OCEAN DRILLING PROGRAM

LEG 182 SCIENTIFIC PROSPECTUS

GREAT AUSTRALIAN BIGHT
Cenozoic Cool-Water Carbonates

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This Scientific Prospectus is based on pre-cruise 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 182 will drill a transect of 10 sites from the shelf-edge (200 m) to the middle continental rise (4465 m) in the western Great Australian Bight. The primary drilling objective is a more detailed understanding of global environmental change in high- to mid-latitude settings. Cores from different facies deposited in various water depths during a range of geologic periods will yield the detailed anatomy of a Cenozoic cool-water carbonate margin. The response of this depositional system to sea-level fluctuations will be compared to records from warm-water, rimmed, and unrimmed carbonate platforms to test and refine the global sea-level curve and, most importantly, to describe the reaction of cool-water carbonate depositional systems to different phases of the sea-level cycle. Biological and chemical paleoenvironmental proxies will be used to decipher a detailed paleoceanographic record to more precisely describe the timing and paleoceanographic effects of the opening of the Tasman Gateway and the influence of the Leeuwin Current on paleoproductivity over time. The shelf-to-basin transect will also provide high-resolution data on the tempo and pattern of biotic evolution in oceanic and neritic environments.

Secondary objectives are directed toward understanding the hydrology of a carbonate platform adjacent to a vast inland karst with sluggish water circulation, and the nature of early burial diagenesis (lithification and dolomitization) in a cold, seawater-dominated system.

INTRODUCTION

Carbonate sediments and sedimentary rocks contain a particularly sensitive record of paleoceanographic and biostratigraphic evolution. The focus of the Ocean Drilling Program (ODP) carbonate drilling on continental margins to date has largely been in warm-water environments. There is a complete sedimentary realm whose nature and history have not yet been investigated; that of continental margin cool-water carbonates. These sediments, formed where seawater temperatures rarely rise above 20°C, are biogenic sediments that commonly mantle continental margins in mid and high latitudes. They are an untapped storehouse of information regarding the evolution of global climates, eustacy, and marine biology.

The southern Australian continental margin is the ideal location to study cool-water carbonate facies and evolution. The shelf has been the site of cool-water carbonate sedimentation since Eocene time, resulting in an almost 1-km-thick succession, and it is now the largest area on the globe composed of such sediments. In addition, slight tectonic tilting in the late Miocene has led to subaerial exposure of Eocene-middle Miocene strata in extensive, shallow basins. These sediments form a more compressed and less continuous section than the one offshore, yet they have permitted the development of actualistic models for the formation and development of these carbonates that can be tested and greatly expanded by drilling.

A critically important benefit of drilling in the Great Australian Bight is that, as the shelf is latitudinally parallel to the southern margin of the Australian plate, the sediments contain a record of the development of the Southern Ocean. In particular, the region offers the potential to collect high-resolution stable isotopic and biostratigraphic profiles to clarify several important stages in the evolution of the Southern Ocean.

Drilling in the Great Australian Bight will also provide essential and original information on the contrast between the sedimentologic, paleontologic, paleoceanographic, and climatic records from warm- and cool-water realms, and will allow the development of well-constrained and much-needed models that can be used in the interpretation of older Mesozoic and Paleozoic continental margin carbonate systems.

BACKGROUND

Tectonic Setting

The southern margin of the Australian continent is a divergent, passive continental margin that formed during the protracted period of extension and rifting that led to the separation of Australia and Antarctica in the Cretaceous and that evolved during the subsequent northward drift of the Australian continent. The initial extension phase before breakup in the mid-Cretaceous (96 Ma), together with the following period of slow spreading (until the middle Eocene [49 Ma]), resulted in deep continental margin basins filled with as much as 12 km of mainly terrigenous clastic sediments (Willcox et al., 1988; Davies et al., 1989). These basins broadly correspond to the sites of modern upper slope terraces (e.g., the Eyre Terrace at 400-1600 m depth in the western Great Australian Bight; Fig. 1). The onset of faster spreading in the middle Eocene also corresponded with the establishment of fully marine conditions and the initiation of carbonate sedimentation in the widening "gulf" between Australia and Antarctica. Carbonate sedimentation continued throughout the remainder of the Cenozoic, as the gulf evolved first into a broad, open seaway, and then into the modern Southern Ocean. Cenozoic sedimentation resulted in an extensive, relatively thin (as much as 800 m thick; Feary and James, in press) Eucla Basin succession deposited in a predominantly platform-sag to platform-edge tectonic regime (Stagg et al., 1990).

Throughout the Cenozoic, the western Great Australian Bight portion of Australia’s southern continental margin has been particularly stable, with geohistory analysis of the Jerboa-1 well indicating minimal Tertiary subsidence (Hegarty et al., 1988). Slight regional tilting (<1°?) in the middle Miocene resulted in uplift and exposure of the Nullarbor Plain and restriction of Neogene sedimentation to the modern outer shelf and upper slope.

Cenozoic Stratigraphy of the Eucla Basin

The Eucla Basin extends inland as far as 350 km from the present coastline and seaward some 200 km to the modern shelf edge and upper slope. Inland, the Eucla Basin succession thins and "feathers" out against Precambrian basement; it gradually thickens southward to its thickest point beneath the modern shelf edge (Fig. 2). Apart from the basal siliciclastic sequence both offshore (Sequence 7) and onshore (Hampton Sandstone), and a thin, transgressive, paleovalley-filling and strandline succession of terrigenous clastics on the inland margins of the basin, the Eucla Basin succession is entirely carbonate.

The succession is basically divisible into two mega-sequences: a Mesozoic (?Late Jurassic-Cenomanian; Stagg et al., 1990) siliciclastic-dominated syn- to early postrift section and a Cenozoic (Paleocene to Holocene), predominantly carbonate-dominated section, separated by a major, basinwide unconformity. The subject of the bulk of this drilling leg is the upper succession, which makes up an overall sigmoid-shaped series of sequences reaching a maximum thickness beneath the present-day outer shelf (Fig. 2). The stratigraphy of the lower, Mesozoic succession can be derived from the sequence intersected in the Jerboa-1 exploration well (Fig. 1); however, little information on the upper, Cenozoic section was obtained from this hole.

The extensive erosional unconformity at the top of the synrift section forms an easily recognizable and mappable surface. Seven unconformity-bounded seismic sequences have been recognized overlying this unconformity (Fig. 2). One of the most striking elements of this seismic stratigraphic analysis is the identification of numerous mound-shaped structures occurring throughout the Cenozoic succession, which have been interpreted as biogenic mounds (Feary and James, 1995). These structures are likely to preserve a detailed record of cool-water faunal community relationships and potentially to provide an analogue for cool-water mounds recognized in the rock record, but for which no modern analogues have previously been identified.

The ages assigned to this succession are extremely tentative and are based on (1) correlation of Sequence 6B with the onshore Eucla Group (Fig. 2); (2) the similarity in depositional style between the Sequence 7 progradational wedge and ?Paleocene-early Eocene progradational sequences elsewhere along Australia’s southern margin; and (3) the division of the remainder of the sequences into a reasonable time-stratigraphic framework. On this basis, the offshore sequences can be placed in a stratigraphic framework (based on Feary and James, in press):

- Sequence 7: Paleocene-middle Eocene progradational siliciclastic wedge deposited in a depositional sag, representing initial transgressive sedimentation.
- Sequence 6A: middle-late Eocene to early-middle Miocene deep-water carbonates forming a multilobed sediment apron.
- Sequence 6B: cool-water ramp carbonates with biogenic mounds (middle-late Eocene to Oligocene), overlain by an upper, warm-water, flat-topped platform rimmed by the ?early-middle Miocene "Little Barrier Reef" (Feary and James, 1995).
- Sequence 5: small late middle Miocene lowstand sediment wedge with restricted distribution,

lying at the foot of the steepest part of the progradational carbonate shelf escarpment zone.

- Sequence 4: extensive late Miocene aggradational deep-water carbonate ramp sequence.
- Sequence 3: latest Miocene and early Pliocene highstand aggradational deep-water carbonate ramp sequence.
- Sequence 2: thick succession of highstand, Plio-Pleistocene cool-water carbonates with spectacular clinoform ramp geometry that forms most of the modern outer shelf and contains large deep-water biogenic mounds.
- Sequence 1: thin Quaternary deep-water drape.

Existing Data

Present knowledge of the western Great Australian Bight margin is based on extensive, high-quality seismic reflection data, together with a single oil exploration drill hole, which provides little information about the Cenozoic succession. The original Leg 182 drilling proposals (James and Feary, 1993; Feary et al., 1994) were based on detailed seismic stratigraphic interpretation (Feary and James, in press) of a grid of 2,350 km of high-quality, regional 2-D seismic reflection lines. These lines were collected and processed by the Japan National Oil Corporation (JNOC) in 1990 and 1991, over an area of 155,000 km^2 on the continental shelf and upper slope of the western Great Australian Bight. An additional 1380 km of moderate-quality, regional 2-D seismic lines, collected by Esso Australia in 1979 and reprocessed by JNOC, were also used to fill gaps in the JNOC dataset. The 1996 seismic-site survey cruise (Feary, 1995) collected high-resolution, 80-channel generator-injector (GI) gun seismic data as 0.5 nmi-spaced grids centered on each site, together with tie-lines between sites. These data permitted minor refinements of some site locations to avoid potential safety concerns.

Jerboa-1 was drilled by Esso/Hematite in 1980 as a wildcat oil exploration well in 761-m water depth, above a prominent tilted basement fault block located in the southern half-graben of the Eyre Sub-basin (Bein and Taylor, 1981). Jerboa-1 penetrated 1738 m of a Cenozoic and Cretaceous sedimentary section before bottoming in Precambrian metabasalt basement and did not encounter any significant hydrocarbon shows. The top 232 m were washed down and cased, so that only 145 m of Tertiary section were actually drilled and logged. No cores were cut in this interval, so lithologic and biostratigraphic inferences are based on cuttings and downhole logs. Thermal modelling and vitrinite data (Stagg et al., 1990) indicate that the entire sedimentary section at Jerboa-1 is thermally immature ($R_v < 0.65\%$).

SCIENTIFIC OBJECTIVES

Leg 182 drilling in the Great Australian Bight will allow six fundamental scientific topics to be addressed:

1. *The paleoceanographic history of a carbonate-dominated, mid-latitude continental margin and adjacent basin during evolution of the Southern Ocean.* As the Southern Ocean is one of the major controlling influences on global circulation and climate, it is imperative that the oceanic history of this region be refined as much as possible. However, at present the paleoceanographic development of this area is not nearly as well known as that of the high-latitude North Atlantic (Kennett and Barron, 1992). Although there are numerous paleoceanographic problems that can be answered by the Leg 182 drilling transect, four stand out as critical.

