

- Ron Boyd (Dalhousie University) noted that multiple sites remained essential to resolve tectonic and global sealevel components of the eustatic sealevel curve. Site EP-12 did appear to address an important tectonic problem, although EP-2A could provide unique data on the structure of the continent-ocean transition. He proposed to drill EP-7, EP-10, EP-12 and EP-2A, considering EP-6 drilled to 1000 m or less being of lower priority than EP-12.

- Neville Exon and Paul Williamson (BMR) agreed as to the merit of EP-12 but not at the expense of EP-2A. They noted the similarity of EP-12 and the Eendracht-1 well, and also the risk of encountering gas in a lower Barrow Group sand apron. They further noted that the EP-12 proposal did not clearly show how the predicted stratigraphy might be related to the tectonic mechanism.

- John Mutter's response emphasized the importance of the structural setting of EP-12 and the COSOD-II emphasis on thematic goals. He stated that EP-2A was probably on oceanic crust, not in a rift-valley setting, and that post-breakup sequences could not be traced from EP-2A to the plateau.

The panel accepted the importance of the tectonic questions addressed by both EP-2A and EP-12 sites and did not consider them as alternates. It noted some similarity between the late Jurassic to recent sections in EP-12, EP-6, and EP-7 and considered that all three locality could provide data relevant to the global sealevel problem. In order to address both sealevel and tectonics questions it would be important that EP-12 should be drilled to the base of the syn-rift (Jurassic) section. At this location, the lower part of the hole would lie below the top of the Triassic Mungaroo Beds in the adjacent upthrown fault block. Gas shows had occured in this section in the nearby Eendracht-1 well, and the safety factor could not be ignored.

The panel also considered that a better formulated proposal for EP-12 was essential. It would need to demonstrate a clear relationship between the anticipated stratigraphy and the postulated tectonic model to show how it might be possible by drilling that section to discriminate between alternative hypotheses. It is not clear how "tectonic environment" can be verified by drilling.

The panel recommends that, if a more definitive EP-12 proposal is presented and if there are no safety concerns, then the drilling priorities for leg 122 should be EP-7, EP-10, EP-12, and EP-2A (in that order). If the tectonic-stratigraphic relationship cannot be demonstrated or safety considerations preclude drilling site EP-12, then the priorities should be EP-7, EP-10, EP-2A and EP-6.

In view of these priorities and objectives IOP considers that the participation of a seismic geophysicist, with regional and petroleum geological expertise, is of paramount importance to assist the co-chief scientists for the safety review and for detailed seismic stratigraphic correlations during and after the cruise. IOP is also concerned about the excessive transit time of Leg 122 by returning to Singapore between the Exmouth Plateau/Argo Abyssal Plain legs.

XII. <u>REVIEW OF THE ARGO ABYSSAL PLAIN DRILLING PROGRAM</u>

PCOM representative U. von Rad reported that PCOM has decided that the drilling program will start with site EP-9E (about 11 days), followed by AAP-1B with approximately 200 m of basement penetration.

IOP confirms these priorities and indicates that if time is available they would favor double-coring of the critical Upper Jurassic-Neocomian section in a second Argo Abyssal Plain site (AAP-2).

PCOM representative reported that a 10 day downhole logging and hydrofracturing experiment at AAP-1B forms part of this leg. IOP has received no information to date on the hydrofracturing experiment and cannot evaluate its scientific merits compared with a second deep site. IOP notes that the most recent time estimate by G. Foss for drilling AAP-1B is 43 days (including all downhole logging and experiments). This is significantly longer than previous estimates and overruns the total time available for the leg.IOP is concerned that all site survey data necessary for final approvals have not yet been submitted to the ODP Data Bank. D. Falvey stated that final processed data would be made available by the end of year, assuming agreement on drilling clearances.

13. IOP MEMBERSHIP CHANGES

D. Falvey, W. Prell, and J. Cochran will rotate off IOP after this meeting. We nominate the following individuals as possible replacements :

J. Weissel (LDGO geophysicist)
L. Peterson (Miami, paleontologist)
S. Wise (FSU, sedimentologist)
E. Bonatti (LDGO, petrologist)
P. Williamson (BMR, Australia, geophysicist/petroleum geologist)
C. von der Borch (Flinders, Australia, sedimentologist).

14. IOP MEMBERS FOR UPCOMING MEETINGS

LITHP - none required.
TECP - none required.
SOHP - if requested, T. Davies will attend the next meeting in Houston (Rice Univesity).

15. FUTURE OF THE INDIAN OCEAN PANEL

In the immediate future, the Indian Ocean drilling program is now set for the complete 9-leg schedule. Barring unforseen difficulties, we will not meet again before the completion of Leg 123. We desire to meet at that time, together with a co-chief from each leg to 1) evaluate the 9-leg program, 2) summarize results, 3) make recommendations about remaining important Indian Ocean program. We suggest a date in November, 1988 for this summary meeting. D. Falvey has offered to host the meeting in Perth (Australia), J. Ludden has offered Montreal (Canada) and R. Duncan has offered Corvallis (Oregon).

In the long-term future, IOP first notes the importance of this regional panel for the Indian Ocean drilling program. In fact, the entire program was constructed from proposals initiated through the IOP. We believe that the IOP must continue to exist in some form as an advocate for future programs in the Indian Ocean which address thematic objectives, to encourage workshops, increase site surveys of poorly investigated regions.

Regarding the more general structure of the advisory panels, IOP supports the intended changes toward a thematically driven drilling program. In the event that regional panels are disbanded or greatly atrophy there is a danger that drilling will be focused only in the most familiar regions, without necessarily identifying the best region to investigate thematic objectives. We strongly recommend that the thematic panels be increased to include members with strong regional expertise and familiarity with data-sets. This membership may be tailored to true projected path of the drillship.

Appendices not attached (drilling proposals re Broken Ridge & Ninetyeast Ridge)

ODP LEG 121
DRILLING ON BROKEN RIDGE
[Related JOIDES drilling proposal: 135/B]

I. Introduction

Broken Ridge, a plateau of the eastern Indian Ocean (Fig. 1), was originally contiguous with the northern portion of the Kerguelen-Gausberg Plateau. Lithospheric extension (rifting), followed by seafloor spreading beginning at anomaly 18-time (~42 Ma - Middle Eocene), are responsible for the present separation of the two platforms. Tectonically, Broken Ridge is both a fossil rift flank and a passive margin. Previous drilling at DSDP Site 255 on Broken Ridge (Fig. 1) has established that the basement age is greater than Santonian (~85 Ma). Dredged basaltic rocks suggest that Broken Ridge and the corresponding portion of the Kerguelen Plateau originated from intraplate volcanism in the Early Cretaceous.

II. Background: Tectonic Setting and Lithospheric Flexure

The effects of the rifting process on Broken Ridge are clearly seen in the seismic stratigraphy (Figs. 2 & 3). In the parlance of detachment tectonics, Broken Ridge west of about 94°E is a simple, flexurally-uplifted footwall block (or lower plate) of an extensional domain. Flexural uplift during rifting was probably due to unloading of the footwall block as the hanging wall block (containing the adjacent portion of Kerguelen Plateau) moved southward along the detachment. We can theoretically model the flexural isostatic response of the lithosphere when the footwall is unloaded by removal of the hanging wall (Fig. 4). The model is shown in the inset (Fig. 4, top), and the resulting topography (Fig. 4, bottom) depends strongly on whether the lithosphere has finite strength (flexural rigidity) at the time of rifting. We can match the morphology of Broken Ridge quite closely with this model (Fig. 5) if we assume that the flexural rigidity at the time of rifting is that of 25 m.y.-old oceanic lithosphere. Gravity anomalies observed over Broken Ridge support the idea that Broken Ridge is a flexurally-uplifted footwall block as shown in Fig. 5.

Two important consequences of flexural uplift of Broken Ridge during rifting are:

a) Tilting of pre-existing strata on the flexed region, and

b) exposure of an E-W trending ridge, initially ~1000m above Paleogene sealevel (as depicted in Fig. 5). Erosion of this exposed material and post-rift subsidence of Broken Ridge produced a distinctive angular unconformity overlain by thin mid-Eocene lagoonal sediments (Figs. 2 & 3). Continued thermal subsidence to the present day has allowed a Neogene pelagic cap to be deposited on the crest of Broken Ridge (Figs. 2 & 3). A critical question for future drilling then is: How much of the (>~1500 m-thick) dipping and truncated stratigraphic section (Figs. 2 & 3) is pre-rift, syn-rift, and post-rift (or is it all pre-rift)?

III. Advantages of Drilling at Broken Ridge

The stratigraphy preserved on Broken Ridge has enormous potential for increasing our understanding of lithospheric extension processes. Since Broken Ridge has remained a relatively shallow water platform throughout its history, it has accumulated depth-sensitive, carbonate-rich sediments before, after, and possibly during the extensional episode. Therefore, its stratigraphy likely recorded the vertical motions of the ridge as it responded to the rifting processes. Moreover, Broken Ridge has always been isolated from nearby continents. Thus it lacks the thick, unfossiliferous, clastic sequences which limit studies of rifting processes by drilling along many passive continental margins. Finally, the end of rifting and the initiation of seafoor spreading at ~42 Ma is well-constrained from magnetic lineations along the southern margin of Broken Ridge.

IV. Drilling Objectives

The main question for drilling at Broken Ridge is:

*Whether the sediments deposited before rifting indicate that Broken Ridge was deepening or shallowing with time.

If drilling shows that Broken Ridge was shallowing prior to rifting, we would conclude that the rifting resulted from a thenospheric processes (i.e. heat transported to the base of the lithosphere by mantle convection) because precursory uplift is a likely consequence of such "active" rifting processes. In contrast, if the drilling shows that Broken Ridge was deepening prior to rifting, we would conclude that extension was driven by far-field horizontal stress, and that footwall uplift by flexure was the only significant response to the process of rifting at Broken Ridge.

To attain this primary objective requires that we know what part of the stratigraphy is pre-rift, versus post-rift (and syn-rift, if any), plus the age and depth of deposition of those units. The Middle Eocene lagoonal unit and the Neogene cap are obviously post-rift deposits, and previous drilling at Site 255 (Fig. 3) has shown that the outermost shelf/upper slope limestones and cherts of Santonian age were probably deposited before rifting began. However, the age and facies of most of the dipping and truncated section is unknown. We are therefore proposing to drill a short N-S transect of four holes BR-1 to BR-4 across the crestal region of Broken Ridge (Figs. 1 & 2, Table I).

By drilling this transect of holes, we will:

a) Sample most of the dipping and truncated sequence in single-bit holes, at sites located to ensure some overlap of section. We hope to establish, from the presence or absence of re-worked limestone and chert detritus, whether the section is completely pre-rift, or if it includes syn-rift (the middle highly-reflective unit and the upper transparent unit), and even post-rift sections as well (Figs. 2 & 3).

b) Verify at site BR-3 that the shallow water lagoonal deposits overlying the erosional unconformity are Middle Eocene - roughly equivalent in age to the oldest magnetic lineation observed between Broken Ridge and the Kerguelen Plateau.

V. Summary

Although the discrimination between "active" and "passive" driving mechanisms for lithospheric extension forms the basis for drilling during ODP Leg 121, flexural uplift at Broken Ridge has wide implications for the rheology of the lithosphere. It is widely believed that the lithosphere has no strength during rifting, and that the lithosphere responds to subsidence and uplift producing forces in a local isostatic manner. However, the topography observed at Broken Ridge in the vicinity of the drill sites is flexural in origin and requires that the lithosphere maintained finite strength during the extensional episode.

TABLE 1

PROPOSED SITES FOR LEG 121: BROKEN RIDGE

Site	Lat (°S)	Long (°E)	Water Depth* WD[m]	Penetr.[m] Sed./Bsmt		On Site Time [d]
BR-1	30°50′	93°35′	1178	450	-	3.8
BR-2	30°53′	93°34′	1074	450	-	3.6
BR-3	30°56′	93°33.5′	1057	450	-	3.6
BR-4	31°01′	93°33′	1056	450	-	3.6

* Corrected meters

Figure Captions

Figure 1. Bathymetry of Broken Ridge, in corrected meters, contoured from precision depth recordings. Prospective drill sites are shown along RC2708 Line 20 (BR-1, BR-2, BR-3, BR-4), further details about the sites are listed in Table 1.

Figure 2. RC2708 Line 20 shows a prominent angular unconformity that separates the northward dipping reflectors below, from the horizontal reflectors above. The prospective drill sites (BR-1 to BR-4) are shown, and their locations should ensure that the entire stratigraphic section can be drilled with modest penetration depths at each site. Note the change in acoustic character amongst the northward dipping reflectors, specifically the middle, highly-reflective unit that thins away from the ridge crest.

Figure 3. RC2708 Line 10 shows a similar stratigraphic evolution as Line 20 in response to the rifting processes that occurred, except that faults become more prevalent. DSDP site 255 is located in a small low that formed between a rider block and the platform, thus the majority of the northward dipping sequences have yet to be sampled. Note the similar variations in acoustic character that were also observed in Line 20, especially the middle highly-reflective unit that thins down-slope.

Figure 4. Isostatic response of basement to extension of the lithosphere via simple shear on a plane, dipping normal fault (see inset). In this model the footwall and hanging wall blocks respond to isostatic restoring stresses but are otherwise undeformed. Note that the resulting topography depends critically on whether the lithosphere has finite flexural rigidity at rifting ($t=0$ m.y.). For local isostasy at $t=0$ m.y., there can be no footwall uplift for $x < 0$. This does not agree with observations at Broken Ridge.

Figure 5. Model of the flexural topography at Broken Ridge (solid dots) for a best-fitting model based on the concepts illustrated in Fig. 4. The observed bathymetry is a N-S profile along 93.3 E longitude in Fig. 1. In order to match the bathymetry across Broken Ridge, a thermal lithospheric thickness of 45 km is required.

