OCEAN DRILLING PROGRAM

LEG 187 SCIENTIFIC PROSPECTUS

MANTLE RESERVOIRS AND MIGRATION ASSOCIATED WITH AUSTRALIAN-ANTARCTIC RIFTING

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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.

Technical Editors: Karen K. Graber and Ginny Lowe

ABSTRACT

The Australian-Antarctic Discordance (AAD) is an anomalously deep region centered on the Southeast Indian Ridge (SEIR) between Australia and Antarctica. Among its unique features is an unusually sharp boundary between the ocean-basin scale upper mantle isotopic domains of the Pacific and Indian Oceans. This boundary has migrated westward into and across the easternmost segment of the AAD at a rate of 25-40 mm/yr during the last 4 m.y., yet the long-term relationship of this important boundary to the AAD remains unclear. There is limited evidence to suggest that the boundary has been migrating westward for ~40 m.y., since the separation of the South Tasman Rise from Antarctica. However, it seems likely, perhaps even probable, that the isotopic boundary is genetically linked to the mantle processes that have maintained the existence of the AAD for >90 m.y., since Australia and Antarctica first rifted apart.

The long-term configuration and dynamic history of the isotopic boundary can be determined by systematic off-axis sampling beyond the limit of effective dredging (~7 Ma). During Leg 187, we will extend the sampling program to older crust (10-30 Ma). An array of 19 drill sites has been designed to determine the configuration of the isotopic boundary and to distinguish among competing hypotheses concerning the nature and extent of mantle migration beneath the SEIR. Approximately 10-12 single-bit holes will sample 20-100 m (ideally about 50 m) into igneous basement. A reactive drilling strategy will allow the selection of later sites within a few hours of core recovery on the basis of trace element data obtained from the earlier sites.

INTRODUCTION

Lavas erupted at Indian Ocean spreading centers are isotopically distinct from those of the Pacific Ocean, reflecting a fundamental difference in the composition of the underlying upper mantle. Along the Southeast Indian Ridge (SEIR), the Indian Ocean and Pacific Ocean isotopic provinces are separated by a uniquely sharp boundary. This boundary has been located to within 25 km along the spreading axis of the SEIR within the Australian-Antarctic Discordance (AAD; Klein et al., 1989; Pyle et al., 1992; Christie et al., 1998), and subsequent off-axis sampling has shown that the Pacific mantle has migrated rapidly westward during at least the last 4 m.y. Specifically, Leg

187 investigations will delineate this boundary farther off-axis, allowing us to infer its history over the last 30 m.y.

Because of its proximity to the AAD, this project exploits a unique opportunity to quantify the dynamic behavior and composition of the Earth's upper mantle. In terms of the Ocean Drilling Program (ODP) Long Range Plan, this proposal addresses a fundamental problem in mantle dynamics, including relationships among ocean crustal composition, mantle composition, spreading, and magma supply rates. It also has strong ties to the U.S. Ridge Interdisciplinary Global Experiments (RIDGE) program and the international InterRidge program.

BACKGROUND

Introduction

The AAD (Fig. 1) is a unique region within the global mid-ocean spreading system. It encompasses the deepest (4-5 km) region of the global mid-oceanic spreading system. Its anomalous depth reflects the presence of both unusually cold underlying mantle and thin crust. Despite a uniform spreading rate, the eastern boundary of the AAD coincides with an abrupt morphologic change from an axial ridge with smooth abyssal topography off-axis (characteristics usually associated with fast-spreading centers) to deep axial valleys with rough off-axis topography (characteristics usually associated with slow spreading). Other anomalous characteristics of the AAD include a pattern of relatively short axial segments separated by long transforms with alternating offset directions, extremely thin oceanic crust, high upper mantle seismic wave velocities, and an intermittent asymmetric spreading history (Weissel and Hayes, 1971, 1974; Forsyth et al., 1987; Marks et al., 1990; Sempéré et al., 1991; Palmer et al., 1993; West et al., 1994, 1997; Christie et al., 1998). Multiple episodes of ridge propagation from both east and west toward the AAD suggest that the upper mantle is converging toward this region (Vogt et al., 1984, West and Lin, unpubl. data). Indeed, from recent numerical model studies, significant subaxial mantle flow converging on the AAD appears to be an inevitable consequence of gradients in upper mantle temperature around the AAD. Finally, the morphological contrasts across the eastern boundary of the AAD are paralleled by distinct contrasts in the nature and variability of axial lavas, reflecting fundamental differences in magma supply because of strong contrasts in the thermal regime of the spreading center.

Within the easternmost AAD, there is a distinct discontinuity in the Sr, Nd, and Pb isotopic signatures of axial lavas that marks the boundary between Indian Ocean and Pacific Ocean mid-ocean ridge basalt (MORB) mantle provinces (Klein et al., 1988; Pyle et al., 1990; 1992). The boundary itself is remarkably sharp, although there is a gradation within the Pacific region toward Indian Ocean characteristics within 50-100 km of the boundary (Fig. 2). At zero-age seafloor, the boundary is located within 20-30 km of the ~126°E transform—the western boundary of the easternmost AAD spreading segment. The boundary has migrated westward across this segment during the last 3-4 m.y. (Pyle et al., 1990, 1992; Lanyon et al., 1995, Christie et al., 1998) (Figs. 3, 4).

Although such a sharp boundary between ocean-basin-scale upper-mantle isotopic domains is unique along the global mid-ocean ridge system, its long-term relationship to the remarkable geophysical, morphological, and petrological features of the AAD is unclear. The AAD is a long-lived major tectonic feature. Its defining characteristic is its unusually deep bathymetry, which stretches across the ocean floor from the Australian to the Antarctic continental margins. The trend of this depth anomaly forms a shallow west-pointing V-shape cutting across the major fracture zones that currently define the eastern AAD segments (Figs. 1, 4). This V-shape implies that the depth anomaly has migrated westward at a long-term rate of ~15 mm/yr (Marks et al., 1991), which is much slower than the recent migration rate of the isotopic boundary discussed above. The depth anomaly may, in fact, have existed well before continental rifting began ~100 m.y. The presence of restricted sedimentary basins on both continents suggests that precursors of the present AAD may have existed for as long as 300 m.y. (Veevers, 1982; Mutter et al., 1985).

Possible long-term relationships between the isotopic boundary and the morphologically defined AAD fall into two distinct classes, schematically illustrated in Figure 4. Either the recent isotopic boundary migration is simply a localized (~100 km) perturbation of a geochemical feature that has been associated with the eastern boundary of the AAD since the basin opened, or the migration is a long-lived phenomenon that has only recently brought Pacific mantle beneath the AAD. In the first case, the boundary could be related either to the depth anomaly or to the eastern bounding transform, but not to both in the long term. In the second case, the isotopic boundary has only recently arrived beneath the AAD. Although the latter possibility may initially seem fortuitous, it has been independently suggested that Pacific mantle has migrated westward into the region since

40-50 Ma, when separation of the South Tasman Rise from Antarctica first allowed upper mantle flow from the Pacific to the Indian Ocean basin (Alvarez, 1982, 1990). Indian and transitional isotopic signatures from altered ~38- and ~45-Ma basalts dredged to the north and east of the AAD (Lanyon et al., 1995) and from 60- to 69-Ma Deep Sea Drilling Project (DSDP) basalts that were drilled close to Tasmania (Pyle et al., 1992) provide limited support for this hypothesis. Recent off-axis sampling in Zone A (Christie et al., 1998) constrains any such boundary to lie within the shaded region of Figure 4 and perhaps requires a hiatus of at least 3 m.y. between the first arrival of Pacific mantle at the eastern boundary of the AAD and its initial penetration into the AAD proper (West and Christie, 1997; Christie et al., 1998).

The Nature of the Indian Ocean MORB Mantle Province

The mantle source for Indian Ocean MORB is distinct from that of the Pacific Ocean MORB in having distinctly lower $^{206}Pb/^{204}Pb$ and $^{208}Pb/^{204}Pb$ and higher $^{87}Sr/^{86}Sr$, as well as systematically lower $^{207}Pb/^{204}Pb$ and $^{143}Nd/^{144}Nd$ (Figs. 2, 3). The sharpness of the Indian/Pacific boundary, as expressed in the seafloor lavas, suggests that Indian MORB mantle presently abuts Pacific MORB mantle beneath the AAD, with little or no intermingling. In contrast, along the Southwest Indian Ridge, there is a much more gradational transition from Indian- to Atlantic-type mantle (Mahoney et al., 1992).

The distinctive characteristics of Indian MORB mantle have been variously attributed to the widespread dispersal throughout an otherwise "typical" depleted upper mantle of material with distinctive isotopic characteristics derived from one or more of the following: (1) Indian Ocean hot spot sources, especially the large long-lived Kerguelen mantle plume, (2) lower continental lithosphere derived from the breakup of Gondwanaland, and/or (3) convectively recycled subducted altered oceanic crust (e.g., Subbarao and Hedge, 1973; Hedge et al., 1973; Dupré and Allègre, 1983; Hamelin et al., 1985; Hamelin and Allègre, 1985; Hart, 1984; Michard et al., 1986; Price et al., 1986; Dosso et al., 1988; Klein et al., 1988; Mahoney et al., 1989). The Indian MORB isotopic signature has also been attributed to the interaction of Gondwana continental lithosphere with the Kerguelen mantle plume before India rifted from Australia (Storey et al., 1988; Mahoney et al., 1989, 1992).

Away from the spreading centers, the extent of the Indian MORB mantle is only poorly known. In the region of interest for Leg 187, Pyle et al. (1992) analyzed all available drilled material. They showed that Indian mantle has been present at 110°E, to the east of Kerguelen, since at least 30-40 Ma, and that it may have been present to the east of the AAD before 39 Ma (Pyle et al., 1992; Lanyon et al., 1995). No basalts of Indian affinity have been reported east of the South Tasman Rise at any age, and none younger than 30 Ma are known anywhere east of the AAD. In addition, all samples analyzed so far from recent sampling of the SEIR west of the AAD are clearly of Indian type (L. Hall, J. Mahoney, pers comm., 1998).

The dispersion of Indian mantle and its areal extent may be controlled by one or more of the following:

1. Flattening of the heads of large mantle plumes (~2000 km) (Mahoney et al., 1992);
2. Global-scale upper mantle convection (Hamelin and Allègre, 1985) and, more specifically, advection by temperature gradient-driven mantle flow within the ocean basin (West et al., 1997);
3. Isolation of the upper mantle by the deep roots of the surrounding Gondwana continents (Alvarez, 1982, 1990); and
4. Restriction of this upper mantle province to the limits of Archean subcontinental lithosphere beneath the Gondwana continents (Klein et al., 1988).

Regardless of its origin and evolution, the nature and behavior of this isolated reservoir can be better understood through a better definition of the configuration and, hence, the dynamics of its eastern boundary. Because this boundary is so sharply defined and uncontaminated by hot spots or other nearby perturbations and because the plate motions between Australia and Antarctica are uncomplicated and well known, simple testable predictions can be made for a broad range of hypotheses.

The Origin and Evolution of the Isotopic Boundary

The most direct objective of this proposal is to define, as closely as possible, the off-axis configuration of the Indian/Pacific mantle isotopic boundary. In addition to its importance as a "local" phenomenon, an improved understanding of this boundary is important for a broader general understanding of the oceanic mantle. In investigating the origins of the AAD and the isotopic boundary, we are also investigating the importance of variations in geochemistry, isotopic makeup, temperature, and other physical characteristics of the oceanic upper mantle in general. Improved knowledge of the distribution of these chemical and physical characteristics in space and time will lead to a better understanding of the dynamics of the oceanic mantle and of its interaction with the magmatic processes of the mid-ocean ridge system.

Three possible end-member configurations of the isotopic boundary on the Southern Ocean seafloor are illustrated in Figure 4. In the simplest configuration, the isotopic boundary has always been associated with the eastern boundary of the AAD and therefore follows a flow line oriented approximately north-south. Small-scale (~100 km) perturbations in the east-west position of the Indian/Pacific MORB boundary would be consistent with the apparent westward migration of the boundary along segment B5 in the eastern AAD during the last 4 m.y. In the second case, the boundary is associated with the depth anomaly and follows its trace off-axis. The V-shaped cofiguration of this trace requires that it has moved westward at ~15 mm/yr (Marks et al., 1991); whereas, the recent migration rate of the isotopic boundary is 25-40 mm/yr (Pyle et al., 1992, Christie et al., 1998), again requiring small-scale east-west fluctuations in the boundary position to be superimposed on the more gradual (~15 mm/yr) westward motion. In the third case, the isotopic boundary is produced by steady westward migration of Pacific mantle since rifting of the South Tasman Rise. In this case, a reasonable rate for Pacific mantle inflow can be calculated from the assumption that a continental barrier to mantle flow was removed at ~40 Ma, when circum-Antarctic ocean circulation was established south of Tasmania (Royer and Sandwell, 1989; Mutter et al., 1985). This rate is comparable to the recent migration rate of the boundary within the AAD and to the propagation rates (which likely reflect mantle flow; West and Lin, unpubl. data) of three westward-propagating rifts along the SEIR east of the AAD. This rate is a long-term average, however, and systematic variations in the along-axis migration rate could be expected with the opening of the ocean basin (West et al., 1997).

Subsurface Biosphere

Recent findings have extended the biosphere to include microbial life in deep subsurface volcanic regions of the ocean floor (Thorseth et al., 1995; Furnes et al., 1996; Fisk et al., 1998; Torsvik et al., 1998). Much attention has been recently focused toward the existence of microbes living on and contributing to the alteration of basaltic glass in lavas from the upper part of the oceanic crust (Thorseth et al., 1995; Furnes et al., 1996; Fisk et al., 1998; Torsvik et al., 1998). The first recognized evidence of this phenomena was from textures in basaltic glass from Iceland (Thorseth et al., 1992). Similar textures were later found in basaltic glass from ODP Hole 896A at the Costa Rica Rift, and the microbial contribution to the alteration history was supported by the presence of DNA along the assumed biogenic alteration fronts (Thorseth et al., 1995; Furnes et al., 1996; Giovannoni et al., 1996). Microbes have recently been documented to inhabit internal fracture surfaces of basaltic glass that specifically were sampled for microbiologic studies during *Mir* submersible dives to the Knipovich Ridge (Thorseth et al. 1999). The presence of dissolution textures underneath many microbes, and manganese and iron precipitates next to microbes, suggests that microbial activity does play an active role in the low-temperature alteration of ocean-floor basalts.

The planned sampling of ocean-floor basalts that range in age from 7 to 30 Ma provides an opportunity to study how microbial alteration progresses with time. It also allows us to isolate microbes in ODP samples taken under specific conditions where the effect of drilling related contamination may be evaluated.

SCIENTIFIC OBJECTIVES

During and after drilling, the primary objective will be to locate the Indian/Pacific isotopic boundary and determine its configuration out to at least 30 Ma. From this information, we will infer the geometry and dynamics of these two mantle reservoirs and their boundary. In addition, there are number of subsidiary objectives. These can be divided into geochemical, geophysical, and microbiological categories for discussion, but we emphasize that these are strongly interrelated and that we will be seeking to thoroughly integrate all the results.

Geochemical Objectives

Geochemical analysis provides the principal tool for locating the isotopic boundary, even if the boundary proves to have a morpho-tectonic expression, as observed within the AAD (Christie et al., 1998). However, the geochemical objectives of Leg 187 extend well beyond this simple task to the problem of defining and understanding the nature and origin of the distinct Pacific and Indian geochemical signatures. Some specific questions that we will address are

- What is the connection between the isotopic boundary and the known "Indian" samples from the DSDP sites near Tasmania and from the Lanyon et al. (1995) dredges northeast of the AAD? If a long-term migrating boundary is identified in Zone A, then these sites might be interpreted as representing Indian mantle that was present throughout the region before the influx of Pacific mantle began. If the boundary is shown not to have migrated across Zone A, then one might conclude that these sites are more influenced by their proximity to the Australian continent than to the Indian Ocean per se. The importance of these questions extends beyond the immediate region. They are relevant to our understanding of the origin of the isotopic signature of Indian Ocean mantle, and they will prove particularly important in considering the origin of recently identified "Indian" samples from western Pacific backarcs (Hergt and Hawkesworth, 1994) and from the Chile Rise in the eastern Pacific (Klein and Karsten, 1995; Karsten et al., 1996; Sherman et al., 1997).

- The shape of the isotopic boundary can potentially contribute to our understanding of the origin of the AAD. Can it, for example, be traced back to some particular feature of the Australian and Antarctic continents, such as the eastern boundary of the Australian craton?

A secondary objective of the program will be to study the long-term petrologic history of the AAD. Have there been changes in depth and/or extent of melting through time? Can we infer temporal changes in mantle temperature beneath the AAD? Has the underlying cold mantle become warmer or colder through time? Have the petrological contrasts between Zone A and AAD lavas persisted through time?

