OCEAN DRILLING PROGRAM

LEG 185 SCIENTIFIC PROSPECTUS

IZU-MARIANA MARGIN

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This Scientific Prospectus is based on precruise JOIDES panel discussions and scientific input from the designated Co-chief Scientists on behalf of the drilling proponents. The operational plans within reflect JOIDES Planning Committee and thematic panel priorities. During the course of the cruise, actual site operations may indicate to the Co-chief Scientists and the Operations Manager that it would be scientifically or operationally advantageous to amend the plan detailed in this prospectus. It should be understood that any proposed changes to the plan presented here are contingent upon approval of the Director of the Ocean Drilling Program in consultation with the Science and Operations Committees (successors to the Planning Committee) and the Pollution Prevention and Safety Panel.

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ABSTRACT

Leg 185 will drill two deep-water (5674 and 6000 m) sites, one, an existing Ocean Drilling Program hole (Hole 801C) seaward of the Mariana Trench, and the other, a new site (Site BON-8A), east of the Izu-Bonin Arc. The primary objectives are to investigate sediment subduction along this arc-trench system and to characterize the chemical fluxes during alteration of the oceanic crust. Despite the simple setting and shared subducting plate, there are still clear geochemical differences between the Marianas and Izu volcanic arc systems. Drilling the crustal inputs (sediments and basalts) will help test whether geochemical differences in the volcanics are derived from contrasts in the crustal inputs to the two trenches. Previous drilling has already provided sections through the sedimentary layer approaching the Mariana Trench. Coring during Leg 185 will provide samples of the remaining input fluxes to the subduction zones: the altered basaltic crust at Hole 801C and the sediments and altered basaltic crust at Site BON-8A. The specific drilling plan is to deepen Hole 801C an additional 250 m (to ~400 m total basement depth) to penetrate the upper oxidative alteration zone, and to core the entire 470 m sedimentary section at BON-8A, along with as much basement as possible (to a maximum of 430 m) in the time allowed.

One outcome of Leg 185 will be the best existing mass balance of input and output fluxes for several key tracers (H_2O, CO_2, U, and Pb) cycled through the subduction factory. These data will permit a better understanding of the recycling of oceanic crust in the Earth’s mantle, the formation of continental crust in arc systems and the role of recycled oceanic crust in the generation of mantle plume magmas. With Hole 801C, which penetrates the world's oldest in situ oceanic crust (~165 Ma), the science party will also provide the first reference site for the structure and composition of old, fast-spreading oceanic crust to compare with other crustal end-members. Based on the seismic structure of the East Pacific Rise crust formed at comparable spreading rates (160 mm/yr full rate), the upper 450 m at Hole 801C may include the entire extrusive section, or layer 2A, of the oceanic crust. Thus, it is possible that Leg 185 will provide the second example of in situ oceanic crust into the sheeted dike complex.

Leg 185 has been targeted to conduct contamination testing and development of a standard sampling procedure for deep biosphere research. The objective of the contamination test is to determine the amount of mixing created by the coring process by introducing a tracer (latex beads) at the mouth of the core barrel as the core is cut.

INTRODUCTION

The State of Crust-Mantle Recycling Science

Subduction zones are the modern sites of continental crust formation and destruction. Continental growth occurs today by accretion of island arcs and magmatic additions to the crust at arcs. Crustal destruction occurs by subduction of crustal material (seawater components, marine sediments, and basaltic crust) at oceanic trenches. Thus, the geochemical and physical evolution of the Earth's crust and mantle depends in large part on the fate of subducted material at convergent margins (Armstrong, 1968; Karig and Kay, 1981). The crustal material on the downgoing plate is recycled to various levels in the subduction zone. Some of it returns to the shallow crust during forearc accretion and dewatering, some returns to the arc crust via volcanism, some is mixed back into the deep mantle, and some may even re-emerge in mantle plumes. Despite strong evidence for these different types of crustal recycling (from seismic imaging, drilling, and isotopic tracers), and despite the important ramifications for mantle evolution, continent formation, and geochemical cycles, few studies have focused on quantifying crustal fluxes through subduction zones.

Von Huene and Scholl (1991) calculated a large global flux of subducted sediment—as high as modern crustal growth rates. Their calculations, however, represent an upper limit on sediment fluxes into the mantle because some material is cycled back to the upper plate. It is a common misconception that the sediment contribution to the volcanic arc is trivial (~1%), based on isotopic mixing arguments, which constrain only the proportion of sediment to the mantle and not the proportion of the total subducting budget that contributes to the arc. To calculate the latter, estimates of input fluxes (sediment) and output fluxes (volcanic) are required. Earlier flux balances by Karig and Kay (1981) for the Marianas suggested that 10% of the sedimentary section contributes elements to the arc, whereas more recent calculations (Plank and Langmuir, 1993; Zheng et al., 1994) give values of 30%-50% globally.

These estimates, however, have large uncertainties because none of them take into account all of the crustal outputs. Plank and Langmuir (1993) do not consider underplating or erosion at the forearc; von Huene and Scholl (1991) do not consider recycling to the arc; and neither study considers the mobile components dissolved in fluids that are lost to the forearc. It is entirely possible that the 50%-70% recycling efficiency to the deep mantle suggested by Plank and Langmuir (1993) could be reduced to 0% for many important element tracers, given the other shallower outputs that have yet to be taken into account. Clearly, the difference between 70% and 0% recycling would lead to vastly different outcomes for mantle evolution and structure.

The Role of Drilling

The recycling equation involves many variables—aging of the oceanic lithosphere, flow of material through accretionary prisms, and fluid circulation at active margins—that are linked across a convergent margin and can be explored in combination through a drilling transect across a margin (Fig. 1; Scholl et al., 1996). The incoming section of sediment and altered oceanic crust can be drilled near trenches. The extent of sediment accretion, underplating, erosion, and subduction can be determined by combining forearc drilling with seismic reflection images and material balance considerations. The fluids lost from the downgoing plate can be sampled by drilling into fault zones and serpentine seamounts. Output to the arc can be determined from the chemical composition of the volcanics and from arc growth rates. The flux of crustal material that is eventually recycled to the mantle is then the input minus the output. Because the bulk sediment is not conserved through the entire subduction process, chemical tracers must be used to track the sediment and deduce the recycling processes. Thus, the problem is impossible to solve by remote means and is completely dependent on drilling to recover material for chemical analysis.

Determination of crustal fluxes into the mantle is not yet possible largely because the various parts of the problem are being investigated at different margins. Although this is a good way to understand individual processes, it is not a good way to determine the behavior of the entire system. The approach that we emphasize here is to try to solve the recycling equation at a few margins where significant progress can be made by a focused drilling effort.

Recent studies have focused on tracers of the subduction process (fluids and chemical components from the subducted sediment and basalt). Subducted material has been successfully identified in forearc fluids and serpentinite mud volcanoes (Mottl, 1992; Fryer, 1992), in arc volcanoes (Tera et al., 1986; Plank and Langmuir, 1993), and in backarc volcanism (Stolper and Newman, 1994). Laboratory experiments have helped in understanding the dehydration and/or melting processes in the downgoing slab that send material back to the overlying crust. What is now needed is to move beyond the tracer approach to begin to try to mass balance the recycling process. How much subducted material returns to the arc lithosphere vs. how much is mixed back into the mantle? How is the subducted material chemically modified during this process? These are the questions behind Crustal Mass Balances, a theme that appears in the Ocean Drilling Program (ODP) Long Range Plan, the MARGINs Initiative Science Plan, and a JOI/USSAC Workshop on Crustal Recycling (Scholl et al., 1996).

BACKGROUND

Crustal Recycling at the Izu-Mariana Margin

There are several reasons why the Izu-Mariana margin (Fig. 2) is ideal for studying subduction recycling. Significant progress has already been made on many parts of the flux equation. Forearc sites of fluid outflow (serpentine seamounts) have already been drilled (Leg 125; Fryer, 1992), as have most of the sedimentary components being subducted at the Mariana Trench (Leg 129; Lancelot, Larson, et al. 1990). These volcanic arcs and backarcs are among the best characterized of intraoceanic convergent margins, both in space and time (Legs 125 and 126; Gill et al., 1994; Arculus et al., 1995; Elliott et al., 1997; Ikeda and Yuasa, 1989; Stern et al., 1990; Tatsumi et al., 1992; Woodhead and Fraser, 1985), and the problem is simplified here because the upper crust is oceanic, so upper crustal contamination is minimized. Sediment accretion in the forearc is nonexistent (Taylor, 1992), so sediment subduction is complete. Despite the simple oceanic setting and the shared plate margin, there are still clear geochemical differences between the Mariana and Izu Arcs (e.g., in Pb isotopes and elemental enrichments; Figs. 3A and 3B). The divergence of compositions between the volcanics of these two oceanic arcs provides the simplest test for how the composition of the subducting crust affects them. The key missing information is the composition of the incoming crustal sections, particularly the (altered) basement sections.

Existing Crustal Inventory at the Izu-Mariana Margin

Of the eight sites drilled in the seafloor immediately east of the Izu-Bonin Trench (not including the Shatsky Rise sites), only one penetrated basement, Site 197 (Leg 20; Fig. 2). No sediments, however, and only 1 m of basalt were recovered. Recovery was poor at most of the other sites: less than 25 m of sediment was recovered at all sites drilled during Leg 20 (Sites 194-198), and the recovered material was dominantly pelagic clays above resistant cherts. Although more was recovered at Sites 52 (45 m) and 578 (165 m), drilled during Deep Sea Drilling Project (DSDP) Legs 6 and 86, respectively, coring again was halted by chert layers, leaving hundreds of meters of unsampled sediment below. Prior drilling has provided us with many samples of the upper 50 to 150 m of the pelagic clay and ash unit, but almost nothing of the units below, including the oceanic crust.

- *The main goal of Izu-Bonin coring is to sample all sedimentary units and the upper alteration zone (~300 m) of the oceanic crust below.*

The success rate in coring sediments and basement to the south, seaward of the Marianas, was just about as poor as that experienced to the north, until Leg 129, when three complete sections (ODP Sites 800-802) were sampled through the cherts to "basement." During Leg 129, sedimentary units were well sampled at Sites 800-802, but normal oceanic crust was sampled at only one site, Hole 801C. At the other two sites, off-axis Cretaceous sills and flows were encountered as "basement." The crustal inventory at the Mariana Trench includes (from top to bottom): pelagic clay, chert, and radiolarite (± chalk), Cretaceous volcaniclastic turbidites, radiolarite, off-axis Cretaceous intrusives and extrusives, and Jurassic oceanic crust. Leg 129 coring and prior DSDP efforts provided adequate samples of the sedimentary units being subducted at the Mariana Trench (providing estimates of chemical fluxes with better than 30% precision for most elements [Plank and Langmuir, 1998]). However, the only sample of Jurassic oceanic crust, which must comprise the largest mass of crustal material being subducted at the Mariana Trench, comes from the lowest 63 m in Hole 801C (of the ~135 m total penetration into basement in Holes 801B and C, only the lower 63 m of drilling recovered 43 m of normal, Jurassic tholeiitic oceanic crust).

- *Thus, the main goal of Mariana coring is to provide a more complete sampling of the upper alteration zones in the Jurassic seafloor, which constitutes a significant part of the budget for many geochemical tracers of the subduction process, including H_2O, CO_2, Rb, and U.*

Existing Crustal Mass Balance for the Marianas

With information in hand, it is possible to calculate many of the input and output fluxes for a few chemical components through the Marianas subduction zone. We consider here a preliminary flux balance for H_2O (Fig. 4). The sediment input is fairly well constrained by previous coring during Leg 129 (Sites 800-802), and by the extensive chemical analyses of the recovered material (Karl et al., 1992; Karpoff, 1992; Lees et al., 1992; France-Lanord et al., 1992) as well as the geochemical logs for the different holes (Pratson et al., 1992; Fisher et al., 1992). As a result, H_2O flux estimates for sediments from Sites 800 and 801 are quite consistent with one another (within 15%). The other crustal input flux is the subducting oceanic crust, which is very poorly constrained because of a lack of significant penetration into the mid-ocean ridge (MOR) basement in this area (63 m in Hole 801C). The geochemical budget of elements in the oceanic crust has two sources: primary igneous and secondary alteration. The primary igneous composition is fairly well constrained, based on extensive sampling of modern mid-ocean ridge basalt (MORB) and on the relatively unaltered samples recovered from Hole 801C. The secondary alteration fluxes are virtually unknown, however, and can only be estimated from various other regions, compilations, and assumptions: the average global H_2O flux in Peacock (1990), alteration studies of DSDP Hole 504B (Leg 69; Alt et al., 1986) and DSDP Sites 417/418 (Legs 51, 52, and 53; Staudigel et al., 1995), and assuming 10% interpillow material in Hole 801C (Castillo et al., 1992b). These estimates show that the alteration fluxes may be large, but are poorly known. The applicability of existing data (obtained for slow-spreading old crust at Sites 417 and 418 and medium-spreading young crust in Hole 504B) to the crust seaward of the Mariana Trench (old-fast spreading) remains to be seen and is, in fact, a major goal of Leg 185.