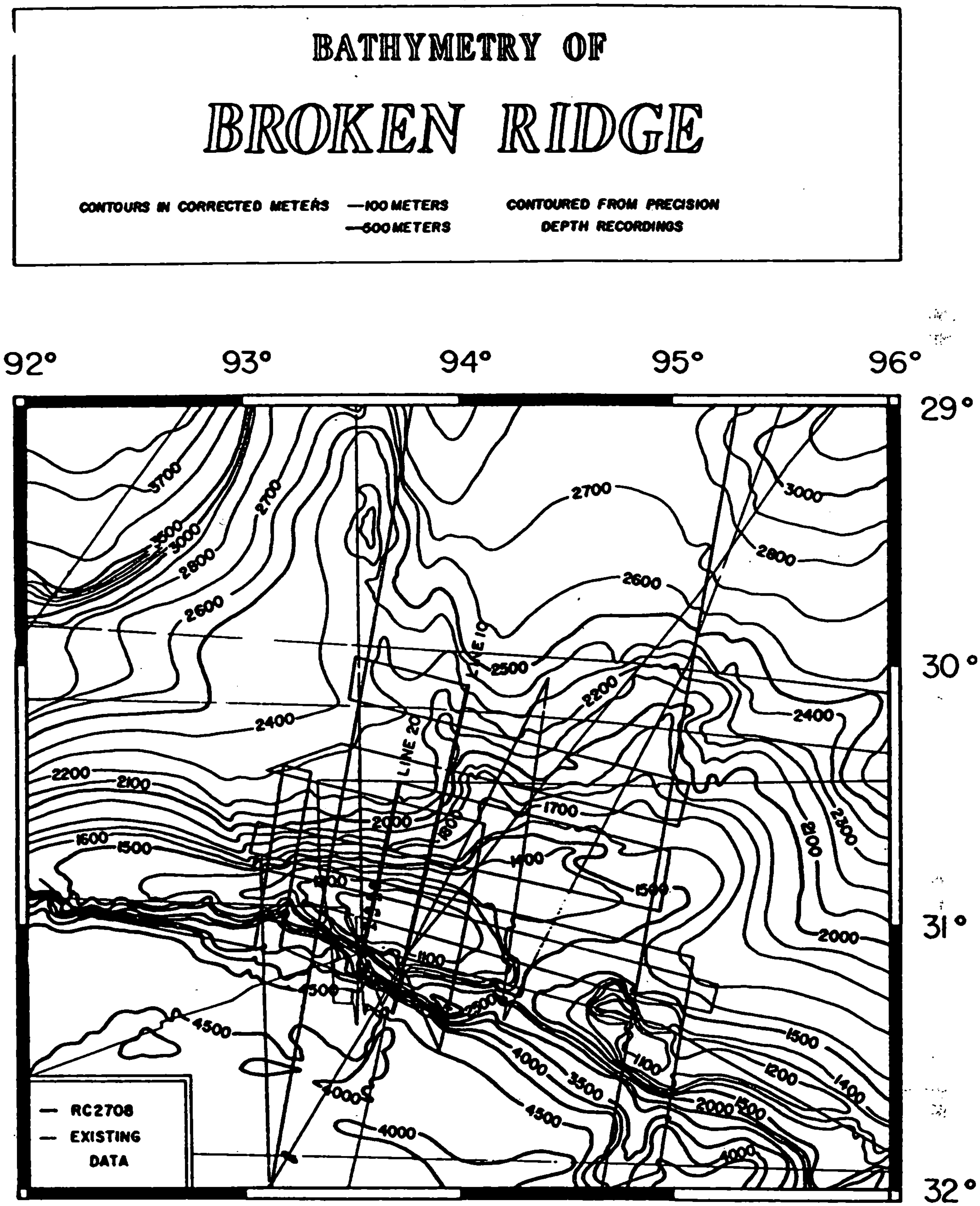

BATHYMETRY OF
BROKEN RIDGE
CONTOURS IN CORRECTED METERS —100 METERS
—500 METERS
CONTOURED FROM PRECISION
DEPTH RECORDINGS
92°
93°
94°
95°
96°
29°
30°
31°
32°
LINE 10
LINE 20
— RC2708
— EXISTING
DATA

Figure 1

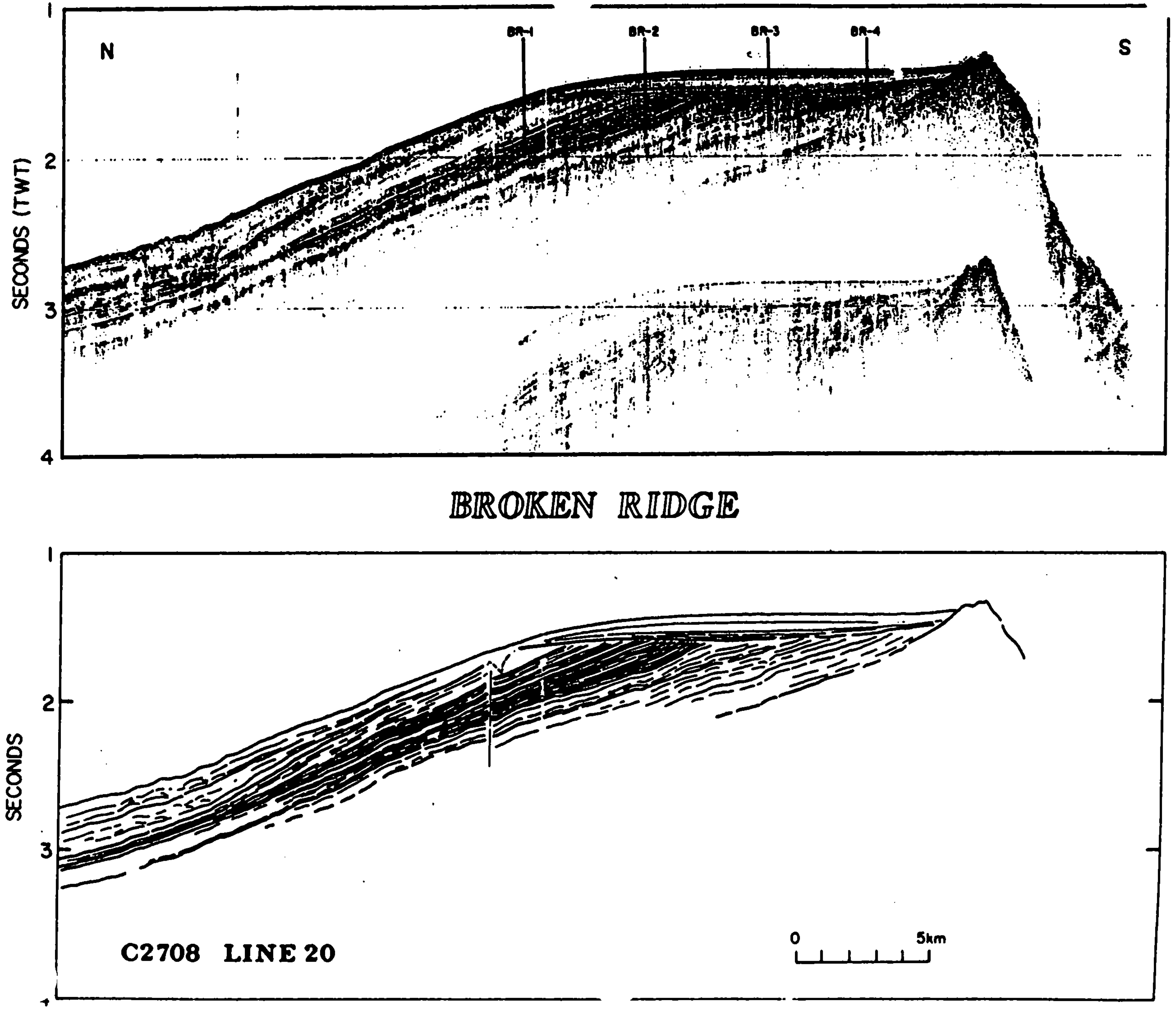

N
S
BR-1
BR-2
BR-3
BR-4
SECONDS (TWT)
1
2
3
4
BROKEN RIDGE
SECONDS
C2708 LINE 20
0
5km

Figure 2

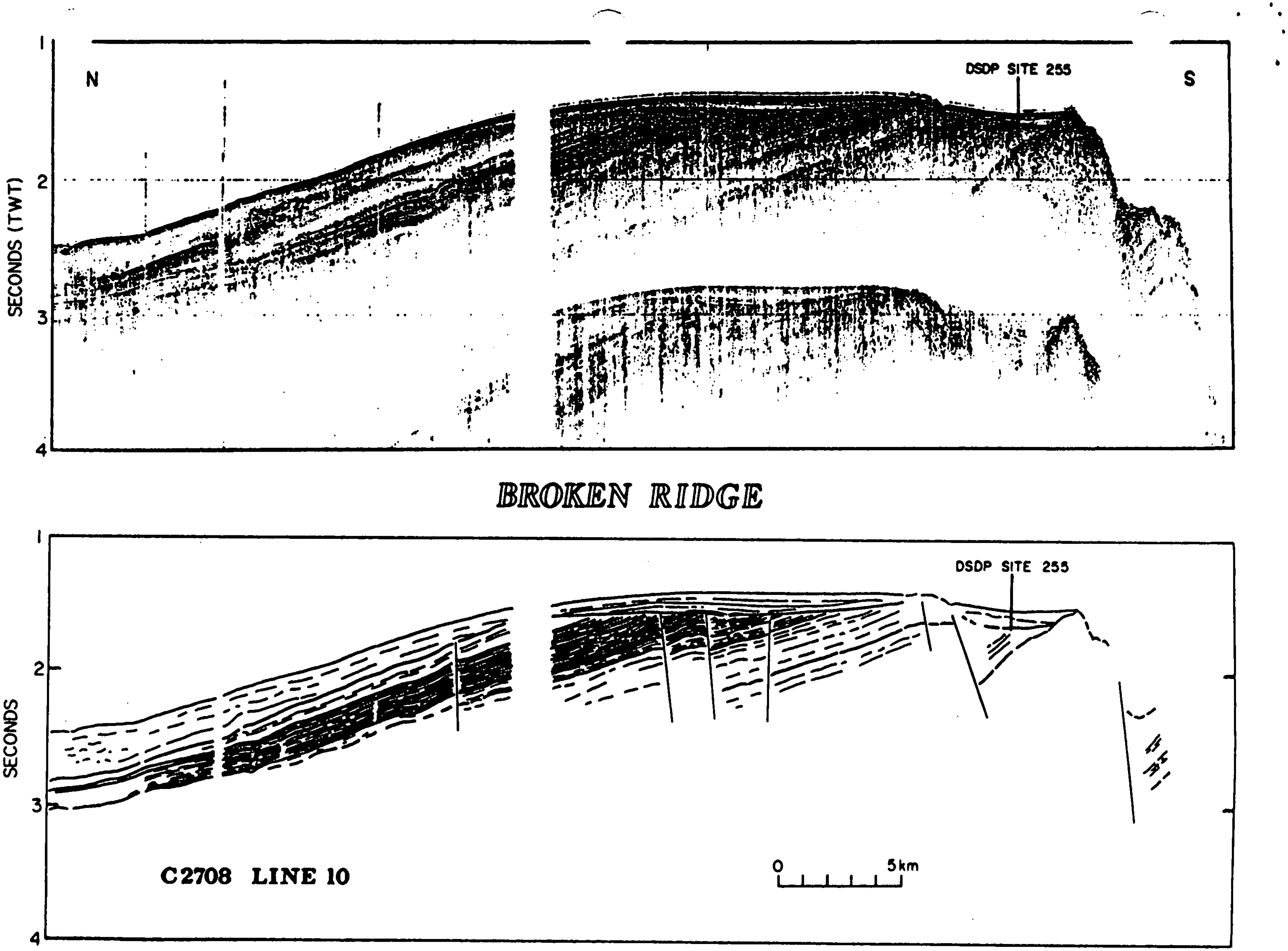
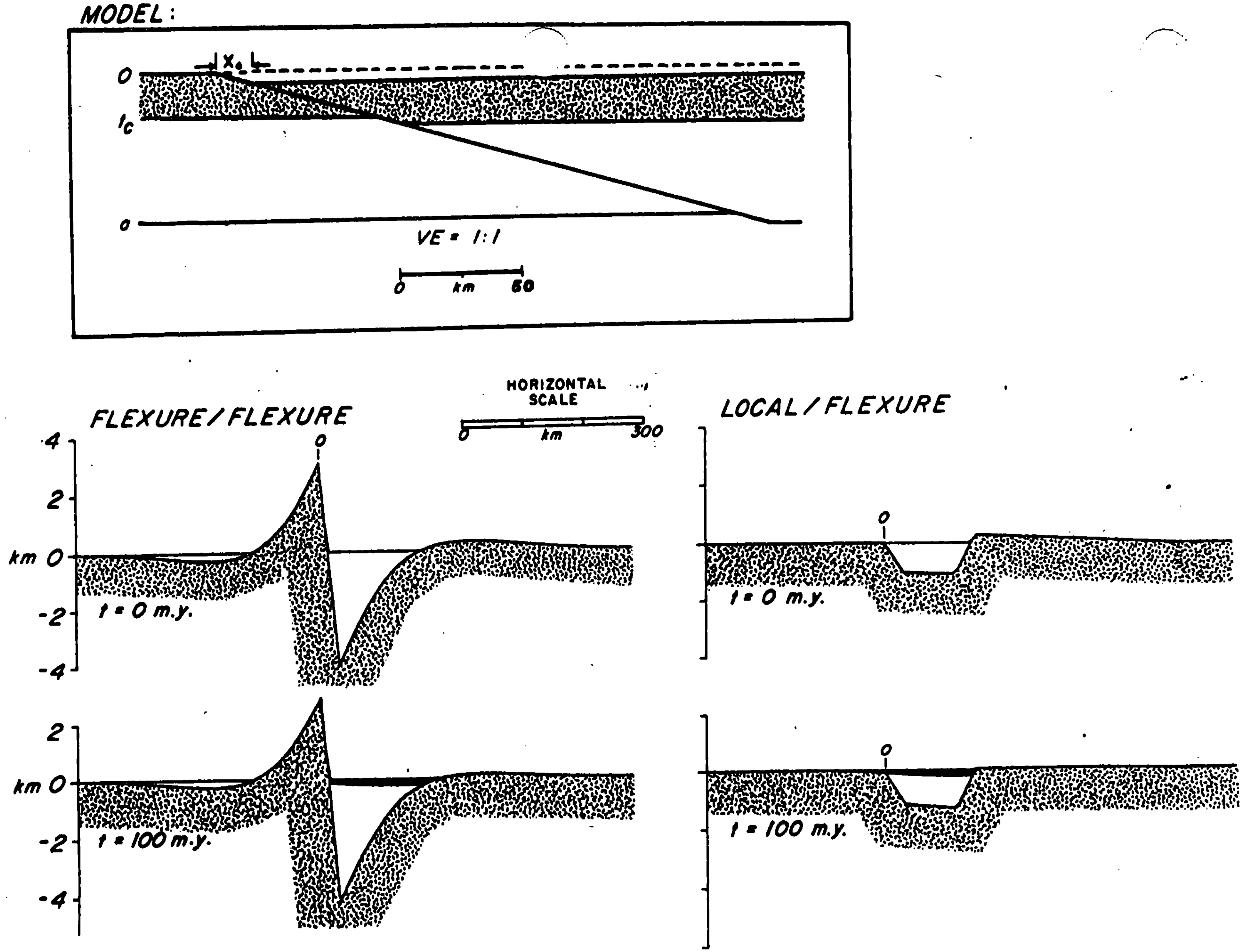