Geophysical Objectives

Geophysical objectives will primarily focus on understanding the mantle dynamics of the region and their relation to the anomalous processes within the AAD. As part of the scientific effort associated with the 1996 cruise, West et al. (1997) and West and Christie (1997) have developed a suite of three-dimensional mantle-flow models specifically tailored to the tectonic history and segmentation characteristic of the eastern SEIR. In addition to integrating cooler-than-normal mantle temperatures beneath the AAD with along-axis asthenospheric flow toward the AAD, these models have a number of important features significant to this proposal:

- Lateral mantle flow appears to be an inevitable consequence of the separation of the continents and mantle temperature gradients. During initial rifting of the continents, simple divergence is the sole force inducing flow, but as the continents separate, a mantle temperature gradient is required to maintain mantle flow consistent with known limits on the boundary configuration.

- Along-axis asthenospheric flow is confined to a relatively narrow low-viscosity zone beneath the ridge axis (West et al., 1997), and the geometry of the overlying spreading system plays a significant role in channeling the along-axis flow where transforms are included in these models. Confining temperature-gradient-driven flow within the low-viscosity zone also results in a temperature inversion in the subaxial mantle that can significantly modify $Na_{8.0}$ and $Fe_{8.0}$ depth correlations.

- Depth gradients in mantle viscosity inevitably lead to a mantle front that slopes in the direction of flow (West et al., 1997). This can lead to a decoupling of flow-related features that are controlled at different mantle depths. Thus, the isotopic boundary, as mapped at the seafloor, may differ in location and in geometry from a flow-driven propagating rift or from a chain of seamounts that form off-axis. Although no such chains are known east of the AAD, several occur to the west. And, although each of these surface features is a manifestation of mantle migration, none of them necessarily mimics in plan view the actual boundary between the two upper mantle provinces.

At the present state of development, modeling clearly demonstrates that hypothesized long-term mantle migration is consistent with, perhaps even favored by, our current understanding of the Pacific/Indian boundary (West et al., 1997, West and Christie, 1997). If the drilling proposed here allows us to identify the off-axis position of the isotope boundary, these models can be more precisely refined. Increasing refinement of the model will lead to stronger constraints on mantle dynamics of the region, including interactions among physical properties such as mantle temperature gradients, viscosity, flow velocities, and flow patterns. Also planned for continuing work are refinements in the resolution of some of the models. At present, the models are being developed to resolve local segment-scale details of flow, particularly the question of whether and why flow is stopped or impeded by major transform offsets as we have inferred from geochemical observations (West and Christie, 1997; Christie et al., 1998). Finally, perturbations in the temperature profile at depth can potentially influence the systematics of mantle melting, and the AAD flow models can be used to predict geochemical features, such as a departure of normalized sodium variations ($Na_{8.0}$; Klein and Langmuir 1987) from predicted trends.

Subsurface Biosphere Objectives

The subsurface biosphere objectives are to isolate and study microbes present in the volcanic sequence of the upper oceanic crust and to study the diagenetic effects of this microbial activity. The specific microbiological objectives include:

- Quantify microbes in the samples using fluorescent-labeled oligonucleotide probes.
- Identify microbes responsible for biodegradation of basalt using molecular biological methods.
- Isolate microbes participating in the biodegradation process.

The microbial diagenetic objectives will focus on how the microbiologic degradation of basalt progresses with time in the upper oceanic crust. Another objective of the cruise will be to further develop methods and procedures that will help to monitor and minimize microbiologic contamination of the core. Monitoring of drilling-induced contamination will be performed by adding 0.5-µ microspheres and per-fluro-methyl-cyclo hexane (PFT) to the drilling water when intervals to be sampled for microbiologic studies are cored.

DRILLING STRATEGY

We will drill as many single-bit holes as possible in the allotted time, perhaps as many as 10-12 holes. Each hole should penetrate ~50 m into basaltic basement, recovering sufficient mid-ocean ridge basalt to enable a satisfactory analytical program. Much of the region is devoid of measurable sediment cover and all sites are located on localized sediment pockets. At each site, we intend to locate specific drilling targets by running a short single-channel seismic survey that crosses the precruise survey line. These data will ensure sufficient sediment thickness for borehole initiation. Because these sediments are expected to be reworked and possibly winnowed, they will be recovered only by rotary core barrel (RCB) drilling. Because basement penetration at as many sites as possible is the primary objective of this leg, we may choose, on a site-by-site basis, to drill through the overlying sediment without expending time on wireline core recovery. A review of recent deep-water legs suggests that at least 10 such short basement penetration holes can reasonably be achieved during a single leg. During Leg 144, for example, 20 holes were drilled at 10 sites on guyots in the northwest Pacific. Basaltic basement was recovered in at least one hole at nine of the sites. For Leg 187, the minimum number of holes required for an acceptable definition of the off-axis isotopic boundary is six, but much higher resolution can be obtained with eight or more holes, especially if the program is able to respond to the results of onboard geochemical analyses of the recovered basalts. For example, Figure 5 shows the along-axis distribution of Zr/Ba and Rb/Ba ratios across the isotopic boundary, strongly indicating that these and other ratios can be used off axis to reliably distinguish Pacific from Indian mantle sources.

The best use of the drillship will result from a reactive drilling strategy, predicated on our ability to distinguish "Indian" from "Pacific" mantle using trace element ratios measured on board by inductively coupled plasma (ICP) or direct-current plasma (DCP) spectrometry. In the event that adequate onboard analysis is unsuccessful, a worst-case plan will allow for acceptable definition of the boundary by onshore isotopic analysis.

The following discussion describes one example of how such a strategy might proceed, but there are numerous other possibilities and final decisions have not yet been made. Site numbers are shown in Figure 6.

An initial series of three holes is drilled at Sites 36, 8c, and 21. These sites straddle likely positions of the boundary, other than the most rapid long-term migration. Each of these sites will prove to have basalts that are either derived from Indian (I) or Pacific (P) mantle.

- *Scenario 1*. Basalts at all three sites (I I I) are derived from Indian mantle. This implies rapid migration of the boundary from the east. Sites 14, 13b, and 1b are drilled to establish the location of the I/P boundary, followed by one or more of Sites 4c, 2b, and 29 to locate the boundary farther west.

- *Scenario 2.* Indian-type basalt is at Sites 36 and 8c. Pacific-type basalt is at Site 21 giving an I I P pattern. This implies slower migration, most likely tied to the depth anomaly. Sites 23 and 16 are drilled to better locate the boundary, followed by one or more of Sites 28, 29, and 2b to locate the boundary close to the eastern AAD fracture zone. Finally, one or more of Sites 3b, 33, 34, 35, and 27 are drilled to locate the boundary within the AAD.

- *Scenario 3.* Indian-type basalt is at Site 36. Pacific-type basalt is at Sites 8c and 21 (I P P pattern). This implies a long-term assocation of the boundary with the eastern AAD. Working from north to south, the following sites will better define its geometry: Sites 27, 35, 34, 33, 28, 29, and 3b.

ONBOARD ANALYSIS

The chemical analyses required for this leg cannot be reliably conducted by current onboard equipment. It will be necessary to install either a DCP or ICP optical emission spectrometer in the chemistry laboratory. DCP instruments have been successfully used at sea during a number of cruises (e.g., Langmuir et al., 1986). Their requirements in terms of space, power, and ventilation are comparable to those of the atomic absorption instruments already on board. Sample dissolution will require small amounts of hydrofluoric and nitric acids.

LOGGING PLAN

No logging is planned for this leg. Neither the sediment sections nor the basement sections is deep enough for scientifically meaningful logs to be obtained.

PROPOSED SITES

Details of the 19 approved sites are given in Table 1. The objectives and strategy are the same for all sites—that is, to recover a satisfactory sample of the basaltic basement as efficiently as possible from as many sites as possible.

SAMPLING STRATEGY

Shipboard Samples and Data Acquisition

Biological samples: As many as four samples per hole will be removed to a sterile environment immediately after opening each basalt core barrel. Procedures for this removal have not yet been decided. Ideal samples will be intact core sections, 10-50 cm in length, with basaltic glass attached at one end. Samples will be cleaned in a sterile environment, then a micro core up to 10 cm in length will be removed from the axis of the core. As quickly as possible, the remaining core will be split and returned to the core storage trays. As soon as possible after shore-based extraction procedures are complete, these samples will be made available for other types of study.

Quick Response Samples: As soon as possible after core recovery, three to five samples per hole will be removed for ICP analysis for Ba and other key indicator elements. Quick analysis will be critical, as these results will determine the next site to be drilled.

Routine Samples: Following core labeling, measurement of nondestructive properties, and core splitting, samples will be selected from working-half cores (approximately one to two samples per 9.5 m of core, or one from each major flow unit) by members of the shipboard party for routine measurement of physical and magnetic properties, bulk chemical analyses by X-ray fluorescence, carbon-nitrogen-sulfur (CNS) analyzer. If necessary, X-ray diffraction samples and polished thin sections of these samples will be prepared for identification of minerals, determination of mineral modes, and studies of texture and fabric.

Sampling for Shore-Based Studies

As a general guideline, shipboard scientists may obtain five to ten whole-rock samples per hole, as many as to ~100 samples for the leg. Samples may be up to 15 cc in size. In special cases, additional or larger samples may be obtained with the approval of the Sample Allocation Committee (SAC), which is composed of the co-chiefs, the staff scientist, the shipboard curatorial representative, and the ODP curator.

Glass samples are expected to be in high demand, and sampling strategies that emphasize cooperation will be encouraged. In general, individuals should expect to receive no more than 1 g of glass from any single layer, but special cases and strategies that maximize scientific return will be evaluated by the SAC.

Other short intervals of unusual scientific interest (e.g., veins, ores, and dikes) may require a higher sampling density, reduced sample size, continuous core sampling by a single investigator, or sampling techniques not available on board ship. These will be identified during the core description process, and the sampling protocol will be established by the interested scientists and shipboard SAC.

In all cases, to minimize the time and effort required for sampling and to maximize scientific return, we encourage sampling consortia involving researchers with complementary expertise. Sample size will depend on need as well as the number of investigators in the group. Additional samples may be requested in writing for distribution soon after the cores return to the ODP repository.

Redundancy of Studies

Some redundancy of measurement is unavoidable, but minimizing the redundancy of measurements among the shipboard party and identified shore-based collaborators will be a factor in evaluating sample requests. Requests from independent shore-based investigators that substantially replicate the intent and measurements of shipboard participants will require the approval of both the shipboard investigators and the SAC.

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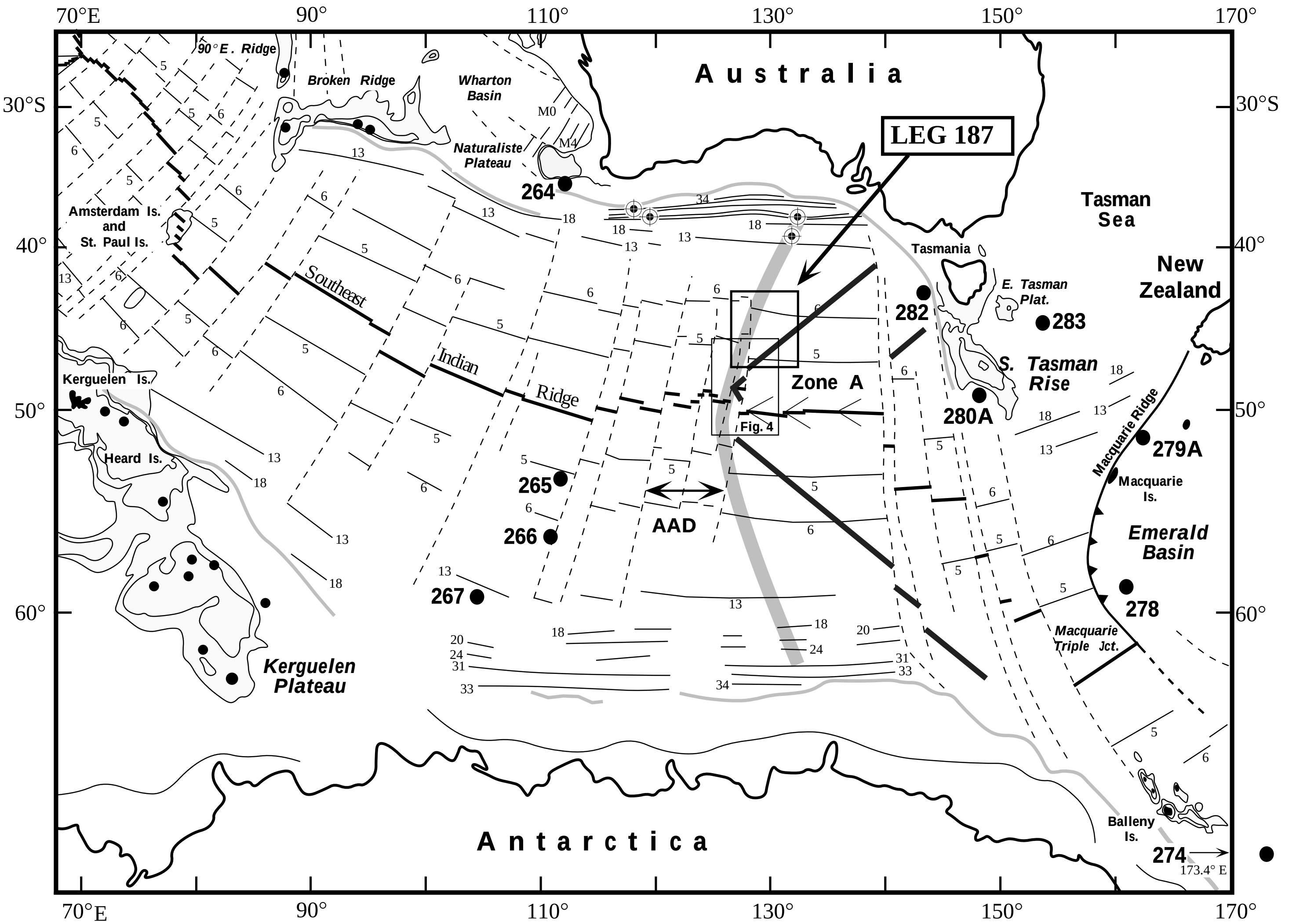


Figure 1. Regional map of the Southeast Indian Ocean showing magnetic lineations (Cande et al., 1989), the Australian-Antarctic Discordance (AAD), and DSDP sites that sampled basement. Thin dark "V" to the east of the AAD is the inferred trace of the isotopic boundary for a migration rate of ~40 mm/yr. The broader gray "V" is the approximate trace of the regional depth anomaly (from Pyle et al., 1995). Bulls-eyes south of Australia indicate approximate positions of dredges by Lanyon et al. (1995). To examine a color perspective view of the AAD, open this location on the World Wide Web: http://www-odp.tamu.edu/publications/tnotes/tn20-6/187figwo.html

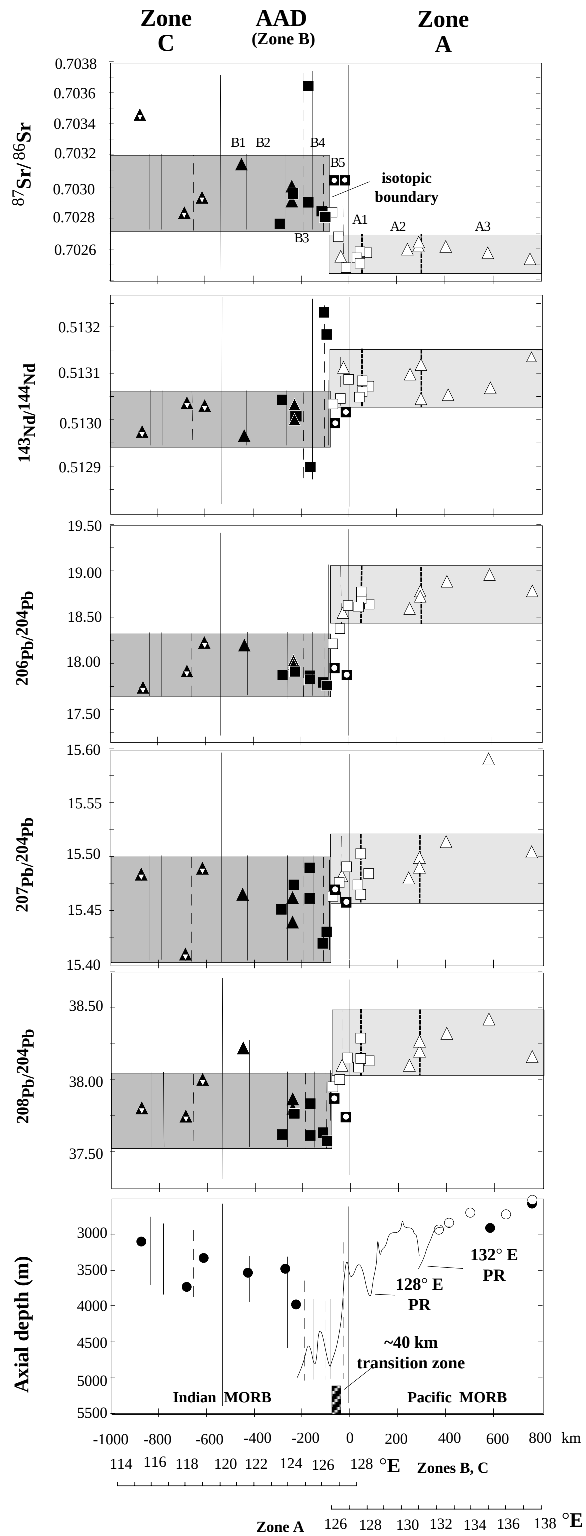


Figure 2. Along-axis profiles of isotopic ratios from the Southeast Indian Ridge (SEIR) between 115˚E and 138˚E. Horizontal scale in kilometers from the eastern bounding transform of the Australian-Anarctic Discordance (AAD). Open symbols and lightly shaded field denote Pacific-type mid-ocean ridge basalts (MORB). Filled symbols and darker field denote Indian-type MORB (from Pyle et al., 1992).