Unique to the seafloor seaward of the Mariana Trench is an overprint of Cretaceous basement flows and sills. There are two sources of uncertainty in estimating this flux: the thickness of the Cretaceous "basement" layer and its chemical composition. Calculations based on sonobuoy velocities, reflection data, and drilling results from Leg 129 indicate a 100- to 400-m-thick layer of massive Cretaceous basalt, and possibly some interbedded sediments, overlying Jurassic oceanic crust (Abrams et al., 1993). Although this is not the case for water, the total flux of many elements depends critically on whether this Cretaceous basalt is alkalic (as for Site 800 basalts and various seamounts of the Pigafetta Basin [PB]) or tholeiitic (as for Site 802 basalts of the East Mariana Basin [EMB]). Although plate trajectories (Fig. 2) indicate that the seafloor subducting beneath the Marianas is largely the tholeiitic EMB, we consider both EMB (tholeiitic) and PB (alkalic) type basalts in estimating the water flux into the subduction zone (Fig. 4). Both estimates yield small water input fluxes relative to the sediment and altered Jurassic MORB.

The first measurable outputs from the subduction zone are the forearc fluids, which have shown to be freshened and from a subducted source (Mottl, 1992). It is currently difficult to estimate rates based on the fluid flow itself. We, therefore, use a model based on the total (maximum) water generated during clay mineral breakdown in the subducted sediments (Plank et al., 1994). This calculation is model dependent, but further study of the nature of these fluids will help to identify the actual dehydration reactions that are occurring with depth during subduction. Figure 4 shows that the water outputs to the forearc may be a significant fraction of the sediment input. Magmatic outputs to the volcanic arc and backarc are determined from the chemical composition of arc and backarc basalts (assuming 5.7 and 1.25 wt% H_2O above MORB background, respectively; Stolper and Newman, 1994) and from magmatic addition rates. The magmatic arc water flux is the largest of the crustal outputs from the subduction zone.

These preliminary calculations provide some initial insights into the flux balance in subduction zones and reveal where the major uncertainties lie. If we ignore the igneous MORB and Cretaceous basalt contributions as no net gain from the mantle perspective, then the continental water inputs and outputs appear to be remarkably closely balanced across the subduction zone. The balance hinges critically, however, on the magnitude of the basement alteration fluxes. Present estimates are poor, and the actual flux balance could still go either way.

- *Drilling through the upper oceanic crust subducting beneath the Marianas can dramatically improve one key flux in the mass balance equation—the alteration flux.*

Existing Crustal Mass Balance for Izu-Bonin

Because neither the sediments nor the altered oceanic crust seaward of the Izu Trench have been sampled to any significant extent, our ability to determine mass balance is much more limited here. However, we can make some predictions about the crustal inputs to the Izu Trench based on the Izu volcanic output. Izu basalts record almost half the K or Ba enrichment of Marianas basalts (Fig. 3B), whereas sediment mass fluxes into the two trenches are roughly comparable, or even greater, at Izu (600 m of sediment into Izu vs. 400 m into the Mariana Trench). Thus, Izu sediments should be much poorer in K and Ba than Marianas sediments. One way to explain this would be to replace the volcaniclastic sections in the Marianas sediment columns with cherts, which are barren of K and may be very poor in Ba (Karl et al., 1992). This makes some sense given what we know about the history of sedimentation in this part of the ocean—the Cretaceous overprint east of the Marianas may be absent to the north, east of Izu (Fig. 2), where the seafloor spent a longer time on average beneath equatorial zones of high biologic productivity (Fig. 5), possibly leading to greater sections of chert and/or carbonates. Drilling the seafloor east of Izu can directly test these predictions. Sediment layers are fairly uniform throughout the region, reflecting uniform pelagic sedimentation. Thus, a single hole should give us a fairly representative sampling of sediments being subducted at the Izu Trench. If the extra thickness of sediments off Izu is not dominantly barren cherts, this means that much of this sediment does not contribute to arc magmas, either because it is underplated (we can see that it is not accreted), or because it fails to dewater or melt beneath the arc. Thus, by drilling and sampling the crustal inputs, we can learn more about the process of sediment subduction and recycling.

The geochemical differences between the Marianas and Izu arc volcanics could also be related to the chemical composition of the altered oceanic crust. The K or water contents in the altered basaltic sections may vary regionally, possibly explaining regional variations in K and the extent of melting reflected in Marianas and Izu lavas. This can be tested by drilling the upper oxidative alteration zone, which contains most of the alkali budget in the oceanic crust, in both regions.

Finally, some of the differences between the Izu and Marianas lavas may have nothing to do with subducted input and may be explained by more enriched mantle beneath the Marianas. Evidence for enriched mantle in the region comes from enriched shoshonites at the adjacent volcanic arc

(Bloomer et al., 1989; Lin et al., 1989). Although drilling cannot test whether enriched mantle exists beneath the Marianas, it can make invoking it unnecessary.

SCIENTIFIC OBJECTIVES

Previous drilling has already provided many parts of the crustal flux equation at the Izu and Mariana Margins and provides a strong rationale for continuing the effort to mass balance fluxes across the subduction zones. The missing part of the flux equation is largely the input: (1) both the incoming sediment and basaltic sections approaching the Izu-Bonin Trench, and (2) the altered oceanic crust seaward of the Mariana Trench. In order to provide this critical information on the crustal inputs to the subduction zone, drilling is planned at two sites: one seaward of the Mariana Trench (ODP Hole 801C), and one seaward of the Izu Trench (proposed Site BON-8A).

Hole 801C

The primary motivation for returning to ODP Hole 801C, seaward of the Mariana Trench (Fig. 2), is to sample the upper oxidative zone of alteration of this oldest in situ oceanic crust. Previous drilling during Leg 129 only penetrated 63 m into "normal" Jurassic basement. Based on Hole 504B and other basement sites with sufficient penetration, the upper oxidative zone of alteration, which contains the lion's share of some element budgets (e.g., K, B, etc.), lies in the upper 200-300 m of the basaltic crust (Alt et al., 1986; Staudigel et al., 1995). The transition from volcanics to sheeted dikes may not lie much deeper: 500-600 m at Hole 504B (Detrick et al., 1994); 450 m to Layer 2b (Carbotte et al., 1997); and only a few 100 m at Hess Deep (Francheteau et al., 1992). We propose to deepen Hole 801C an additional 250 m (~400 m total basement penetration) into basement at Hole 801C to accomplish the following scientific objectives to

1. characterize the geochemical fluxes and geophysical aging attending the upper oxidative alteration of the oceanic crust in Hole 801C (as discussed above);
2. compare igneous compositions, structure, and alteration with other drilled sections of in situ oceanic crust, in particular 504B, contrasting a young site in Pacific crust with the oldest site in Pacific crust;
3. help constrain general models for seafloor alteration that depend on spreading rate and age.

Hole 801C is in the world's oldest drilled oceanic crust, which is at 165 Ma and was formed at a fast-spreading ridge at ~160 mm/yr full-rate, therefore it embodies several end-member characteristics; and

4. test models for the Jurassic Magnetic "Quiet" Zone (JQZ). Hole 801C is located in an area of very low amplitude magnetic anomalies, usually called the Jurassic Magnetic "Quiet" Zone. The JQZ has been suggested to result from (1) oceanic crust of a single polarity with small anomalies due to intensity fluctuations, (2) oceanic crust with magnetic reversals so numerous as to "cancel each other out" when measured at the sea surface, or (3) oceanic crust with a more normal frequency of magnetic reversals acquired when the dipole field intensity was anomalously low. Deepening Hole 801C would allow testing of the above hypotheses, and in particular, of the third hypothesis of magnetic reversals during a period of anomalously low field intensity, if fresh unaltered volcanic glass could be obtained. Such material can yield reliable paleointensity information (Pick and Tauxe, 1993) on the very fine, single-domain grains of the titanium-free magnetite within the volcanic glass.

Site BON-8A

The primary motivation for proposed Site BON-8A, a site ~60 km seaward of the Izu Trench (Fig. 6), is to provide the first complete section of sediment and a significant section of altered oceanic crust that enters this subduction zone. Previous drilling failed to penetrate successfully through resistant cherts, so most of the sediment column is unsampled. Only 1 m of basalt has been recovered from basement in this vast area (at DSDP Site 197). We propose to drill and core the entire sedimentary sequence (470 m) at Site BON-8A, and as far into the upper oxidative alteration zone of the basaltic basement as possible to a maximum basement penetration of 430 m. The scientific objectives are to

1. provide estimates of the sediment inputs and altered basalt inputs (geochemical fluxes) into the Izu subduction zone (as discussed above);
2. contrast crustal budgets here with those for the Marianas, to test whether along-strike differences in the volcanics can be explained by along-strike variations in the crustal inputs (as discussed above);
3. compare basement alteration characteristics with those in Hole 801C (also in old Pacific

crust);

4. provide constraints on the Early Cretaceous paleomagnetic time scale. Site BON-8A is approximately on magnetic anomaly M12 (Nakanishi et al., 1988). Its basement age should be about 135 Ma and should correspond to the Valanginian Stage of the Early Cretaceous according to recent time scale calibrations (Harland et al., 1990; Gradstein et al., 1994; Channell et al., 1995). However, those age estimates are poorly known and can be tested by drilling at Site BON-8A. Specifically, a reasonably precise date on M12 at Site BON-8A could test the proposed new time scale of Channell et al. (1995); and
5. provide constraints on mid-Cretaceous carbonate compensation depth (CCD) and equatorial circulation fluctuations. Based on its theoretical Cretaceous paleolatitude history, Site BON-8A may have formed at ~5°S, drifted south to 10°S in its early history and then gradually drifted north, crossing the paleoequator as the Pacific plate accelerated its northward motion about 85-90 Ma. A site such as BON-8A with an Early Cretaceous basement age (~135 Ma), an equatorial paleolatitude history during the mid-Cretaceous, and a predictable subsidence history for the Cretaceous is ideal for testing proposed CCD variations (Theirstein, 1979; Arthur et al., 1985). In addition, Erba (1992), following Roth (1981), has shown that certain species of nannoplankton can be characterized as "high fertility indices" and used as approximate indicators for the paleoequatorial upwelling zone. Using these nannoflora, potential fluctuations in the mid-Cretaceous equatorial circulation system could be studied at Site BON-8A when the site was nearly stationary near the paleoequator (especially from 115-95 Ma).

Deep Biosphere

During Leg 185, scientists will conduct contamination tests and develop a standard sampling procedure for deep biosphere research. The objective of the contamination test is to determine the amount of mixing created by the coring process by introducing a tracer (latex beads) at the mouth of the core barrel as the core is cut. Some limited shipboard microbiological analyses will be conducted during Leg 185 (i.e., direct bacterial counts using the existing epifluorescence microscope). Most of the samples, however, will be adequately stored for shore-based analysis.

Diamond Core Barrel (DCB)

Leg 185 has a total of two days allocated to conduct tests of the diamond core barrel (DCB) at both Sites 801C and Bon-8A. Comparison of DCB techniques, hardware, and results in varied lithologies has great value to longer-term ODP goals and the DCB development program. The greatest potential benefit of the DCB tests to Leg 185 is to optimize core recovery and quality.