N
S
DSDP SITE 255
SECONDS (TWT)
1
2
3
4
BROKEN RIDGE
SECONDS
DSDP SITE 255
C2708 LINE 10
0
5km

Figure 3



• Importance of Flexure at Rifting

Figure 4

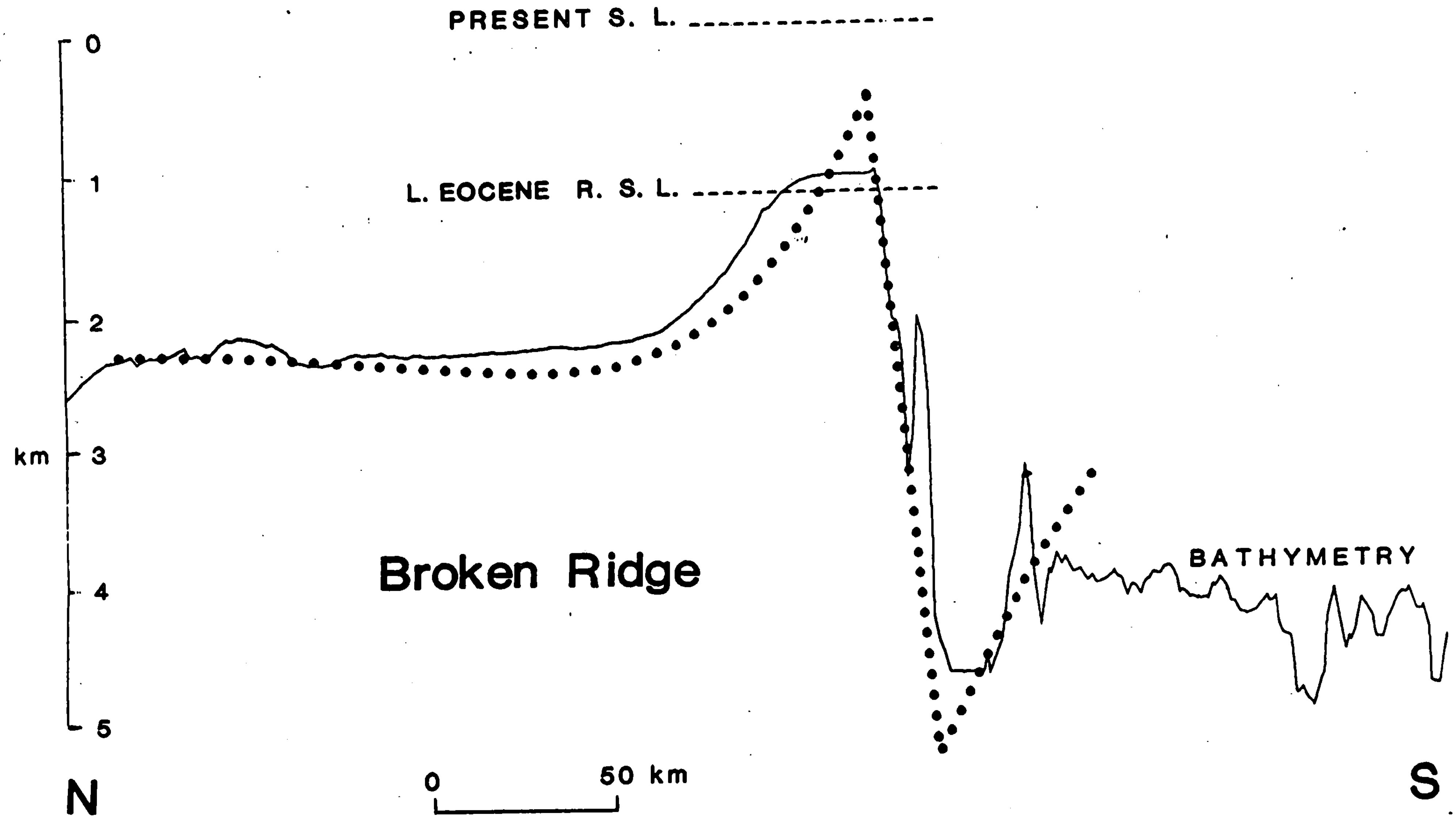

PRESENT S. L.
L. EOCENE R. S. L.
0
1
2
km
3
4
5
Broken Ridge
BATHYMETRY
0
50 km
N
S

Figure 5

To: JOIDES and ODP 18 May 1987

From: Joseph R. Curray
Scripps Institution of Oceanography

Subject: Proposal for Drilling on the Ninetyeast Ridge, Supplement-2

On 28 March 1987, prior to the IOP meeting of 31 March and 1 April, I submitted a supplement to the Ninetyeast Ridge drilling proposals for the northernmost site proposed at about 5°N. In that supplement, I proposed eight different possible sites which were selected for the objectives of petrology and chemistry of the basalts, tectonics of the northward drift of the Indian plate and formation and subsidence of the ridge, and paleoceanography. Previous seismic work and drilling on Legs 22 and 26 showed three parts of the section: an upper sedimentary section, a lower sedimentary section, and the basement basalts. The sites proposed in my memo were selected to sample all three parts of the section in one single bit hole. During the discussion at the IOP meeting, concern was expressed that a single bit might not survive the chert layers anticipated in the lower sedimentary section, and that the highest priority objective of basement sampling might be lost. I have therefore further studied the seismic data I obtained during my site survey on cruise leg RC-2705 in June 1986, and I submit revised recommendations for drilling two shallower holes.

The plan I propose is first to drill a site with a well developed upper sedimentary section, but thin lower section, to assure optimum basement penetration. The drilling at the second site would then wash through the thin upper sedimentary section, and continuous coring would start above the contact over the lower section and would be carried as deeply as time and bit life permit, if possible all the way through the lower sedimentary section and again into basement.

Previous seismic work and the drilling on Legs 22 and 26 of DSDP, showed a two part sedimentary section over the Ninetyeast Ridge which expands into a three part section off the ridge. The contacts between the parts of the section appear locally to be unconformities. DSDP drilling results suggested that the contact between the two parts of the section on the Ridge was approximately late Paleocene to mid-Eocene, although coring was only intermittent. I have attempted to carry that horizon from DSDP Sites 216 and 217 into this survey area (orange horizon, Figs. 1 and 2), but the correlations are very tenuous because of the spotty coring and the very poor seismic reflection data of those earlier surveys. The age assignment is especially tenuous. Regardless of the age, however, the horizon I have followed appears to be present and identifiable in records over the whole region, and does subdivide the section into two parts, which I will call the upper and lower sections. The horizon also appears locally in our records to be an unconformity. The other unconformity, mentioned previously, which further subdivides the upper section off the Ridge, appears from DSDP 218 results to be uppermost Miocene. That unconformity will be further tested in the intraplate deformation drilling of Leg 116.

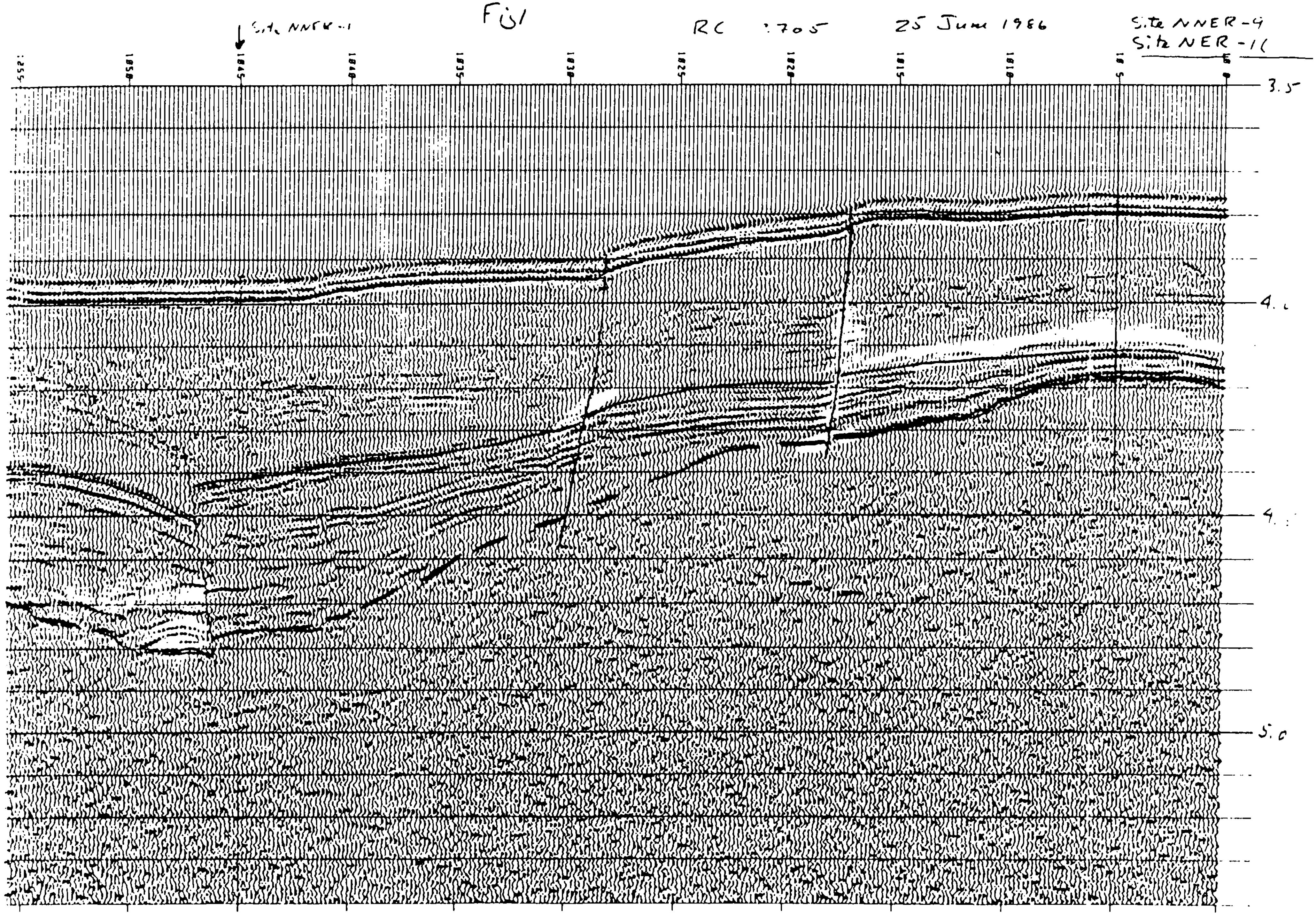
Site NNER-9 (see Table 1, supplement, and Fig. 1) is the thinnest development of the lower section I have found in this survey where the upper section is well developed. Little stratification appears here in the upper section, perhaps because of a lack of cherty layers, but the section otherwise appears undisturbed and undeformed. Basement should be encountered at a sub-seafloor depth of only about 400 meters. This is a shoal part of one of the hills which forms the crest of the Ridge here, so the uppermost basalts could have been cooled subaerially. Total hole depth should be between 400 and 500 meters, depending on depth of penetration into the basalt.

Site NNER-10 (Fig. 2) lies in somewhat deeper water. The upper section is thin and probably disturbed by slumping, but the drilling should wash through this material to just above the contact. Both the contact between the sections (orange horizon) and the basement surface (brown horizon) appear to be especially strong and clean reflectors here, and the lower section appears to be undisturbed. Again maximum total hole depth should be between 400 and 500 meters, depending on penetration through the cherts anticipated in the lower section and the possible penetration into basalt, if the bit survives the chert.

I propose that these two sites be considered for the northern Ninetyeast Ridge program, and that they be redesignated NER-1(9) and NER-1(10), respectively, to conform with the IOP site numbering system. I also request that if they are put into the program, Carl Brenner obtain precise coordinates for these times and dates at L-DGO. I have not yet received the final navigation from the cruise.

Northern Ninetyeast Ridge ODP Sites - Table 1, Supplement, 18 May 1987
J.R.Cu[illegible]

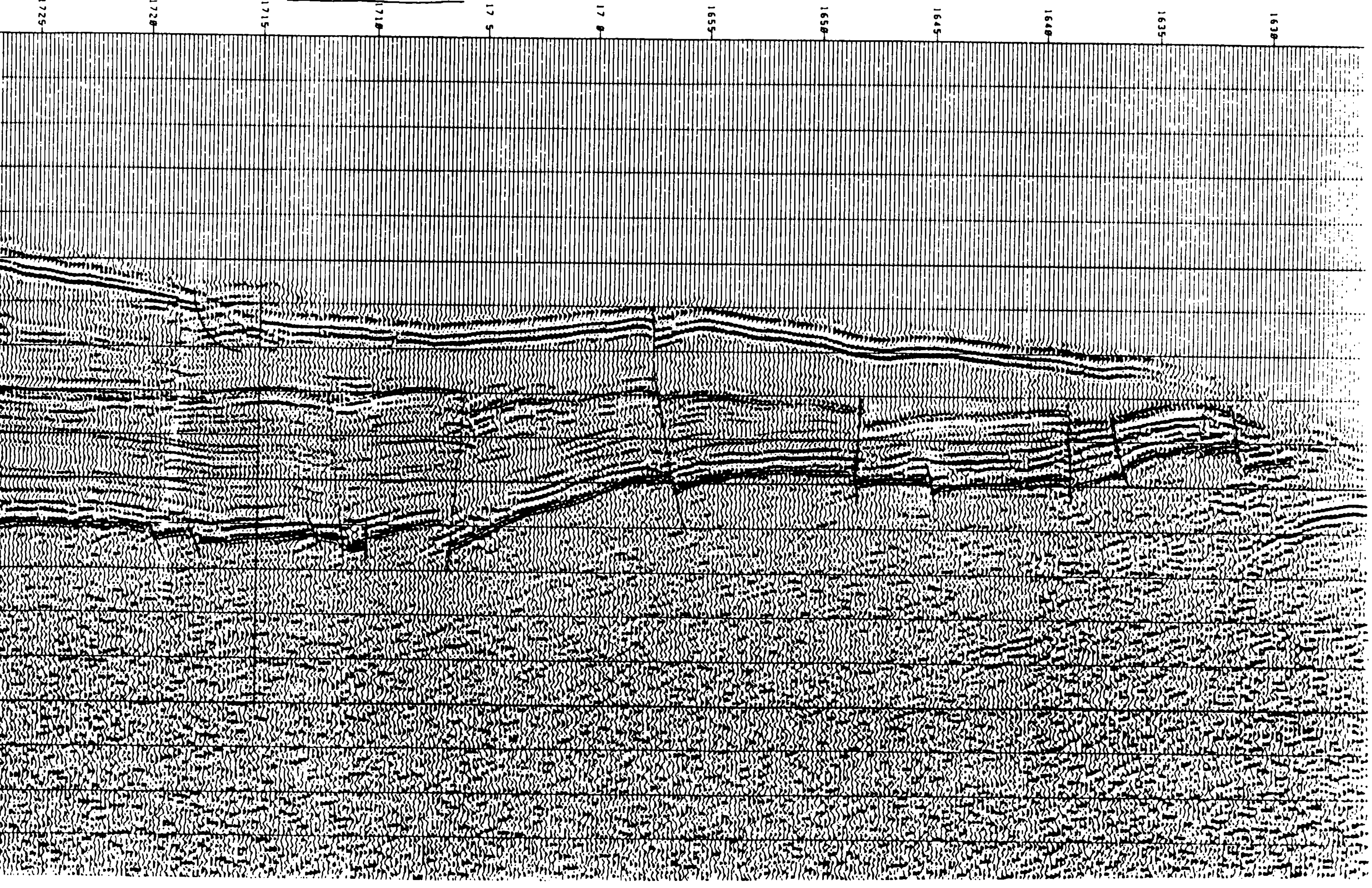
Site #	Line #	[illegible] Sect.	Time + Date	Lat.	Long.	Water Depth	Upper Section	Lower Section	Depth to b.s.	Comments
	RC2705									
9	8-9	B	1005/25 June 1986	5° 39.2' N	90° 02.2' E	2816 m	324 m	75 m	399 m	Recommend as first site NER-1(9), for continuous coring for detail of upper section, plus optimum basement sampling to bit destruction
10	9-10	H	1715/25 June	5° 22.25' N	90° 23.4' E	3045	216	412	628	Recommend as second NNER site, NER-1(10), to wash through thin upper section and core through distinct contact above lower section and as deeply into lower section as time and bit life permit, if possible into basement again



Site NNER-1
RC 2705
25 June 1986
Site NNER-4
Site NER-11
1855
1850
1845
1840
1835
1830
1825
1820
1815
1810
3.5
4.0
5.0

Fig. 2

25 June 1986 Site NNER-10 Site NER-1 (10) RC 2705 Line H Fig 2



. **Southern Ninetyeast Ridge** : Profile 2A, site 3

Location : 27.33°S and 87.46°E

(shot point 13670)

Water depth : 1539 m ;

Sediment thickness : 177 m ;

Predicted basement age : 43 m.y.