   (a) *The relationship between circulation patterns in the deep ocean and on the shelf during times of warm vs. cold ocean conditions.* The stratigraphic record in the Southern Ocean is punctuated with numerous breaks in sedimentation that are attributed to erosive periods related to increased circulation during initiation of the Circum-Antarctic Current (Miller et al., 1987; Kennett and Barker, 1990). Although such hiatuses are thought to develop on deep margins during times of lower sea level and to correlate with unconformities on the continental shelf, there are apparently continuous onshore sequences of Oligocene shelf carbonates deposited while there was erosion or nondeposition of the entire Oligocene on the adjacent ocean floor.

   (b) *The precise timing and nature of the opening of the Tasman Gateway.* Subsidence of the Tasman Rise, which permitted initiation of the cold circum-Antarctic circulation and thermal isolation of Antarctica, is one of the most important developments in Cenozoic paleoceanography (Kennett, 1982). The history of this event is poorly constrained because so much of the oceanic record is missing as a result of seafloor erosion. The Leg 182 shelf-to-basin transect is sufficiently proximal to the Tasman Rise that it should contain an excellent record of the paleoceanographic development of this seaway.

   (c) *The evolution and effect of the Leeuwin Current.* The first evidence for the existence of the Leeuwin Current occurs in middle Eocene time, when currents from the Indian Ocean were deflected into the elongate proto-Great Australian Bight embayment. In support of this, the record of warm-water intervals is more common in the west than it is in the east, implying that the source of the water is from the west. Studies of Quaternary cores from the Great Australian Bight suggest a complex interplay between the Leeuwin Current and the West Wind Drift. This interplay appears to have had dramatic effects on primary productivity, as the Leeuwin Current is a source of warm oligotrophic waters, whereas the West Wind Drift causes upwelling of cooler eutrophic waters.

(d) *The relationship between primary productivity and cool-water carbonate development*. The Leg 182 shelf-to-basin transect should contain an important record of paleoproductivity linked to upwelling. Such periods should be recorded in the biota by low species diversity, high numbers of individuals, increased sedimentation rate, and distinctive changes in stable-isotopic and trace-element compositions.

2. *The formulation of models for carbonate sedimentation on continental margins bathed predominantly by cool oceanic waters.* The deposition and accumulation of platform (neritic) carbonate sediments under cool-water (~<20°C) conditions is poorly understood compared to warm-water carbonates, primarily because the database is so small (Nelson, 1988; James and Kendall, 1992). Yet, because of their dominantly skeletal composition, nutrient-dependent biology, and low diagenetic potential, cool-water carbonates record the history of oceanic change in ways that are profoundly different from tropical carbonates. In hydrodynamic terms, cool-water carbonate shelves are hybrids, possessing some of the characteristics of both terrigenous clastic shelves and warm-water carbonate shelves. Sediments are produced on the shelf, in contrast to terrigenous clastic shelves where sediment is transported onto the shelf from the hinterland. Without the elevated rim that typifies warm-water carbonate shelves, however, the sediments are subject to the full sweep of oceanic waves and swells, as they are on terrigenous clastic shelves. Cenozoic exposures of inner-shelf facies in Australia suggest that storm- and wave-dominated processes tend to control deposition. By contrast, many contemporaneous deposits in New Zealand are clearly tide dominated. Are the models of wave-dominated shelf deposition developed onshore applicable throughout the Cenozoic? All seismic profiles across the southern margin of Australia indicate that a large proportion of the youngest part of the succession is made up of prograding clinoforms (James and von der Borch, 1991; Feary and James, in press). Such clinoforms seem to be a signature of

cool-water platforms and ramps and are postulated to be a product of accumulation dynamics (Boreen and James, 1993). There is little information regarding the composition of these deposits; specifically, are they produced by in-place, enhanced bioproduction along the shelf edge, or are they made up of finer grained material produced on the shelf and swept offshore to accumulate below the wavebase?

3. *Determination of the Southern Ocean basin sea-level record, and the effect of sea-level fluctuations on stratigraphic packaging and early diagenesis of cool-water carbonates.* The Eucla margin is rich in biogenic carbonate sediments that respond in a sensitive way to variations in sea level and contain vital geochemical information needed for linking sea-level changes to paleoceanography. This information can then be utilized to address two major questions of global and temporal significance.

(a) *What is the detailed sea-level history of the Southern Ocean basin, and can it be linked to paleoceanographic variations?* Specifically, the southern Australian neritic shelf record, derived largely from onshore successions in which the marine record is preserved only in highstand systems tracts, appears to be at odds with the global model (Haq et al., 1987) during several critical periods. Is this because the sediments were deposited in cool water? By using a combination of physical stratigraphy and proxy paleoenvironmental parameters in a much more expanded section than exists onshore, the well-preserved Eocene to Oligocene and early to middle Miocene successions will permit a thorough testing of this part of the sea-level curve and resolution of specific eustatic events. The late Miocene to Pliocene sequence is unknown onshore except for the early Pliocene highstand, and so this will be the first clear record of this component of the sea-level record in the region.

(b) *How do cool-water carbonate platforms respond to changes in sea level*? Carbonate platforms, with their chemically metastable sediments born largely in place, are particularly responsive to changes in seawater temperature and chemistry and variations in sea state and sea level. To date, most information on carbonate platforms comes from rimmed, warm-water platforms (Kendall and Schlager, 1981; Sarg, 1988). There is almost no information on the manner in which cool-water carbonate platforms respond to changes in these critical parameters at a variety of different time scales. Specifically, we require information to describe how different segments of the shelf react during different parts of the sea-level cycle and to determine whether cold- and warm-water carbonate platforms have basically different depositional geometries as a result of the different ways the carbonate factory responds to sea-level changes.

4. *The circulation patterns of shallow subsurface fluids in an area of low hydraulic gradient and minimal recharge.* The Eucla margin is one of the few modern shelves where the onshore recharge zone is an areally vast, flat-lying karst (the Nullarbor Plain). The high primary depositional permeability of winnowed grainstones of the Eucla Shelf and the lack of early cementation suggest that significant groundwater circulation may occur, at least at shallow depths. The drive for such a circulation may come from temperature contrasts between cool ocean waters and groundwaters warmed by geothermal heat flux (and possibly volcanics) within the shelf, concentrating waters on the shelf margin (Simms, 1984). Alternatively, despite inland aridity, recharge occurring over the vast continental hinterland may drive brackish to saline waters southward to discharge through the flooded shelf. Such a circulation has been recognized by James (1992) and is associated with cave development on the Nullarbor Plain (James et al., 1989). In contrast to the long-lived nature of the above systems, differences in sea-surface elevation, on and off the shelf, associated with regional wave buildup (Feary, 1995), current flow (Rockford, 1986), and atmospheric pressure system changes may cause pumping of marine waters into and out of the platform (Marshall, 1986).

5. *Early seafloor and shallow burial diagenesis and dolomitization of calcite-dominated sediments.* Cool-water carbonates exhibit a radically different pattern of diagenesis from that of tropical aragonitic carbonates. Slow sedimentation permits seafloor lithification by intermediate Mg-calcite cements, but these appear to be volumetrically limited and localized to omission surfaces and hardgrounds, which are ubiquitous in the inner platform. Indeed, both shallow-marine and meteoric cements appear to be very sparse, with magnesium being lost from high-Mg calcite to low Mg calcite during grain recrystallization. Sparse calcium-rich dolomites may be present (Reeckmann, 1988; Bone et al., 1992), and at some locations replacement can be pervasive (James et al., 1993), although the fine subtidal evaporation-related dolomites typical of tropical platforms are absent. It is not known whether dolomitization is episodic, as recognized in other present-day platforms (Vahrenkamp, et al. 1991; McKenzie et al., 1993), or occurred over extended time periods. The Eucla margin carbonates will provide an opportunity to determine the present-day associations among

groundwater circulation, fluid geochemistry, and diagenetic products, and by inference from the temporal and spatial distribution of ancient diagenetic components, those that occurred under different conditions in the past. This has the potential to provide fundamental insights into the diagenesis of cool-water, open-shelf carbonates, which are direct analogues for the comparable carbonate platforms that were ubiquitous during Paleozoic and other times.

6. *The pace and style of evolution of mid-latitude oceanic and neritic biotas.* The Leg 182 drilling transect offers the opportunity for pioneering analysis of the Cenozoic evolution of cool-water calcareous biota, with direct applicability to studies of ancient carbonate platforms presently lacking modern analogues. Linked information from the neritic and oceanic high- to mid-latitude carbonate realm should produce an unmatched record of paleobiological information. Specifically, the patterns and modes of speciation and diversification of coeval shallow- and deep-water benthic organisms as well as contemporaneous planktonic biota should be revealed. By comparing these results with those from Antarctica and the northeast Australian shelf, the geography of such processes and their relationship to physiochemical factors should be discernible.

DRILLING STRATEGY

The Leg 182 drilling strategy must be developed with the knowledge that although ODP has great experience with drilling deep-water pelagic carbonates, it is difficult to predict drilling conditions in the cool-water carbonates at the shallower sites. Accordingly, operational considerations may dictate that significant changes to drilling strategies are necessary on site. In particular, although easily drilled nanno-foram and foram-nanno oozes are expected to dominate the upper sequences at each site, there is the possibility that thin bioclastic grainstone horizons and/or thin chert horizons may complicate drilling at the shallowest sites. In addition, the order in which sites are drilled will need to be flexible to accommodate operational restrictions dependent on sea state for the sites in less than 650 m water depth (Sites GAB-05B, GAB-06B, GAB-07A, GAB-08A, and GAB-09A). This will be particularly important for the sites located in less than 300 m water depth (Sites GAB-06B and GAB-09A), where calm conditions will be imperative. The Leg 182 operational plan is summerized in Table 1.

Triple coring with the advanced hydraulic piston corer (APC), extended core barrel corer (XCB), and rotary core barrel corer (RCB) will be carried out at the four high-resolution paleoceanography and sea-level sites (Sites GAB-01C, GAB-02B, GAB-06B, and GAB-13B), which comprise the shelf-to-basin transect (water depth range of 332-4465 m). After the cores and downhole logs have been tied to the extensive seismic data in the area, these sites will provide the fundamental basis for regional stratigraphic and lithologic characterization. Lithologies intersected at all these sites should pass from carbonate oozes in the upper part of the holes down into more indurated calcareous siliciclastic sediments at the base. The 500- to 600-m high-resolution records of Plio-Pleistocene sea-level fluctuations within carbonate oozes targeted at Sites GAB-07A, GAB-08A, and GAB-09A should be achievable with double APC and XCB drilling, with triple APC at Site GAB-09A providing additional resolution.

The sites predominantly targeting cool-water carbonate facies objectives (Sites GAB-03B, GAB-04B, and GAB-05B) should be drilled using double APC and XCB, with the deeper (Cretaceous) parts of Site GAB-04B possibly requiring RCB, and the siliciclastic sequence in the deeper part of Site GAB-05B certainly requiring RCB.