REGIONAL GEOLOGICAL SETTING OF PROPOSED SITES

Hole 801C

Although located almost 1000 km from the Mariana Trench, Hole 801C is the most promising site for penetrating Jurassic MORB in the region. Throughout much of the Pigafetta and East Mariana Basin (Fig. 2), "basement" consists of Cretaceous flows and sills that overlie the "normal" Jurassic crust. Because these Cretaceous units have already been sampled by Leg 129 drilling, the remaining goal is the MORB section. Hole 801C is the only location where Jurassic-aged material (165 Ma) was reached in a reasonable amount of drilling time, and that material should be essentially the same as what is now being subducted beneath the Marianas (also fast spreading and within 15 m.y. in age). It is necessary to penetrate several hundred meters into the upper oxidative layer of Jurassic basement to constrain that part of the crustal input equation, and that section is now available directly beneath the bottom of Hole 801C. Hole 801C was left clean with a reentry cone that is cased and cemented into basement, and is ready for more extensive basement drilling.

Above basement, the 460 m sedimentary section is dominated by pelagic clays and cherts, with notable intervals of volcaniclastic material from the mid-Cretaceous, derived from the nearby Magellan Seamounts. Specifically, the sedimentary stratigraphy at Site 801 consists of a thin pelagic brown clay unit (64 m, Cenozoic-Campanian /Maestrichtian?) overlying 63 m of brown chert and porcellanite (Campanian-Cenomanian) overlying 192 m of volcaniclastic turbidites (Cenomanian-Albian) overlying 125 m of brown radiolarite (Valangian-Oxfordian), with a basal unit of alternating red radiolarite and claystone (19 m, Callovian). Further background on Site 801 can be found in Lancelot, Larson, et al. (1990).

Site BON-8A

Site BON-8A is ~60 km east of the Izu-Bonin Trench, where the plate surface is broken by normal faults as it bends into the subduction zone (Fig. 7). Avoiding some of this complexity, Site BON-8A is located on the top of a fault block in flat-lying sediments. Coring the complete sedimentary section as well as the altered oceanic crust at Site BON-8A will sample the main crustal components that enter the Bonin trench. Based on our assessment of regional variations in subducting sediments elsewhere (Plank and Langmuir, 1998), we feel confident that a single reference site will provide adequate constraints on the crustal inputs to the Izu-Bonin Trench. Even though the sedimentary stratigraphy will vary regionally, changes in unit thickness can be mapped more efficiently seismically than with multiple drill holes. Site BON-8A should provide us with samples of the largely pelagic sediments from the region. Of the ~470 m of sediment, we anticipate 170 m of pelagic clay and volcanic arc ash above 300 m of mid- to Early Cretaceous cherty porcellanites and chalks (Fig. 7). The basement should be Early Cretaceous MORB (135 Ma), with the upper 200-300 m of extrusives containing the oxidative alteration zone.

DRILLING STRATEGY

Hole 801C

The objective at this site is to re-enter the cone at Hole 801C (Leg 129) and penetrate through the upper, oxidative alteration zone in basaltic basement, deepening Hole 801C at least another 250 m, to >850 mbsf or ~400 m sub-basement. A drill-string length of 6530 m will be deployed, which would be one of the longest drill strings that the *JOIDES Resolution* will have deployed, and drilling will be in basaltic rocks. Expected rates of penetration with the rotary core barrel (RCB) may be as low as 1.5 m/hr (as experienced during Leg 129) and trip times will be long. It should be possible with 20 days on site to achieve >250 m of penetration into basement, and conduct three logging runs. We will actively monitor the chemical composition of the cores on board the ship to determine the changes in the alteration zones.

The most likely drilling problems to be encountered will be due to drilling materials (junk) left in the hole. In such an event some time will be spent fishing the junk, to continue the hole to >250 m depth into basement. A decision will be made on site as to the time to be dedicated to fishing and continued drilling, given the requirement for at least 15-20 days operations at Site BON-8A. If a new hole is needed for technological reasons, our first recourse will be to move a few 100 ft and wash to basement and start again. In the case where drilling problems are geological (an unfavorable formation) an alternate site has been designated (PIG-3B), ~75 km east of Site 801 (Fig. 2). Given the amount of time involved in washing down to the last depth of penetration at Hole 801C (~600 m) or starting a new hole at PIG-3B, it is likely that if such problems are encountered after the first week of operation at Hole 801C, further efforts will be shifted to Site BON-8A.

Site BON-8A

The objectives for Site BON-8A are to continuously core the sedimentary section (470 m) and the upper pillow alteration zone in the basement section (as deeply as possible). Drilling conditions and hole stability in the sedimentary section are predicted to be good at this site, but recovery will be moderate to poor in the anticipated chert-rich sediments. In order to optimize recovery, a combination of the advanced hydraulic piston/extended core barrel/motor-driven core barrel (APC/XCB/MDCB) corers will be used, ideally, to core the entire sedimentary section. Recovery within chert sequences, especially of soft, chalky sediments, was still a problem on Leg 129 because of the need to pump heavily during chert penetration to keep the hole clean. The dramatically increased recovery of hydrothermal sediments in the Trans-Atlantic Geotraverse (TAG) area on Leg 158 with the newly designed MDCB raises the encouraging possibility of similar enhanced recovery in chert/chalk sequences. Four logging runs will follow APC/XCB/MDCB drilling in the pilot hole.

As stated above, if the drilling operation in Hole 801C fails, and there is insufficient time to achieve our stated objectives at this site, operations will be moved to Site BON-8A. Complete operations at this site involve coring of the sedimentary section, logging the sediments, installation of a reentry cone and casing and cementing into basement (470 m), and drilling with a combination of RCB, MDCB, and diamond coring system (DCS) to at least 200 m below the sediment/
basement interface. The basement will be logged following drilling operations. The entire operation involving the establishment, coring, and logging of a legacy hole will take 26–28 days.

Depending on the time spent in Hole 801C, a series of scenarios are envisaged for coring the sediments and penetrating at least 50 m into basement, and logging the section at Site BON-8A. We stress the fact that it is essential that the sedimentary section at this site be logged to define the proportions of representative lithologies and compute the mass flux into the subduction zone. This operation could involve a minimum program, involving drilling a single hole using a single RCB bit, through the sediments and basement, dropping the bit, and logging through the hole through the drill-string (10–12) days. A more complete drilling operation (using APC/XCB/RCB/MDCB combinations) at this site would involve reentry of the hole by use of a Free-Fall Funnel (FFF). This would allow deeper coring into basement and complete logging of the section (15 to 22 days), depending on depth of penetration into basement and the number of logging operations. The logging operations will involve, either (1) a logging run after the sediment section is cored and a further run after basement is cored, thus creating maximum hole quality for logging the sediments, or (2) a single logging operation at the end of coring the sediments and basement. If hole quality is not good enough for logging, the possibility exists for drilling a separate hole using a tricone bit, followed by logging.

In the case of loss of the hole at Site BON-8A (again this would most likely be because of drilling problems involving junk in the hole in the basement section), we propose to drill a hole adjacent to the lost hole. For this hole, we would wash down through the sedimentary section, install a second reentry cone, and drill as deep as possible within the time constraints; a minimum drilling operation as described above would be essential to the success of the project. In the case where the drilling problems are geological (an unfavorable formation) an alternate site has been designated (proposed Site BON-9), ~10 km east of BON-8A (Figs. 6, 7).

LOGGING PLAN

Recording downhole geochemical and physical properties data during Leg 185 is essential to filling recovery gaps in both sediment and basement sections, as well as enabling site-to-site comparisons of the geochemical signatures of the drilled sequences.

Downhole Measurements in Hole 801C

Downhole measurements were conducted in the upper 100 m of basement during Leg 144 to begin the characterization of typical old oceanic crust generated at a fast-spreading rate (Larson et al., 1993). The most surprising result from Leg 144 downhole measurements was the extremely high permeability measured below 501 mbsf in a hydrothermal alteration zone. This zone appears to act as an aquifer, an argument supported with the apparent bulk porosity profile. Below the hydrothermal zone and within the tholeiitic basalts, the logs begin to approximate more expected values for old oceanic crust. To further characterize the petrology, hydrogeology, structure, and physical properties of the old oceanic crust, the hole will be logged with the triple combo, Formation MicroScanner (FMS)/Sonic, and Geologic High-resolution Magnetometer Tool (GHMT) tool strings. The triple combo consists of the HNGS (Hostile Environment Natural Gamma Sonde), APS (Accelerator Porosity Sonde), HLDS (Hostile Environment Litho-Density Sonde) and DITE (Dual Induction Tool) with the Lamont Temperature Logging Tool (TLT) attached to the bottom of the string. The FMS/Sonic string will contain a standard four pad FMS tool combined with a DSI (Dipole Shear Sonic Imager) sonic tool. Lastly, to satisfy the time-scale objective (i.e., to determine the age of the basement), the magnetic susceptibility and total magnetic field measurements obtained by the GHMT will be deployed to provide a paleomagnetic reversal sequence of the overlying sediment.The anticipated logged interval will be from casing at 481 mbsf to the new total depth expected to be about 850 mbsf.

In addition, if enough time is available, a packer experiment will be completed for the interval below the hydrothermal deposit drilled on Leg 129 at 501 mbsf and the bottom of the newly drilled basement section. This experiment will complement results on the permeability of the basement obtained on Leg 144 (Larson et al., 1993), and may provide important constraints on the alteration process and fluid flow in old oceanic crust.

Downhole Measurements at Site BON-8A

The oceanic crust subducted in the Izu-Bonin Trench has never been sampled or logged. Because determining the geochemical budgets in sediment and basement columns is central to the objectives of Leg 185, geochemical logging tool (GLT) will be extremely valuable. Geochemical logging on Leg 129 served as an excellent proxy for actual recovery of sediments similar to those expected at Site BON-8A (Fisher et al., 1992).

To compare the sedimentary sequence and the upper oceanic crust at Site BON-8A with those in Hole 801C, the triple combo, FMS/Sonic, and GLT will be deployed. The GLT is typically combined with an AACT (Aluminum Activation Tool), which requires a Californium 252 source.

Logging at Site BON-8A will occur in two stages to optimize data quality and logged depth. The first logging operation will be completed through the APC/XCB bottom-hole assembly (BHA) following the cessation of drilling near the sediment/basement contact. The second logging program will be completed through the RCB BHA after completion of the hole to basement. The standard tool-string deployment sequence is triple combo, FMS/Sonic, GLT, and GHMT.

SAMPLING STRATEGY

New sampling guidelines specify that a formal, leg-specific sampling strategy must be prepared by the Sample Allocation Committee (SAC: co-chiefs, staff scientist, and ODP curator onshore—curatorial representative on board ship) for each prospectus. Any modification of the sampling strategy during Leg 185 must be approved by the SAC following evaluation of sample requests by the shipboard party at each site.

Nominal Sample Limit

Leg 185 shipboard scientists may expect to obtain up to 100 samples of no more than 15 cm^3 in size. Additional samples may be obtained upon written request onshore soon after the cores are sent to the ODP Repository. Depending on the penetration and recovery during Leg 185, the number of samples taken may be increased by the shipboard SAC. All sample requests must be made on the standard sample request form and approved by the SAC.

Samples larger than 15 cm^3 may be obtained with approval of the SAC, but will be considered as the equivalent of multiple samples in partial or complete increments of 15 cm^3. Requests for large samples must be specified on the sample request form.

Multiple Analysis of Samples

Some redundancy of measurement is unavoidable, but minimizing redundancy of measurements among the shipboard party and identified shore-based collaborators will be a factor in evaluating sample requests. For Leg 185, we anticipate the preparation of samples for which splits will be analyzed in different laboratories. We stress the importance of having a coherent data set on the same powdered or solid samples.

Shipboard Samples and Data

Following core labeling, measuring nondestructive properties, and splitting, samples will be selected from core working halves by members of the Leg 185 shipboard party for routine measurement of physical and magnetic properties, bulk chemical analyses by X-ray fluorescence (XRF) and carbon-hydrogen-nitrogen-sulfur (CHNS) analyzer, and X-ray diffraction (XRD), as necessary. Polished thin sections will be prepared for identification of minerals, determination of mineral modes by point counting, and studies of texture and fabric. In most cases these samples will serve as the shore-based material for full analysis by multiple laboratories.