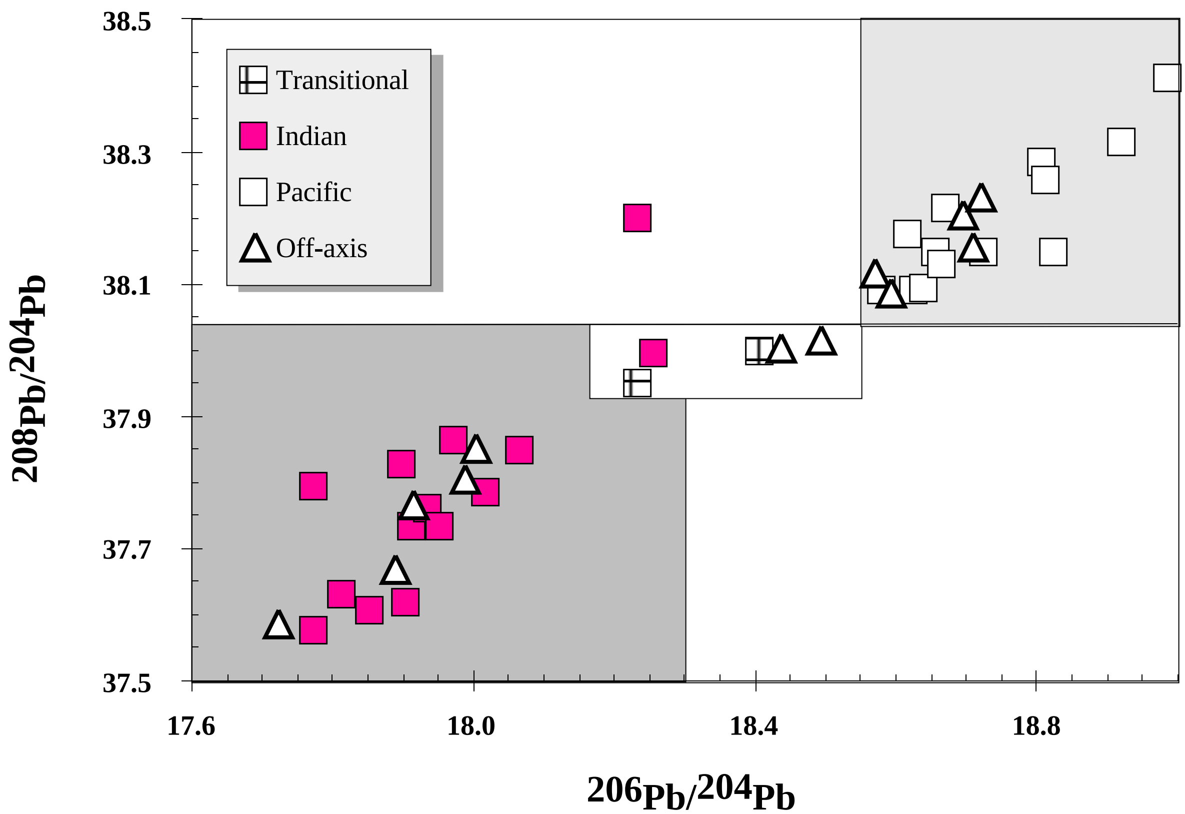


Figure 3. Pb isotopic ratios of axial lavas (squares) showing the Indian and Pacific populations from Figure 2, as well as transitional lavas from Segment B5. Triangles represent off-axis lavas which can be assigned to either the Indian or the Pacific population on the basis of this diagram.

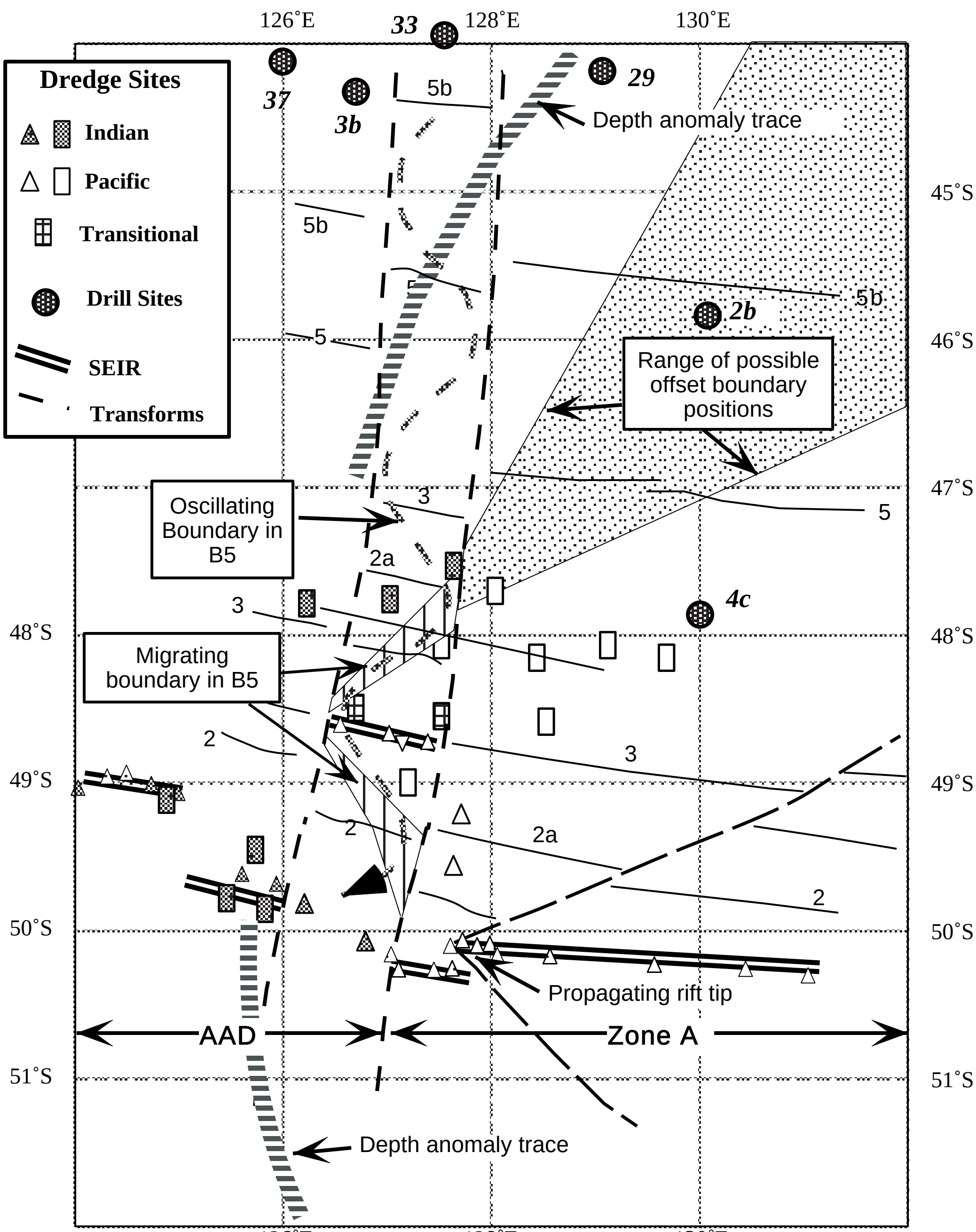


Figure 4. Mantle boundary configurations allowed by current geochemical data from the dredge sites shown. Indian and Pacific populations are the same as in Figure 3. Migration across Segment B5 is confirmed, with the boundary constrained to the vertically ruled area labeled "Migrating boundary in B5." East of the AAD, a boundary produced by long-term westward migration is constrained to the medium gray shaded region in the upper right quadrant. Alternate boundary configurations are associated with the curving trace of the depth anomaly or oscillation between the easternmost AAD transforms. The more southerly Leg 187 drill sites are shown as dark gray filled circles. The remaining sites lie to the north and east of this map. Magnetic anomalies are numbered 2 through 5.

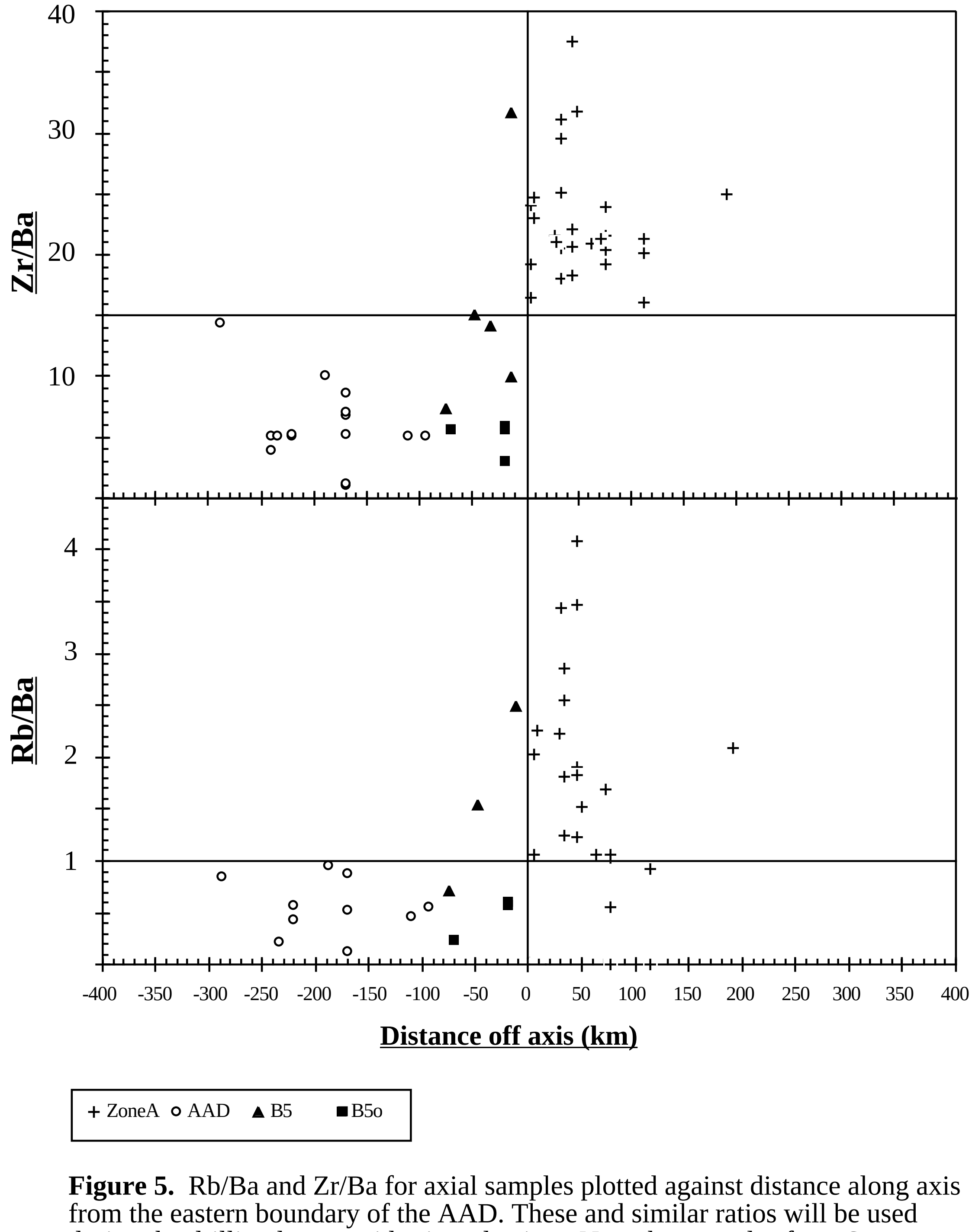


Figure 5. Rb/Ba and Zr/Ba for axial samples plotted against distance along axis from the eastern boundary of the AAD. These and similar ratios will be used during the drilling leg to guide site selection. Note that samples from Segment B5, immediately to the east of the isotopic boundary, are transitional in many characteristics. Black squares are off-axis B5 samples dredged in 1988.

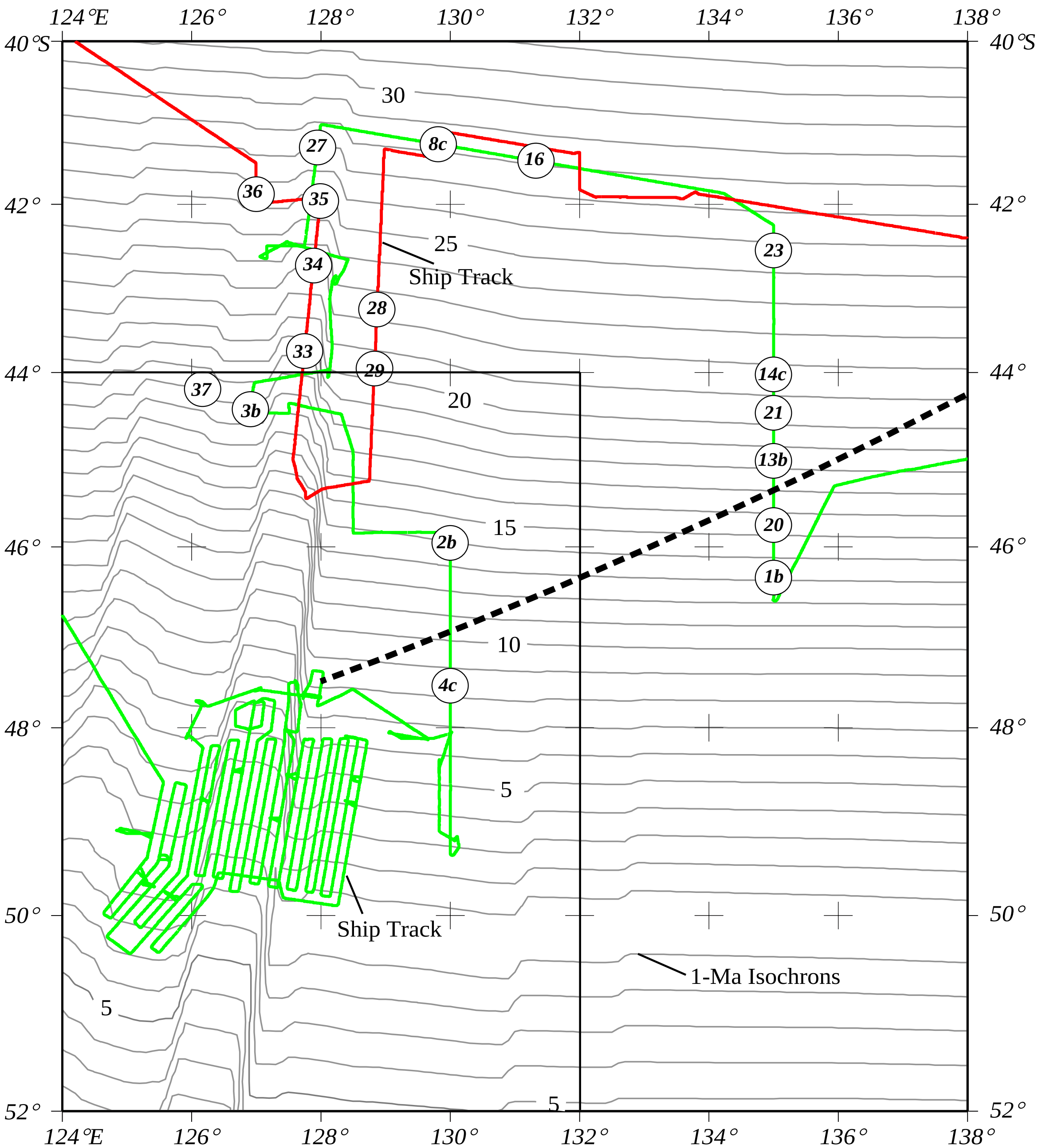


Figure 6. Proposed drill sites in relation to 1-Ma isochrons and to site survey ship tracks. Transforms appear as deflections of the isochrons. The spreading axis (zero isochron) is not plotted. The dashed line marks the predicted southernmost limit for possible locations of the isotopic boundary based on sampling of 0-7 Ma seafloor (Christie et al., 1998).