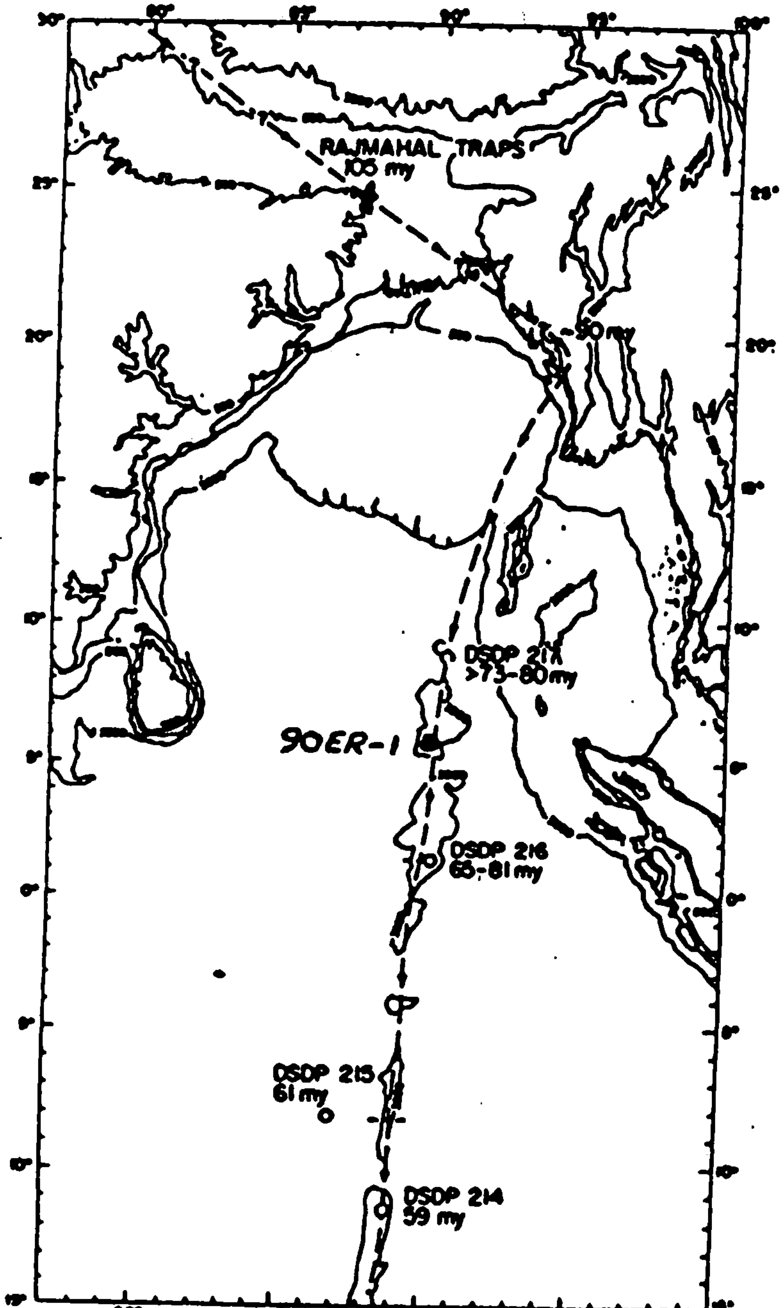
PROPOSAL FOR DRILLING ON THE CENTRAL AND SOUTHERN NINETYEAST RIDGE

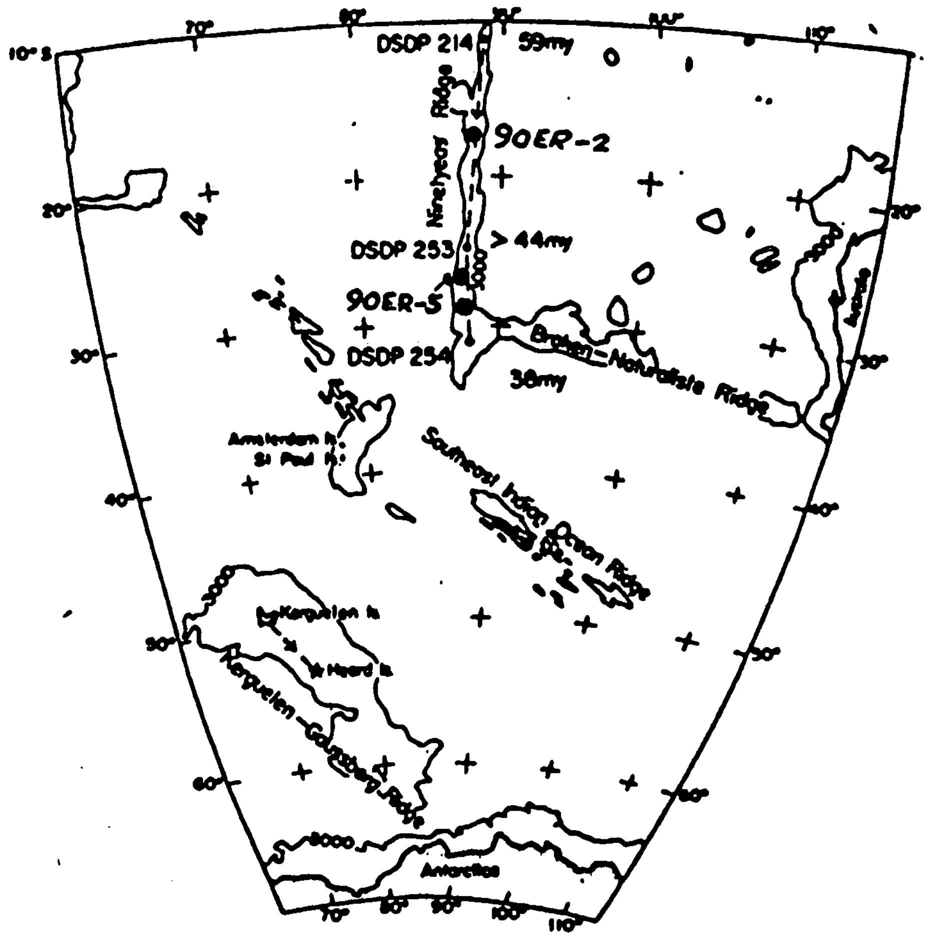
The Ninetyeast Ridge is a linear feature extending along the 90°E meridian from 32°S to north of the equator. The central and southern parts of the ridge were sampled at three sites during DSDP-IPOD. These sites show a characteristic stratigraphic sequence of basalt basement overlain by volcanic ashes and lavas passing up into shallow water sediments and capped by pelagic carbonate. The basalts show affinities with Kerguelen Plateau and are geochemically distinct from typical mid ocean ridge basalt. The top of the volcanic ash at each site is early Oligocene in age, but the basement ranges from Late Eocene/Early Oligocene at site 254 (south) to Paleocene (59 m.y.) at site 214 (north). Combining these ages with data from other sites further north, the age progression along the ridge, from south (young) to north (old) appears to be linear with a marked change of slope at 40 m.y. However this is not well constrained.

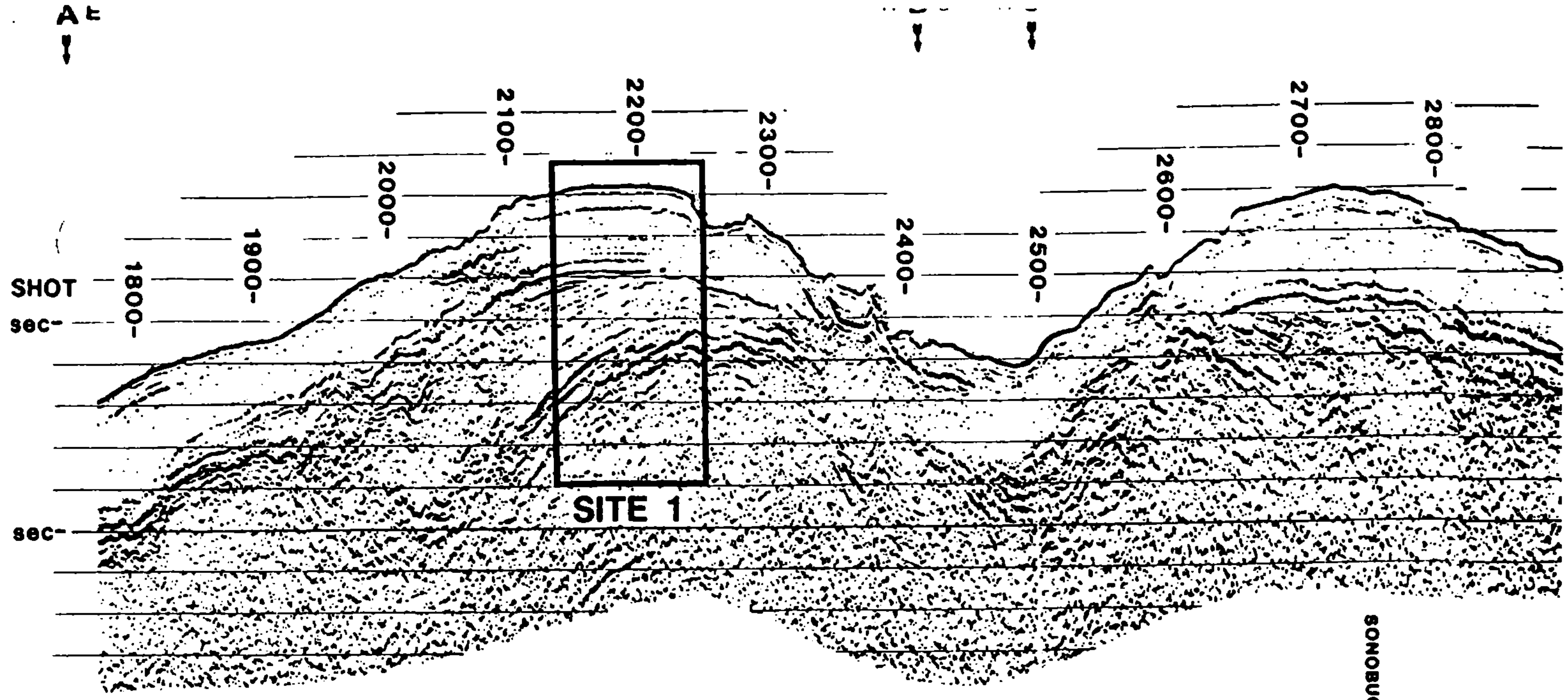
The objectives of ODP drilling further sites on the central and southern Ninetyeast Ridge are to better constrain the age progression along the ridge and to obtain basement samples to further characterize the basalt geochemically.

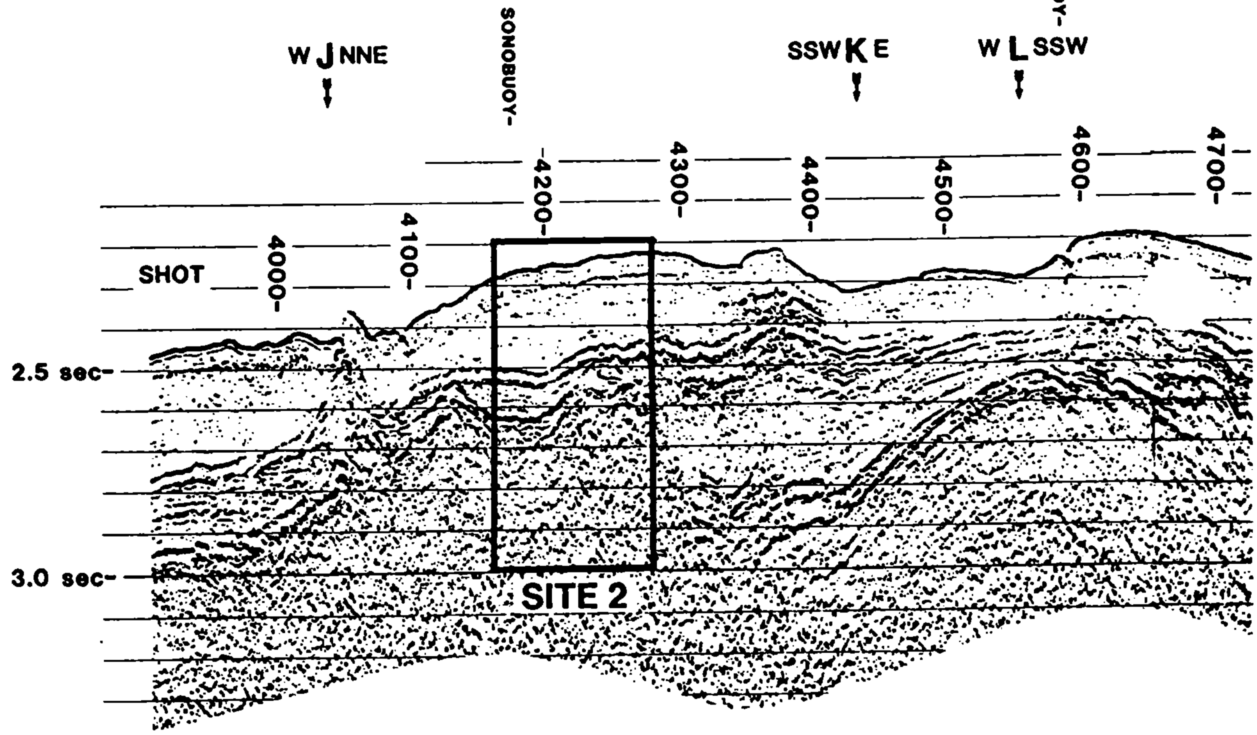
Site surveys were conducted on the Ninetyeast Ridge at 17°S and 27°S by Conrad and the data analysed by J. Newman and J. Sclater at UTIG. Within each survey area several possible sites were suggested with one identified as the preferred option.