Shipboard thin sections, selected from representative sections of the core and at some critical intervals, will remain the property of ODP. The thin-section chips from which the sections are made will be retained by ODP and should normally be thick enough to allow for the production of additional sections unless the sampling plan for a critical interval precludes this. Members of the Leg 185 shipboard party can request the production of a thin section from these thin-section chips for their personal use, at their own expense, and as part of their nominal 100-sample limit. Scientists must arrange for the prepaid manufacture of these thin sections with a third-party commercial service unless otherwise approved by the ODP core lab curator. The thin-section chip will then be sent directly to the commercial service and returned directly to ODP.

Critical Intervals

If critical intervals of unusual scientific interest are identified during the core description process, a sampling protocol will be established by the interested scientists and shipboard SAC.

Small Samples

Studies requiring only small-sample volumes (1 cm^3 or less, e.g., for veins, fluid inclusions, etc.) may require more than 100 samples to characterize a long section of core. The SAC will review the appropriate sampling interval for such studies as the cores are recovered. Ideally, many of these studies will be coordinated with the shipboard and shore-based sampling protocols.

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FIGURE CAPTIONS

Figure 1. The crustal fluxes through a subduction zone (after von Huene and Scholl, 1993). Arrows indicate schematic flow, not detailed flow patterns. The return flux of crustal material to the mantle depends on many other fluxes: the partitioning of bulk sediment in the shallow part of the subduction zone (by accretion, underplating, and erosion), the chemical and fluid fluxes due to sediment dehydration and melting, and the chemical fluxes to the volcanic arc and backarc.

Figure 2. Map of the Western Pacific and Mariana, Izu-Bonin, and Northern Mariana Seamount Province volcanic arcs. Solid circles = existing drill holes; most coring that occurred prior to Sites 800-802 failed to penetrate the complete sedimentary section and/or had poor recovery. Shaded seafloor includes Pigafetta Basin (PB) and Magellan Seamount, where alkalic Cretaceous overprint predominates. Solid triangles = active volcanoes. Site BON-8A and Hole 801C are proposed drill sites. Ogasawara Fracture Zone-Magellan Seamount Flexural Moat (OFZ-MSM) after Abrams et al., 1992 (their fig. 2). Curved arrows = instantaneous trajectories for the Pacific Plate relative to the Philippine Plate, after Seno et al., (1993). Dashed curves = continuation of trajectories beneath the arc. EMB = East Mariana Basin. N. Smt. Prov. = Northern Seamount Province. Gray shaded boxes show Leg 125 and 126 drilling areas and the Izu Crosschains. The Izu Crosschains shaded box shows the location of a cruise in 1995 that conducted detailed sampling of the Izu Crosschain seamount volcanoes. These samples provide excellent controls on spatial and temporal variations in slab outputs across the Izu-Bonin arc.

Figure 3. A. Contrasting Pb isotopic composition of Marianas (open circle) and Izu-Bonin (solid circle) arc volcanics. Marianas volcanics form a mixing trend (arrow), almost perfectly coincident with mixtures of ODP Hole 801C sediment (open boxes) and basalt (solid boxes) averages. Drilling at Site BON-8A will test whether the Izu-Bonin Arc trend (arrow) is consistent with different subducted material than for the Marianas. Modern Indian MORB, Pacific MORB, and Honshu Arc data are shown for reference. Data sources: Elliott, et al., 1997; Gill, et al., 1994; Plank and Langmuir, 1998; Castillo et al., 1992a; and Gust et al., 1997. **B.** Correlation between Ba flux in subducted sediment and Ba enrichment of arc basalts for various arcs (Ant = Northern

Antilles, Mar = Marianas, T= Tonga, Mex = Mexico, J = Java, Al = Aleutians, and G = Guatemala) around the world (after Plank and Langmuir, 1993). Open circles = three different sediment flux estimates for the Marianas, based on the three ODP Sites drilled during Leg 129 (800-802) (Plank and Langmuir, 1998). Although there are variations from site to site, the average sediment input to the Marianas is fairly well constrained (+/- 20%). Note Izu volcanics are lower in Ba/Na than Marianas volcanics by a factor of two. Drilling at Site BON-8A will help to test if the low Ba/Na of the Izu volcanics is related to a lower Ba sediment flux. Shown for reference are the average Mariana Ba sediment flux and the flux for a 600-m section of chert (with 125 ppm Ba, similar to the upper radiolarites in Hole 801C; Karl, et al., 1992).

Figure 4. Estimates of H_2O input and output fluxes for the Marianas subduction zone. Height of bar gives the flux for each parameter (scale on the left); bars are placed side-by-side to show competing estimates (as for Site 801 vs. Site 800 sediment) and are stacked to show cumulative input (on the right) and output (on the left). Shaded bars represent "continental" fluxes; unshaded bars are pristine igneous fluxes. Note that continental inputs and outputs may be very closely balanced; however, the balance depends critically on the real alteration fluxes for Hole 801C, which can only be constrained by further drilling. Cretaceous overprint given for both the East Mariana Basin (EMB) and Pigafetta Basins (PB); lines show fluxes resulting from different layer thickness (100, 250, 400 m).

Figure 5. Theoretical Mesozoic paleolatitude histories of ODP Sites 801 and BON-8A based on the combined polar wander paths for the Pacific plate of Sager and Pringle (1988) for 60-100 Ma and Larson and Sager (1992) for 100-155 Ma. Great circle distances are measured at 5-Ma intervals on the combined polar wander path to the present-day site locations and then converted to paleolatitudes to construct these histories. The paleolatitudes of 155-165 Ma for ODP Site 801 are based on measured remanent inclinations in Jurassic core samples from that site.

Figure 6. Location of Leg 185 drill site BON-8A and alternate BON-9.

Figure 7. Portion of seismic Line 39 from Conrad 2005 crossing the Izu-Bonin Trench. These multichannel data have not been reprocessed. Note location of Leg 185 drill site BON-8A and alternate BON-9 on top of fault blocks.