Direct seismic ties connecting the dry oil exploration well Jerboa-1 (Fig. 1) to all sites—except Site

GAB-01C and GAB-13B—demonstrate that there is negligible likelihood of encountering hydrocarbons, and vitrinite reflectance data show that most or all of the sedimentary succession underlying these shallower sites is thermally immature. Water depths at Sites GAB-01C (3884 m) and GAB-13B (4465 m) are too great for any significant safety risks.

LOGGING PLAN

All sites should be logged with standard logging tool strings (triple-combo, formation microscanner [FMS]/sonic), together with deployment of the well seismic tool (WST) and geological high-sensitivity magnetometer tool (GHMT) at selected sites. The geophysical logs (triple-combo) will be important for evaluating the lithostratigraphic response of cool-water carbonates to sea-level and climatic fluctuations. The fine-scale characteristics of the bedding, including pore spaces, bioturbation, fractures, and stylolites, may be imaged through FMS.

Integrated interpretation of FMS and geophysical logs should provide a good complement to cores in describing the lithostratigraphy. Diagenesis in carbonates usually is well expressed through changes in porosity and chemical precipitation of soluble elements (such as uranium), leading to large changes in log properties seen on sonic, resistivity, density, and neutron gamma-ray logs. Thus, the diagenetic changes in the carbonate sediments, another key objective of the leg, may be evaluated through the petrophysical response measured in the wireline logs. Magnetostratigraphic characterization at selected deeper penetration sites using the GHMT string should also contribute to the sedimentary/stratigraphic objectives and intersite correlation.

Interstitial fluid characterization from cores will be the primary tool for the fluid-flow objectives, with logging data being of secondary importance. However, the assessment of fracture networks and basic fluid properties using sonic and resistivity logs, together with FMS images should provide an important contribution to this leg objective.

A detailed correlation between cores and logs and the extensive suite of high-quality seismic reflection data, including the closely spaced site survey grids and regional 2-D lines, will be critical for understanding the 3-D architecture of the Cenozoic sequences and for compiling a detailed sequence stratigraphy. Accordingly, check-shot (WST) surveys, at 30- to 50-m spacing, should also be run at all sites—except Site GAB-08A (where data from adjacent Sites GAB-07A and GAB-09A will be applicable).

SAMPLING STRATEGY

During Leg 182, the upper sections (approximately 200 m) at all sites will be recovered by either triple APC coring (four sites) or double APC coring (four sites). Sampling for high-resolution isotopic, sedimentologic, and micropaleontologic studies at these sites will be conducted after construction of the spliced composite section. Only low-resolution sampling will be carried out aboard ship to support description/characterization, facilitate pilot studies, and provide material for projects that do not require high-temporal resolution. High-resolution sampling will be deferred until after the cruise. Whole-round sampling for pore-water geochemical analyses is anticipated at a higher resolution than the typical routine ODP scheme. The archive halves (permanent and temporary) in all holes will not be sampled aboard ship, and the permanent archive will be designated postcruise. The sampling plan for Leg 182 must be approved by the sampling allocation committee (SAC), consisting of the Co-chief Scientists, Staff Scientist, and Curatorial representative. The initial sampling plan is preliminary and can be modified depending upon actual material recovered and collaborations that may evolve between scientists during the leg.

PROPOSED SITES

Sites GAB-01C, GAB-02B, and GAB-13B

Sites GAB-01C (southern Australian upper continental rise), GAB-02B (mid-upper slope), and alternate GAB-13B (middle continental rise) are paleoceanographic sites located to intersect pelagic sections that collectively span the entire Cenozoic succession and a substantial part of the Late Cretaceous section. These sites compose the deeper water component of the shelf-to-basin transect. The principal objective at these sites is to obtain a complete record of the Cenozoic section in a deep oceanic setting, with the principal aim of elucidating the evolution of the Circum-Antarctic Current within the evolving seaway between Australia and Antarctica. As the condensed section in the Jerboa-1 well contains early Oligocene faunas, there is a high probability that the intermediate and deep pelagic successions will together contain a more expanded record of this critically important time of Antarctic ice-cap evolution and Southern Ocean paleoceanographic development.

Sites GAB-03B and GAB-04B

Sites GAB-03B and GAB-04B are located to intersect the Eocene to early middle Miocene section deposited in lobes on the upper slope, coeval with deposition of the extensive carbonate platform on the continental shelf. In addition, these sites will also intersect an early Neogene succession poorly sampled at other sites; a highly condensed late Neogene succession; and the upper part of the marine Cenomanian section at Site GAB-04B. The principal objective at these sites is to collect a detailed record of Paleogene-early Neogene temperate to subtropical, mid-latitude sedimentation in an upper slope environment and to recover a record of marine flooding of the evolving rift basin in the Cenomanian (Site GAB-04B).

Sites GAB-05B and GAB-06B

Sites GAB-05B and GAB-06B are located to intersect distal (Site GAB-05B) and proximal (Site GAB-06B) parts of the Paleocene to middle Eocene progradational siliciclastic wedge. In addition, these sites will intersect a major portion of the overlying Neogene succession (Seismic Sequences 2 to 4). The principal objective at these sites is to recover a detailed record of shelf-edge siliciclastic deposition to evaluate the sedimentary response to Paleogene sea-level fluctuations and to evaluate the complex interaction between sea-level variation, accommodation space, and subsidence evident in stratal patterns.

Sites GAB-07A, GAB-08A, and GAB-09A

Sites GAB-07A, GAB-08A (alternate), and GAB-09A will intersect a spectacular set of late Neogene (?Plio-Pleistocene) clinoforms immediately seaward of the present-day shelf edge. Site GAB-07A will intersect the lowest, more condensed portion of the clinoform sequence, but will also have the best record of the youngest clinoforms; Site GAB-08A will intersect a ?Pleistocene-Holocene biogenic mound immediately below the seafloor, together with the best record of the middle part of the clinoform sequence; and Site GAB-09A will intersect a buried biogenic mound originally formed immediately below the paleoshelf edge, together with the best record of the oldest part of the clinoform sequence. The principal objective at these sites is to collect detailed, high-resolution profiles through a late Neogene shelf-edge (high energy) to upper slope (low energy) succession deposited within a cool-water carbonate environment to determine the response of such a depositional system to Plio-Pleistocene sea-level fluctuations.

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FIGURE CAPTIONS

Figure 1. Location of the proposed ODP drill sites in the western Great Australian Bight.

Figure 2. Schematic N-S diagram from the Nullarbor Plain to the upper continental slope across the Eyre Terrace (along longitude 128°E), showing the distribution and internal relationships of seven Cenozoic sequences (unshaded) defined from seismic data, overlying Mesozoic synrift siliciclastic sequences and Precambrian crystalline basement (after Feary and James, in press). Vertical scales are approximate.

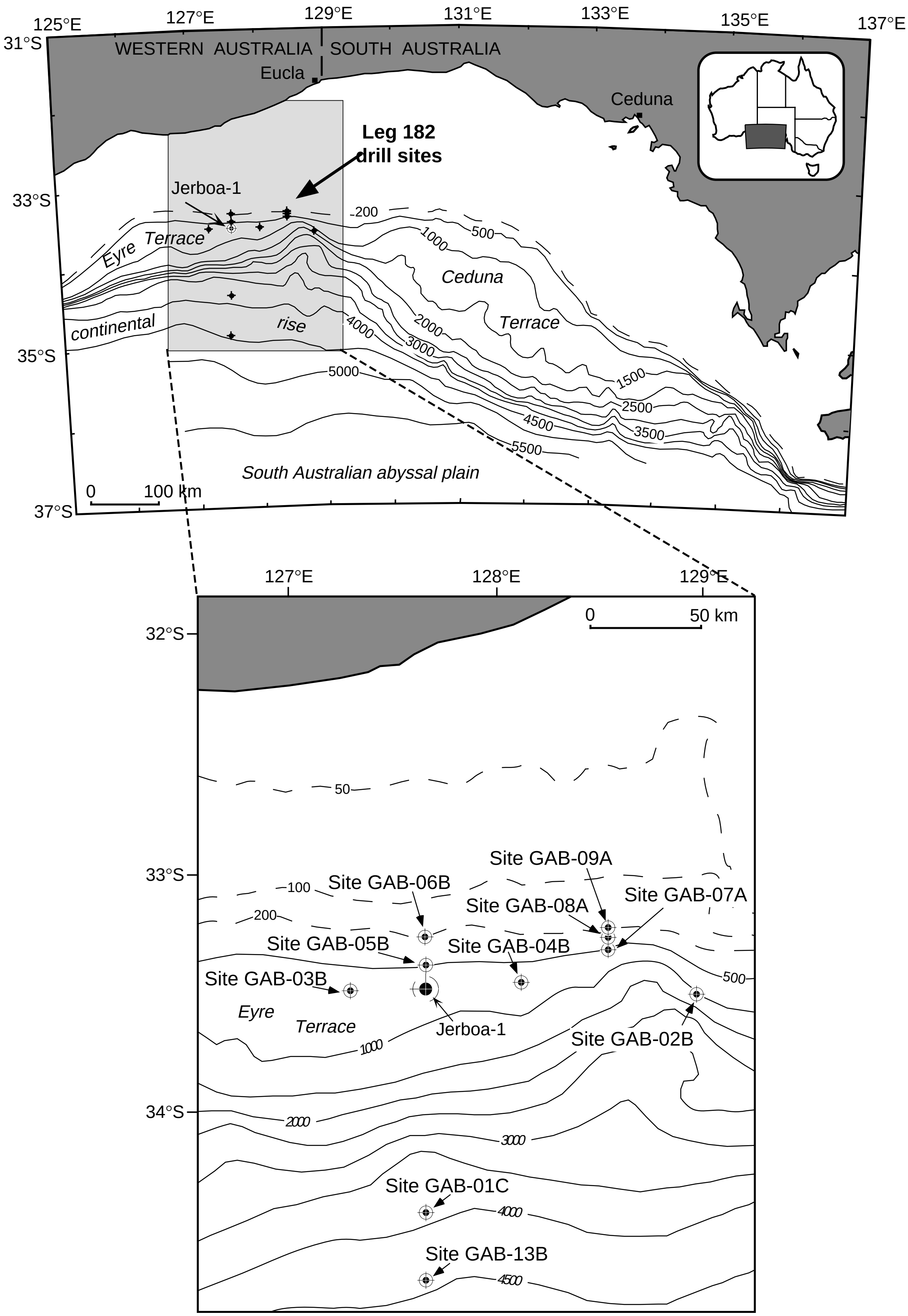

125°E
127°E
129°E
131°E
133°E
135°E
137°E
31°S
33°S
35°S
37°S
WESTERN AUSTRALIA
SOUTH AUSTRALIA
Eucla
Ceduna
Leg 182
drill sites
Jerboa-1
Eyre Terrace
Ceduna
Terrace
continental
rise
South Australian abyssal plain
0
100 km
200
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
127°E
128°E
129°E
32°S
33°S
34°S
0
50 km
50
100
200
500
1000
2000
3000
4000
4500
Site GAB-09A
Site GAB-06B
Site GAB-08A
Site GAB-07A
Site GAB-05B
Site GAB-04B
Site GAB-03B
Eyre
Terrace
Jerboa-1
Site GAB-02B
Site GAB-01C
Site GAB-13B