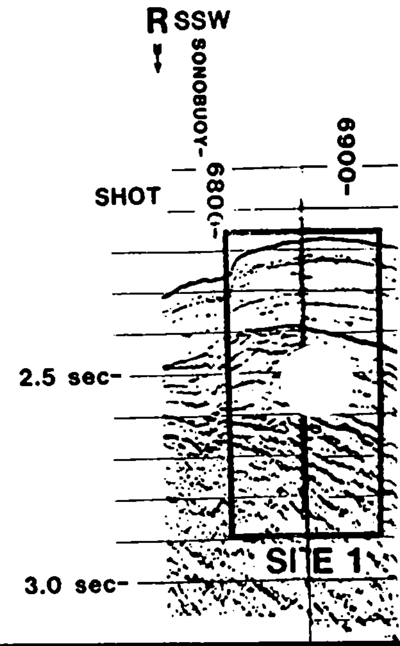
. **Central Ninetyeast Ridge** : Profile 1A, site 2
Location : 17.08°S and 88.11°E
(shot points 3113 and 4219)
Water depth : 1705 m ;
Sediment thickness : 400 m ;
Predicted basement age : 53 m.y.


RAJMAHAL TRAPS
105 my
DSDP 217
>73-80 my
90ER-1
DSDP 216
65-81 my
DSDP 215
61 my
DSDP 214
59 my


DSDP 214
59 my
Ninetyeast Ridge
90ER-2
DSDP 253
> 44 my
90ER-5
DSDP 254
Broken-Naturaliste Ridge
38 my
Amsterdam Is.
St Paul Is.
Southeast Indian Ocean Ridge
Kerguelen Is.
Heard Is.
Kerguelen-Gaussberg Ridge
Antarctica