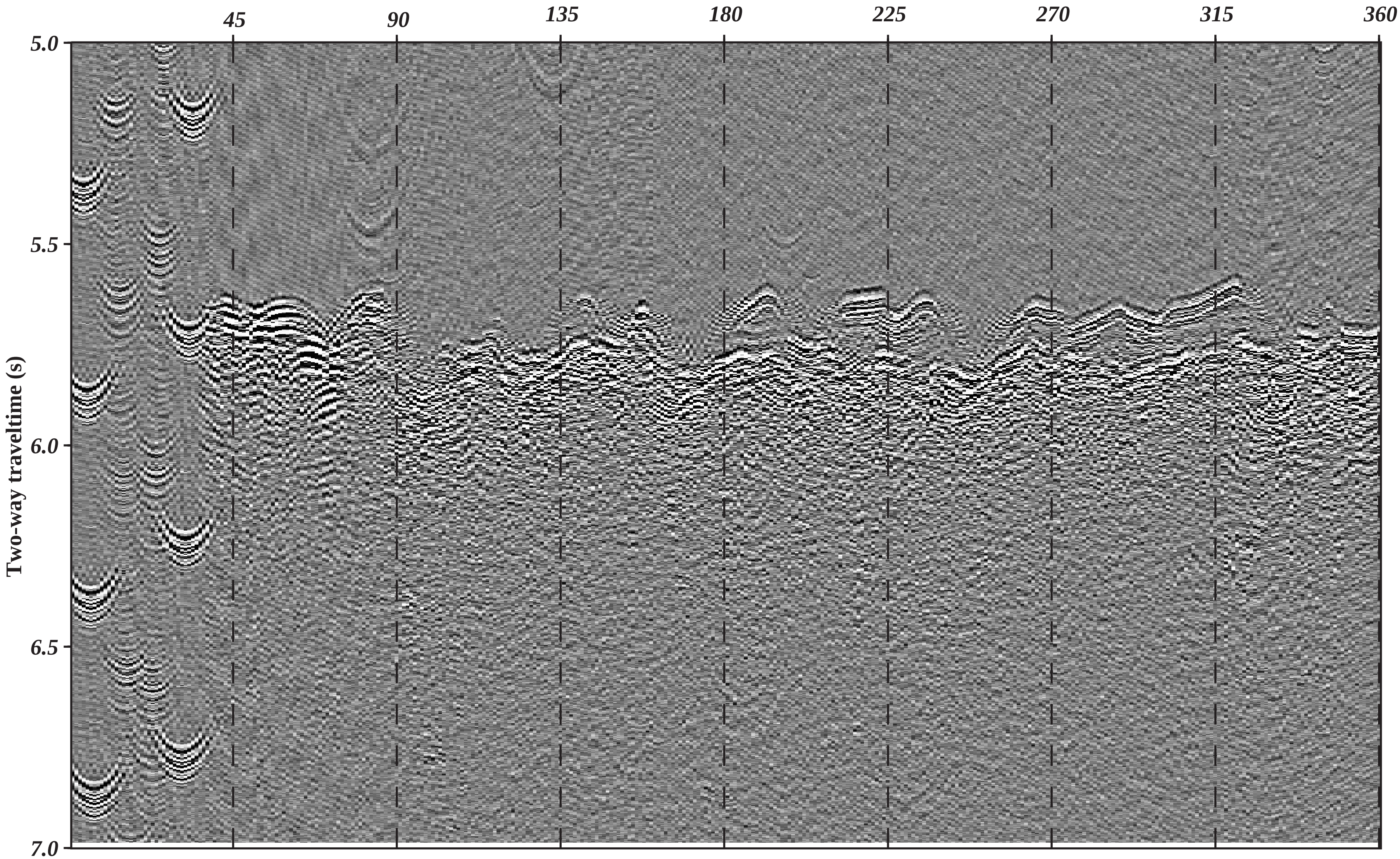
Table 1. Leg 187 Operations Plan and Time Estimate

Site No.	Location Lat/Long	Water Depth	Projected Operations Plan	Transit (days)	Drilling (days)	Logging (days)	Total On-site
PRIMARY SITES							
Fremantle			Transit 861 nmi from Fremantle to Site AAD-36A @ 10.5 kt	3.7			
AAD-36A	41°52.7' S	5000 m	RCB through 100 m of sediment and 50m of basement		2.8	0.0	2.8
	127°00.1' E		(no wireline logging estimated)				
			Transit 65 nmi from AAD-36 to AAD-8C @ 10.5 kt	0.3			
AAD-8C	41°16.3' S	5500 m	RCB through 100m of sediment and 50m of basement		3.0	0.0	3.0
	129°48.9' E		(no wireline logging estimated)				
			Transit 273 nmi from AAD-8C to AAD-21A @ 10.5 kt	1.1			
AAD-21A	44°27.9' S	4575 m	RCB through 200m of sediment and 50m of basement		3.4	0.0	3.4
	134°59.9' E		(no wireline logging estimated)				
			Transit 154 nmi from AAD-21A to AAD-23A @ 10.5 kt	0.6			
AAD-23A	42°33.9' S	4950 m	RCB through 200m of sediment and 50m of basement		3.6	0.0	3.6
	135°00.1' E		(no wireline logging estimated)				
			Transit 203 nmi from AAD-23A to AAD-16A @ 10.5 kt	0.9			
AAD-16A	41°28.4' S	5700 m	RCB through 200m of sediment and 50m of basement		3.9	0.0	3.9
	131°19.5' E		(no wireline logging estimated)				
			Transit 207 nmi from AAD-16A to AAD-28A @ 10.5 kt	0.9			
AAD-28A	43°15.3' S	5100 m	RCB through 200m of sediment and 50m of basement		3.7	0.0	3.7
	128°52.1' E		(no wireline logging estimated)				
			Transit 42 nmi from AAD-28A to AAD-29A @ 10.5 kt	0.2			
AAD-29A	43°56.9' S	5100 m	RCB through 200m of sediment and 50m of basement		3.8	0.0	3.8
	128°49.7' E		(no wireline logging estimated)				
			Transit 172 nmi from AAD-29A to AAD-2B @ 10.5 kt	0.7			
AAD-2B	45°57.4' S	4500 m	RCB through 100m of sediment and 50m of basement		2.9	0.0	2.9
	130°00.0' E		(no wireline logging estimated)				
			Transit 214 nmi from AAD-2B to AAD-3B @ 10.5 kt	0.9			
AAD-3B	44°25.5' S	4350 m	RCB through 100m of sediment and 50m of basement		2.7	0.0	2.7
	126°54.5' E		(no wireline logging estimated)				
			Transit 214 nmi from AAD-3B to AAD-33A @ 10.5 kt	0.4			
AAD-33A	43°44.9' S	4800 m	RCB through 200m of sediment and 50m of basement		3.5	0.0	3.5
	127°44.9' E		(no wireline logging estimated)				
			Transit 60 nmi from AAD-33A to AAD-34A @ 10.5 kt	0.3			
AAD-34A	42°44.2' S	4875 m	RCB through 200m of sediment and 50m of basement		3.6	0.0	3.6
	127°53.2' E		(no wireline logging estimated)				
			Transit 74 nmi from AAD-34A to AAD-35A @ 10.5 kt	0.3			
AAD-35A	41°57.5' S	5000 m	RCB through 200m of sediment and 50m of basement		3.7	0.0	3.7
	127°59.7' E		(no wireline logging estimated)				
Fremantle			Transit 819 nmi from AAD-35A to Fremantle @ 10.5 kt	3.3			
				13.4	40.6		40.6

TOTAL DAYS: 54.0

SITE AAD-1b

1400-1559 GMT 18jan96, Shot # labeled every 15 min, Site 1b at ~Shot 315, bmrg05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



SITE SUMMARIES

Site: AAD-1b

Priority: 1
Position: 46°20.6´S, 134°59.8´E
Water Depth: 4200 m
Sediment Thickness: As much as 200 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 250 m
Seismic Coverage: BMRG05, 1400-1559 GMT 18 Jan. 1996, shot 315

Objectives: The objective of Site AAD-1b is to recover basement samples for geochemical analysis in the minimum time possible.

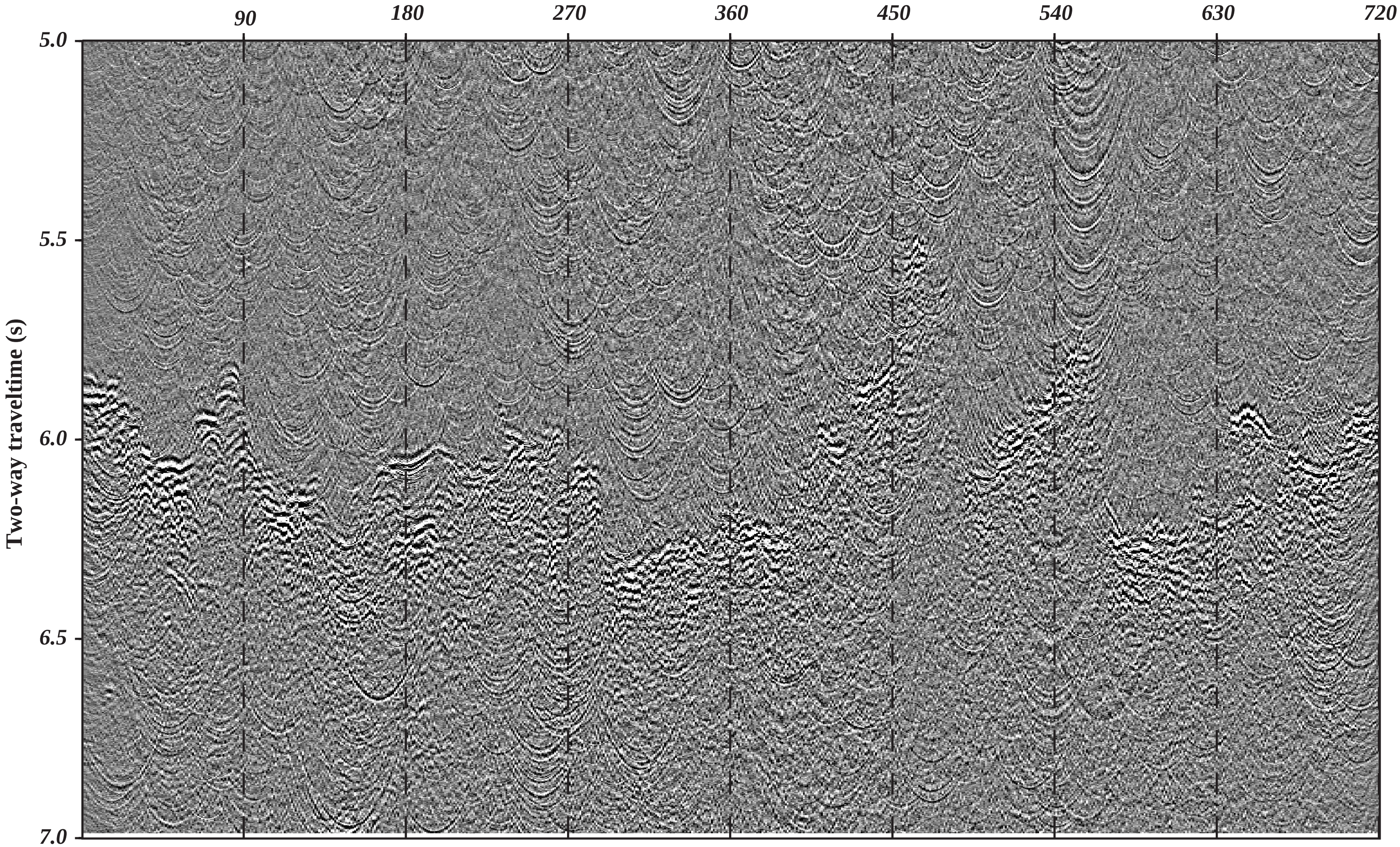
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Biogenic ooze, basalt.

SITE AAD-2b

400-559 GMT 25jan96, Shot # labeled every 15 min, Site 2b at ~Shot 180, bmrg05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-2b

Priority: 1
Position: 45°57.4´S, 130°00.0´E
Water Depth: 4500 m
Sediment Thickness: Up to 100 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 200 m
Seismic Coverage: BMRG05, 400-559 GMT 25 Jan. 1996, shot 180

Objectives: The objective of Site AAD-2b is to recover basement samples for geochemical analysis in the minimum time possible.

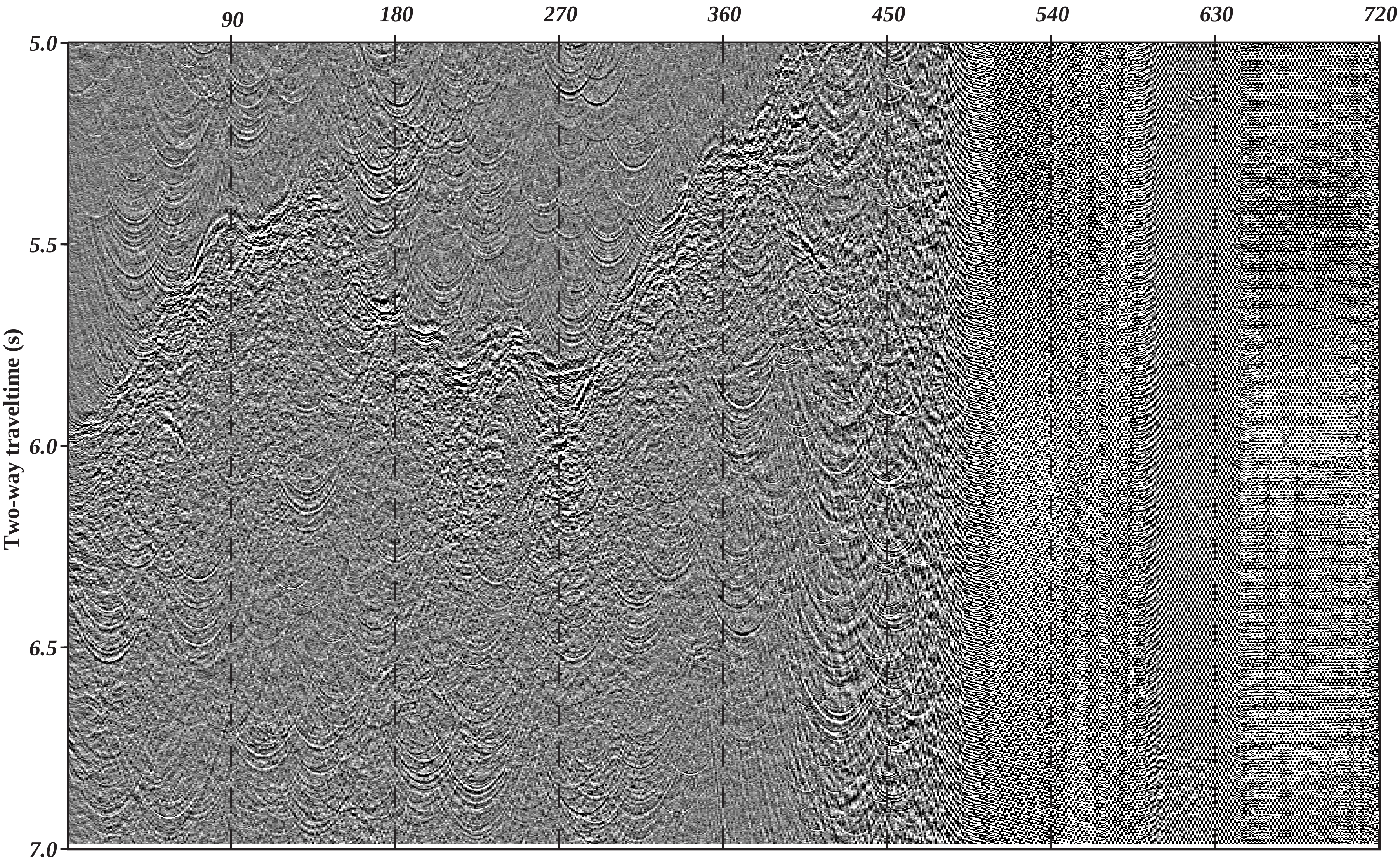
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-3b

000-159 GMT 24jan96, Shot # labeled every 15 min, Site 3b at ~Shot 270, bmrg05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-3b

Priority: 1
Position: 44°25.5´S, 126°54.5´E
Water Depth: 4350 m
Sediment Thickness: Up to 100 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 150 m
Seismic Coverage: BMRG05, 000-159 GMT 24 Jan. 1996, shot 270