Figure 1

Distribution of Cenozoic Seismic Sequences across the Western Eucla Basin

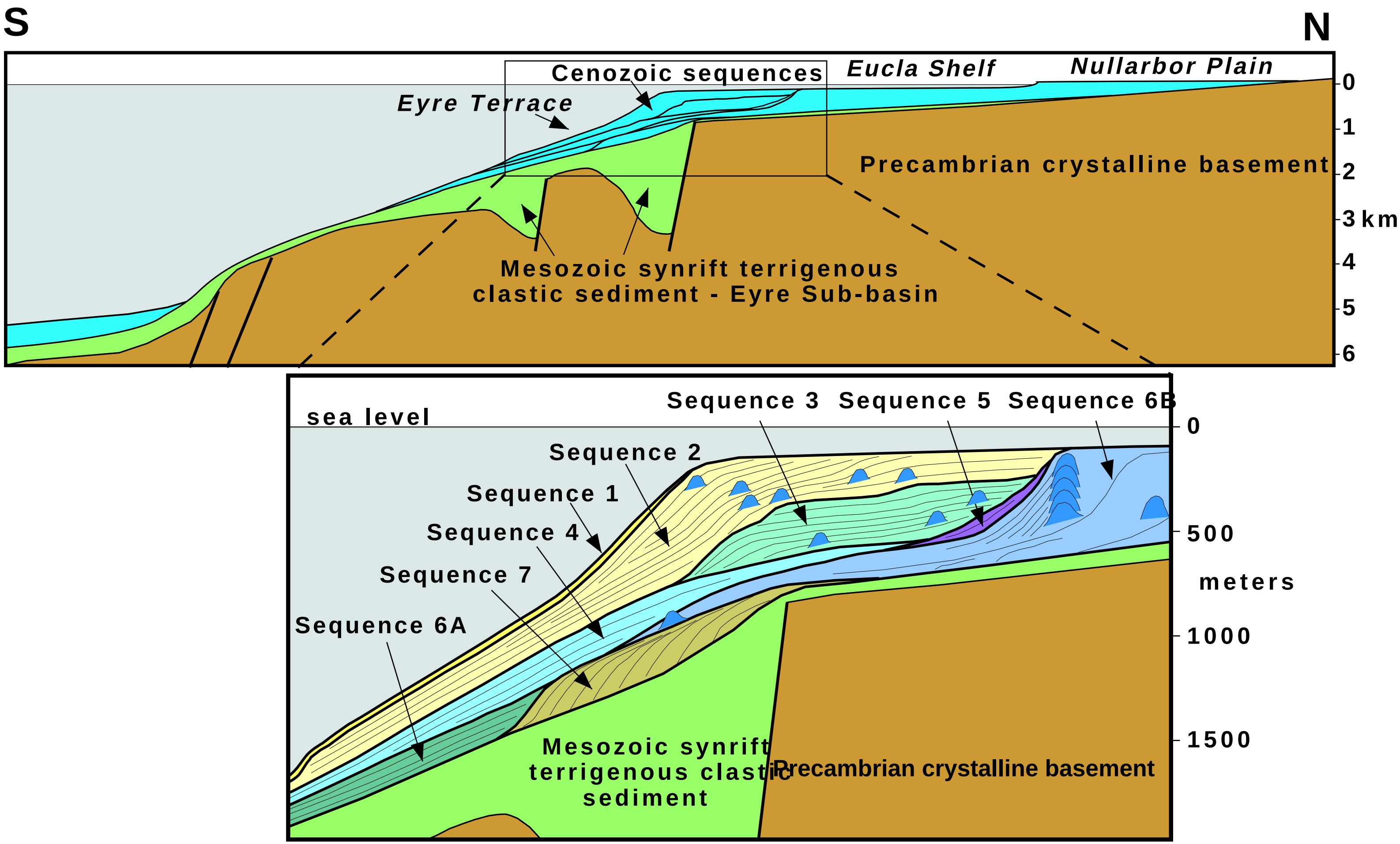


Figure 2

Table 1. Leg 182 Operational Time Estimates

Site Name	Latitude S Longitude E	Water Depth (m)	Sediment Depth (m) ***PPSP Approval***	Projected Operations Plan	Transit (days)	Operation (days)	Log (days)	**TOTAL** (days)
Transit from Wellington					8.7			8.7
GAB-01C	34°23.4672'	3884	5950	A:APC 200 m, XCB 500 m		4.1		4.1
	127°35.4393'		**700**	B:APC 200 m		1.1		1.1
				C:APC 200 m		1.5		1.5
				D:Drill 500 m, RCB 651 m, Log		2.8	1.5	4.3
GAB-02B	33°32.3730'	1043	4600	A:APC 200 m, XCB 500 m	0.3	2.2		2.5
	128°54.3002'		**1750**	B:APC 200 m		0.6		0.6
				C:APC 200 m		0.8		0.8
				D:Drill 500 m, RCB 1000 m, Log		3.6	1.7	5.3
GAB-03B	33°31.7255'	704	2830	A:APC 200 m, XCB 510 m, Log	0.3	2.0	0.9	3.2
	127°15.8565'		**550**	B:APC 200 m		0.6		0.6
GAB-04B	33°30.5568'	790	950	A:APC 200 m, XCB 400 m, Log	0.1	1.5	0.8	2.4
	128°03.9950'		**570**	B:APC 200 m		0.7		0.7
GAB-06B	33°18.9842'	220	1405	A:APC 200 m, XCB 500 m	0.1	1.7		1.8
	127°36.1287'		**720**	B:APC 200 m		0.4		0.4
			GAB-6 before -5	C:APC 200 m		0.5		0.5
				D:Drill 500 m, RCB 707 m, Log		1.4	0.8	2.2
GAB-05B	33°25.2122'	488	3910	A:APC 200 m, XCB 340 m	0.0	1.4		1.4
	127°36.1382'		**600**	B:APC 200 m		0.6		0.6
				D:Drill 340 m, RCB 580 m, Log		1.5	1.2	2.7
GAB-07A	33°21.4498'	480	2645	A:APC 200 m, XCB 561 m, Log	0.2	2.1	0.9	3.2
	128°28.8772'		**580**	B:APC 200 m		0.5		0.5
GAB-09A	33°17.3793'	200	2480	A:APC 200 m, XCB 585 m, Log	0.0	1.6	0.9	2.5
	128°28.8748'		**600**	B:APC 200 m		0.4		0.4
				C:APC 200 m		0.5		0.5
Transit to Fremantle					3.5			3.5
				LEG 182 TOTALS	13.3	34.2	8.5	56.0
				Time Available	13	43		56
				Alternate Sites				
GAB-13B	34°45.4940'	4465	3500	A:APC 200 m, XCB 500 m		4.7		4.7
	127°35.4358'		**800**	B:APC 200 m		1.3		1.3
				C:APC 200 m		1.7		1.7
				D:Drill 500 m, RCB 769 m, Log		4.2	1.6	5.8
GAB-08A	33°19.5628'	332	2880	A:APC 200 m, XCB 620 m, Log		1.8	1.1	2.9
	128°28.8788'		**650**	B:APC 200 m		0.4		0.4
				C:APC 200 m		0.5		0.5

SITE SUMMARIES**

Site: GAB-01C

Priority: 1
Position: 34°23.4672´S, 127°35.4393´E
Water Depth: 3884 m
Sediment Thickness: ≈5950 m
Approved Maximum Penetration: 700 m
Seismic Coverage: Intersection of AGSO Lines 169/08 (SP 729.5) and 169/11 (SP 1962.5)

Objectives: The objectives of GAB-01C are to

1. Recover pelagic ooze from the upper continental rise to construct a Cenozoic and Late Cretaceous paleoceanographic record of the opening of the Southern Ocean and the development of the Circum-Antarctic Current.

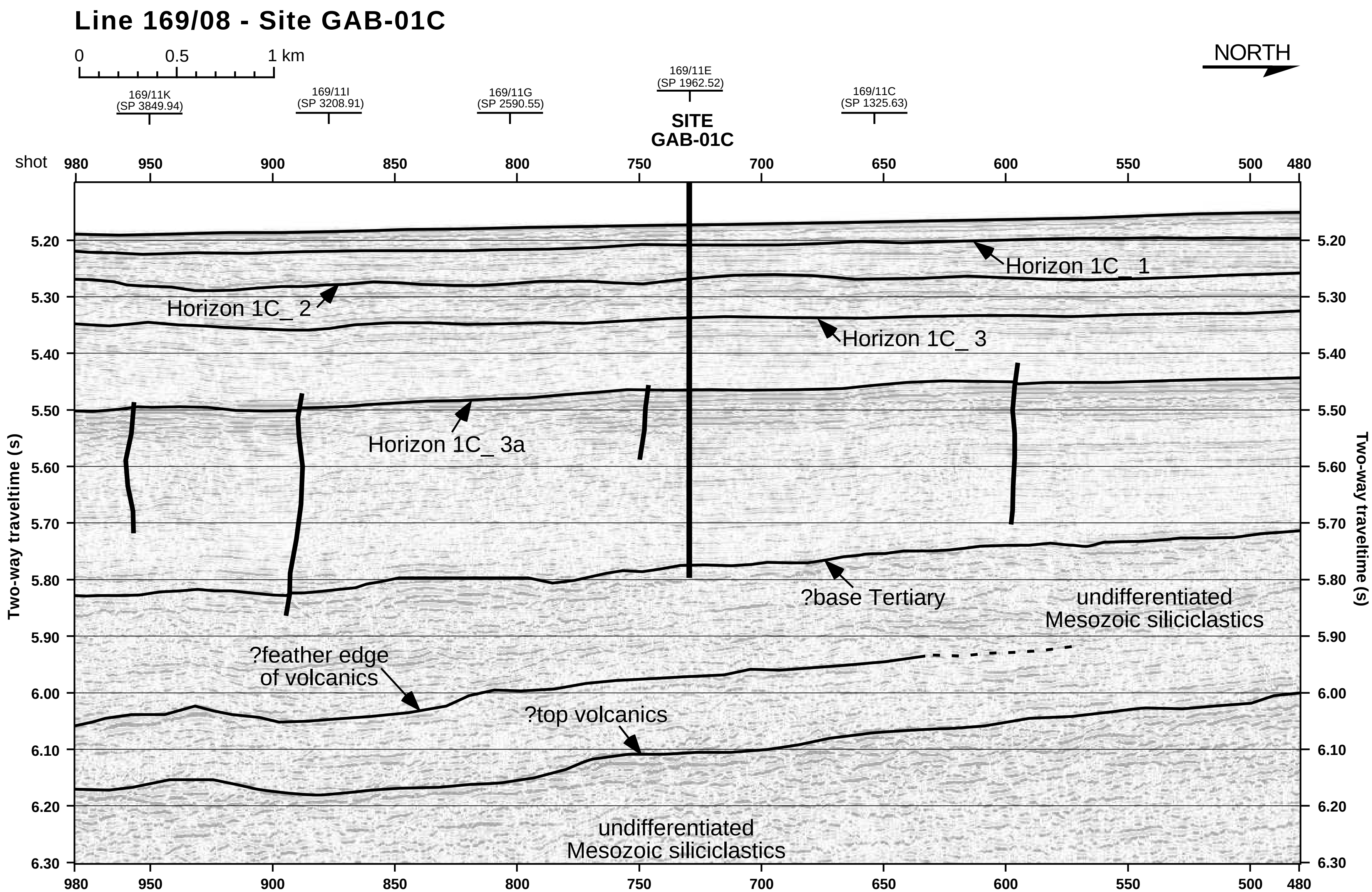
2. Determine the history of Cenozoic and Late Cretaceous carbonate compensation depth (CCD) fluctuations and deep-water mass variations during the evolution of the Southern Ocean (in conjunction with Sites GAB-02B and GAB-13B).