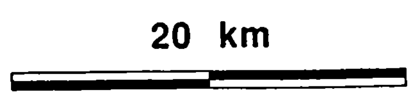


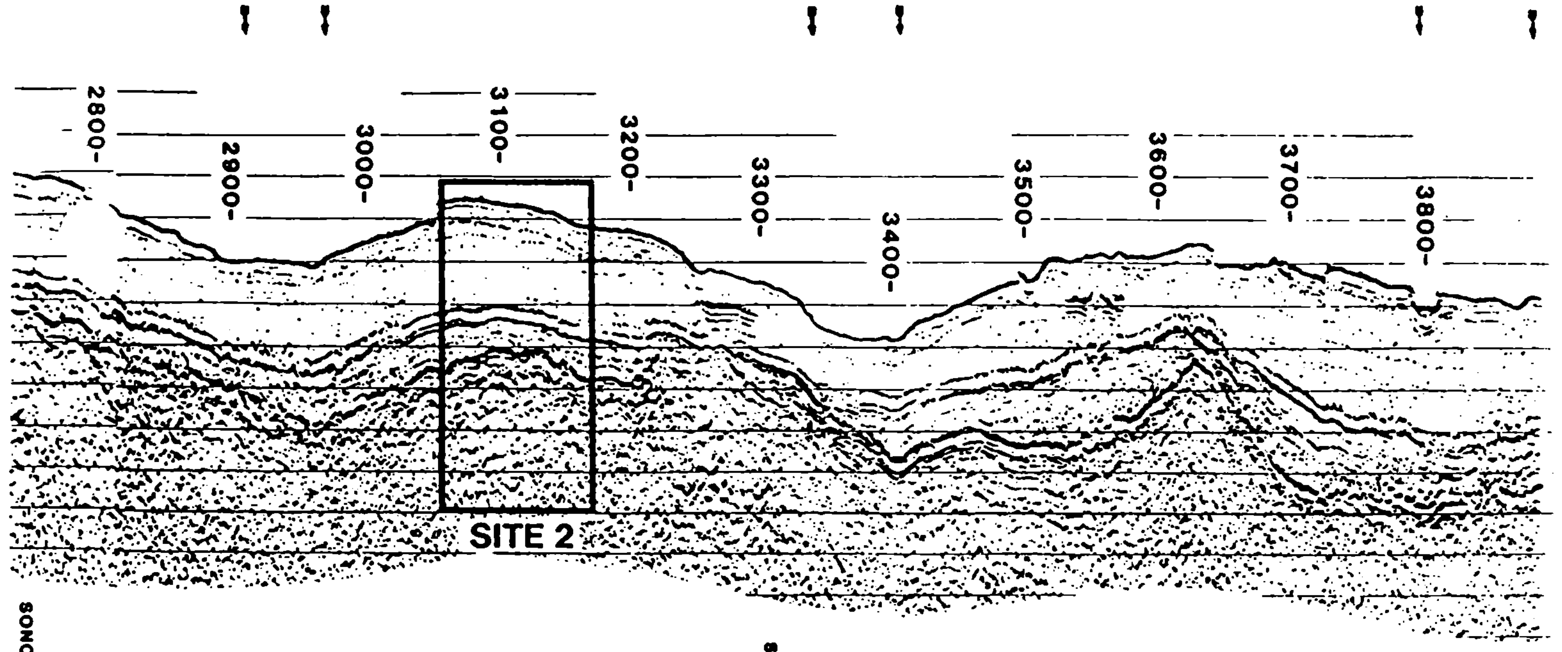


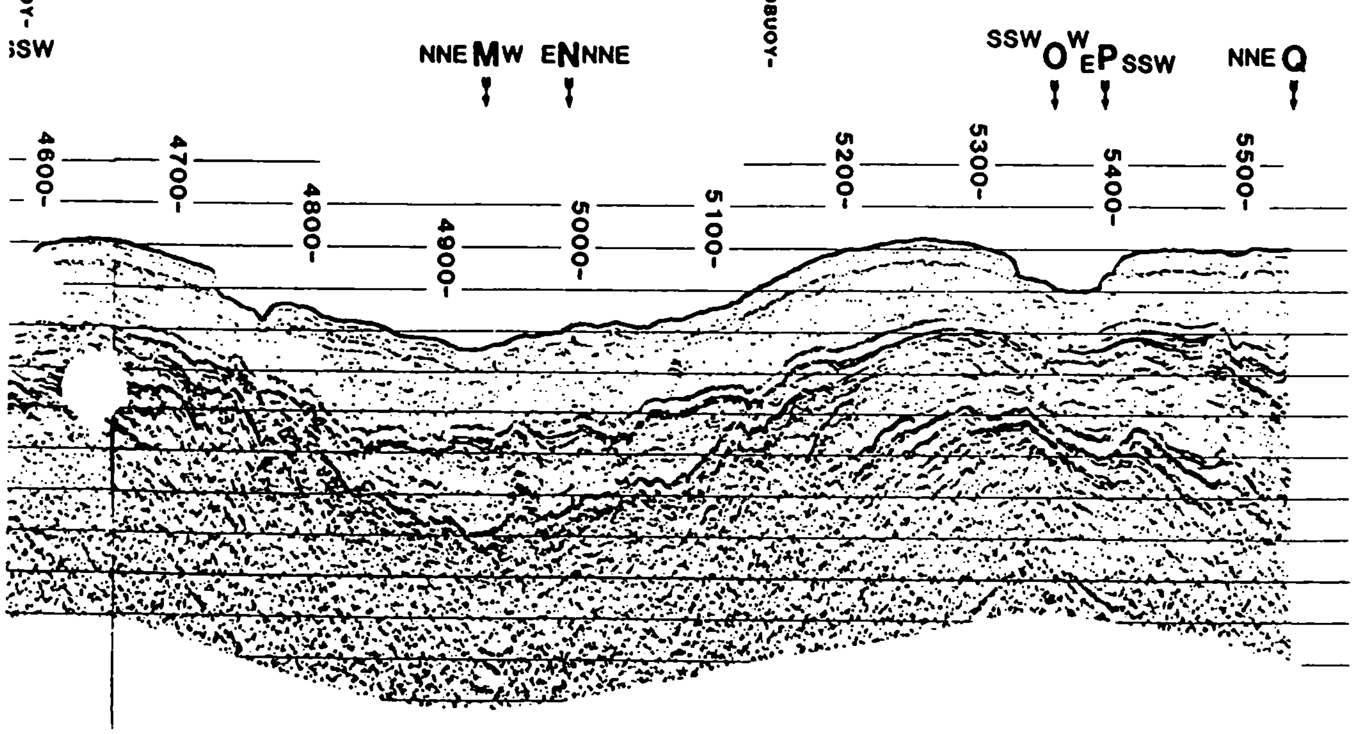


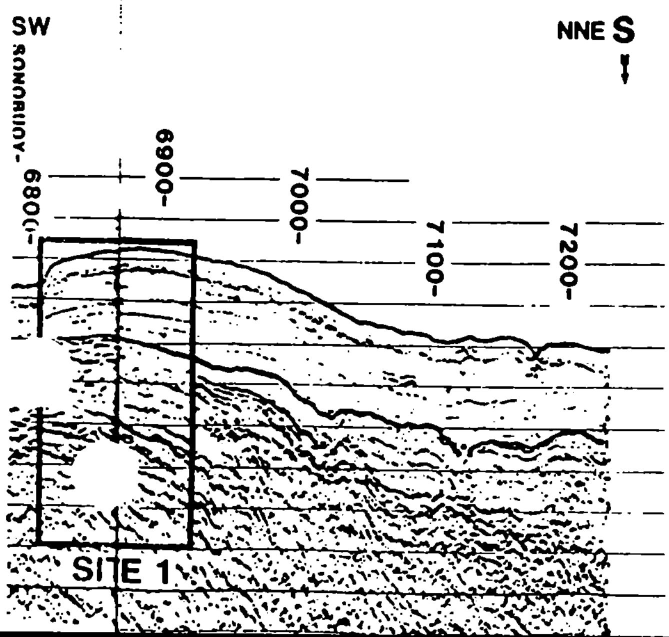
PROFILE 1 A

CENTRAL 90E RIDGE SURVEY SITE

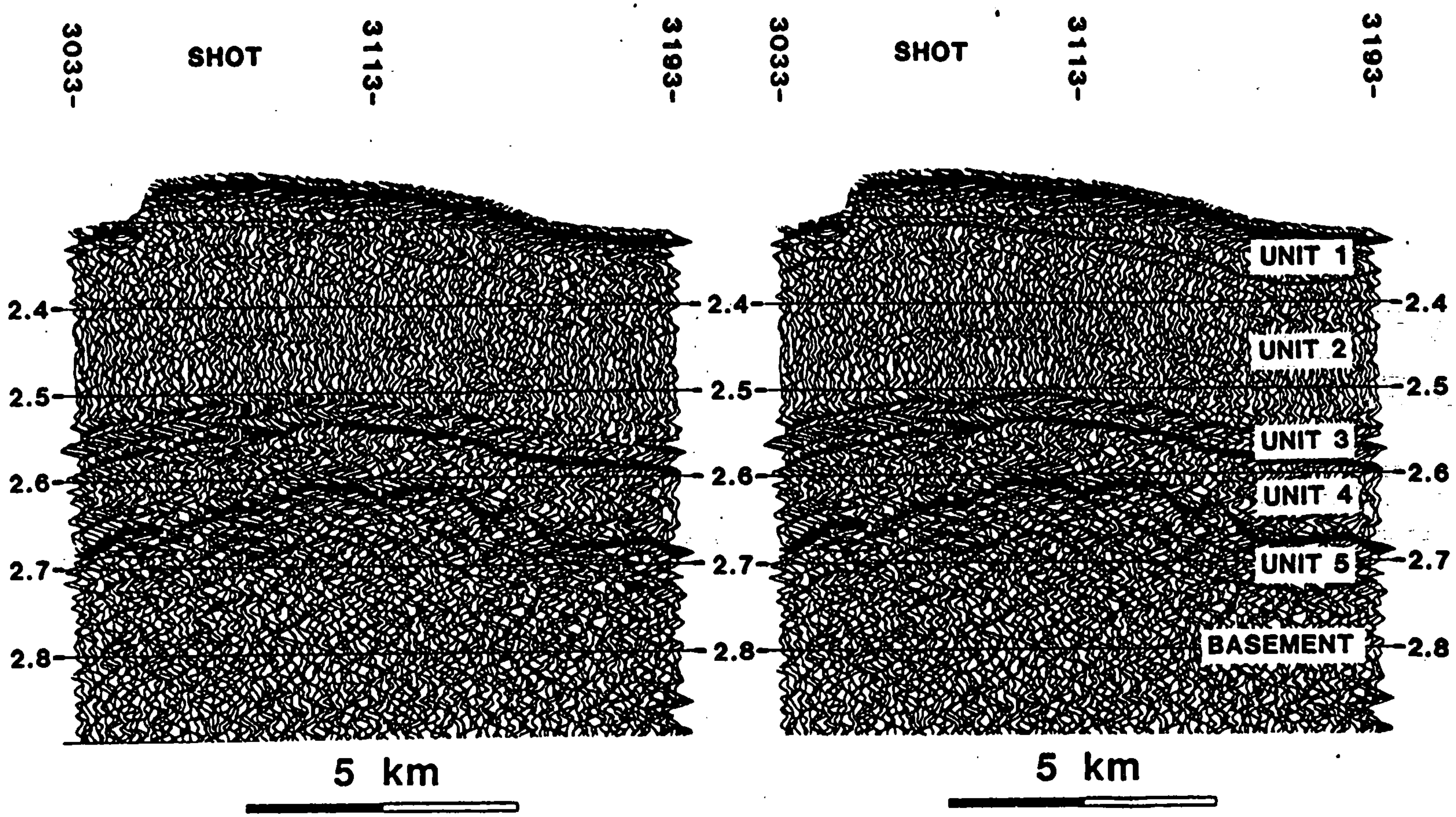




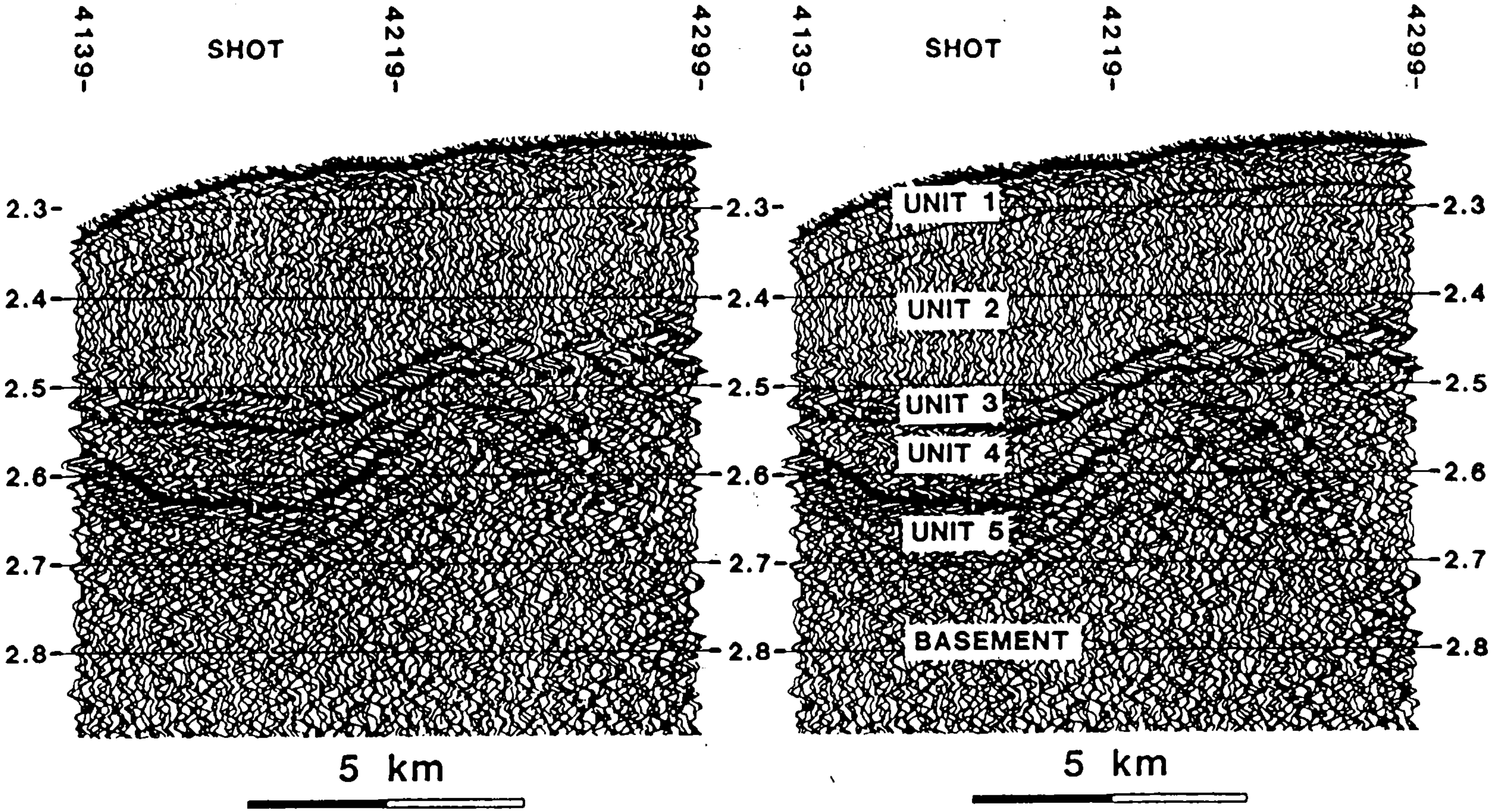




Preferred Site
= Site 2



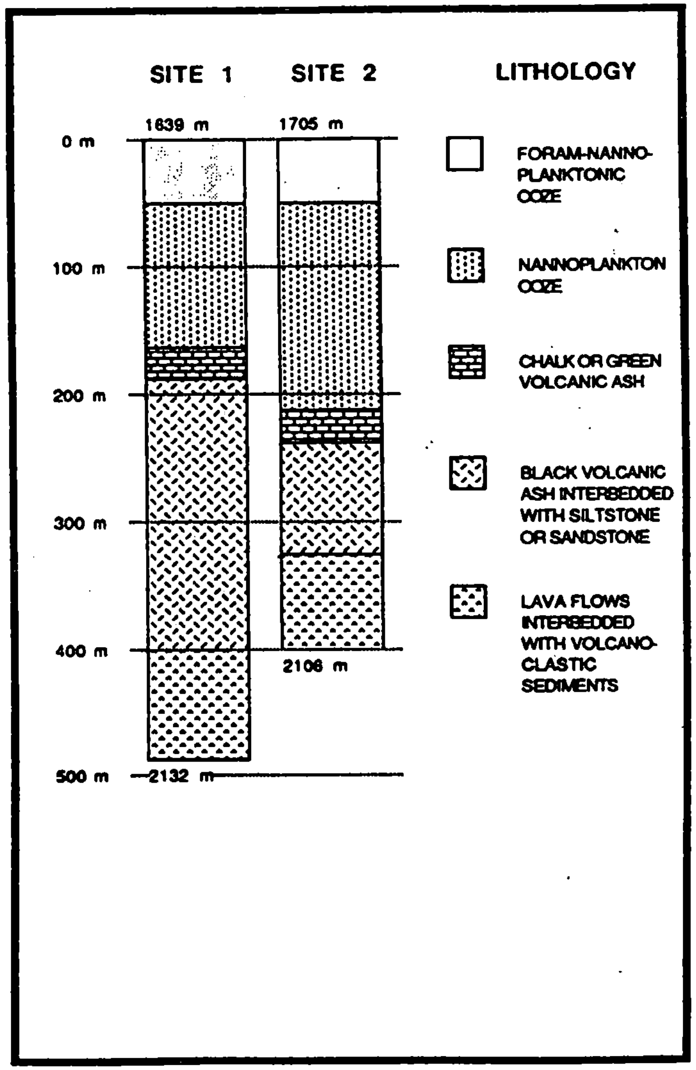
The Central Ninetyeast Ridge survey area.
Seismic section of the W-E line which crosses the suggested drilling site 2 at Shot point 3113.



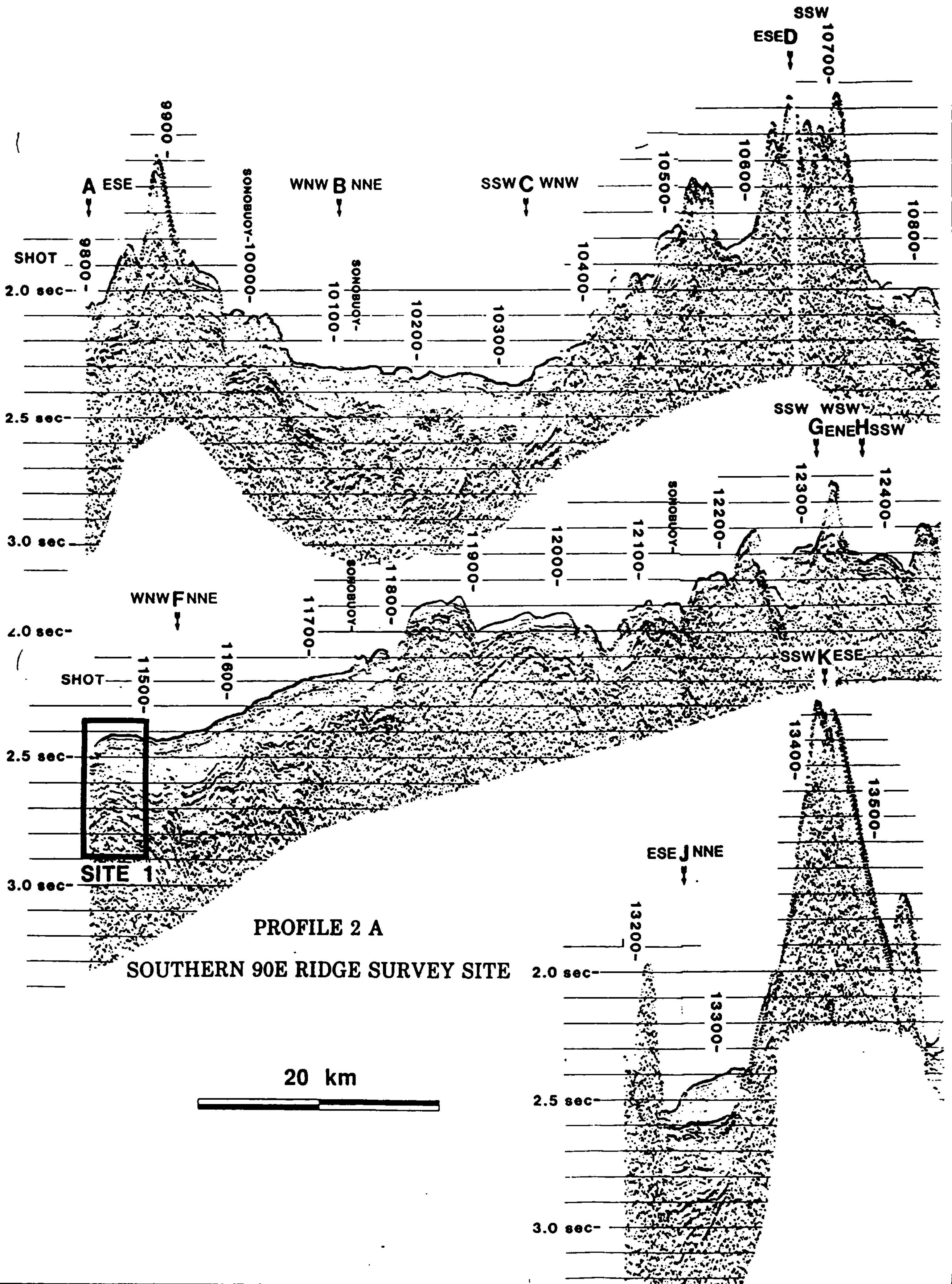
The Central Ninetyeast Ridge survey area.
Seismic section of the N-S line which crosses the suggested site 2 at shot point 4219.

SITE PARAMETERS		
	SITE 1	SITE 2
THICKNESS - UNIT 1	45	46
THICKNESS - UNIT 2	115	168
THICKNESS - UNIT 3	26	25
THICKNESS - UNIT 4	210	84
THICKNESS - UNIT 5	97	78
TOTAL THICKNESS	493	401
WATER DEPTH	1639	1705
DEPTH TO UNIT 2	1684	1751
DEPTH TO UNIT 3	1799	1919
DEPTH TO UNIT 4	1825	1944
DEPTH TO UNIT 5	2035	2028
DEPTH TO BASEMENT	2132	2106

Site parameters for suggested drilling sites for the central Ninetyeast Ridge survey area. Thickness are in meters, depths are in uncorrected meters.



Estimated stratigraphic columns of the suggested drilling sites for the central Ninetyeast Ridge survey area.



PROFILE 2 A

SOUTHERN 90E RIDGE SURVEY SITE

MEMORANDUM

FROM: Leg 122 Site proponents
Ulrich von Rad, Hannover (FRG)
Ron Boyd, Halifax (Canada)
Neville Exon, Canberra (Australia)

TO: IOP, ODP (TAMU)

Objectives, priorities and new drilling time estimates for ODP Leg 122 Sites (Exmouth Plateau)

See revised ODP proposal 121B by v.Rad, Exon, Williamson and Boyd (May 1986) and new proposal by J. Mutter & R. Larson on EP12 (July 1987) for detailed objectives, location maps, track charts, seismic sections, line drawings, isopach maps etc. For a bathymetric map of Exmouth Plateau and a generalized cross-section of Exmouth Plateau, both with ODP Sites, see Figs. 1 and 2, for the predicted stratigraphy and lithology of all sites see Figs. 3 and 4.

1. Objectives and priorites

In its April 1987 meeting PCom has decided to drill the following, Exmouth Plateau Sites during Leg 122 (July-September, 1988): EP-2A, EP-6, EP-7, EP-10A. In its March 1987 meeting, SOHP has set up the following order of priorities: EP-7, EP-10A, EP-2A, EP-6. In its spring meeting (1987), IOP agreed on the same priorities for the top two priorities (EP7 and EP10A). They were followed by EP2A and then by EP6 (or EP9 which will now be drilled by Leg 123). After checking the interval velocities and correlating with nearby commercial wells, we found out that the total depths to the drilling targets for EP6, 7, and 10A are about 20-30% higher than estimated in the original proposal. This increased the drilling time estimates. Therefore it is probable that only one of the upper plateau sites (EP6 and 7) can be drilled. Note that we have inserted Site EP-12 on the western margin of Exmouth Plateau, proposed by J. Mutter & R. Larson as an alternate Site for EP 2A. Since EP9 and AAP1B which are part of the same Exmouth-Argo transect (Fig. 2) will be drilled during Leg 123, both legs should be considered as one major scientific venture with much interaction during the planning stage, pre- and post- cruise conferences, and publication of results.

EP-7 (Fig. 3) is the primary site on the top of the Exmouth Plateau which will provide an almost complete, condensed Early Cretaceous to Neogene section, especially a test of the Cretaceous global sea level curve in the classic type-section of the upper, middle and lower Barrow delta (derived from the south) and overlying mid-to late Cretaceous strata. EP7 is also important for the differential subsidence history between plateau and outer margin (paleodepth transect). Tectonically, the substructure of this site is characterized by thin-skinned extension and very slow subsidence. The high-resolution down-hole seismic logging tool should be used at that site.

EP-2A (Fig. 3) at the foot of the western escarpment of the Exmouth Plateau is on "transitional" crust (=continental crust with volcanic intrusions and extrusions) or oldest oceanic crust. It would study the subsidence history of the westernmost plateau margin, the nature of pre-breakup volcanics and the facies, paleo-bathymetry and tectonic evolution of the early rift and juvenile ocean stages in a near ocean-continent boundary setting.

EP-12 (Fig.3) is the alternate site for EP2A (Fig. 3) proposed by J. Mutter & R. Larson in July 1987. It will penetrate the most seaward, large, rotated fault-block on the western margin of the Exmouth Plateau at a water depth of 2025 m. Main objectives: evolution from an Early Cretaceous syn-rift to a Late Cretaceous to Tertiary post-breakup facies and the timing, duration and amount of subsidence and deformation of the outer plateau margin close to the ocean/continent boundary (but overlying unambiguous, deformed continental crust). EP12 is in a region, where the whole crust was deformed by brittle failure, as opposed to the setting of EP7 with "thin-skinned" deformation.

EP10A (Fig. 4) provides the best opportunity to sample the Triassic to Jurassic (to earliest Cretaceous) pre-and synrift (as well as early post-breakup) sediments on Wombat Plateau, a subplateau of the northern Exmouth Plateau that experienced breakup already in mid-to late Jurassic times. The nearby companion Site EP9E, to be drilled during Leg 123, will continue this section upwards from the Early Cretaceous to the Neogene. EP10A and EP9E are important shallow-water comparison sites to the deep-water Argo Abyssal Plain Site AAP1B: paleodepth transect, Tethys-type circulation, and subsidence history. EP11 or EP8 are back-up sites for EP10A.

EP6 (Fig. 3) is a companion site to Site EP7. It is located on the southeastern Exmouth Plateau in the Kangaroo Syncline close to the slope to the NW Shelf. The detailed correlation of sedimentation events and hiatuses between Site EP6, 7 and 12 will allow the differentiation of global sea level events from local or regional tectonic or sedimentological (delta input) events. In EP6 it will probably only be possible to penetrate to the Gearle Siltstone (Albian-Turonian, 1000 m), if enough time is left. Otherwise EP-6 is an alternate Site for EP7.