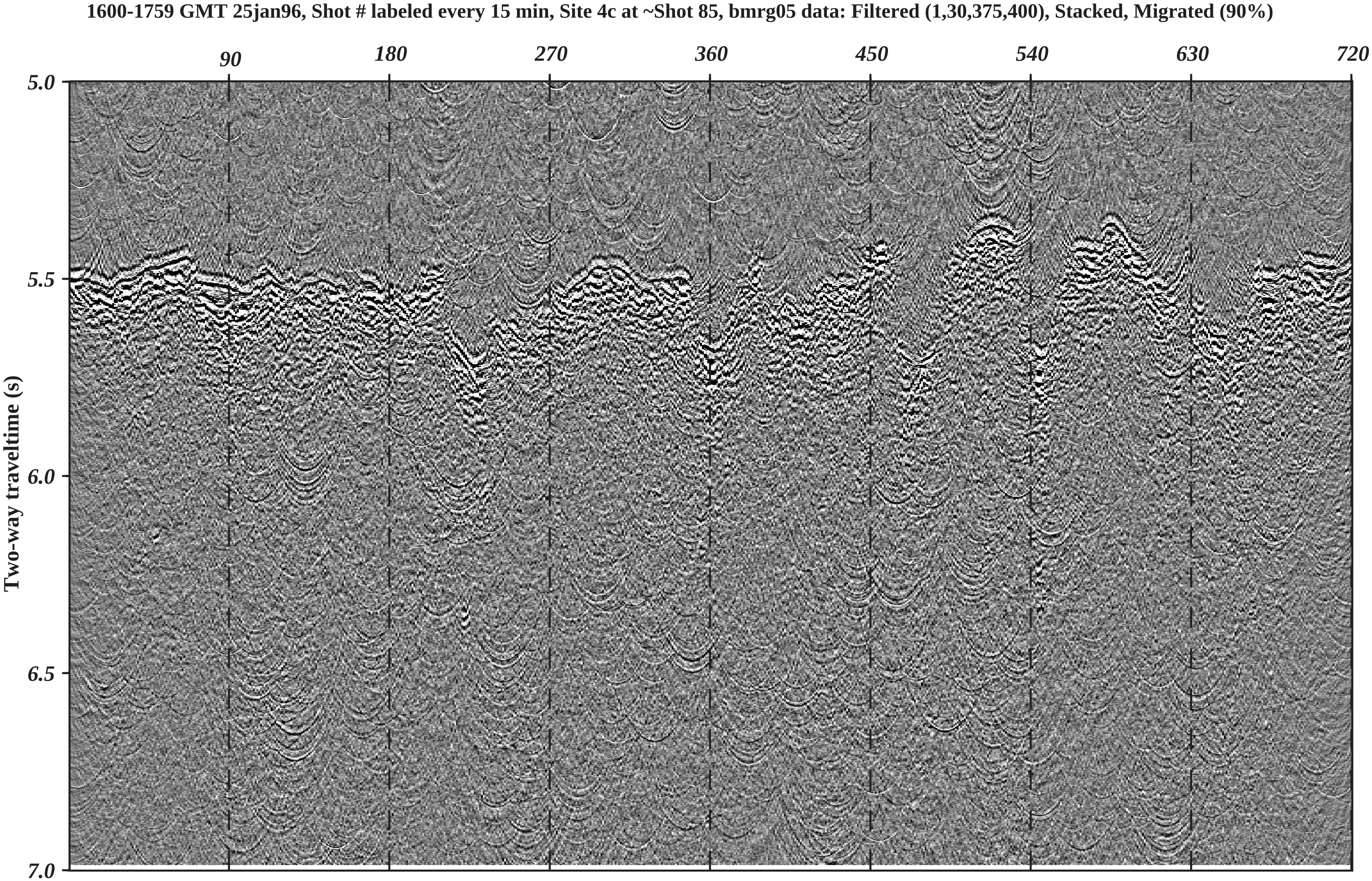
Objectives: The objective of Site AAD-3b is to recover basement samples for geochemical analysis in the minimum time possible.

Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-4c


1600-1759 GMT 25jan96, Shot # labeled every 15 min, Site 4c at ~Shot 85, bmrg05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)
90
180
270
360
450
540
630
720
5.0
5.5
6.0
6.5
7.0
Two-way traveltime (s)

Site: AAD-4c

Priority: 1
Position: 47°32.7´S, 130°00.´E
Water Depth: 4050 m
Sediment Thickness: Up to 100 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 150 m
Seismic Coverage: BMRG05, 1600-1759 GMT 25 Jan. 1996, shot 85

Objectives: The objective of Site AAD-4c is to recover basement samples for geochemical analysis in the minimum time possible.

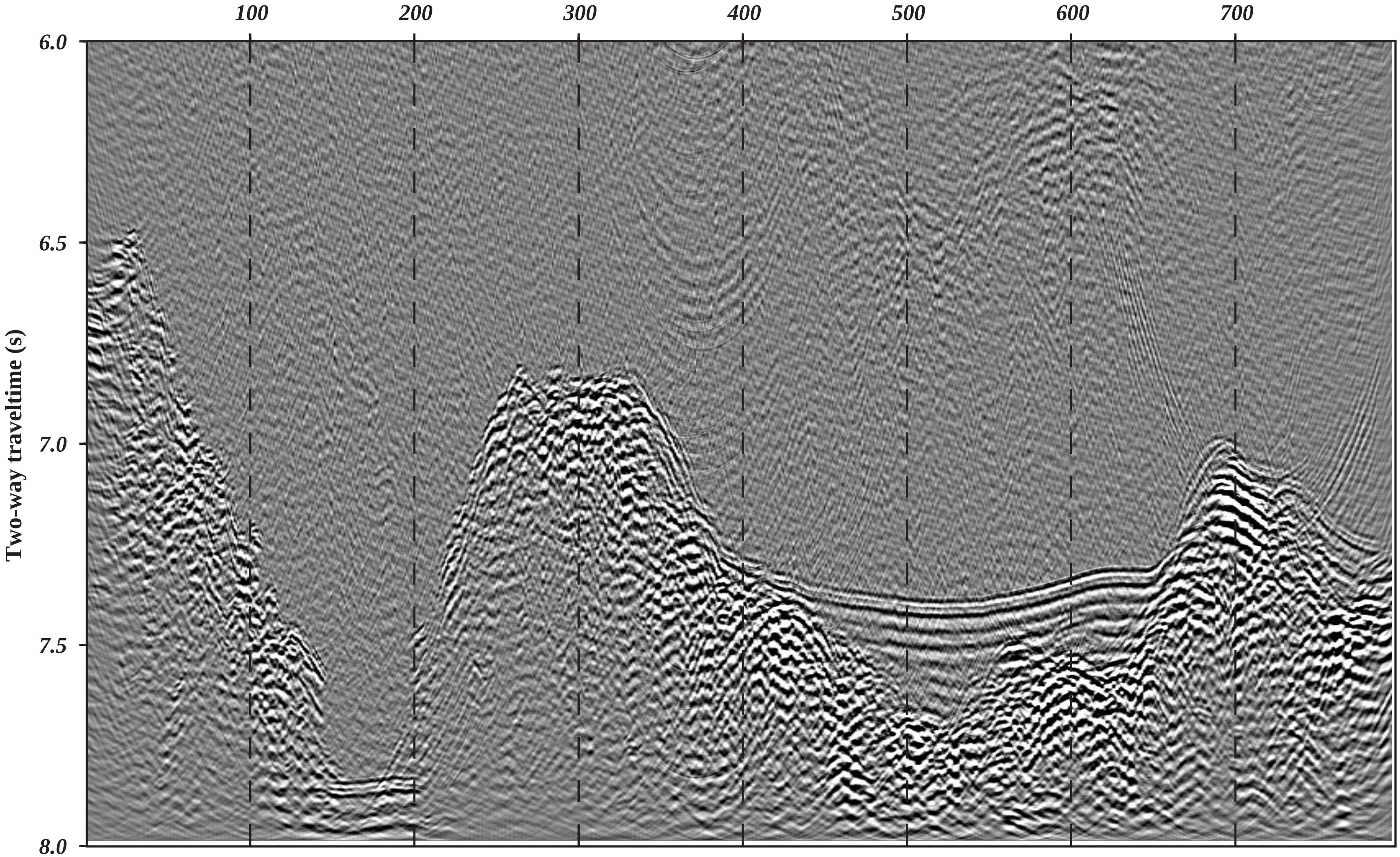
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD- 8c

400-559 GMT 27feb97, Shot # labeled every 15 min, Site 8c at ~Shot 520, sojn05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-8c

Priority: 1
Position: 41°16.3´S, 129°48.9´E
Water Depth: 5550 m
Sediment Thickness: Up to 300 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 350 m
Seismic Coverage: SOJN05, 400-559 GMT 27 Feb. 1997, shot 520

Objectives: The objective of Site AAD-8c is to recover basement samples for geochemical analysis in the minimum time possible.

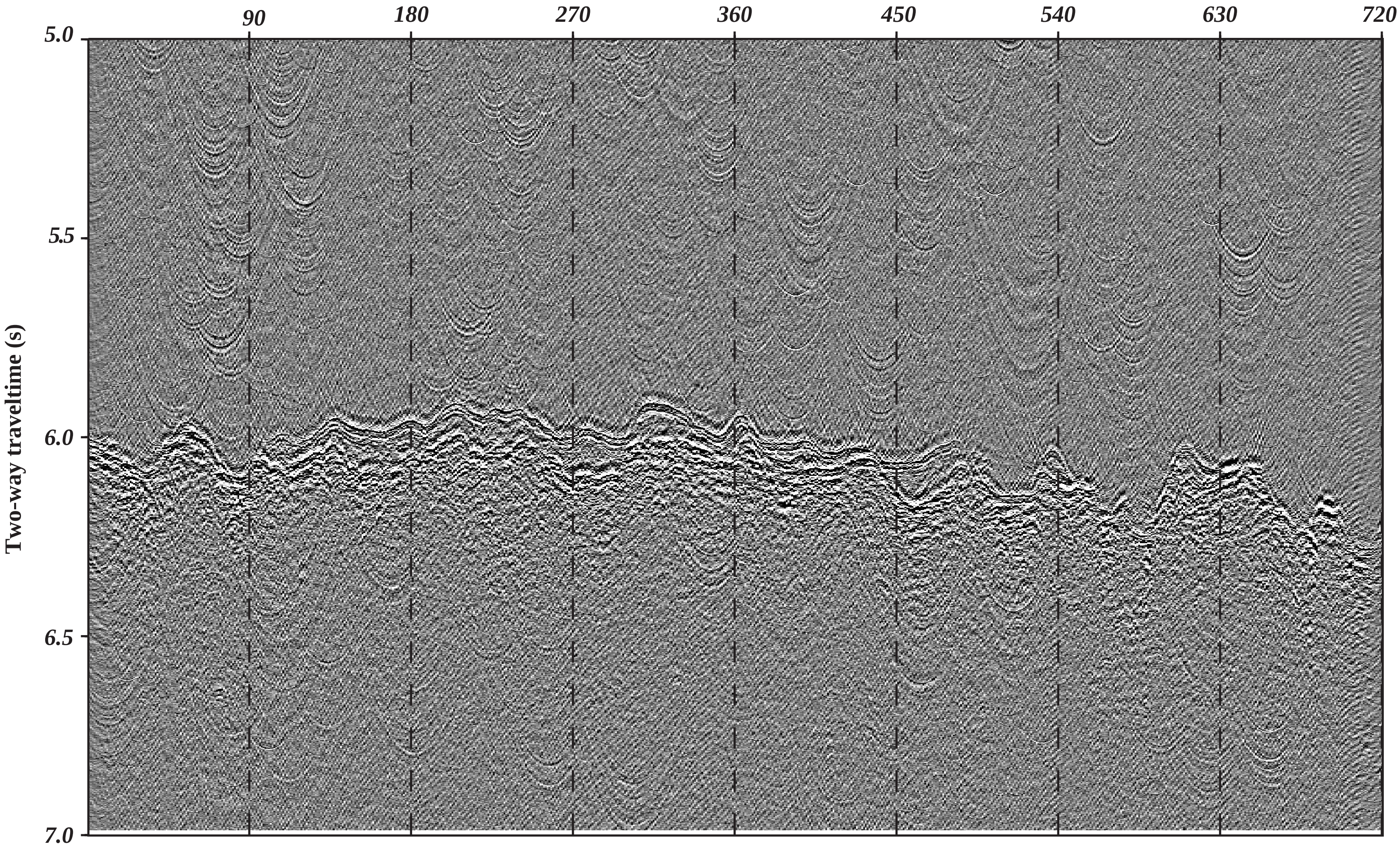
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-13b

000-159 GMT 19jan96, Shot # labeled every 15 min, Site 13b at ~Shot 455, bmrg05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-13b

Priority: 1
Position: 45°01.2´S, 135°00.2´E
Water Depth: 4575 m
Sediment Thickness: Up to 200 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 250 m
Seismic Coverage: BMRG05, 000-159 GMT 19 Jan. 1996, shot 455

Objectives: The objective of Site AAD-13b is to recover basement samples for geochemical analysis in the minimum time possible.

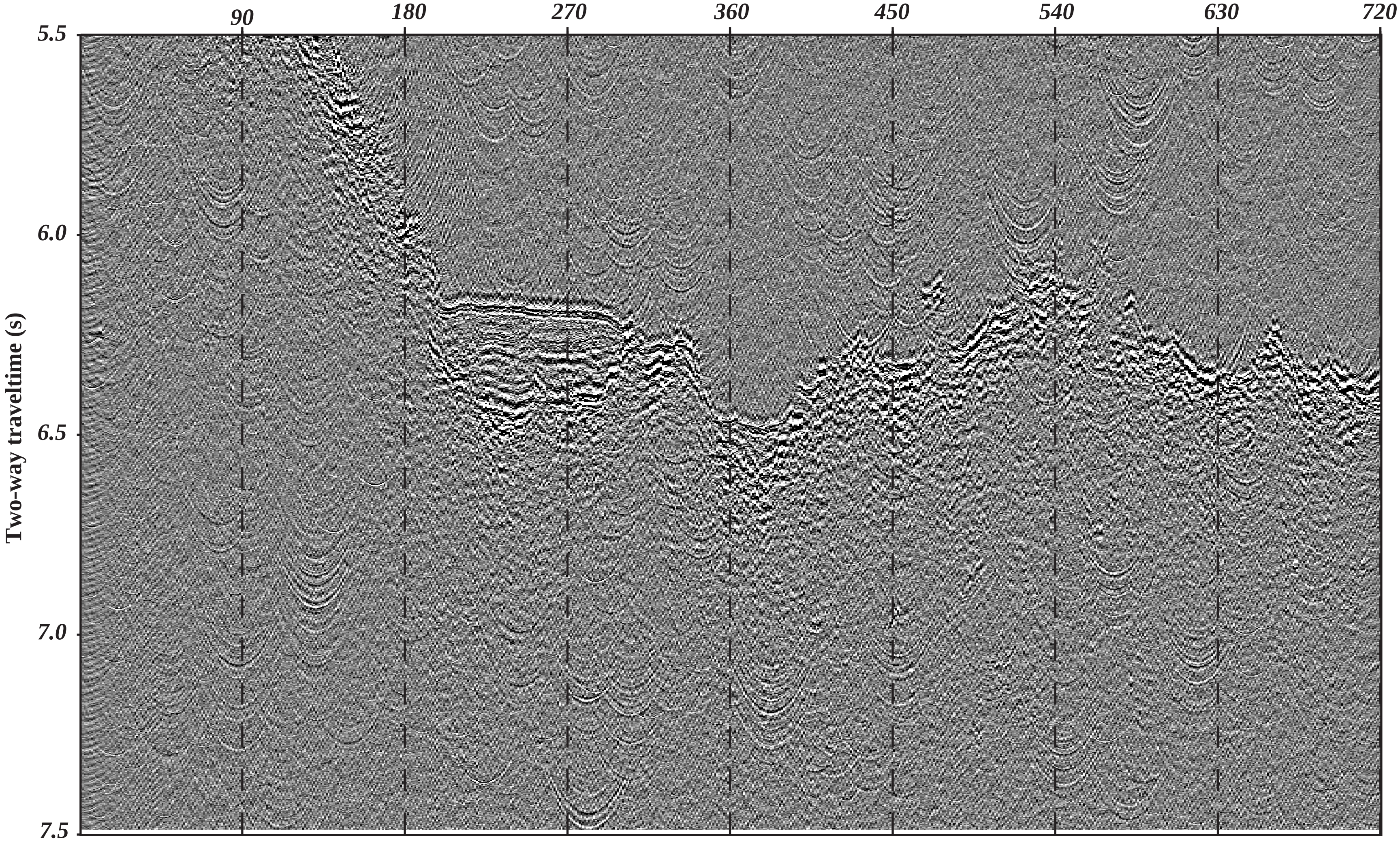
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-14c

800-959 GMT 19jan96, Shot # labeled every 15 min, Site 14c at ~Shot 240, bmrg05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-14c

Priority: 1
Position: 44°01.3´S, 134°59.9´E
Water Depth: 4700 m
Sediment Thickness: Up to 300 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 350 m
Seismic Coverage: BMRG05, 800-959 GMT, 19 Jan. 1996, Shot 240

Objectives: The objective of Site AAD-14c is to recover basement samples for geochemical analysis in the minimum time possible.