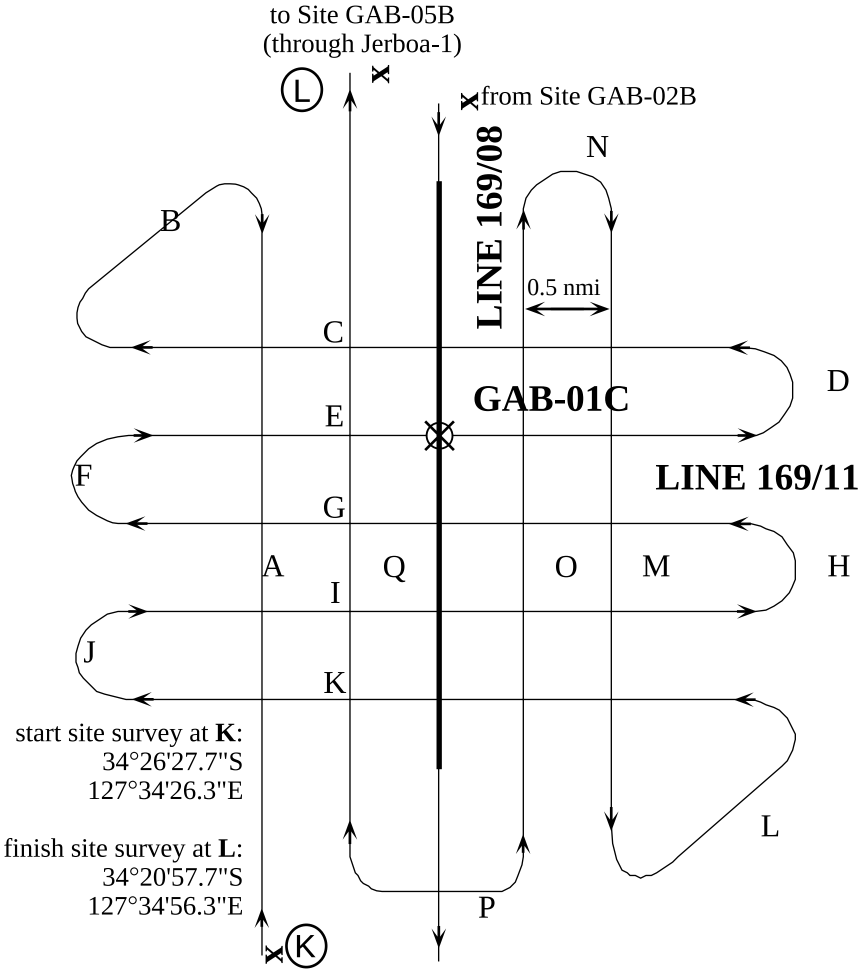
3. Determine depositional and diagenetic facies on the upper continental rise.

Drilling Program: Triple APC, XCB, RCB

Logging and Downhole Operations: Triple combo, FMS/Sonic, GHMT, WST

Nature of Rock Anticipated: Nanno-foram ooze and chalk (590 m), sandstone (24 m); and volcanics (1 m)


Line 169/08 - Site GAB-01C
0
0.5
1 km
NORTH
169/11K (SP 3849.94)
169/11I (SP 3208.91)
169/11G (SP 2590.55)
169/11E (SP 1962.52)
SITE GAB-01C
169/11C (SP 1325.63)
shot
980
950
900
850
800
750
700
650
600
550
500
480
Two-way traveltime (s)
5.20
5.30
5.40
5.50
5.60
5.70
5.80
5.90
6.00
6.10
6.20
6.30
Horizon 1C_ 1
Horizon 1C_ 2
Horizon 1C_ 3
Horizon 1C_ 3a
?base Tertiary
undifferentiated Mesozoic siliciclastics
?feather edge of volcanics
?top volcanics
undifferentiated Mesozoic siliciclastics



to Site GAB-05B
(through Jerboa-1)
L
from Site GAB-02B
LINE 169/08
N
B
0.5 nmi
C
D
GAB-01C
E
F
LINE 169/11
G
A
Q
O
M
H
I
J
K
L
P
K
start site survey at **K**:
34°26'27.7"S
127°34'26.3"E
finish site survey at **L**:
34°20'57.7"S
127°34'56.3"E

Site: GAB-02B

Priority: 1
Position: 33°32.3730´S, 128°54.3002´E
Water Depth: 1043 m
Sediment Thickness: ≈4600 m
Approved Maximum Penetration: 1750 m
Seismic Coverage: Intersection at SPs 428 and 3550 on AGSO Line 169/07

Objectives: The objectives of GAB-02B are to

1. Recover pelagic ooze from the middle-upper slope to construct a Cenozoic and Late Cretaceous paleoceanographic record of the opening of the Southern Ocean and the development of the Circum-Antarctic Current.

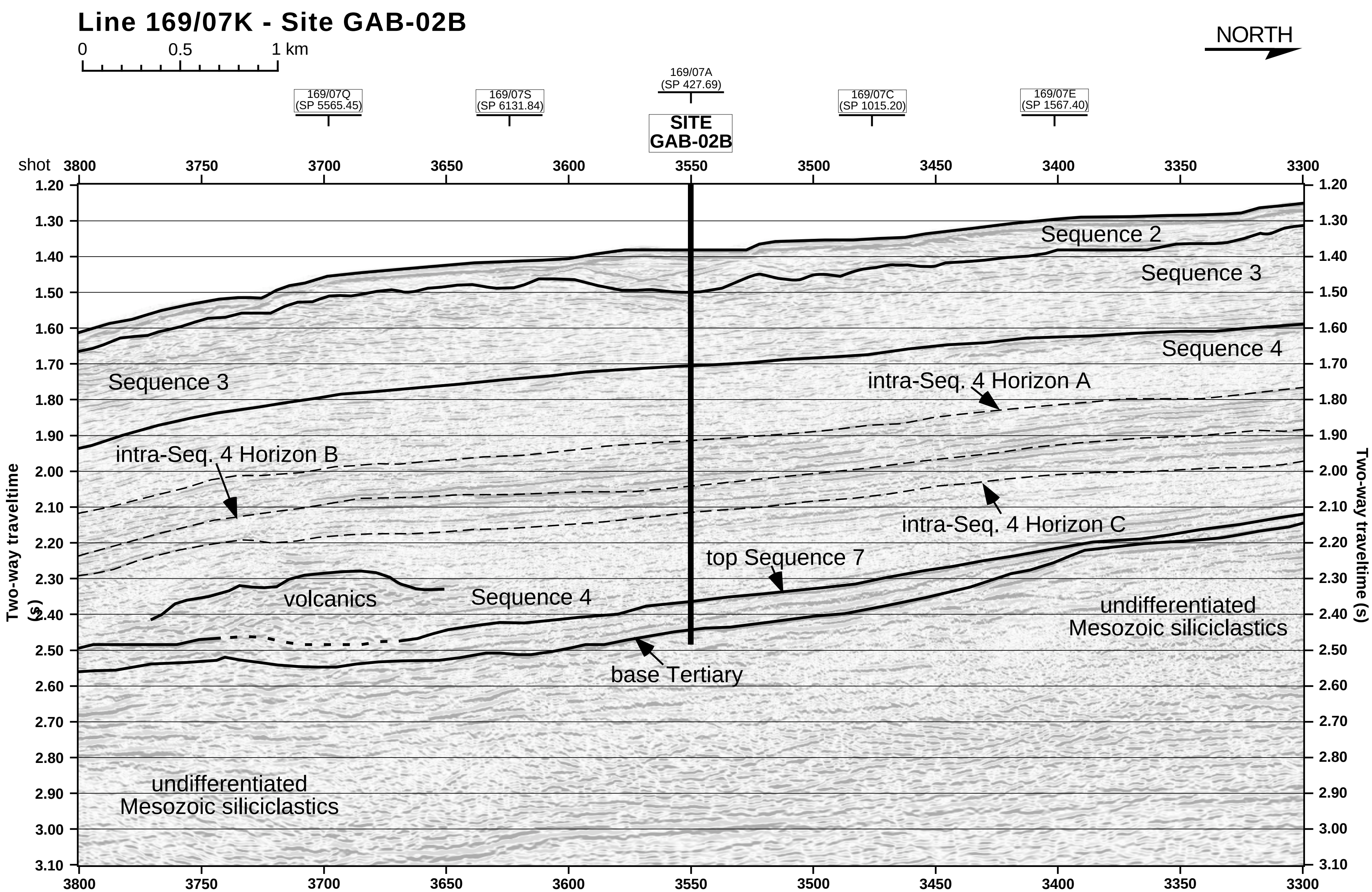
2. Determine the history of Cenozoic and Late Cretaceous CCD fluctuations and intermediate-water mass variations during the evolution of the Southern Ocean (in conjunction with Sites GAB-01C and GAB-13B).