2. Drilling Time estimates

In the following table we give different estimates for drilling times, including about 1 to 2 days of logging per site. The estimates are based on estimates provided by ODP. The listing shows our suggested order of priorities. Because of its more complete section and penetration down to the Jurassic Dingo Claystone, EP7 has a much higher priority than EP6. Also we would rate the early Mesozoic (Tethys) objectives of EP10A and the outer margin (syn-rift half-graben fill) objectives of EP12 or EP2A higher than those of a second site on the top of the Plateau (EP6).

New drilling time estimates Leg 122 (Exmouth Plateau)

(Oct. 1987)

Available time

60 days
- 12 days transit *

48 operat. days

Site	Lat. (S)	Long. (E)	W.D. (m)	Penetration (mbsf)	days (incl. logging!) min. estimates	max. estimates (G. Foss, Sept. 87)	S = single-bit R = reentry
EP 7	20°36'	112°07'	1365	1350	S 12	R 18	
EP10A	16°56.6'	115°33.1'	2050	1250	S 13	R 18	
EP12	19°19'	112°08'	2025	1050	S 10	S 12	
EP2A	19°56'	110°27'	4050	800	S 12	S 12	
EP 6	21°17.8'	113°28.5'	1250	1150	S 10	S 10	

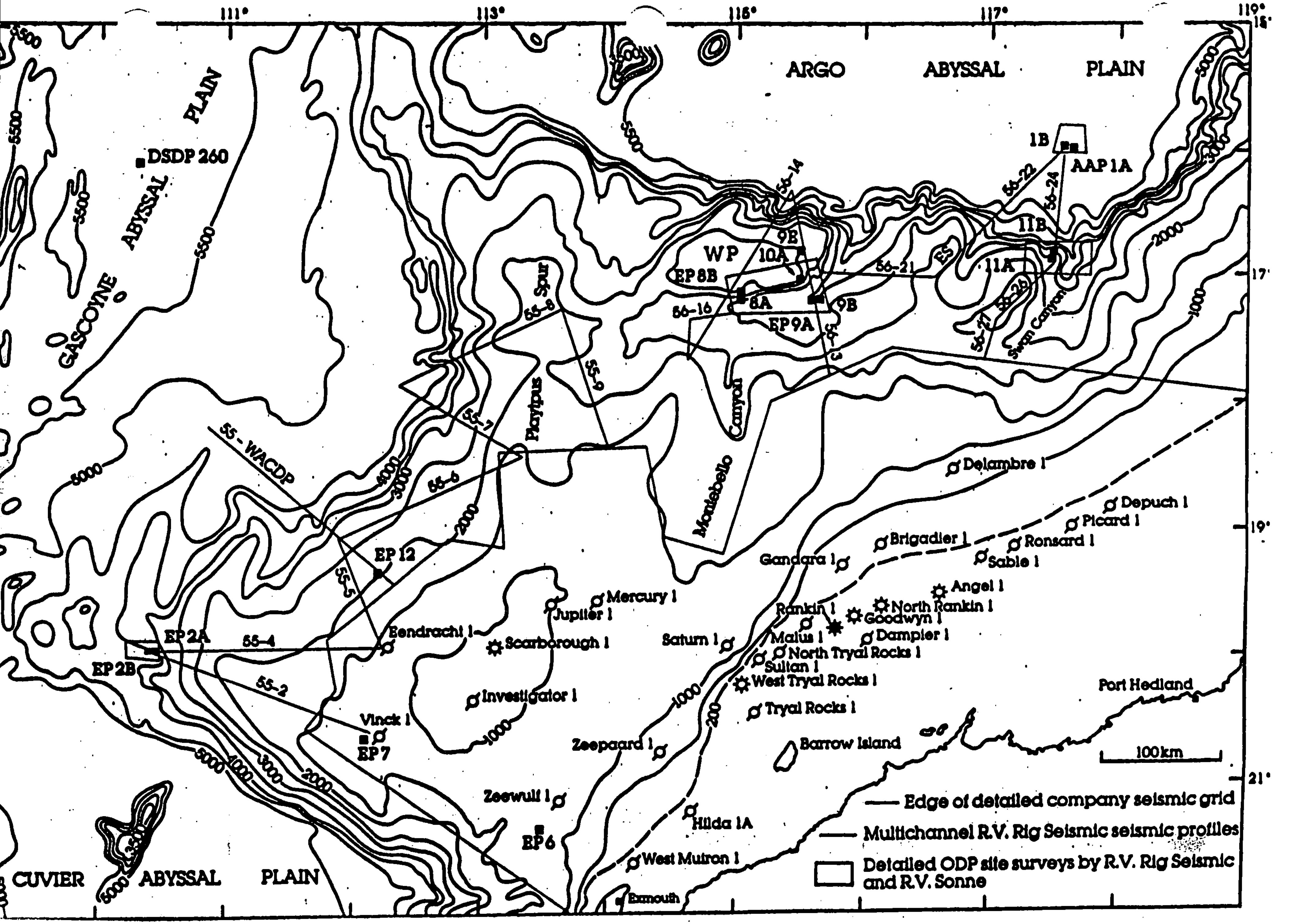
With maximum estimates:

	EP7(R)	18 days
	EP10A(R)	18 days
EP 12 or	EP 2A	12 days
	total	48 days

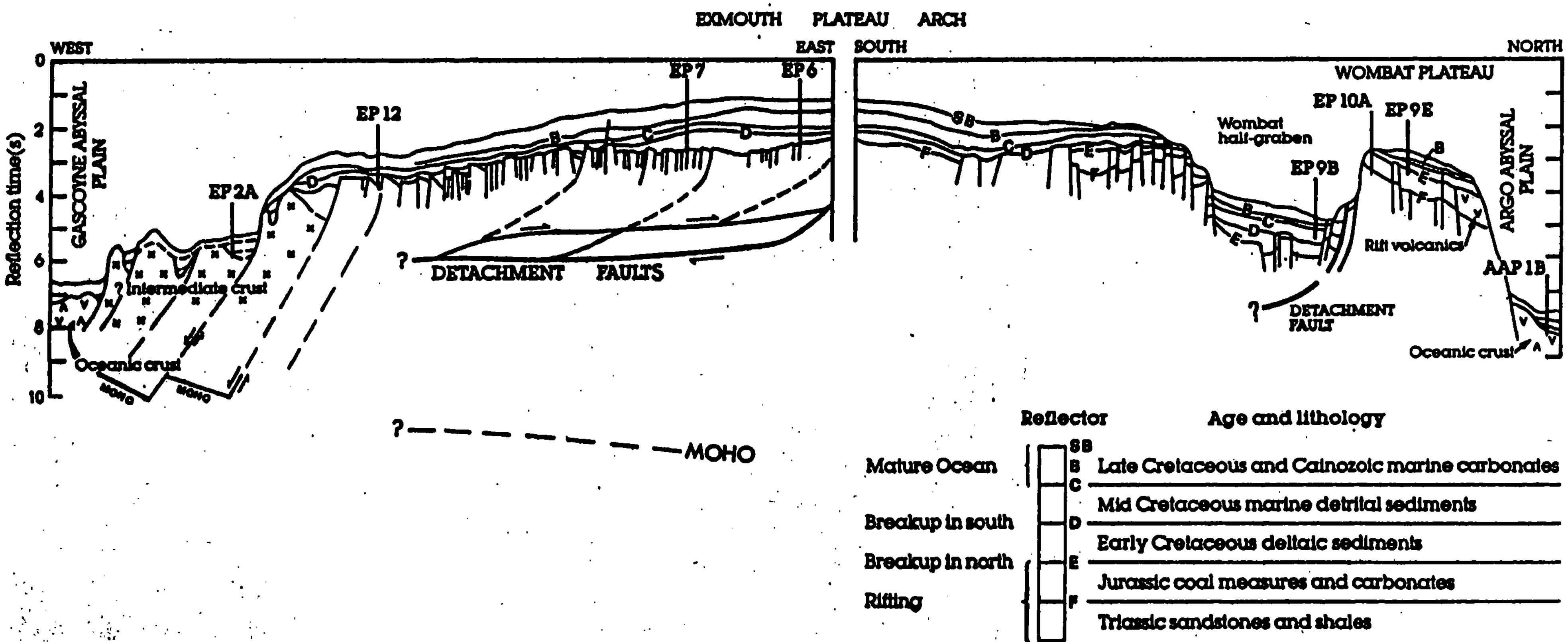
With min. estimates:

	EP7(S)	12 days
	EP10A(S)	13 days
(EP 6 or)	EP12 (S)	10 days
	EP 2A(S)	12 days
		47 days

* assur[illegible] Singapore - Exmouth Plateau - Singapo[illegible]



111°
113°
115°
117°
119°
15°
17°
19°
21°
ARGO ABYSSAL PLAIN
GASCOYNE ABYSSAL PLAIN
CUVIER ABYSSAL PLAIN
DSDP 260
1B
AAP 1A
11B
11A
ES
WP
9E
10A
EP 8B
8A
9B
EP 9A
Swan Canyon
Spur
Platypus
Montebello
Canyon
55 - WACDP
EP 12
EP 2A
EP 2B
EP 7
EP 6
Delambre 1
Depuch 1
Picard 1
Ronsard 1
Sable 1
Brigadier 1
Gandara 1
Angel 1
North Rankin 1
Goodwyn 1
Rankin 1
Malus 1
Dampier 1
North Tryal Rocks 1
Sultan 1
West Tryal Rocks 1
Tryal Rocks 1
Saturn 1
Mercury 1
Jupiter 1
Bendracht 1
Scarborough 1
Investigator 1
Vinck 1
Zeepaard 1
Zeewulf 1
Hilda 1A
West Muiron 1
Exmouth
Barrow Island
Port Hedland
100 km
Edge of detailed company seismic grid
Multichannel R.V. Rig Seismic seismic profiles
Detailed ODP site surveys by R.V. Rig Seismic and R.V. Sonne


EXMOUTH PLATEAU ARCH
WEST
EAST
SOUTH
NORTH
Reflection time(s)
0
2
4
6
8
10
GASCOYNE ABYSSAL PLAIN
EP 2A
EP 12
EP7
EP6
WOMBAT PLATEAU
EP 10A
EP 9E
EP 9B
Wombat half-graben
ARGO ABYSSAL PLAIN
AAP 1B
? Intermediate crust
Oceanic crust
MOHO
DETACHMENT FAULTS
? DETACHMENT FAULT
Rift volcanics
Oceanic crust
?— — — — — — —MOHO
SB
B
C
D
E
F
Reflector
Age and lithology
Mature Ocean
Breakup in south
Breakup in north
Rifting
Late Cretaceous and Cainozoic marine carbonates
Mid Cretaceous marine detrital sediments
Early Cretaceous deltaic sediments
Jurassic coal measures and carbonates
Triassic sandstones and shales

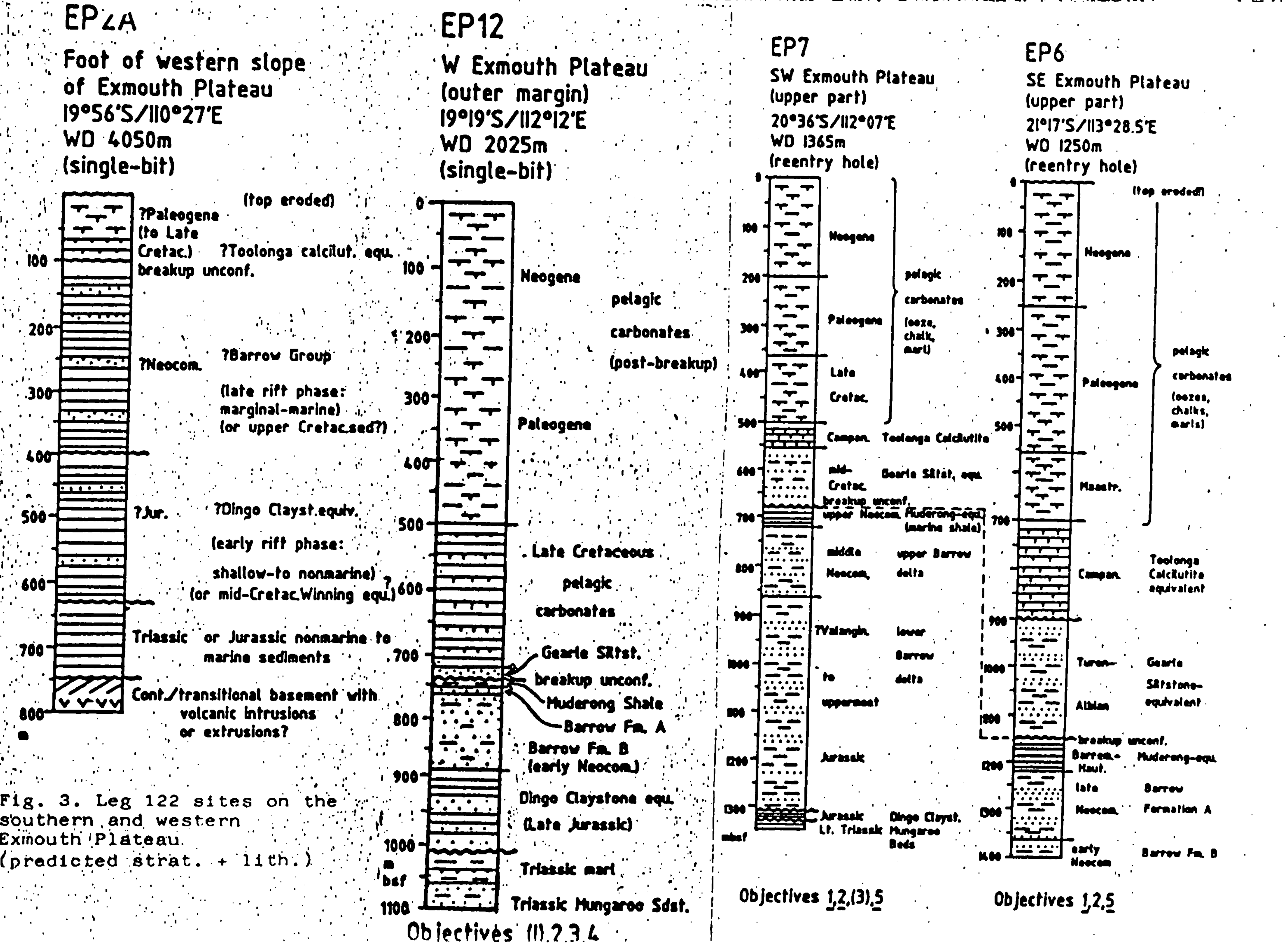


Fig. 3. Leg 122 sites on the southern and western Exmouth Plateau (predicted strat. + lith.)

Fig.