Crustal Fluxes at Subduction Zones

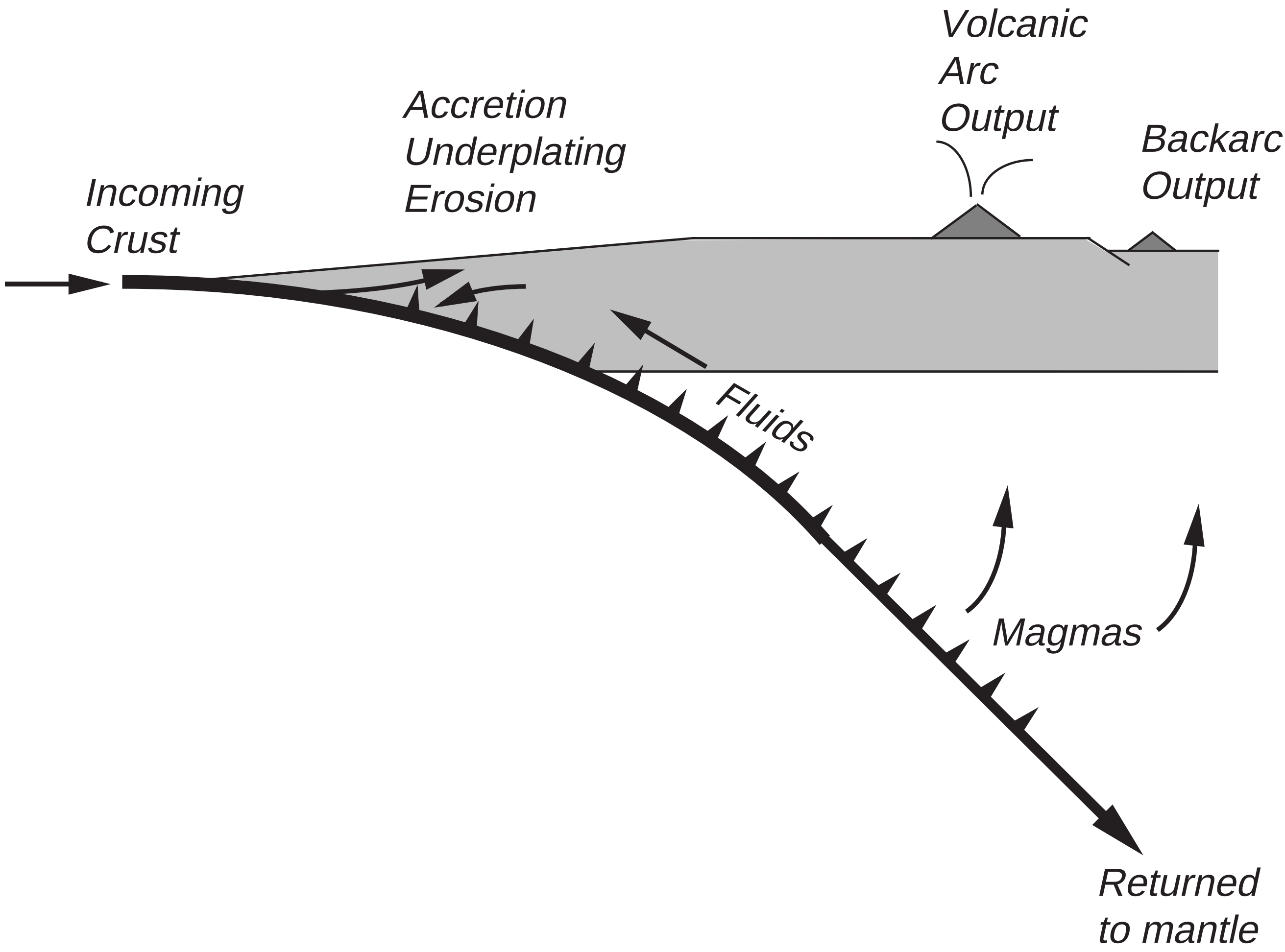


Figure 1

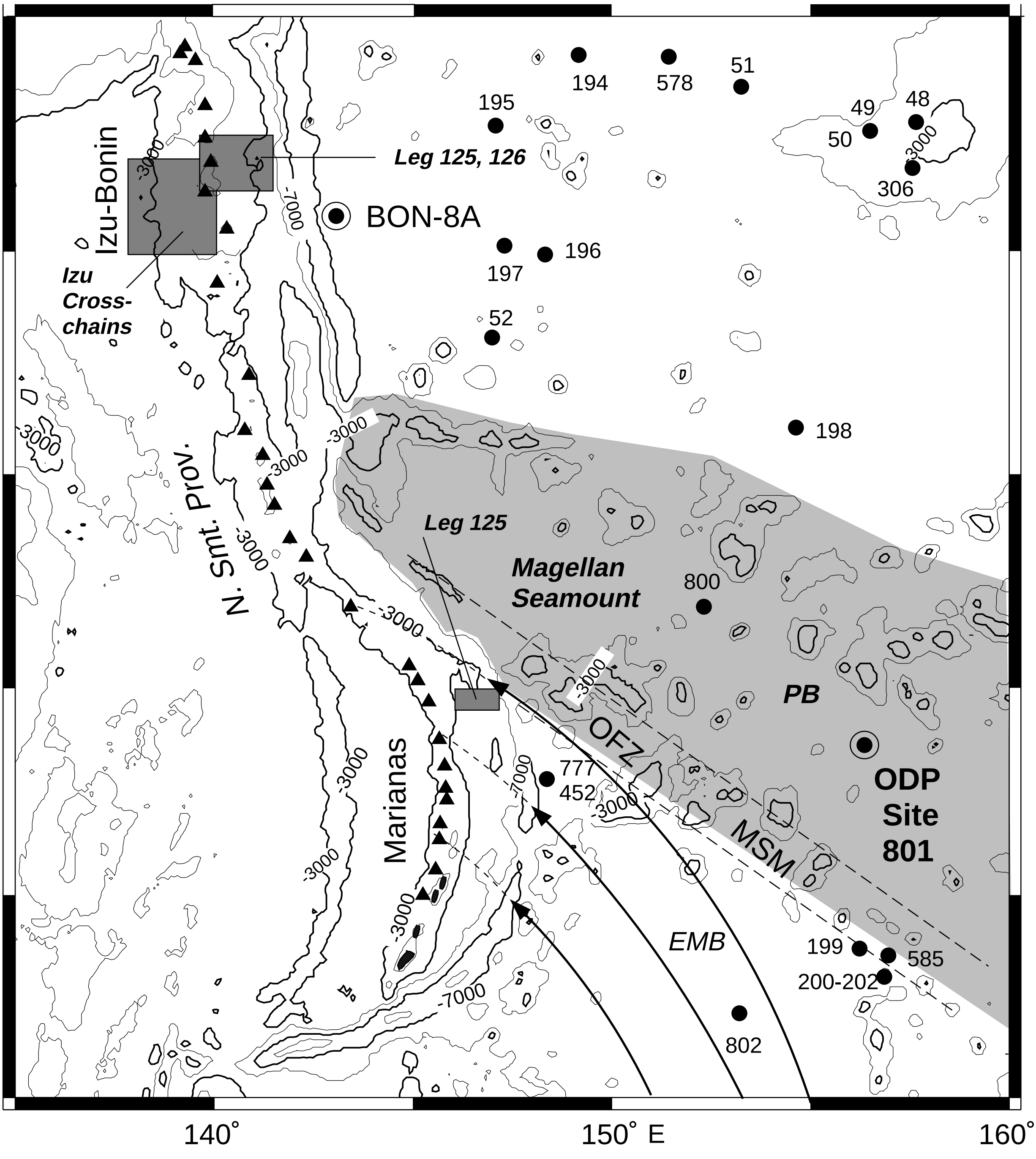

Izu-Bonin
Leg 125, 126
Izu Cross-chains
BON-8A
194
578
51
195
49
48
50
306
197
196
52
198
30° N
-3000
-7000
N. Smt. Prov.
Magellan Seamount
800
Leg 125
PB
20°
OFZ
777
452
ODP Site 801
MSM
Marianas
EMB
199
585
200-202
802
10°
140°
150° E
160°

Figure 2

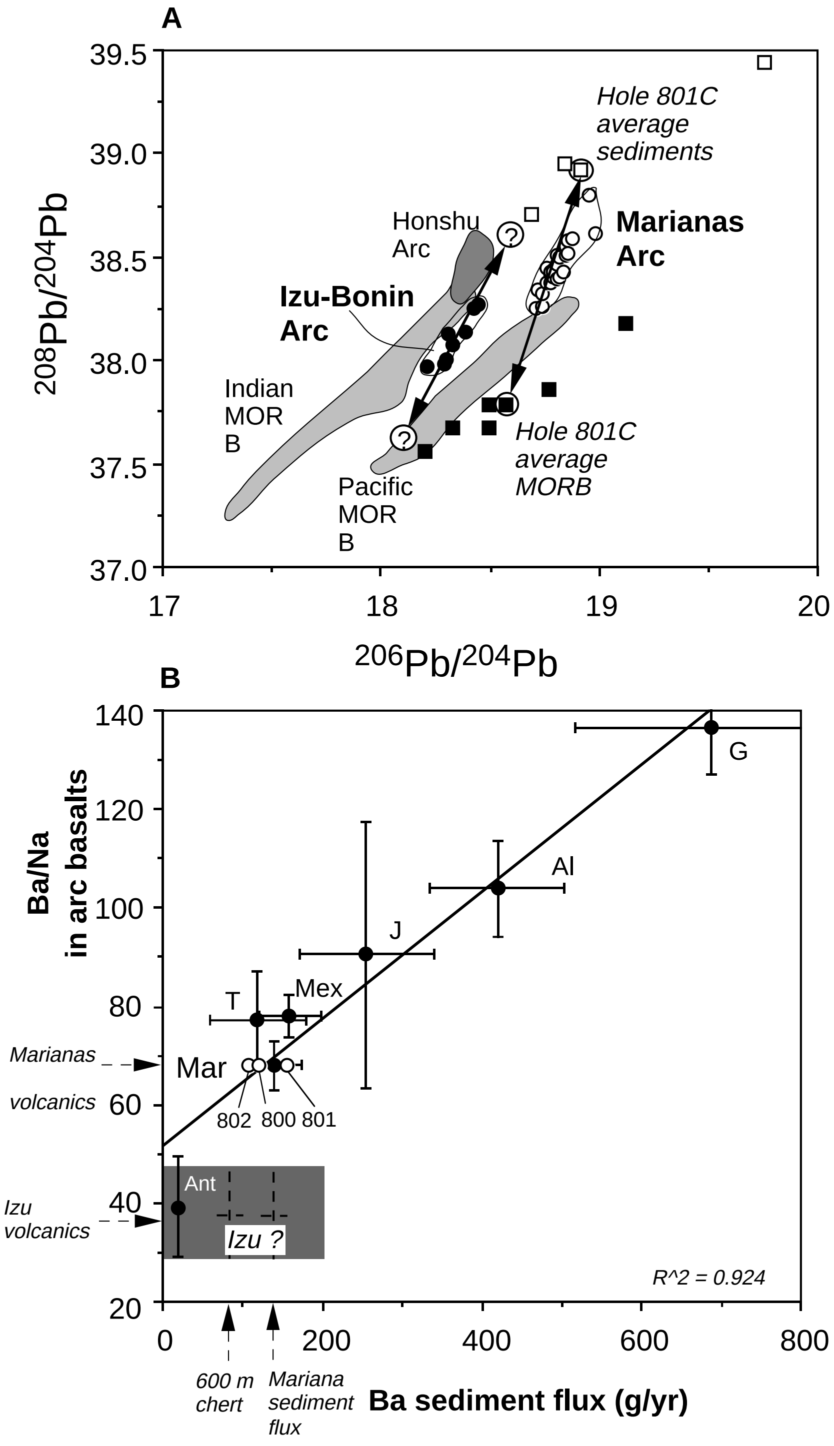

A
Hole 801C average sediments
Honshu Arc
Marianas Arc
Izu-Bonin Arc
Indian MOR B
Pacific MOR B
Hole 801C average MORB
$^{208}Pb/^{204}Pb$
$^{206}Pb/^{204}Pb$
B
Ba/Na in arc basalts
G
Al
J
Mex
T
Mar
802
800
801
Marianas volcanics
Izu volcanics
Ant
Izu ?
R^2 = 0.924
600 m chert
Mariana sediment flux
Ba sediment flux (g/yr)

Figure 3

Existing Water Mass Balance Across the Mariana Margin

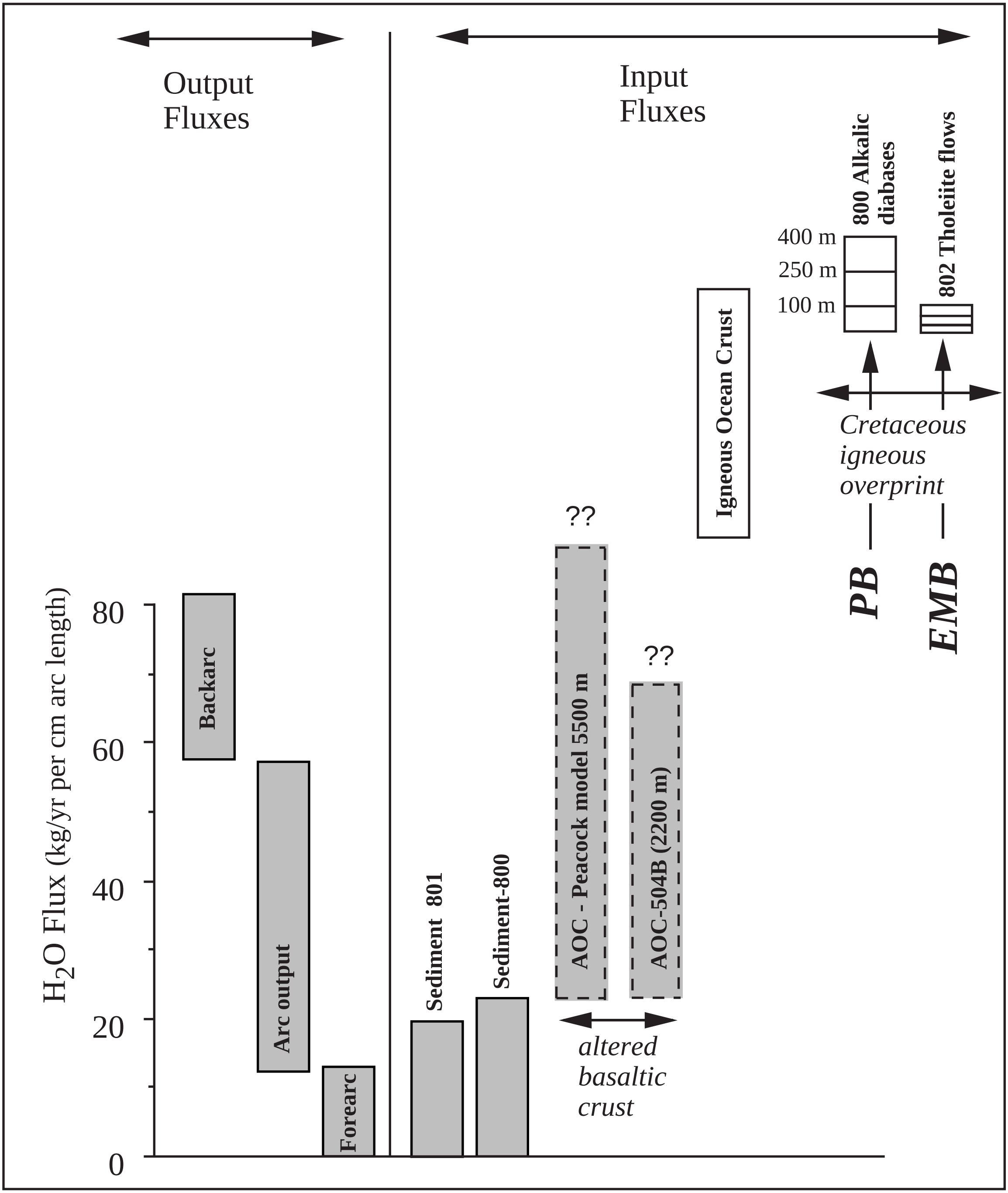


Figure 4

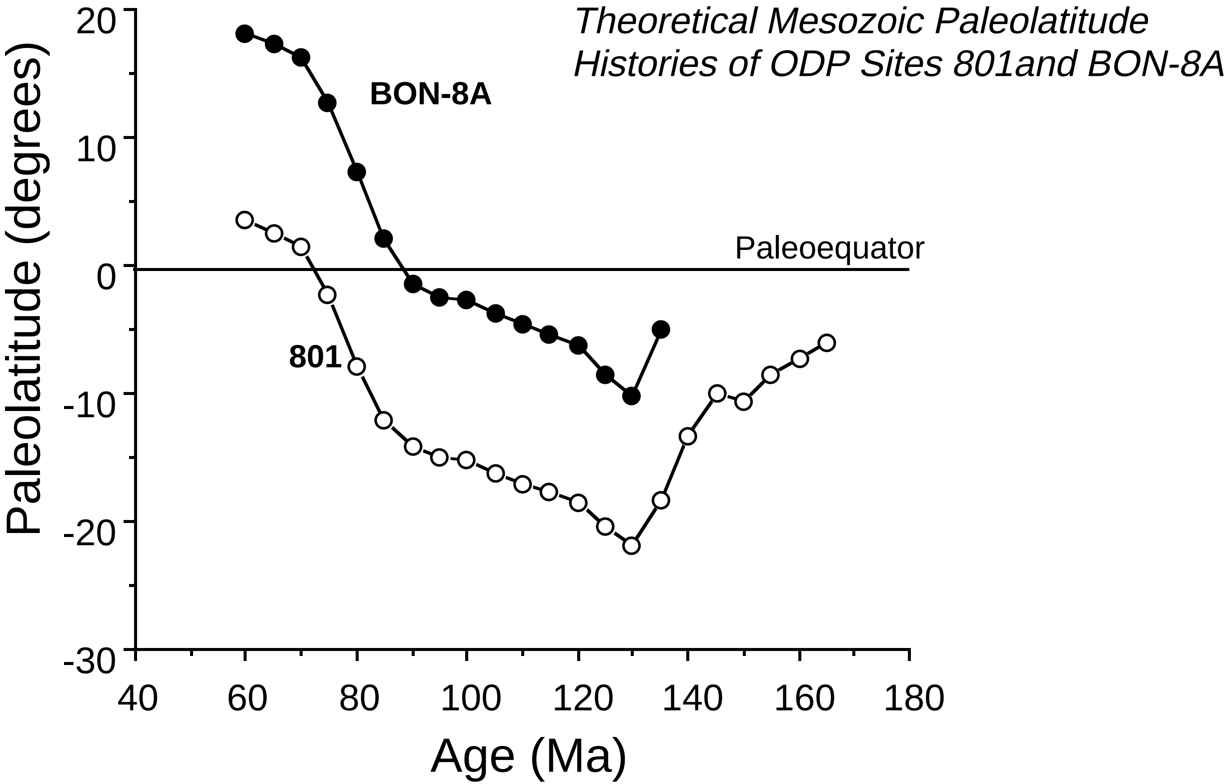

Theoretical Mesozoic Paleolatitude
Histories of ODP Sites 801and BON-8A
BON-8A
801
Paleoequator
Paleolatitude (degrees)
20
10
0
-10
-20
-30
40
60
80
100
120
140
160
180
Age (Ma)