3. Determine depositional and diagenetic facies on the middle-upper slope.

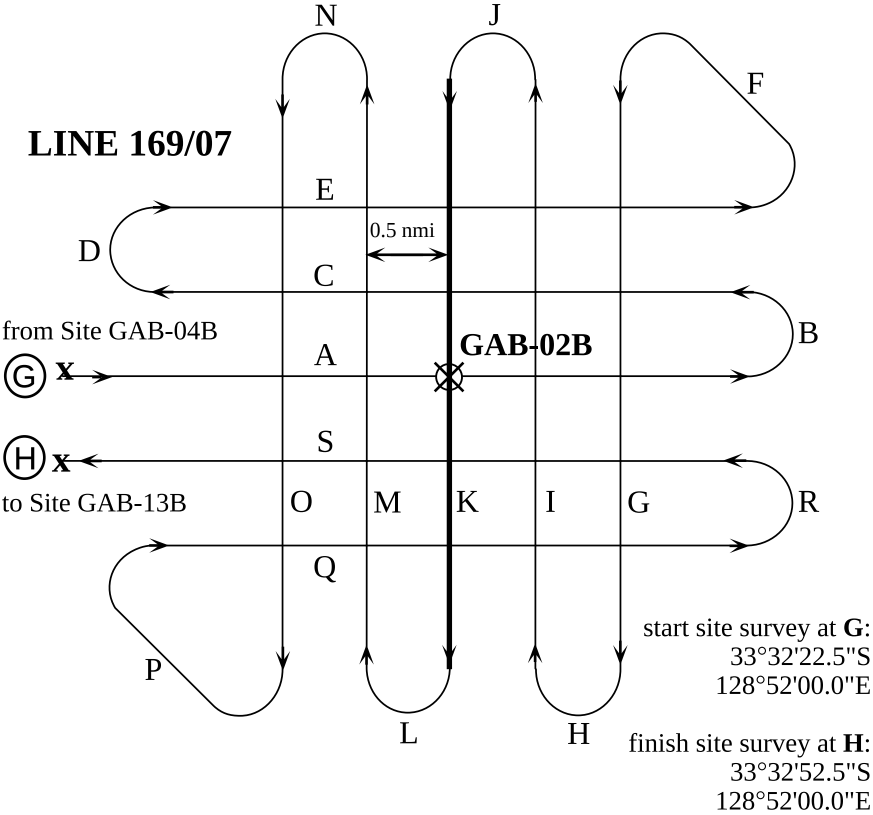
Drilling Program: Triple APC, XCB, RCB

Logging and Downhole Operations: Triple combo, FMS/Sonic, GHMT, WST

Nature of Rock Anticipated: Nanno-foram ooze and chalk with minor wackestone (1400 m); indurated sandy calcareous mudstone (310 m)



Line 169/07K - Site GAB-02B
0 0.5 1 km
NORTH
169/07Q (SP 5565.45)
169/07S (SP 6131.84)
169/07A (SP 427.69)
SITE GAB-02B
169/07C (SP 1015.20)
169/07E (SP 1567.40)
shot
3800 3750 3700 3650 3600 3550 3500 3450 3400 3350 3300
1.20 1.30 1.40 1.50 1.60 1.70 1.80 1.90 2.00 2.10 2.20 2.30 2.40 2.50 2.60 2.70 2.80 2.90 3.00 3.10
Two-way traveltime (s)
Sequence 2
Sequence 3
Sequence 4
Sequence 3
intra-Seq. 4 Horizon A
intra-Seq. 4 Horizon B
intra-Seq. 4 Horizon C
top Sequence 7
volcanics
Sequence 4
undifferentiated Mesozoic siliciclastics
base Tertiary
undifferentiated Mesozoic siliciclastics
Two-way traveltime (s)


LINE 169/07
N
J
F
E
D
0.5 nmi
C
B
from Site GAB-04B
GAB-02B
A
G
x
S
H
x
to Site GAB-13B
O
M
K
I
G
R
Q
P
L
H
start site survey at **G**:
33°32'22.5"S
128°52'00.0"E
finish site survey at **H**:
33°32'52.5"S
128°52'00.0"E

Site: GAB-03B

Priority: 1
Position: 33°31.7255´S, 127°15.8565´E
Water Depth: 704 m
Sediment Thickness: ≈2830 m
Approved Maximum Penetration: 550 m
Seismic Coverage: Intersection at SPs 1668.5 and 4696 on AGSO Line 169/01

Objectives: The objectives of GAB-03B are to

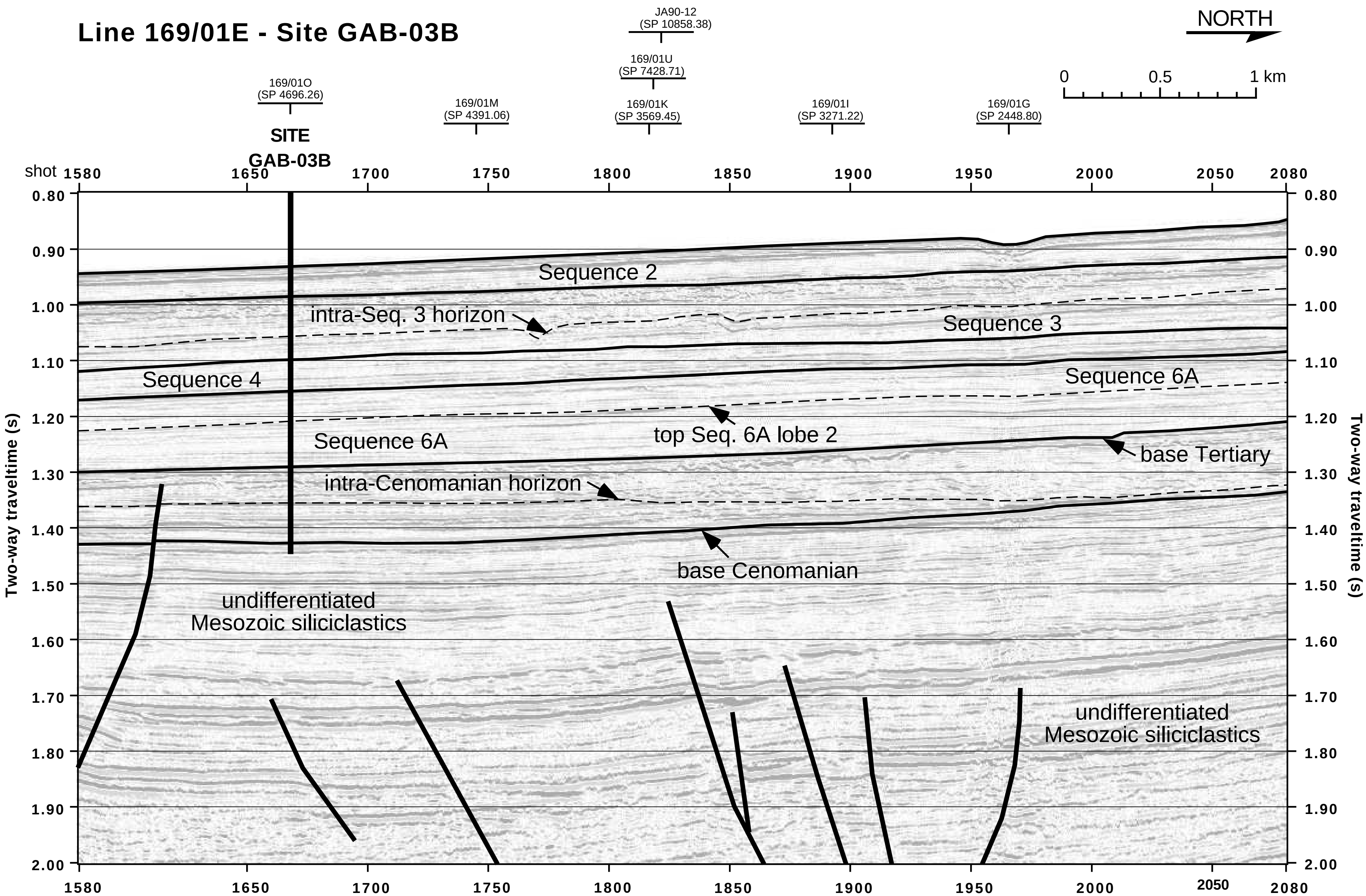
1. Collect a detailed record of Paleogene-early Neogene temperate to subtropical, mid-latitude sediments deposited as lowstand sediment lobes in an upper slope environment.
2. Contribute to the upper slope component of the shelf-to-basin paleoceanographic transect.
3. Evaluate sea-level control on Neogene facies within an upper slope setting; in particular, to evaluate stratigraphic response to eustatic oscillations by comparison with equivalent time intervals in shelf and deep oceanic settings.
4. Determine diagenetic history and processes within Neogene upper slope facies.

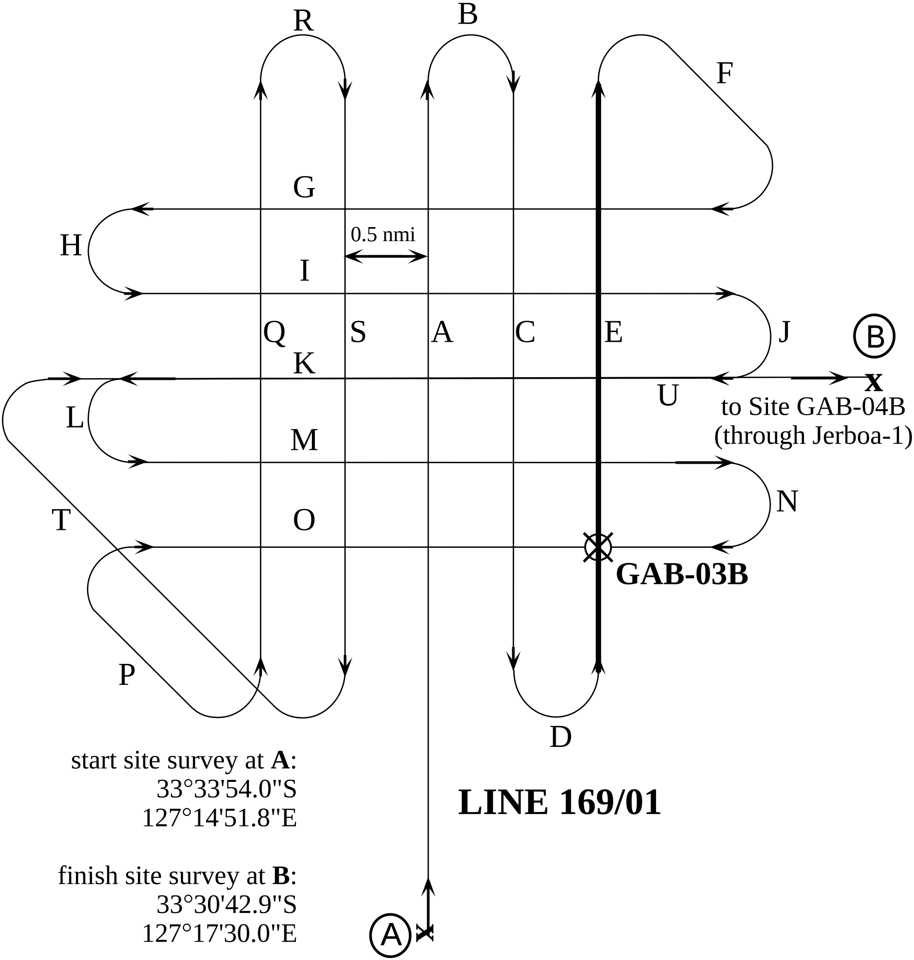
Drilling Program: Double APC, XCB

Logging and Downhole Operations: Triple combo, FMS/Sonic, WST

Nature of Rock Anticipated: Nanno-foram ooze and chalk with minor wackestone (320 m); sandy calcareous mudstone (190 m)

Line 169/01E - Site GAB-03B




R
B
F
G
H
0.5 nmi
I
Q
S
A
C
E
J
B
K
U
X
to Site GAB-04B
(through Jerboa-1)
L
M
N
T
O
GAB-03B
P
D
start site survey at **A**:
33°33'54.0"S
127°14'51.8"E
finish site survey at **B**:
33°30'42.9"S
127°17'30.0"E
LINE 169/01
A

Site: GAB-04B

Priority: 1
Position: 33°30.5568´S, 128°03.9950´E
Water Depth: 790 m
Sediment Thickness: ≈950 m
Approved Maximum Penetration: 570 m
Seismic Coverage: Intersection at SPs 1131.5 and 3209.5 on AGSO Line 169/03

Objectives: The objectives of GAB-04B are to

1. Collect a detailed record of Paleogene-early Neogene temperate to subtropical, mid-latitude sediments deposited as lowstand sediment lobes in an upper slope environment.