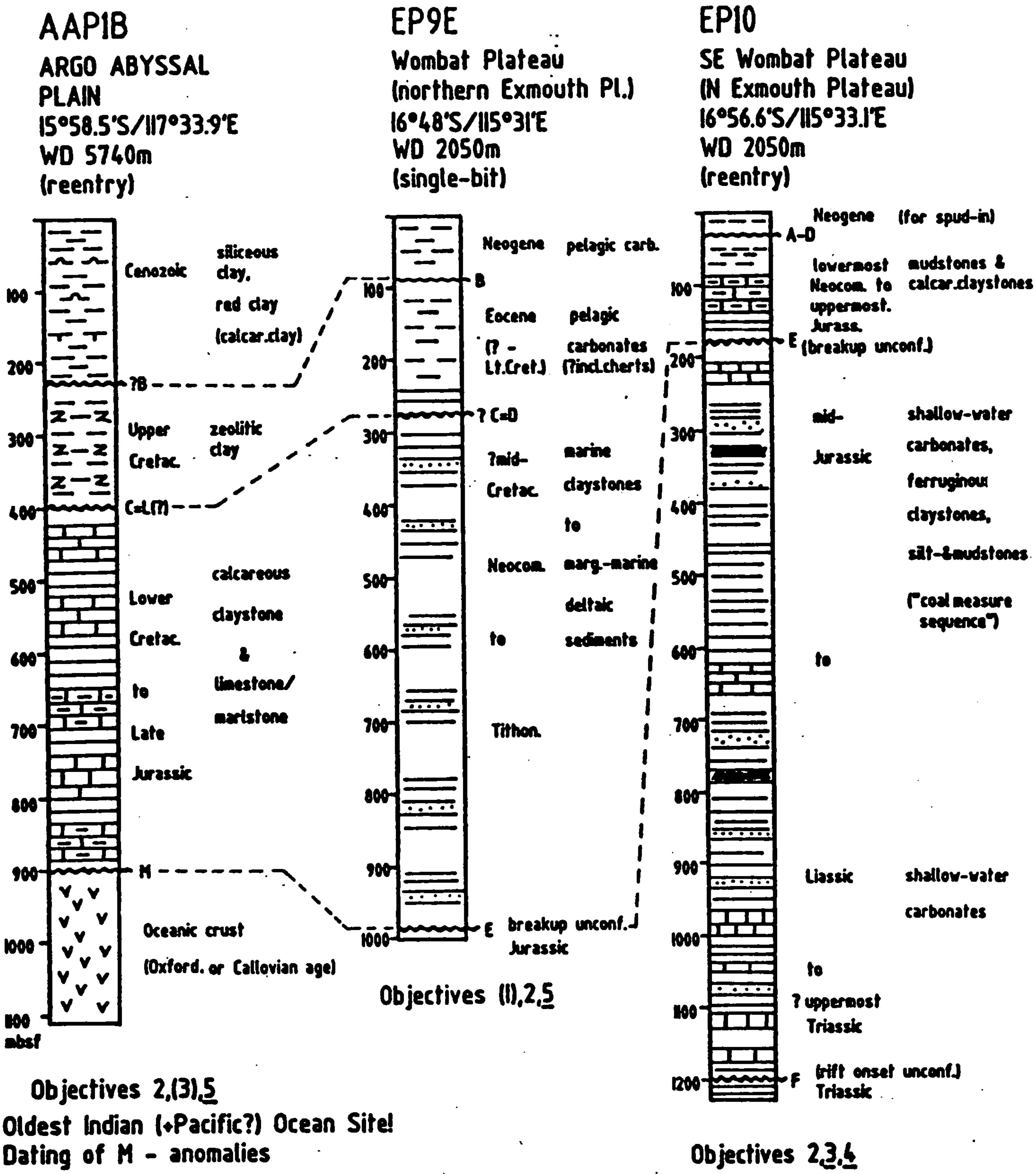
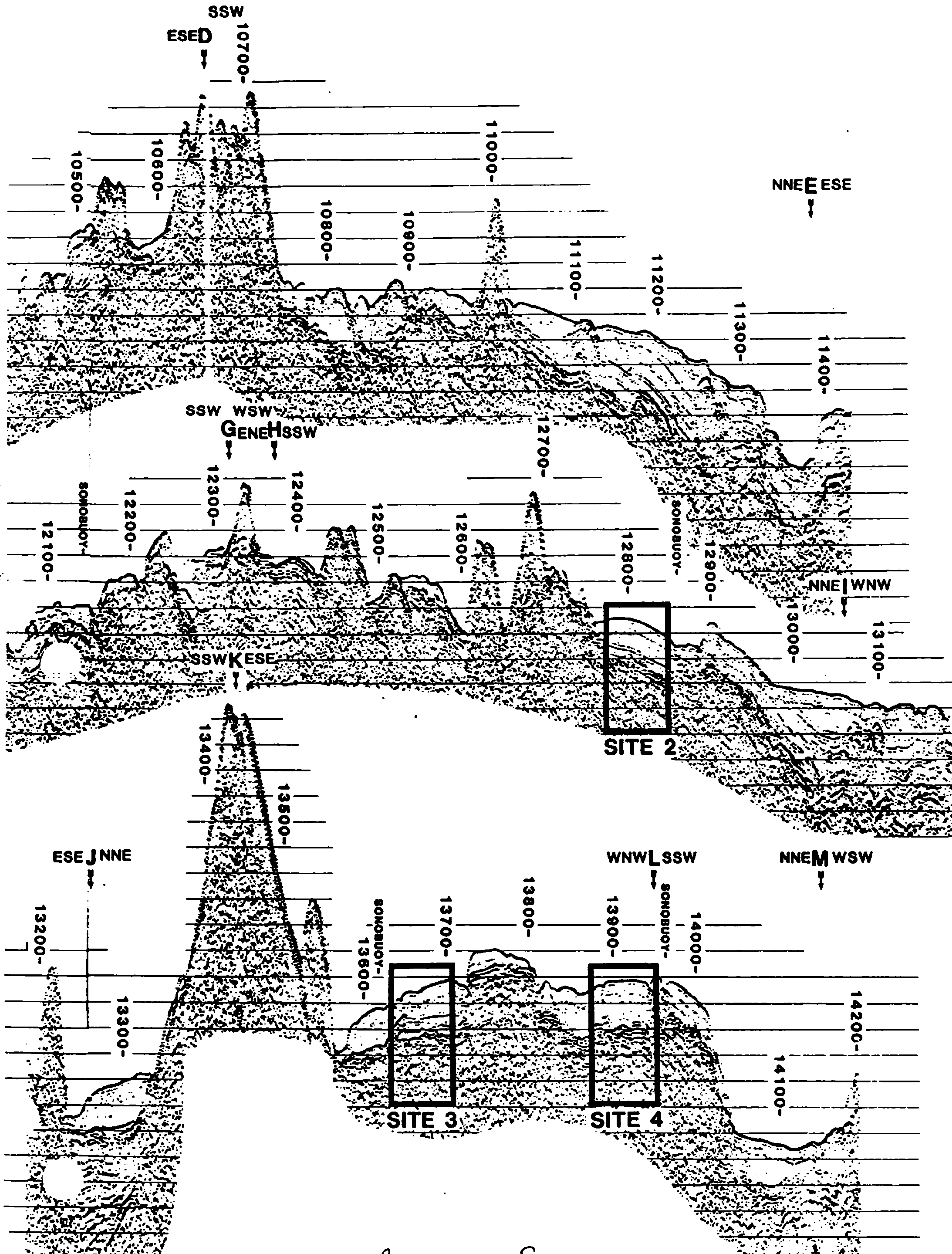
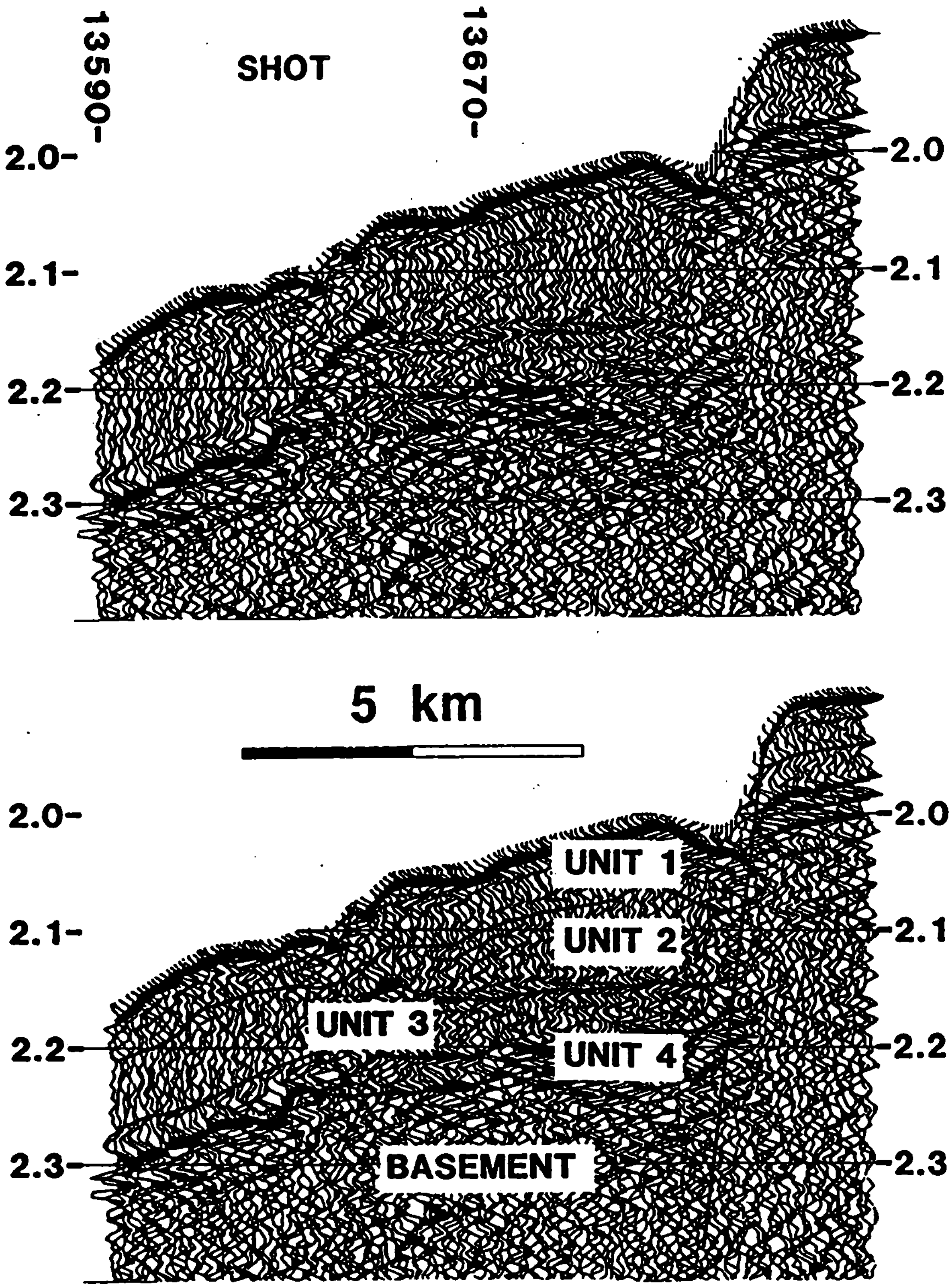


Fig. 4: Leg 122 & 123 Sites on the northern Exmouth Plateau and Argo Abyssal Plain:predicted stratigraphy and lithology.
EP10A will be drilled during Leg 122, EP9E and AAP1B during Leg 123



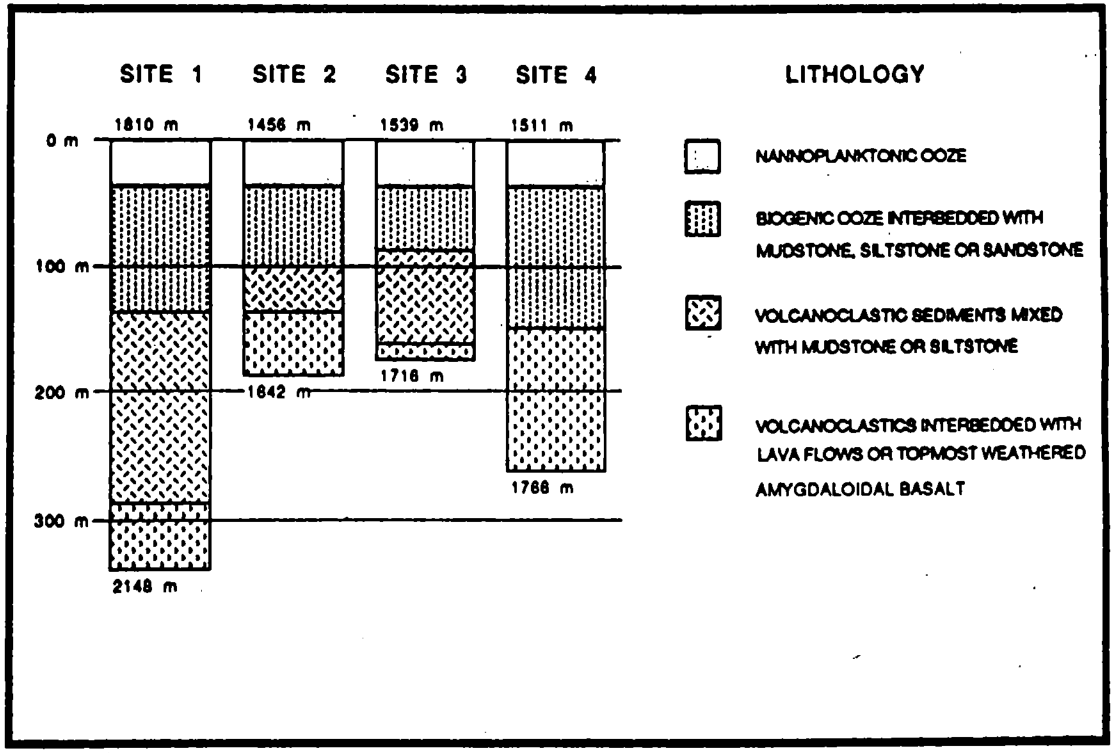
Preferred Site



The Southern Ninetyeast Ridge survey area.
Seismic section of the W-E line which crosses the suggested drilling site 3 at shot point 13670. Both interpreted and uninterpreted sections are shown.

SITE PARAMETERS				
	SITE 1	SITE 2	SITE 3	SITE 4
HICK. - UNIT 1	41	40	36	42
HICK. - UNIT 2	103	62	52	112
HICK. - UNIT 3	141	30	84	0
HICK. - UNIT 4	53	54	5	107
OTAL THICK.	338	186	177	255
WATER DEPTH	1810	1456	1539	1511
DEPTH TO 2	1851	1496	1575	1553
DEPTH TO 3	1954	1558	1627	1665
DEPTH TO 4	2095	1588	1711	1665
EPTH TO BASE.	2148	1642	1716	1766

parameters for suggested drilling sites for the southern Ninetyeast
e survey area. Thickness are in meters, depths are in uncorrected meters.



Estimated stratigraphic columns of the suggested drilling sites for the southern Ninetyeast Ridge survey area.