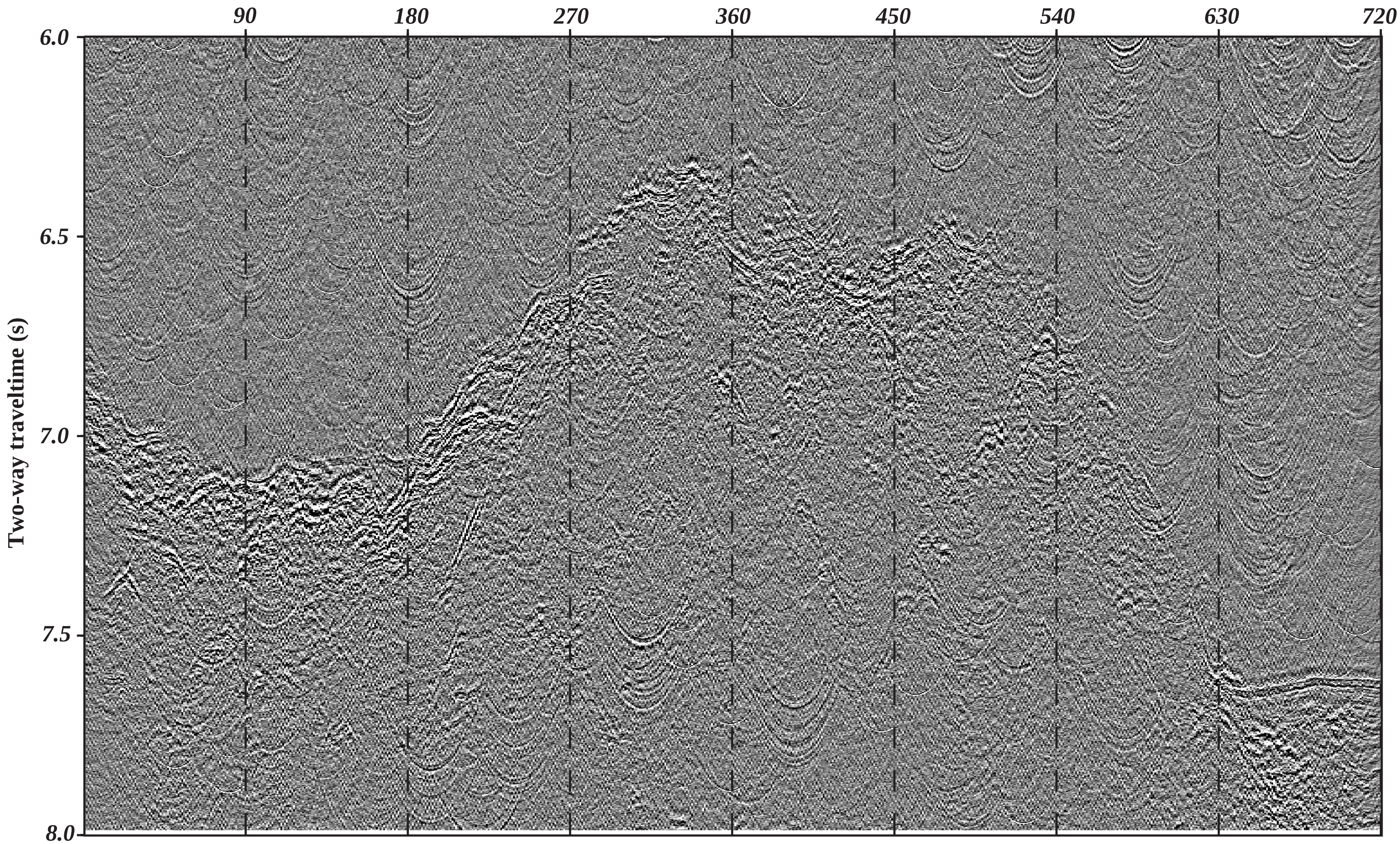
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-16a

1600-1759 GMT 20jan96, Shot # labeled every 15 min, Site 16a at ~Shot 660, bmrg05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-16a

Priority: 1
Position: 41°28.4´S, 131°19.5´E
Water Depth: 5700 m
Sediment Thickness: Up to 200 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 250 m
Seismic Coverage: BMRG05, 1600-1759 GMT, 20 Jan. 1996, shot 660

Objectives: The objective of Site AAD-16a is to recover basement samples for geochemical analysis in the minimum time possible.

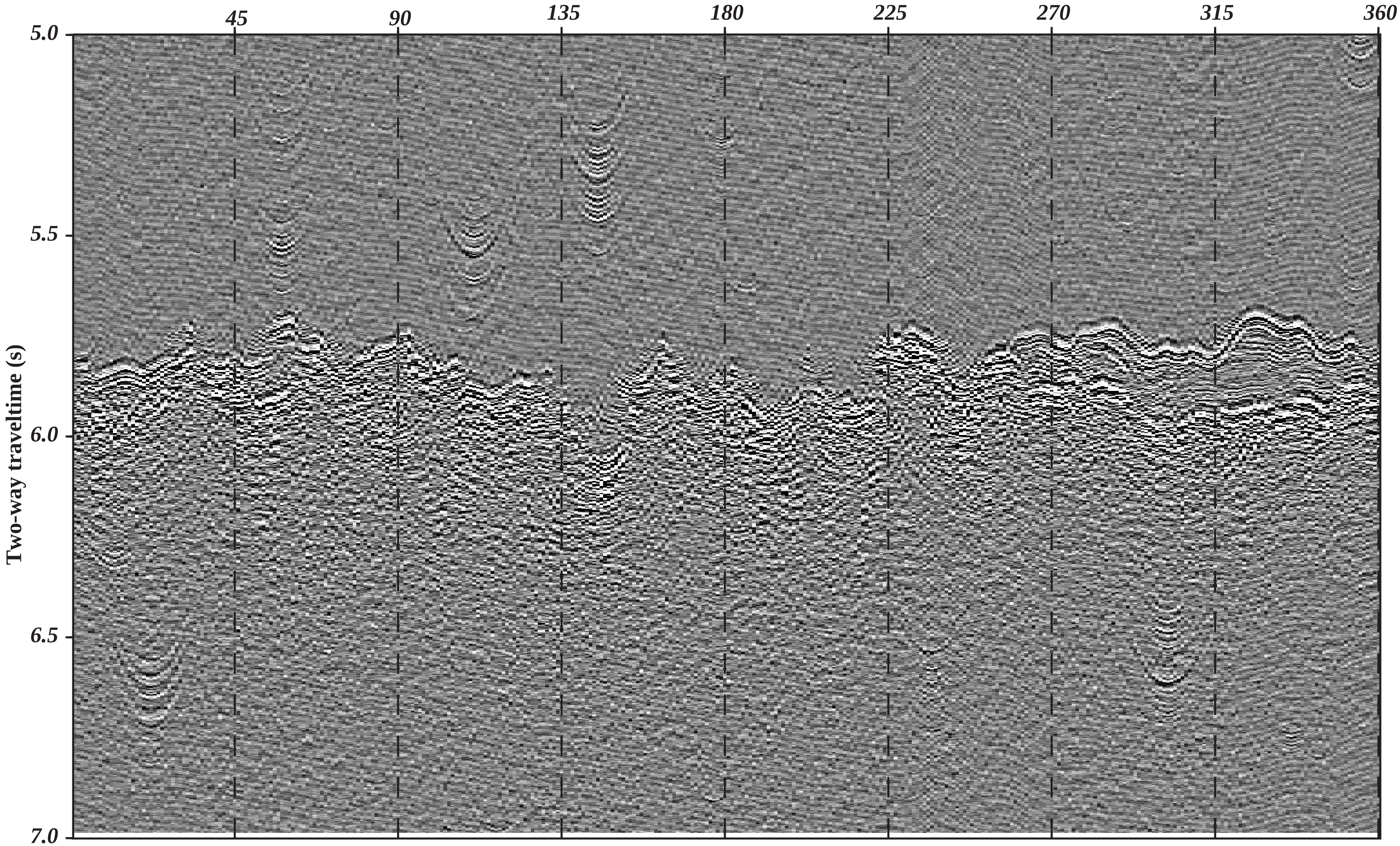
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-20a

1800-1959 GMT 18jan96, Shot # labeled every 15 min, Site 20a at ~Shot 330, bmrg05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-20a

Priority: 1
Position: 45°45.2´S, 134°59.9´E
Water Depth: 4275 m
Sediment Thickness: Up to 200 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 250 m
Seismic Coverage: BMRG05, 1800-1959 GMT, 18 Jan. 1996, shot 330

Objectives: The objective of Site AAD-20a is to recover basement samples for geochemical analysis in the minimum time possible.

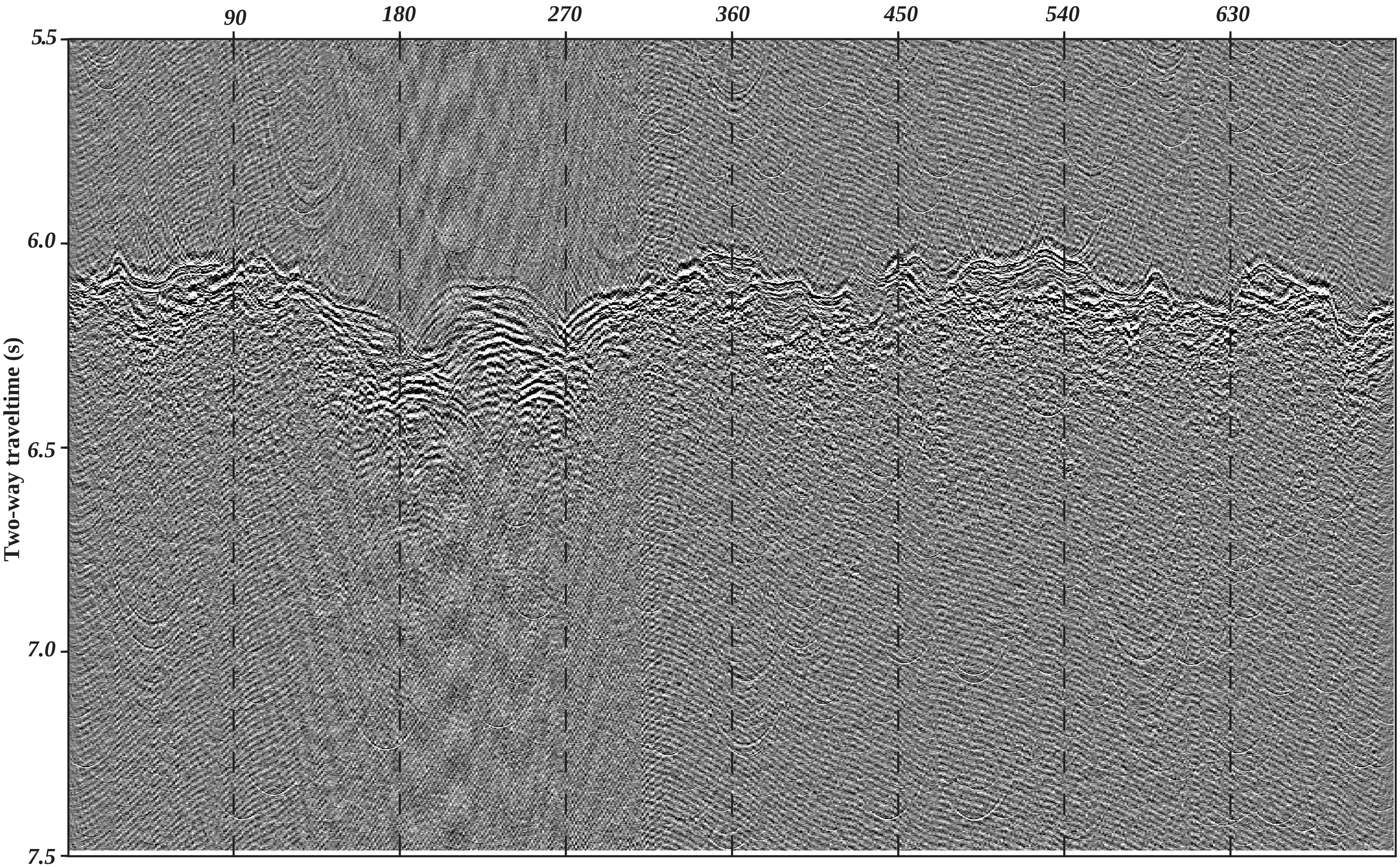
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-21a

400-559 GMT 19jan96, Shot # labeled every 15 min, Site 21a at ~Shot 540, bmrg05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-21a

Priority: 1
Position: 44°27.9´S, 134°59.9´E
Water Depth: 4575 m
Sediment Thickness: Up to 200 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 250 m
Seismic Coverage: BMRG05, 400-559 GMT, 19 Jan. 1996, shot 540

Objectives: The objective of Site AAD-21a is to recover basement samples for geochemical analysis in the minimum time possible.

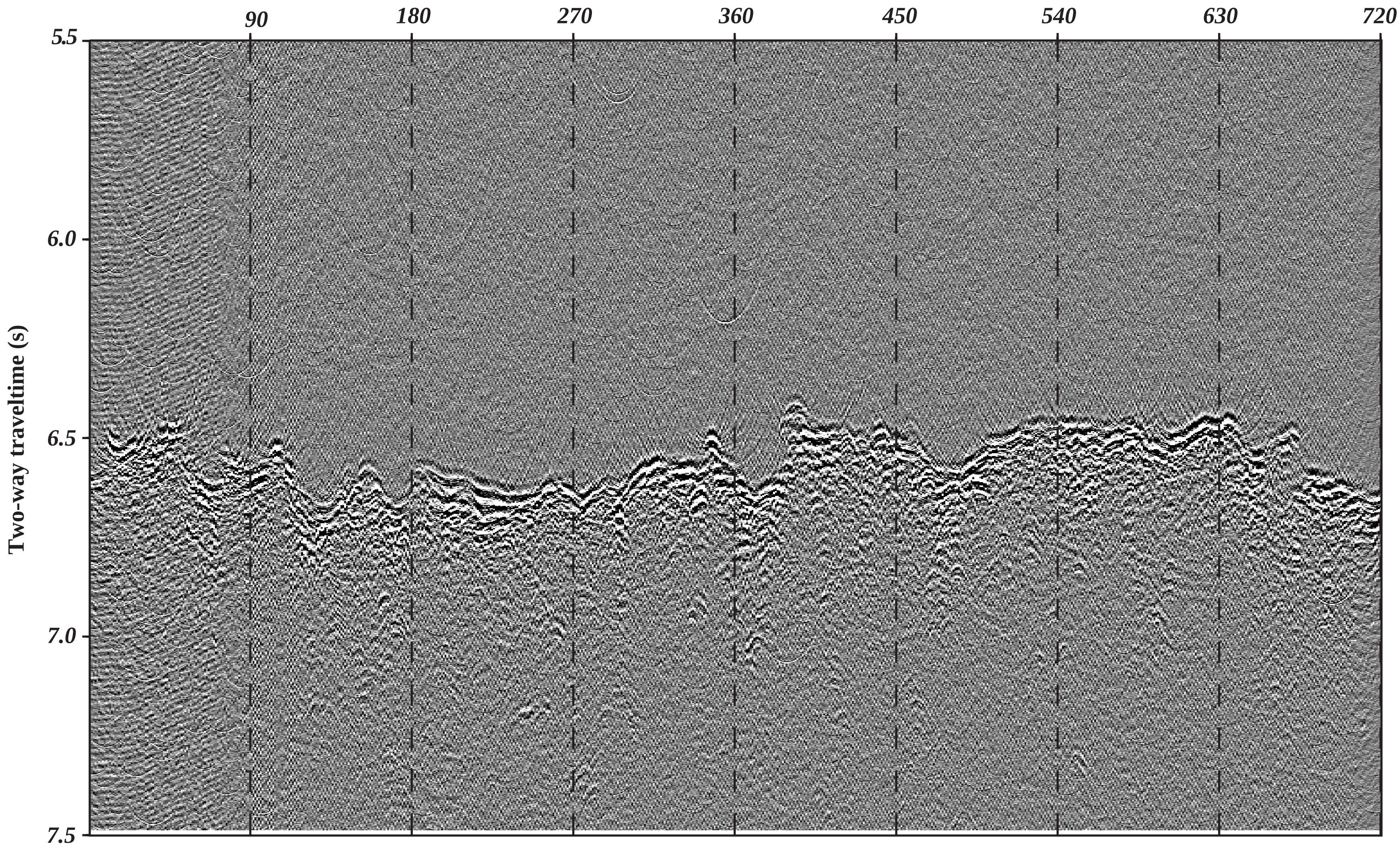
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-23a

1800-1959 GMT 19jan96, Shot # labeled every 15 min, Site 23a at ~Shot 225, bmrg05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-23a

Priority: 1
Position: 42°33.19´S, 135°00.1´E
Water Depth: 4950 m
Sediment Thickness: Up to 200 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 250 m
Seismic Coverage: BMRG05, 1800-1959 GMT, 19 Jan. 1996, shot 225

Objectives: The objective of Site AAD-23a is to recover basement samples for geochemical analysis in the minimum time possible.