2. Contribute to the upper slope component of the shelf-to-basin paleoceanographic transect.

3. Evaluate sea-level control on Neogene facies within an upper slope setting; in particular, to evaluate stratigraphic response to eustatic oscillations by comparison with equivalent time intervals in shelf and deep oceanic settings.

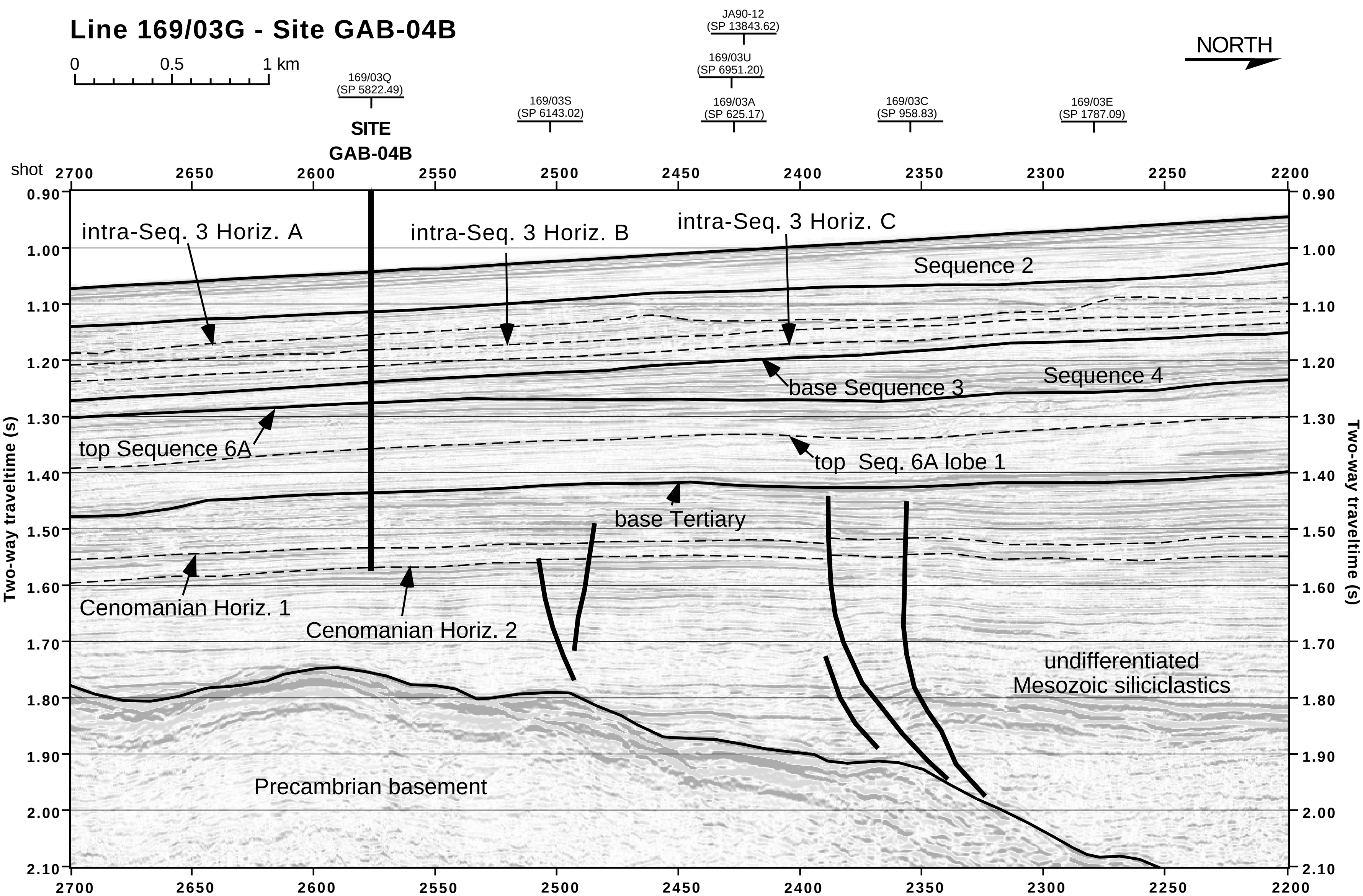
4. Determine diagenetic history and processes within Neogene upper slope facies.

5. Collect a record of marine flooding of the evolving rift basin between Australia and Antarctica from the Cenomanian.

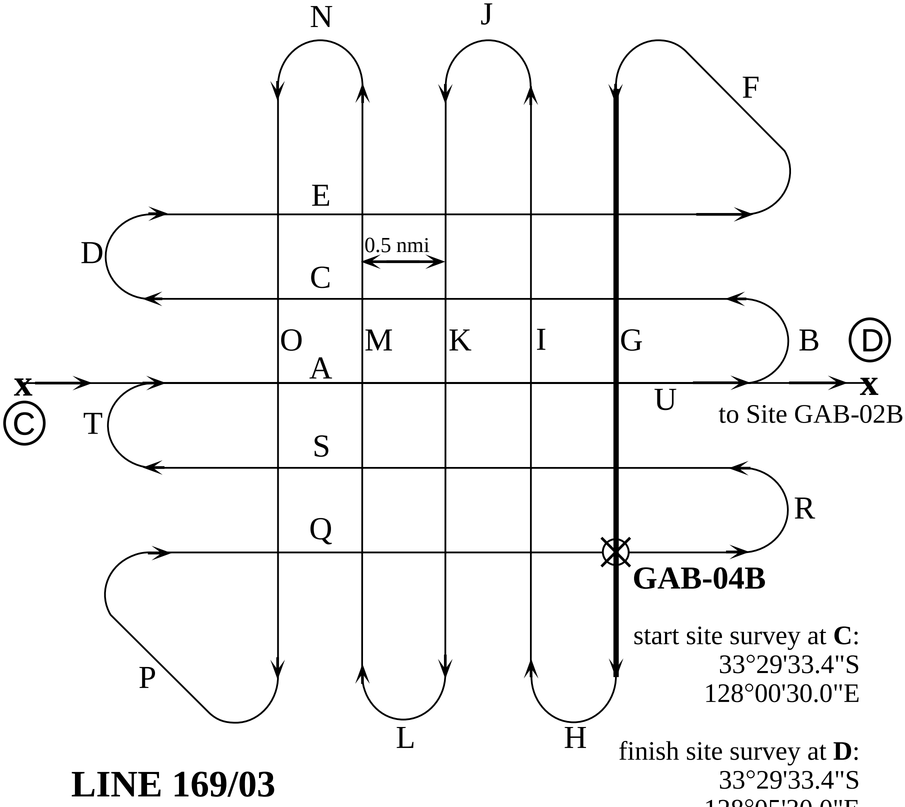
Drilling Program: Double APC, XCB

Logging and Downhole Operations: Triple combo, FMS/Sonic, WST

Nature of Rock Anticipated: Nanno-foram ooze and chalk with minor wackestone (330 m); sandy calcareous mudstone (210 m)



Line 169/03G - Site GAB-04B
0
0.5
1 km
169/03Q (SP 5822.49)
SITE GAB-04B
169/03S (SP 6143.02)
JA90-12 (SP 13843.62)
169/03U (SP 6951.20)
169/03A (SP 625.17)
169/03C (SP 958.83)
169/03E (SP 1787.09)
NORTH
shot
2700
2650
2600
2550
2500
2450
2400
2350
2300
2250
2200
Two-way traveltime (s)
0.90
1.00
1.10
1.20
1.30
1.40
1.50
1.60
1.70
1.80
1.90
2.00
2.10
intra-Seq. 3 Horiz. A
intra-Seq. 3 Horiz. B
intra-Seq. 3 Horiz. C
Sequence 2
base Sequence 3
Sequence 4
top Sequence 6A
top Seq. 6A lobe 1
base Tertiary
Cenomanian Horiz. 1
Cenomanian Horiz. 2
undifferentiated Mesozoic siliciclastics
Precambrian basement


N
J
F
E
D
0.5 nmi
C
O
M
K
I
G
B
D
A
x
x
U
C
T
to Site GAB-02B
S
R
Q
GAB-04B
start site survey at **C**:
33°29'33.4"S
128°00'30.0"E
P
L
H
finish site survey at **D**:
33°29'33.4"S
128°05'30.0"E
LINE 169/03

Site: GAB-05B

Priority: 1
Position: 33°25.2122´S, 127°36.1382´E
Water Depth: 488 m
Sediment Thickness: ≈3910 m
Approved Maximum Penetration: 600 m
Seismic Coverage: Intersection at SPs 995 and 13195 on AGSO Line 169/13

Objectives: The objectives of GAB-05B are to

1. Recover a detailed record of shelf-edge siliciclastic deposition (at a "distal" site compared with Site GAB-06B) to evaluate the sedimentary response to Paleogene sea-level fluctuations and to evaluate the complex interaction between sea-level variation, accommodation space, and subsidence.

2. Determine the characteristics of cool-water carbonate facies within the Neogene succession (Sequences 2 to 4).

3. Determine paleoceanographic parameters within a shelf-edge setting in Sequences 2 to 4, to complement other components of the shelf-to-basin transect.

4. Evaluate sea-level control on Neogene facies within an upper slope/shelf-edge setting (cf Sites GAB-03B and GAB-04B).

5. Evaluate the diagenetic history and processes within Neogene facies in an upper slope/shelf-edge setting.

Drilling Program: Double APC, XCB, RCB

Logging and Downhole Operations: Triple combo, FMS/Sonic, GHMT, WST

Nature of Rock Anticipated: Nanno-foram ooze/chalk and wackestone with minor grainstone (350 m); interbedded calcareous mudstone and sandstone (230 m)

Site: GAB-06B

Priority: 1
Position: 33°18.9842´S, 127°36.1287´E
Water Depth: 220 m
Sediment Thickness: ≈1405 m
Approved Maximum Penetration: 720 m
Seismic Coverage: Intersection at SP’s 1916 and 7400 on AGSO Line 169/13

Objectives: The objectives of GAB-06B are to

1. Recover a detailed record of shelf-edge siliciclastic deposition (at a "proximal" site compared with Site GAB-05B) to evaluate the sedimentary response to Paleogene sea-level fluctuations and to evaluate the complex interaction between sea-level variation, accommodation space, and subsidence.