Figure 5

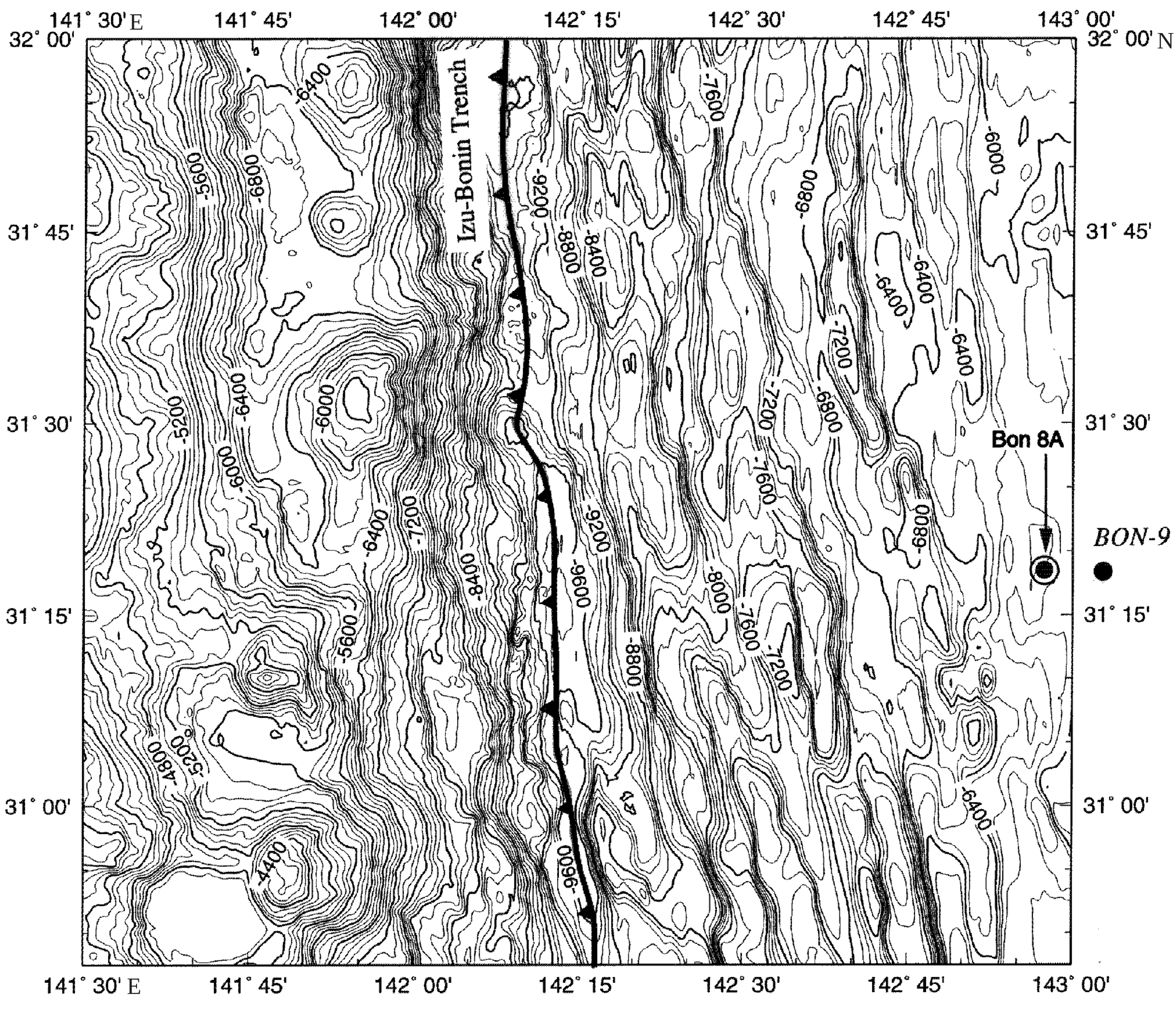

141° 30' E
141° 45'
142° 00'
142° 15'
142° 30'
142° 45'
143° 00'
32° 00'
32° 00' N
31° 45'
31° 30'
31° 15'
31° 00'
Izu-Bonin Trench
Bon 8A
BON-9

Figure 6

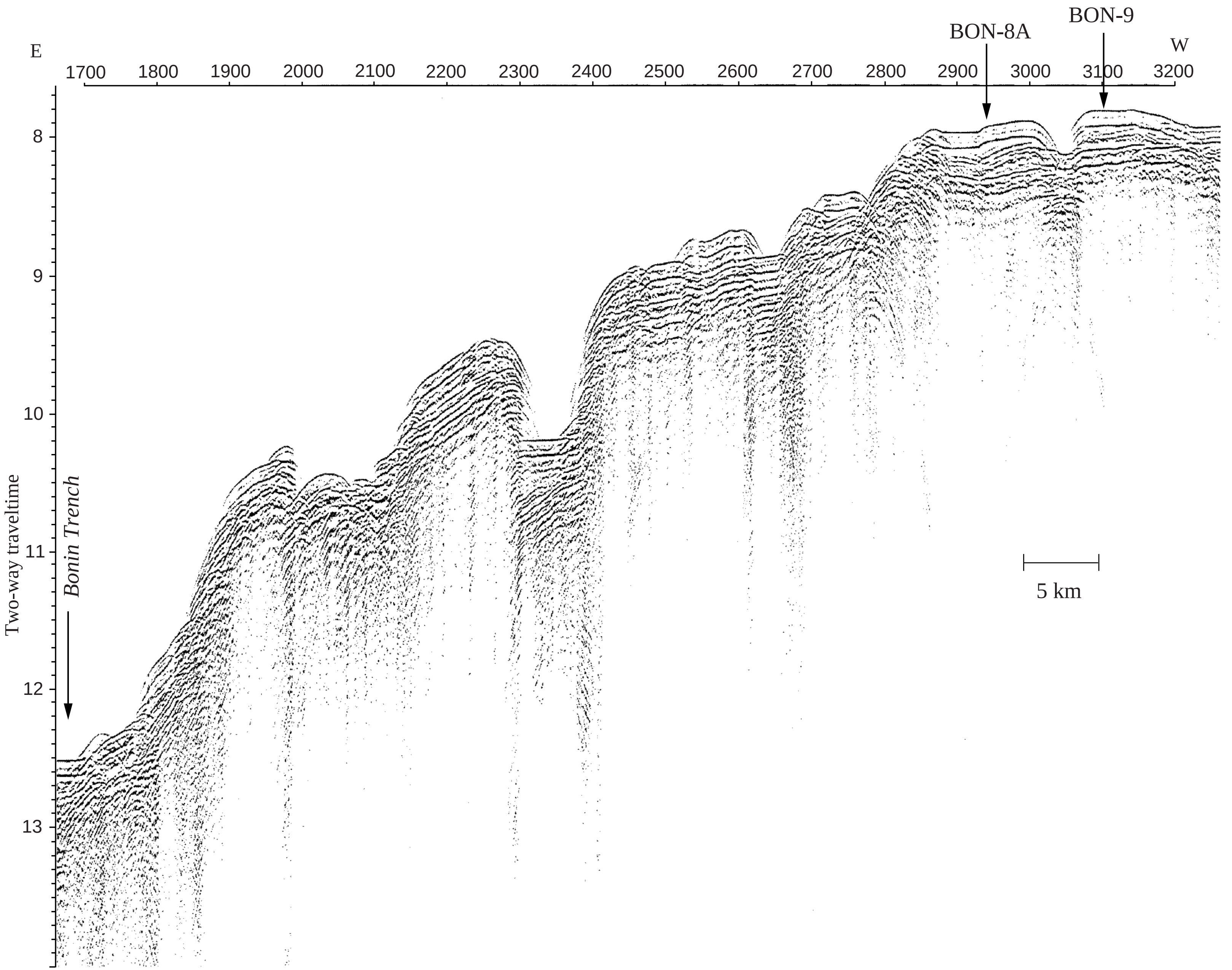

BON-8A
BON-9
E
W
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
3200
8
9
10
11
12
13
Two-way traveltime
Bonin Trench
5 km

Figure 7

Table 1. Leg 185 Operations Plan and Time Estimate

Site No.	Location Lat/Long	Water Depth	Operations Description	Transit (days)	Drilling (days)	Logging (days)	Total On-site
PRIMARY SITES							
Hong Kong	**Transit 2362 nmi from HONG KONG to 801C @ 9.5 kt**			10.4			
801C	18°38.54'N	5674 m	C: Deepen by RCB 252 m, DCB 54 m, Log		18.5	1.9	20.4
	156°21.6'E						
			Total Days on Site:				**20.4**
Port			**Transit 1097 nmi from 801C to BON-8A @ 10.5 kt**	4.5			
BON-8A	31°18.5'N	6000 m	A: APC 100 m, XCB 70 m, MDCB 13.5 m, XCB 96.5 m		4.2		4.2
	142°57.5'E		FFF reentry, DCB 198 m		3.7		3.7
			B: Drill 170 m, DCB 90 m		2.3		2.3
			C: Drill 495 m, Log		2.3	1.8	4.1
			D: Drill 470 m, RCB 110 m, Log (FFF reentry)		6.3	1.0	7.3
			Total Days on Site:				**21.6**
Tokyo			**Transit 268 nmi from BON-8A to TOKYO @ 10.5 kt**	1.1			
			Subtotals	**16.0**	**37.3**	**4.7**	**42.0**
				TOTAL DAYS: 58.0			
ALTERNATE SITES							
PIG-3B	18°39.78'N	5700 m	A: Install reentry cone, dual casing, drill to 594 mbsf		9.7		9.7
	157°5.7'E		RCB 300 m, Log		17.6	1.9	19.5
			Total Days on Site:				**29.2**
BON-9	31°18.5'N	5875 m	A: APC 100 m, XCB 70 m, MDCB 13.5 m, XCB 96.5 m		4.1		4.1
	143°2.5'E		FFF reentry, DCB 198 m		3.6		3.6
			B: Drill 170 m, DCB 90 m		2.3		2.3
			C: Drill 495 m, Log		2.3	1.8	4.1
			D: Drill 470 m, RCB 110 m, Log (FFF reentry)		6.2	1.0	7.2
			Total Days on Site:				**21.3**

DIR: **ODPPUB.ART:185 Dropbox:PDF** **BY:**

SITE SUMMARIES

Site: BON-8A

Priority: 1
Position: 31°18.5´N, 142°57.5´E
Water Depth: 6000 m
Sediment Thickness: 600 m
Target Drilling Depth: 900 mbsf
Approved Maximum Penetration: 900 mbsf
Seismic Coverage: Conrad 2005, Line 39, shotpoint #2936 at 1613Z on 10/13/76

Objectives: The objectives of BON-8A are the following

1. Provide estimates of the sediment inputs and altered basalt inputs (geochemical fluxes) into the Izu-Bonin subduction zone.