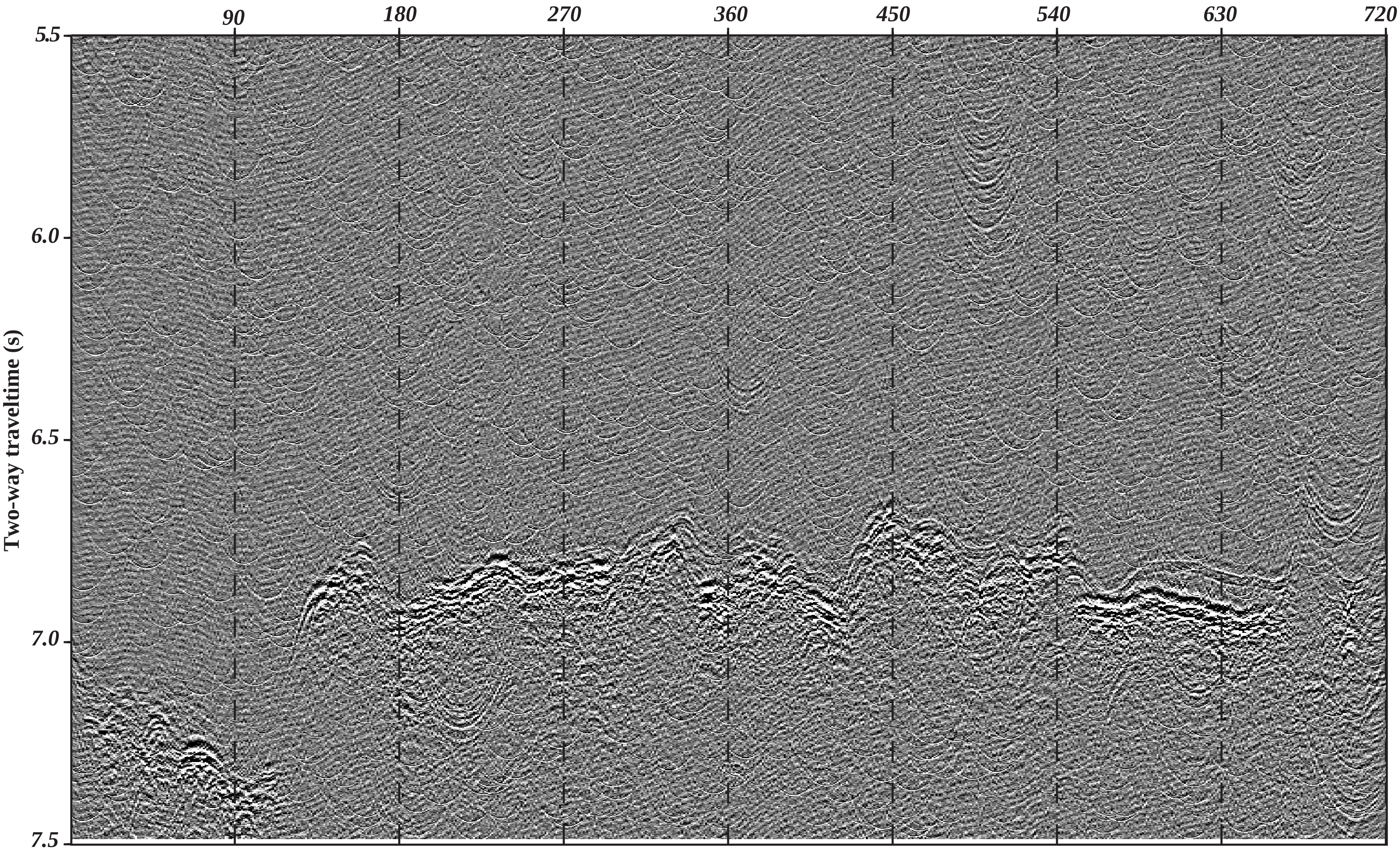
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-27a

1400-1559 GMT 21jan96, Shot # labeled every 15 min, Site 27a at ~Shot 605, bmrg05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-27a

Priority: 1
Position: 41°18.6´S, 127°57.1´E
Water Depth: 5100 m
Sediment Thickness: Up to 200 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 250 m
Seismic Coverage: BMRG05, 1400-1559 GMT, 21 Jan. 1996, shot 605

Objectives: The objective of Site AAD-27a is to recover basement samples for geochemical analysis in the minimum time possible.

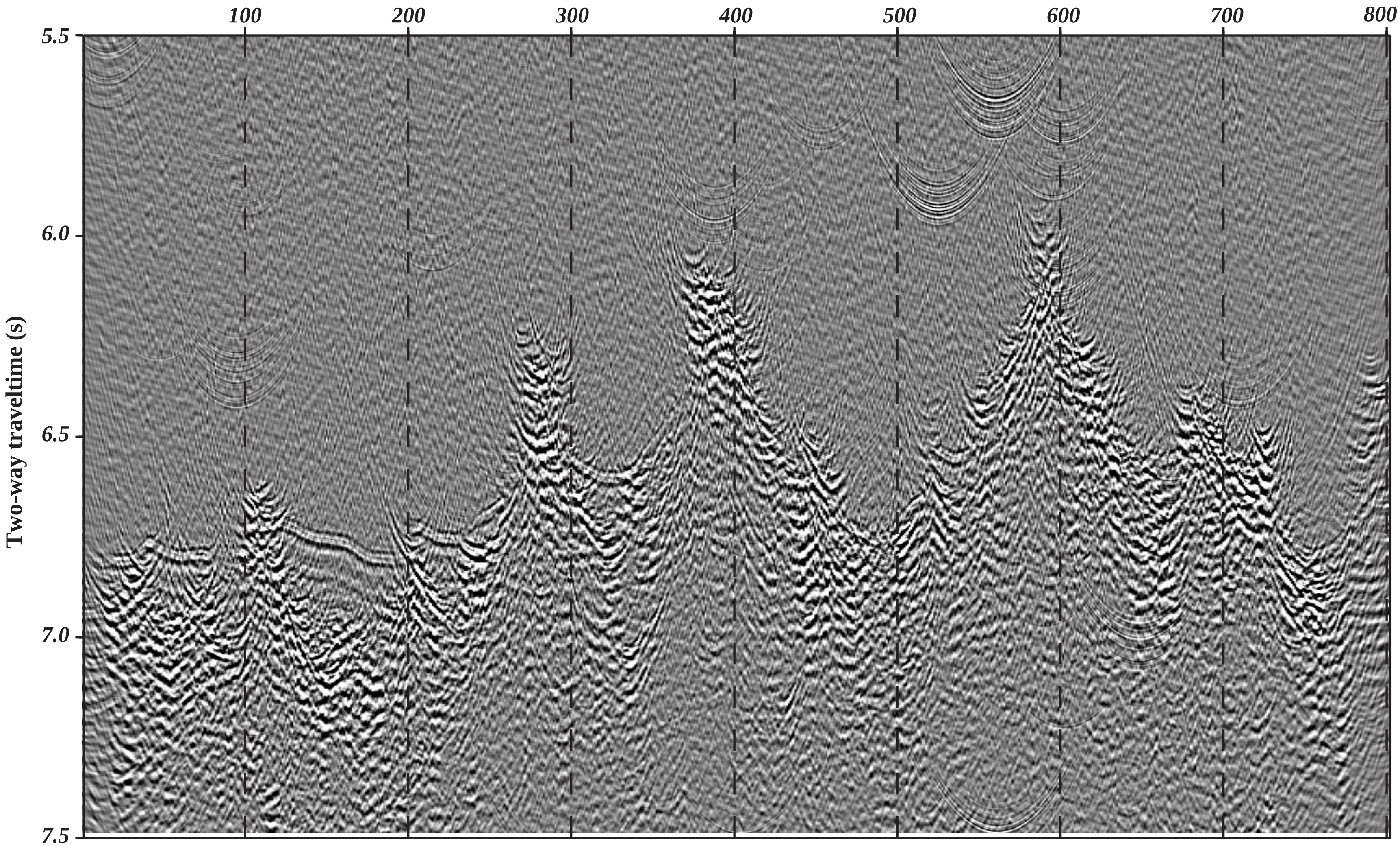
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-28a

800-959 GMT 26feb97, Shot # labeled every 15 min, Site 28a at ~Shot 160, sojn05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-28a

Priority: 1
Position: 43°15.3´S, 128°52.1´E
Water Depth: 5100 m
Sediment Thickness: Up to 300 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 350 m
Seismic Coverage: SOJN05, 800-959 GMT, 26 Feb. 1997, shot 160

Objectives: The objective of Site AAD-28a is to recover basement samples for geochemical analysis in the minimum time possible.

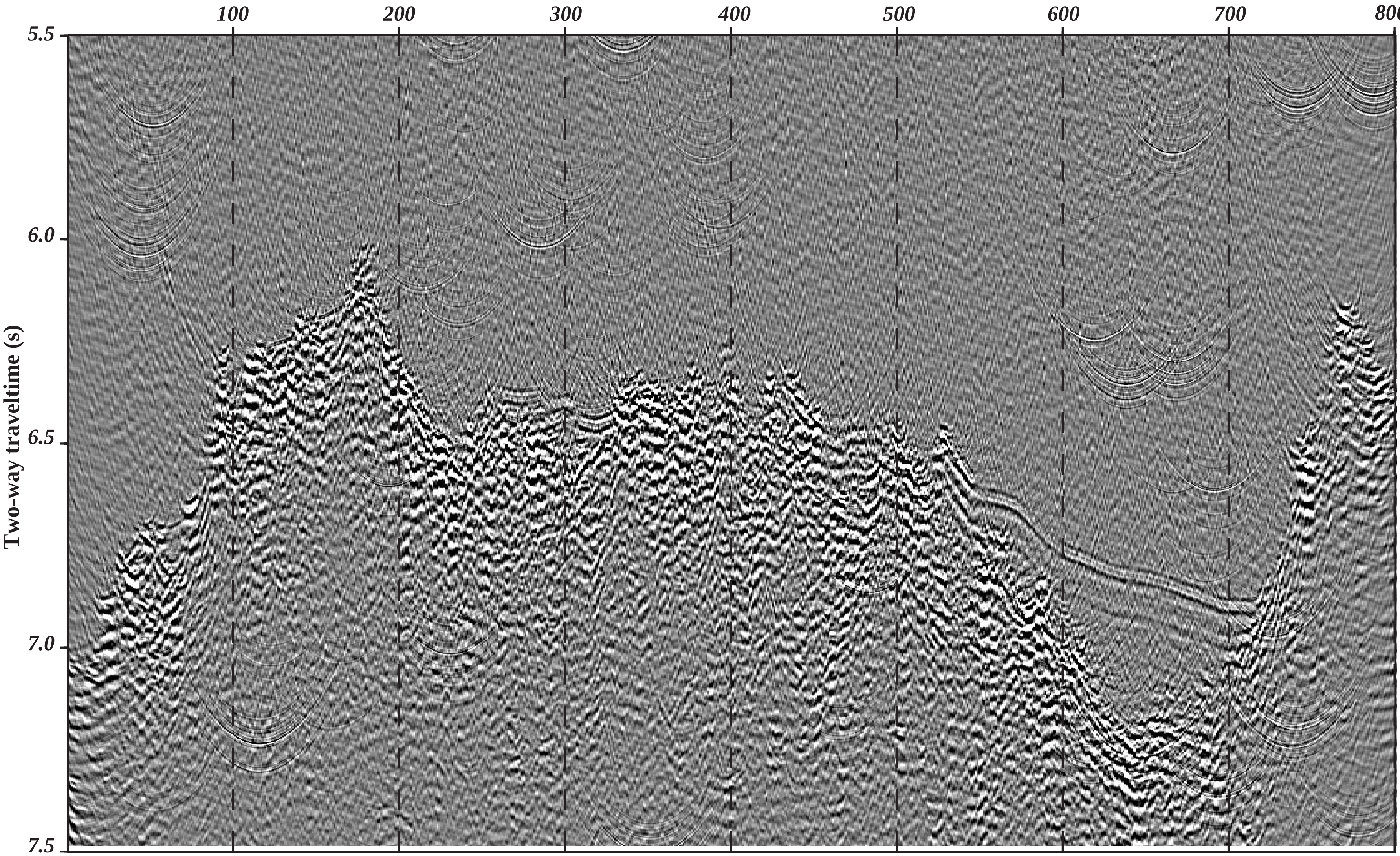
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-29a

000-159 GMT 26feb97, Shot # labeled every 15 min, Site 29a at ~Shot 680, sojn05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-29a

Priority: 1
Position: 43°56.9´S, 128°49.7´E
Water Depth: 5100 m
Sediment Thickness: Up to 300 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 350 m
Seismic Coverage: SOJN05, 000-159 GMT, 26 Feb. 1997, shot 680

Objectives: The objective of Site AAD-29a is to recover basement samples for geochemical analysis in the minimum time possible.

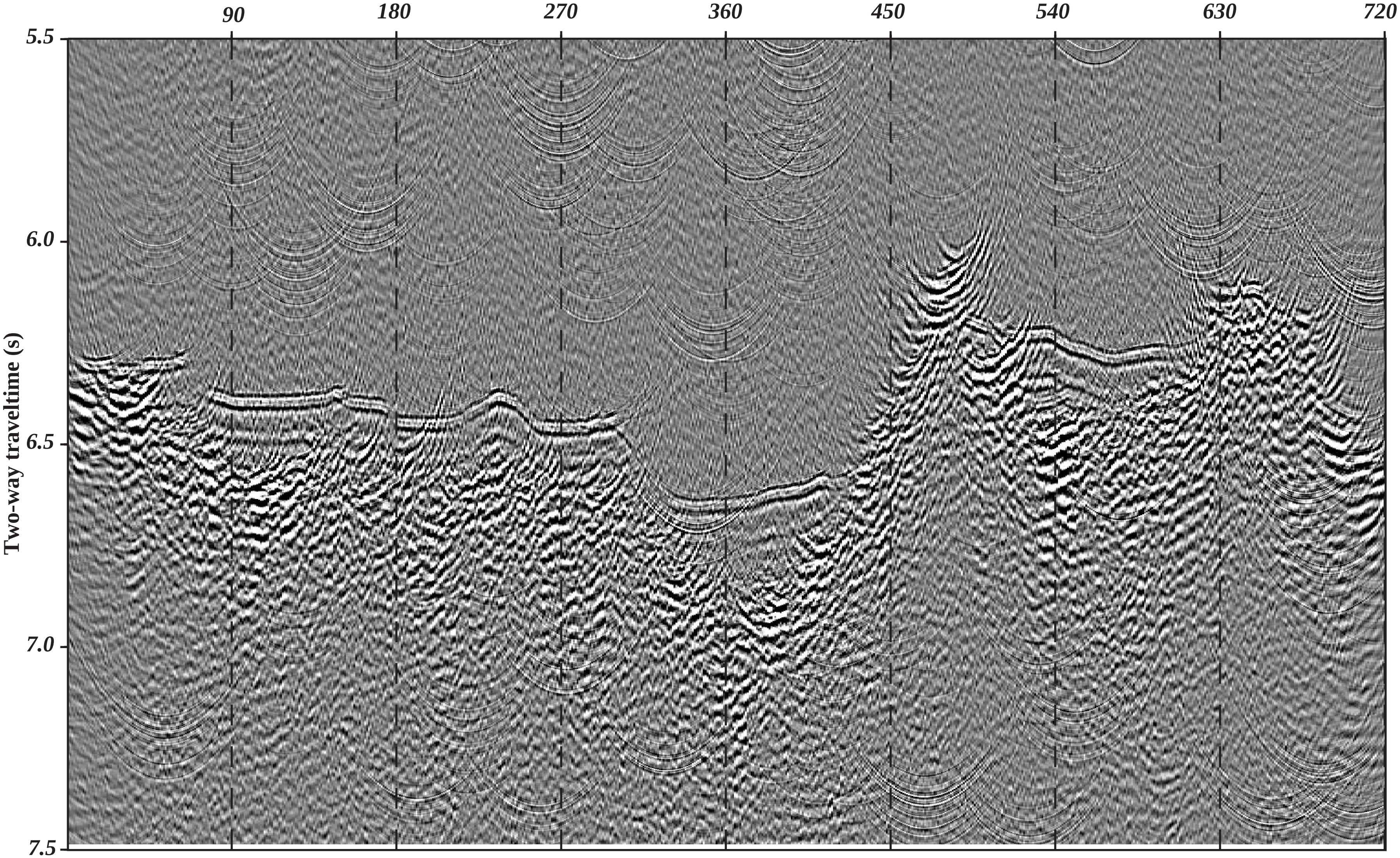
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-33a

1500-1659 GMT 24feb97, Shot # labeled every 15 min, Site 33a at ~Shot 120, sojn05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-33a

Priority: 1
Position: 43°44.9´S, 127°44.9´E
Water Depth: 4800 m
Sediment Thickness: Up to 200 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 250 m
Seismic Coverage: SOJN05, 1500-1659 GMT, 24 Feb. 1997, shot 120

Objectives: The objective of Site AAD-33a is to recover basement samples for geochemical analysis in the minimum time possible.