2. Contrast crustal budgets here with those for the Marianas to test whether along-strike differences in the volcanics can be explained by along-strike variations in the crustal inputs.

3. Compare basement alteration characteristics with those in Hole 801C (also in old Pacific crust).

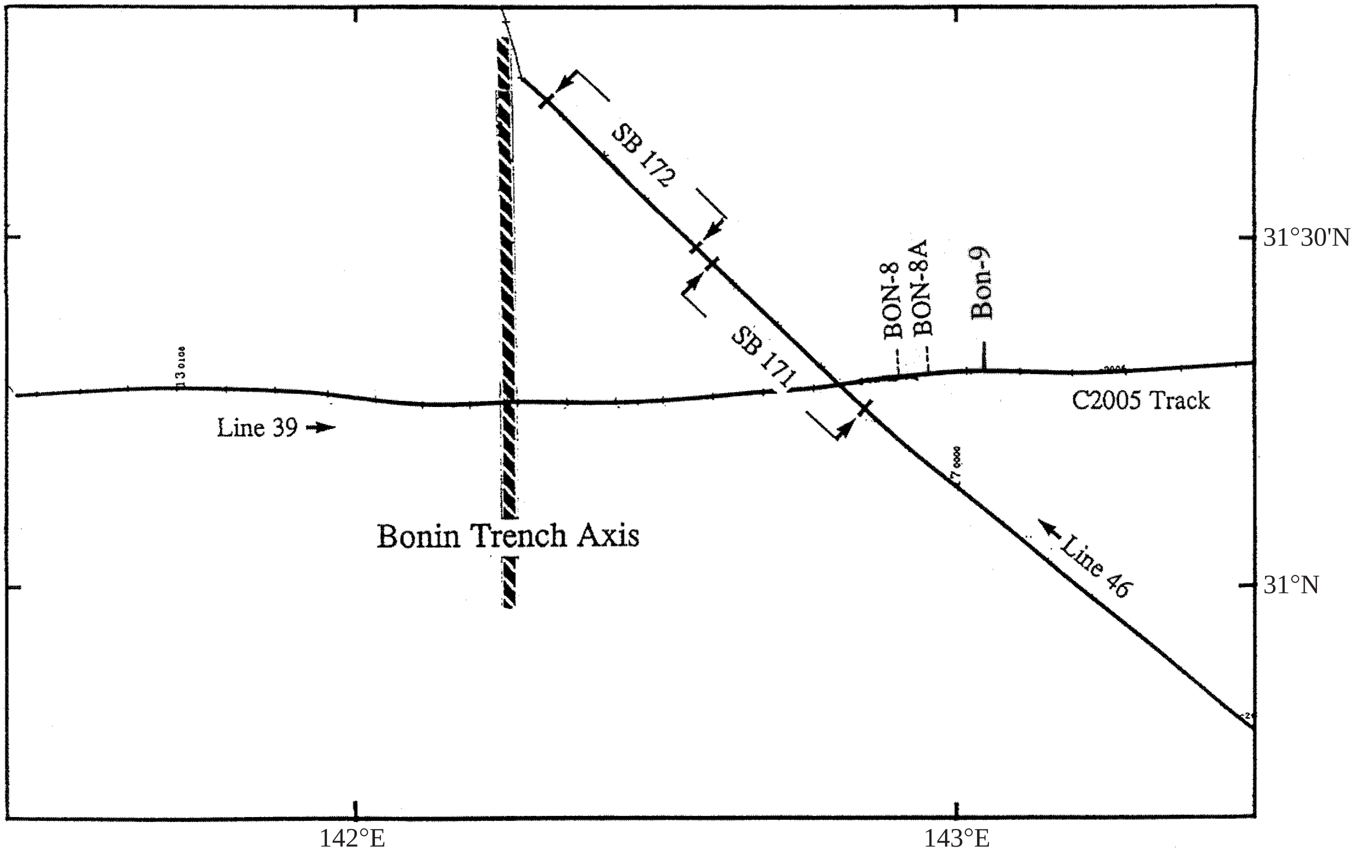
4. Provide constraints on the Early Cretaceous paleomagnetic time scale.

5. Provide constraints on mid-Cretaceous carbonate compensation depth (CCD) and equatorial circulation fluctuations.

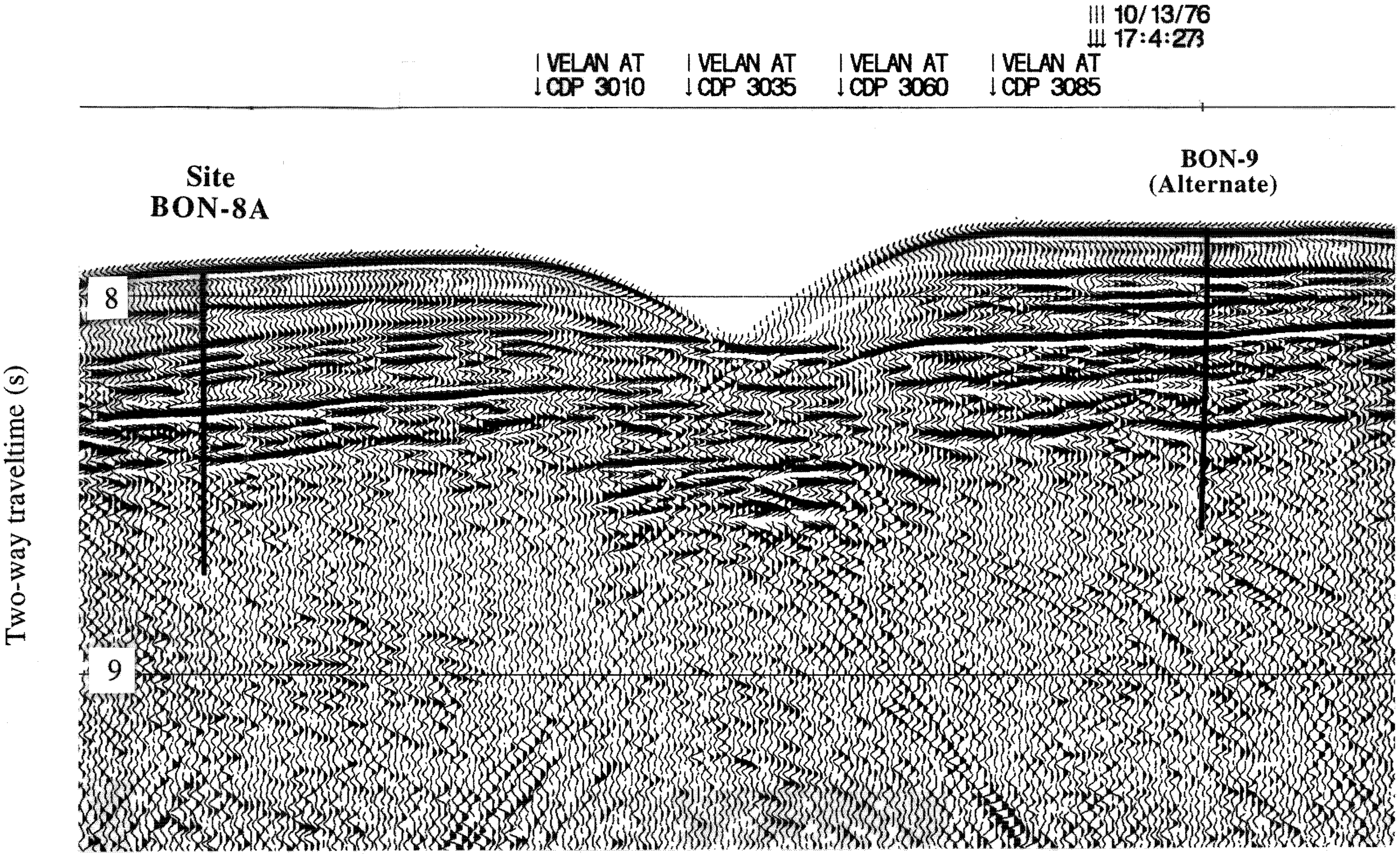
Drilling Program: APC, XCB, MDCB, RCB

Logging and Downhole Operations: Triple combo, GLT, FMS/Sonic, GHMT, ARI, Permeability

Nature of Rock Anticipated: Pelagic clay with volcanic arc ash (150 m); cherty porcellanites and chalks (450 m); basaltic pillows, flows, breccia, and possibly dikes (>300 m)



Conrad 2005 track chart showing site location of Leg 185 Site BON-8A and Bon-9 (alternate) as well as the axis (deepest portion) of the Bonin Trench.



10/13/76
17:4:273
VELAN AT CDP 3010
VELAN AT CDP 3035
VELAN AT CDP 3060
VELAN AT CDP 3085
Site BON-8A
BON-9 (Alternate)
Two-way traveltime (s)
8
9

Site: BON-9

Priority: 2
Position: 31°18.5´N, 143°2.5´E
Water Depth: 5875 m
Sediment Thickness: 600 mbsf
Target Drilling Depth: 900 mbsf
Approved Maximum Penetration: 900 mbsf
Seismic Coverage: Conrad 2005, Line 39

Objectives: The objectives of Site BON-9 are the same objectives as the primary site, BON-8A.

Drilling Program: Triple APC/XCB, MDCB, RCB

Logging and Downhole: Same as Site BON-8A

Nature of Rock Anticipated: Same as Site BON-8A

Site: 801

Priority: 1
Position: 18°38.52´N, 156°21.6´E
Water Depth: 5674 m
Sediment Thickness: 460 m
Target Drilling Depth: >850 mbsf
Approved Maximum Penetration: 950 mbsf
Seismic Coverage: MESOPAC II, Line 10 at 0600, 8/26/89

Objectives: The objectives of Site 801 are to:

1. Characterize the geochemical fluxes and geophysical aging attending the upper oxidative alteration of the oceanic crust in Hole 801C.

2. Compare igneous compositions, structure, and alteration with other drilled sections of in situ oceanic crust (in particular Hole 504B, contrasting a young site in Pacific crust with the oldest site in Pacific crust).