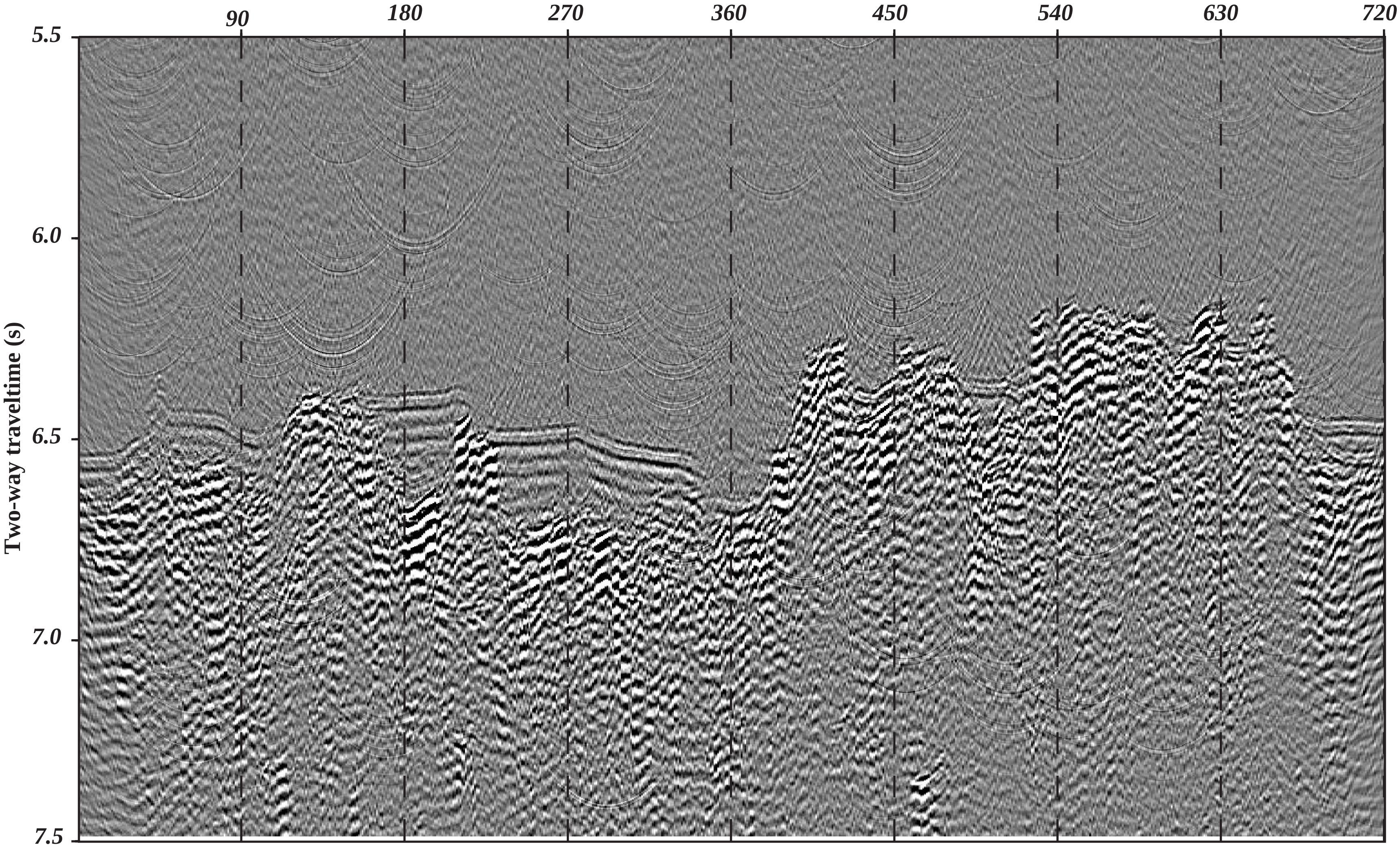
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-34a

400-559 GMT 24feb97, Shot # labeled every 15 min, Site 34a at ~Shot 275, sojn05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-34a

Priority: 1
Position: 42°44.2´S, 127°53.2´E
Water Depth: 4875 m
Sediment Thickness: Up to 200 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 250 m
Seismic Coverage: SOJN05, 400-559 GMT, 24 Feb. 1997, shot 275

Objectives: The objective of Site AAD-34a is to recover basement samples for geochemical analysis in the minimum time possible.

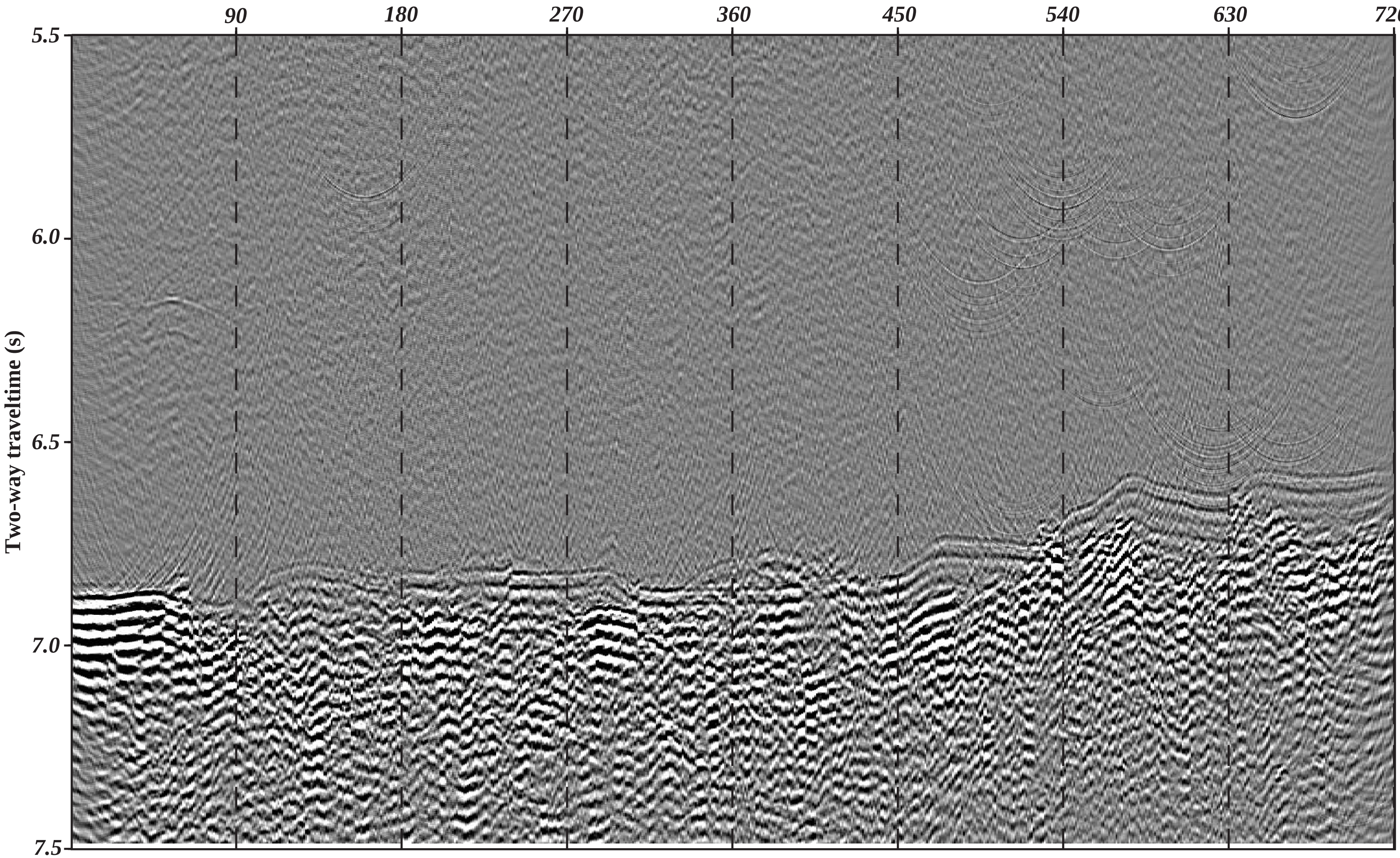
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-35a

1800-1959 GMT 23feb97, Shot # labeled every 15 min, Site 35a at ~Shot 605, sojn05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-35a

Priority: 1
Position: 41°57.5´S, 127°59.7´E
Water Depth: 5000 m
Sediment Thickness: Up to 200 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 250 m
Seismic Coverage: SOJN05, 400-559 GMT, 24 Feb. 1997, shot 605

Objectives: The objective of Site AAD-35a is to recover basement samples for geochemical analysis in the minimum time possible.

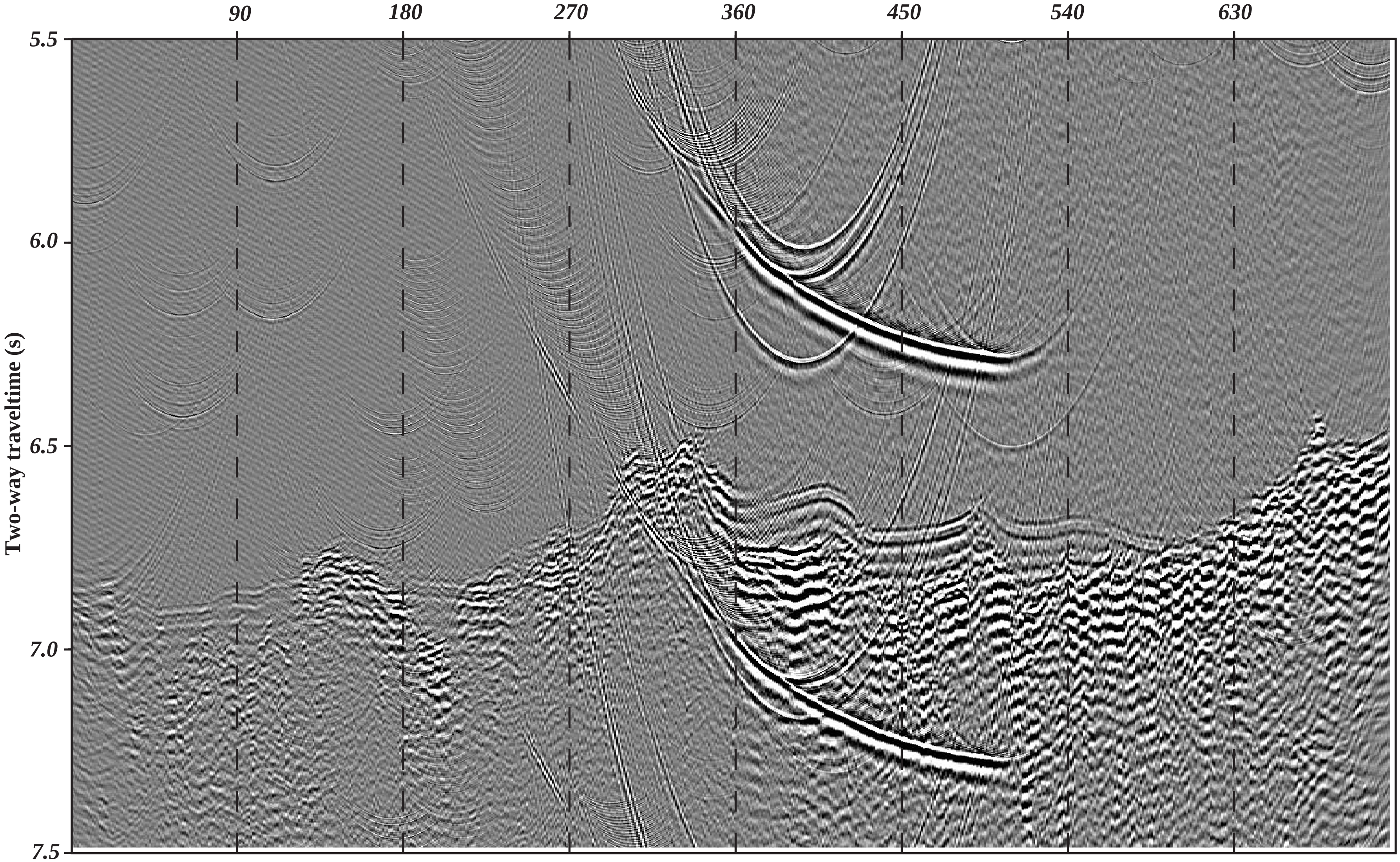
Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

SITE AAD-36a

800-959 GMT 23feb97, Shot # labeled every 15 min, Site 36a at ~Shot 475, sojn05 data: Filtered (1,30,375,400), Stacked, Migrated (90%)



Site: AAD-36a

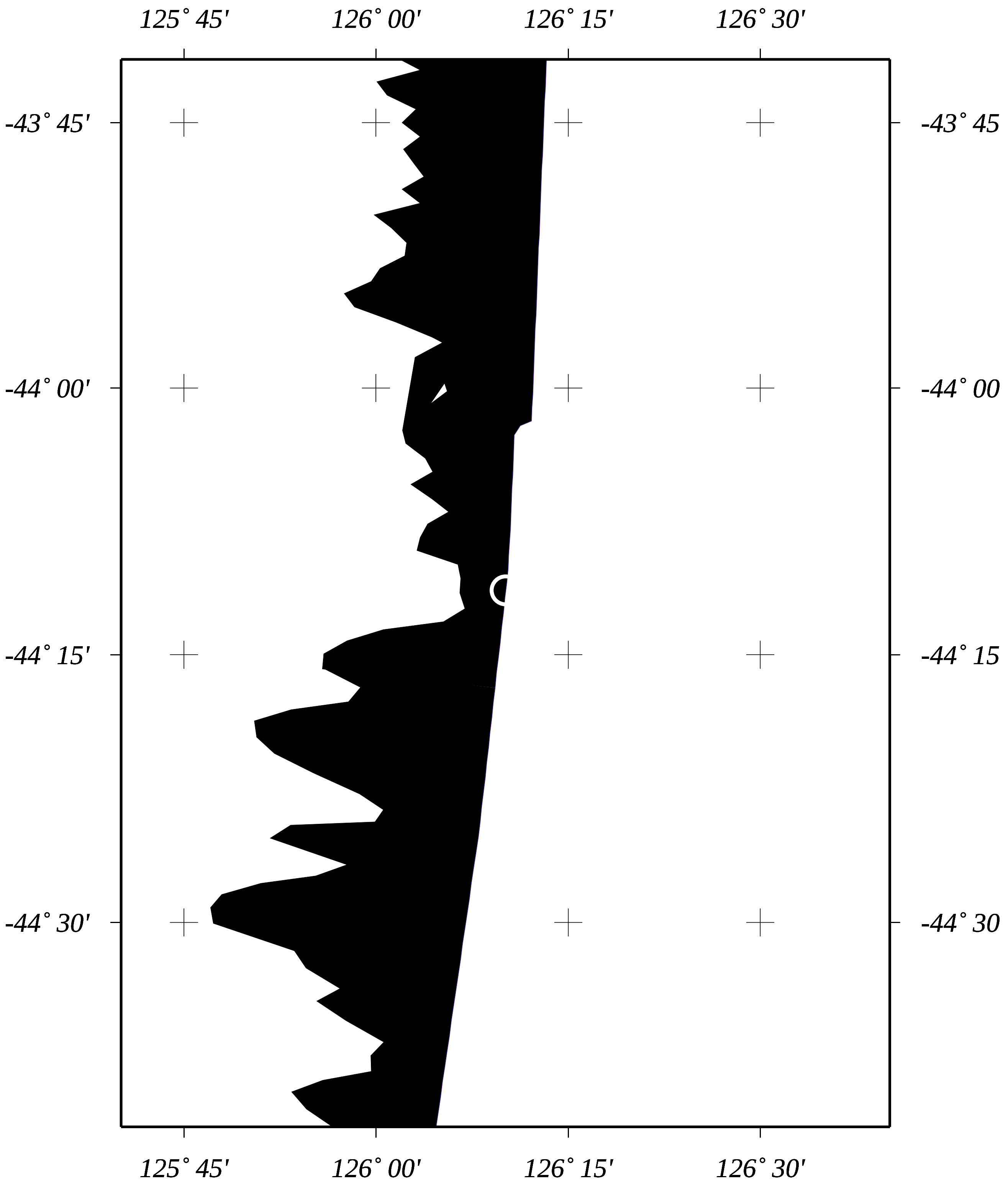
Priority: 1
Position: 41°52.7´S, 127°00.1´E
Water Depth: 5000 m
Sediment Thickness: Up to 150 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 200 m
Seismic Coverage: SOJN05, 800-959 GMT, 23 Feb. 1997, shot 475

Objectives: The objective of Site AAD-36 is to recover basement samples for geochemical analysis in the minimum time possible.

Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.



ODP Proposed Site 37a bathymetry

Site: AAD-37a

Priority: NA
Position: 44°11.4´S, 126°10.1´E
Water Depth: 5100 m
Sediment Thickness: <100 m
Target Drilling Depth: 50 m into basement
Approved Maximum Penetration: 150 m
Seismic Coverage:

Objectives: The objective of Site AAD-37 is to recover basement samples for geochemical analysis in the minimum time possible.

Drilling Program: RCB to ~50 m basement

Logging and Downhole Operations: None

Nature of Rock Anticipated: Pelagic ooze, basalt.

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