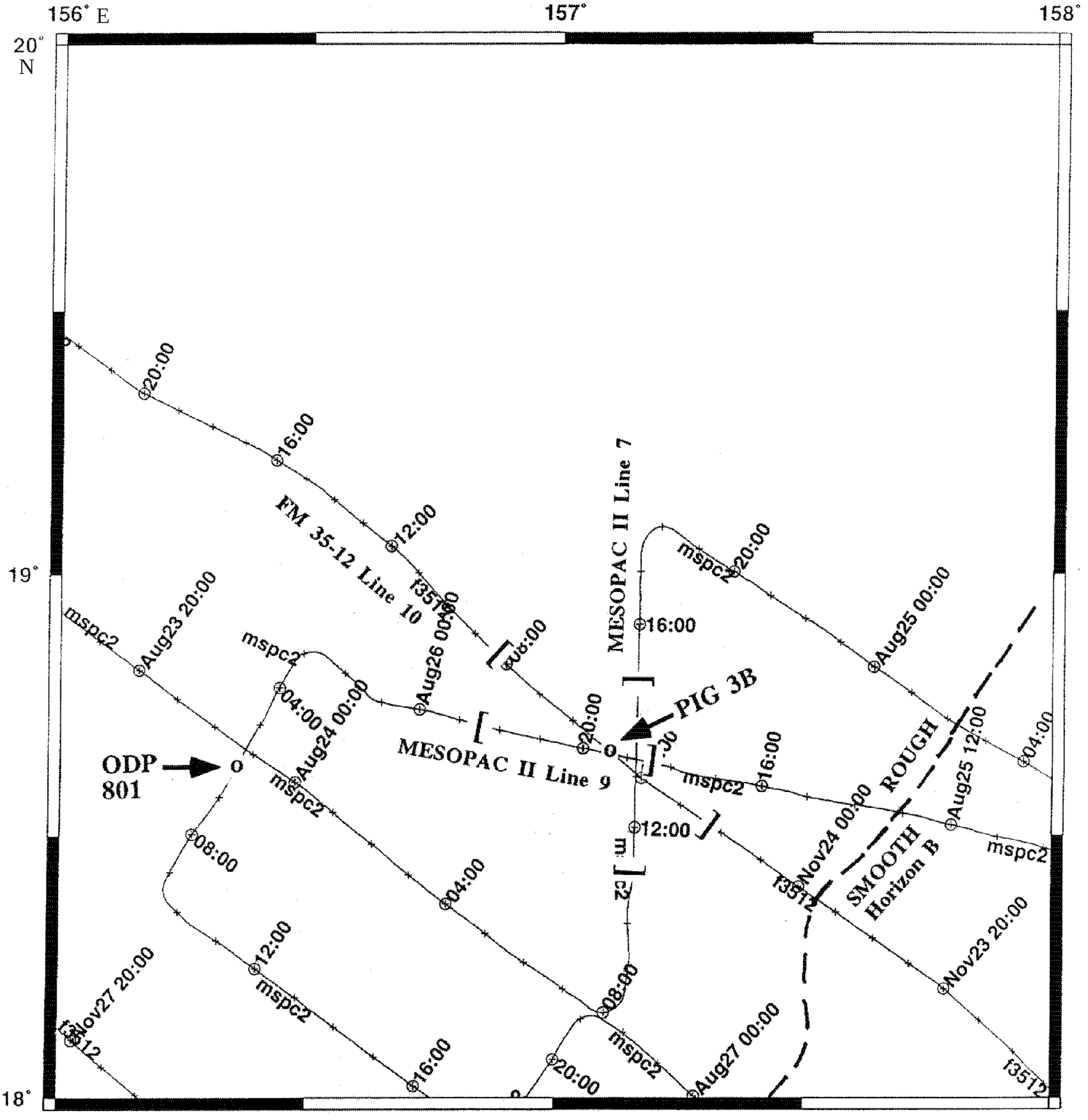
3. Help constrain models for seafloor alteration that depend on spreading rate and age (Hole 801C contains the world's oldest oceanic crust drilled to date, which was formed at a fast-spreading ridge, so it embodies several end-member characteristics).

4. Test models for the Jurassic Magnetic "Quiet" Zone.

Drilling Program: RCB

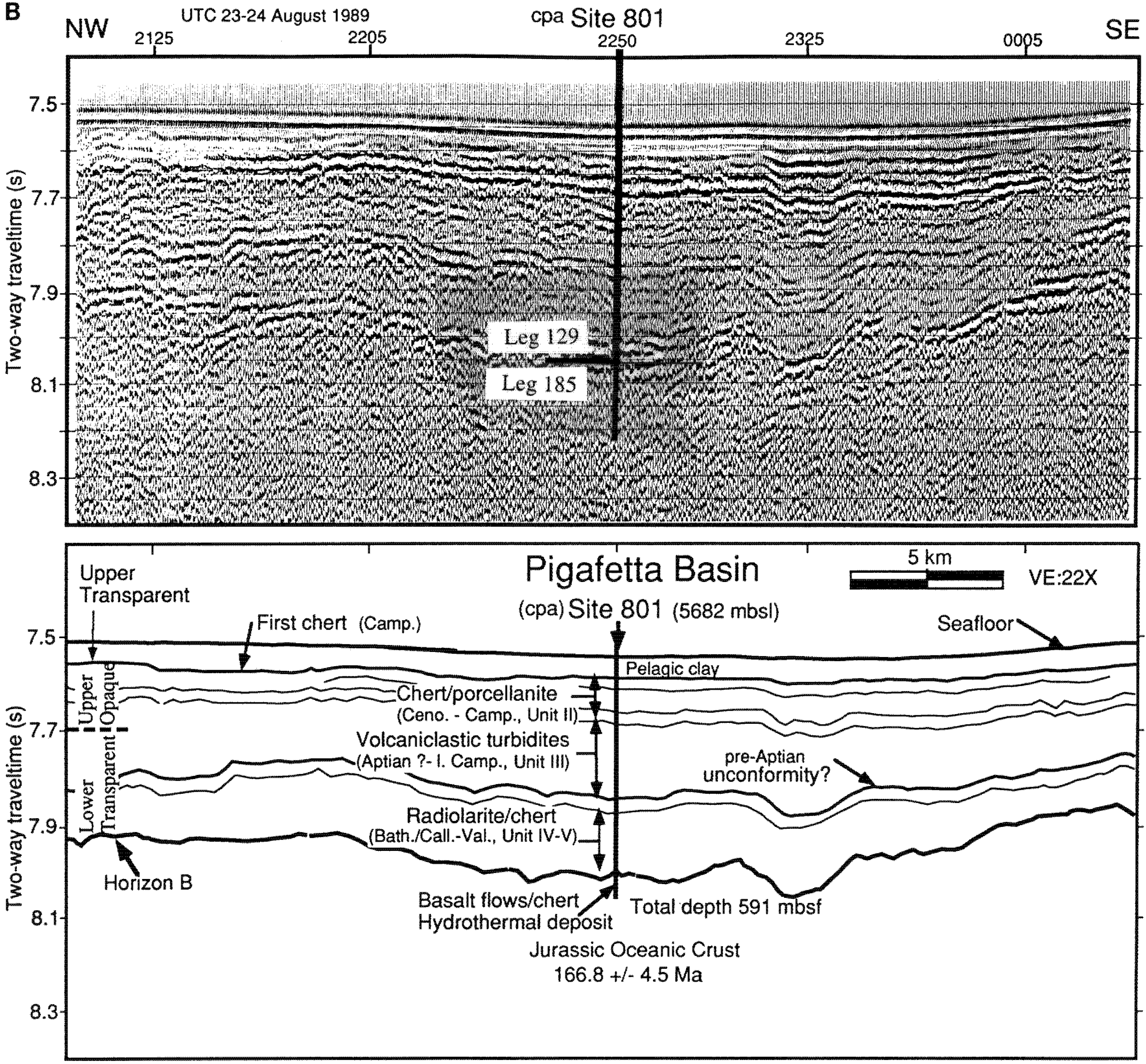
Logging and Downhole Operations: Triple Combo, GLT, FMS/Sonic, ARI, Permeability

Nature of Rock Anticipated: Basaltic pillows, flows, breccia, and possibly dikes (>350 m)



GMT Jun 13 14:19 pstrack -Jm3.2 -R156/158/18/20 -A -Ba1f.5g0 -Ma4ht1h -N100 -Uc -V

B



NW
UTC 23-24 August 1989
cpa Site 801
SE
2125
2205
2250
2325
0005
Two-way traveltime (s)
7.5
7.7
7.9
8.1
8.3
Leg 129
Leg 185
Pigafetta Basin
5 km
VE:22X
(cpa) Site 801 (5682 mbsl)
Upper Transparent
First chert (Camp.)
Seafloor
Pelagic clay
Upper Opaque
Chert/porcellanite
(Ceno. - Camp., Unit II)
Volcaniclastic turbidites
(Aptian ?- l. Camp., Unit III)
pre-Aptian unconformity?
Lower Transparent
Radiolarite/chert
(Bath./Call.-Val., Unit IV-V)
Horizon B
Basalt flows/chert
Hydrothermal deposit
Total depth 591 mbsf
Jurassic Oceanic Crust
166.8 +/- 4.5 Ma

Site: PIG-3B

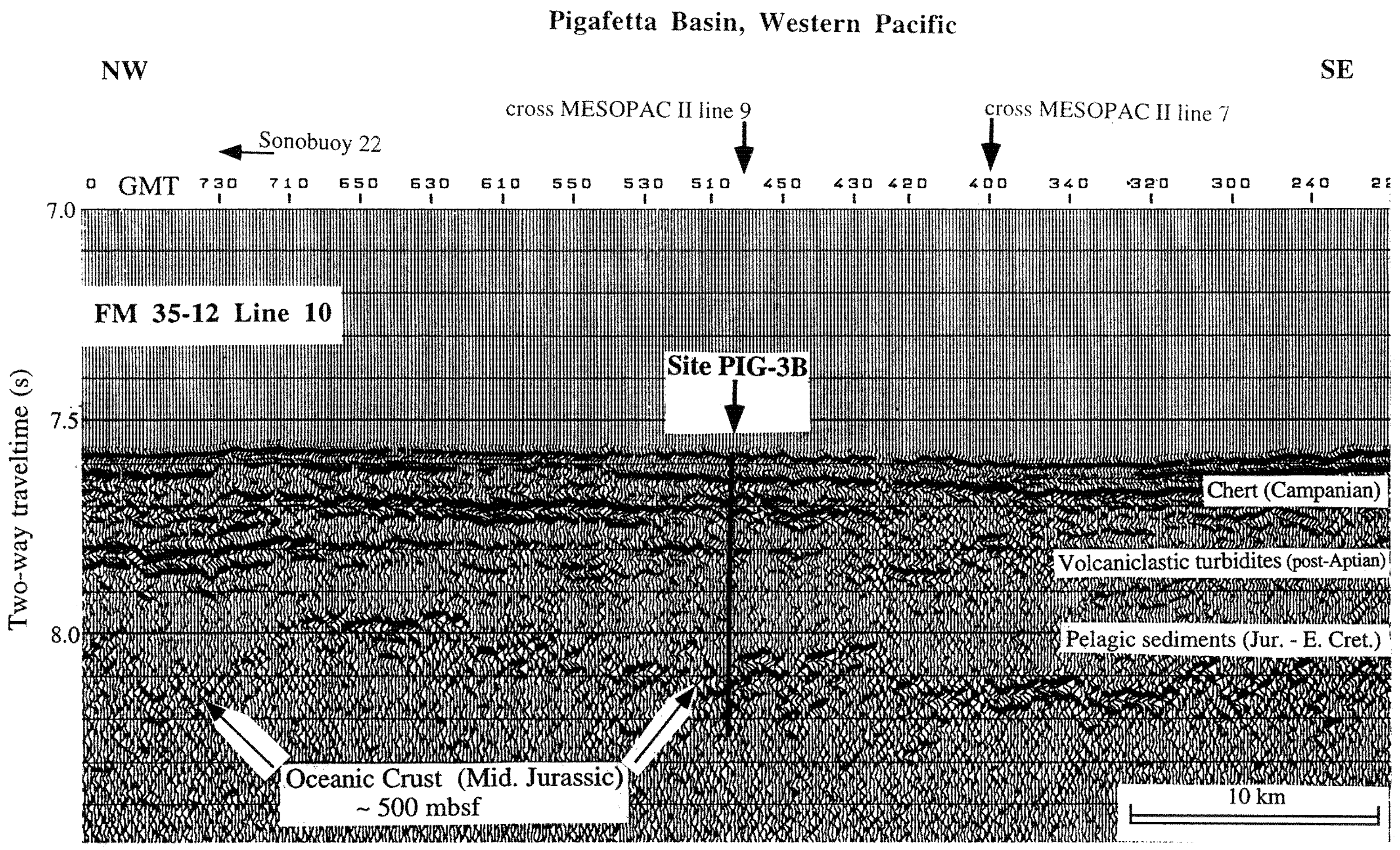
Priority: 2
Position: 18°39.78´N, 157°5.7´E
Water Depth: 5700 m
Sediment Thickness: 460 m
Target Drilling Depth: 1000 mbsf
Approved Maximum Penetration: mbsf
Seismic Coverage: MESOPAC II, Line 9

Objectives: The objectives of Site PIG-3B are the same objectives as the primary site, Site 801.

Drilling Program: Triple APC/XCB to <350 m

Logging and Downhole: Same as Site 801

Nature of Rock Anticipated: Same as Site 801


Pigafetta Basin, Western Pacific
NW
SE
cross MESOPAC II line 9
cross MESOPAC II line 7
Sonobuoy 22
GMT
730
710
650
630
610
550
530
510
450
430
420
400
340
320
300
240
7.0
7.5
8.0
Two-way traveltime (s)
FM 35-12 Line 10
Site PIG-3B
Chert (Campanian)
Volcaniclastic turbidites (post-Aptian)
Pelagic sediments (Jur. - E. Cret.)
Oceanic Crust (Mid. Jurassic)
~ 500 mbsf
10 km

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