2. Determine the characteristics of cool-water carbonate facies within the Neogene succession (Sequences 2 to 4).

3. Determine paleoceanographic parameters within a shelf-edge setting in Sequences 2 to 4 to complement other components of the shelf-to-basin transect.

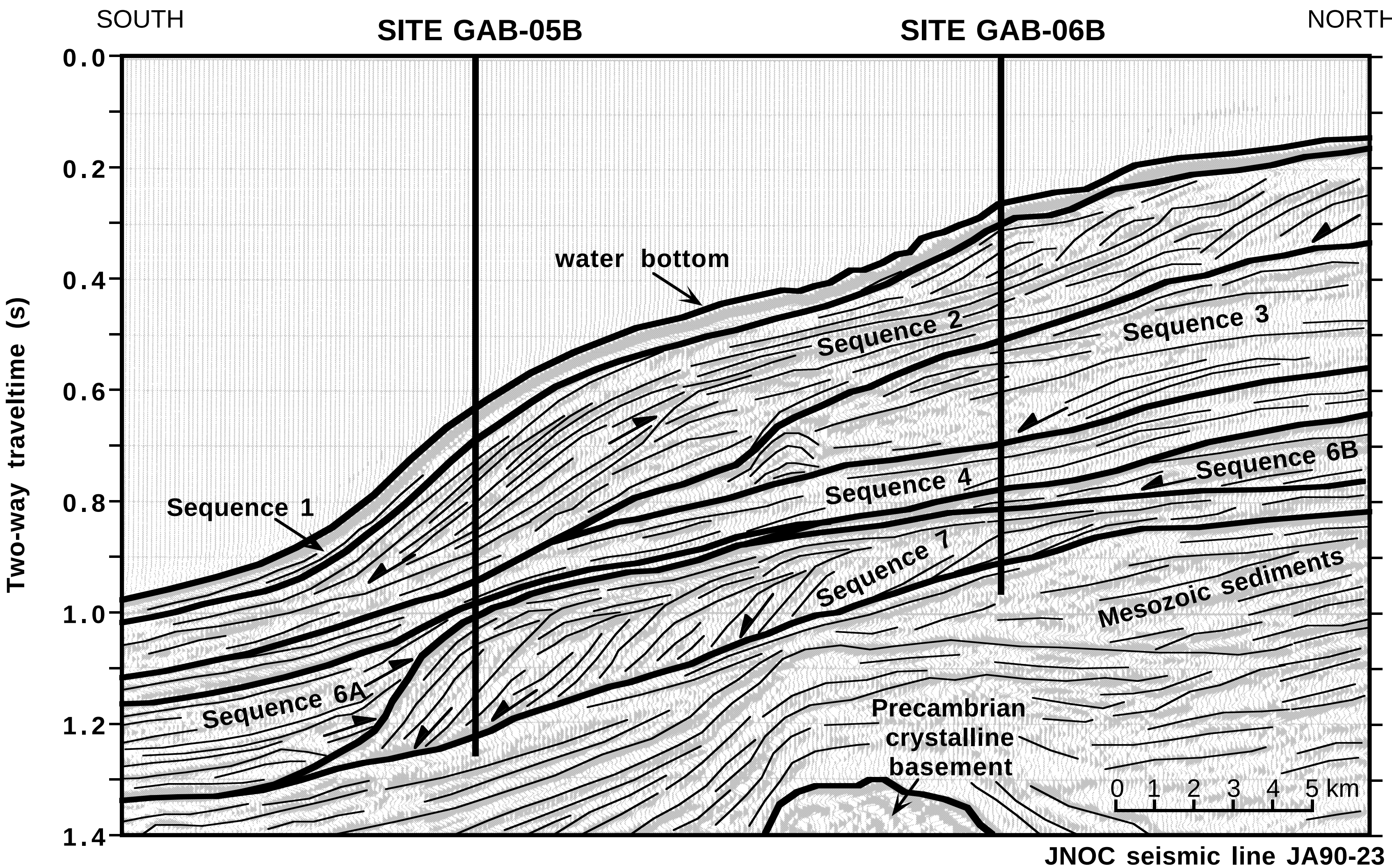
4. Evaluate sea-level control on Neogene facies within an upper slope/shelf-edge setting (cf Sites GAB-03B and GAB-04B).

5. Evaluate the diagenetic history and processes within Neogene facies in an upper slope/shelf-edge setting.

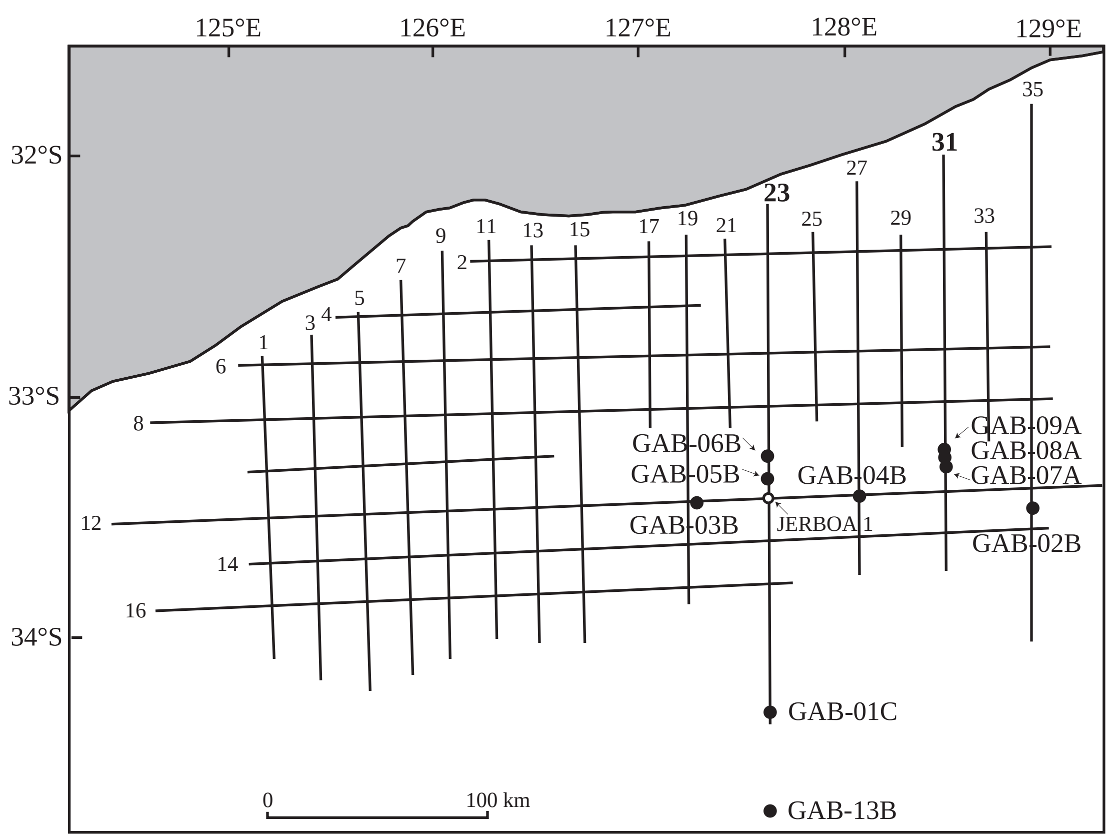
Drilling Program: Triple APC, XCB

Logging and Downhole Operations: Triple combo, FMS/Sonic (WST if time permits)

Nature of Rock Anticipated: Nanno-foram ooze/chalk and wackestone with minor grainstone (560 m); interbedded calcareous mudstone and sandstone (135 m)



SOUTH
SITE GAB-05B
SITE GAB-06B
NORTH
Two-way traveltime (s)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
water bottom
Sequence 1
Sequence 2
Sequence 3
Sequence 4
Sequence 6A
Sequence 6B
Sequence 7
Mesozoic sediments
Precambrian crystalline basement
0 1 2 3 4 5 km
JNOC seismic line JA90-23



Map showing Leg 182 drill sites relative to the JNOC (1990) seismic grid. Portions of Lines 23 and 31 are shown for GAB-06B and GAB-05B, and GAB-07A, GAB-08A, and GAB-09A.

Site: GAB-07A

Priority: 1
Position: 33°21.4498´S, 128°28.8772´E
Water Depth: 480 m
Sediment Thickness: ≈2645 m
Approved Maximum Penetration: 580 m
Seismic Coverage: Intersection at SPs 600 and 10569.5 on AGSO Line 169/05

Objectives: The objectives of GAB-07A are to

1. Collect detailed, high-resolution profiles through a late Neogene succession deposited within a low-energy, cool-water carbonate environment to determine the response of such a depositional system to Plio-Pleistocene sea-level fluctuations.

2. Obtain a high-resolution record of late Neogene paleoceanographic variation within a middle-upper slope setting, as a component of the shelf-to-basin paleoceanographic transect.

3. Evaluate the diagenetic history of calcitic sediments deposited within a low-energy environment below storm wave base, for comparison with the higher energy environments at Sites GAB-08A and GAB-09A.

Drilling Program: Double APC, XCB

Logging and Downhole Operations: Triple combo, FMS/Sonic, WST

Nature of Rock Anticipated: Foram-nanno ooze and chalk; minor wackestone

Site: GAB-08A

Priority: 2
Position: 33°19.5628´S, 128°28.8788´E
Water Depth: 332 m
Sediment Thickness: ≈2880 m
Approved Maximum Penetration: 650 m
Seismic Coverage: Intersection at SPs 879 and 8253.5 on AGSO Line 169/05

Objectives: The objectives of GAB-08A are to

1. Collect a detailed, high-resolution profile through a late Neogene succession deposited within a moderate-energy, cool-water carbonate environment to determine the response of such a depositional system to Plio-Pleistocene sea-level fluctuations.

2. Obtain a high-resolution record of late Neogene paleoceanographic variation within an upper slope setting, as a component of the shelf-to-basin paleoceanographic transect.

3. Evaluate the diagenetic history of calcitic sediments deposited within a moderate-energy environment below storm wavebase, for comparison with the higher energy environment at Site GAB-09A.

Drilling Program: Triple APC, XCB

Logging and Downhole Operations: Triple combo, FMS/Sonic, GHMT, WST

Nature of Rock Anticipated: Wackestone; foram-nanno ooze and chalk; minor grainstone

Site: GAB-09A

Priority: 1
Position: 33°17.3793´S, 128°28.8748´E
Water Depth: 200 m
Sediment Thickness: ≈2480 m
Approved Maximum Penetration: 600 m
Seismic Coverage: Intersection at SPs 1202 and 5574.5 on AGSO Line 169/05

Objectives: The objectives of GAB-09A are to

1. Collect detailed, high-resolution profiles through a late Neogene succession deposited within a high-energy, cool-water carbonate environment to determine the response of such a depositional system to Plio-Pleistocene sea-level fluctuations.

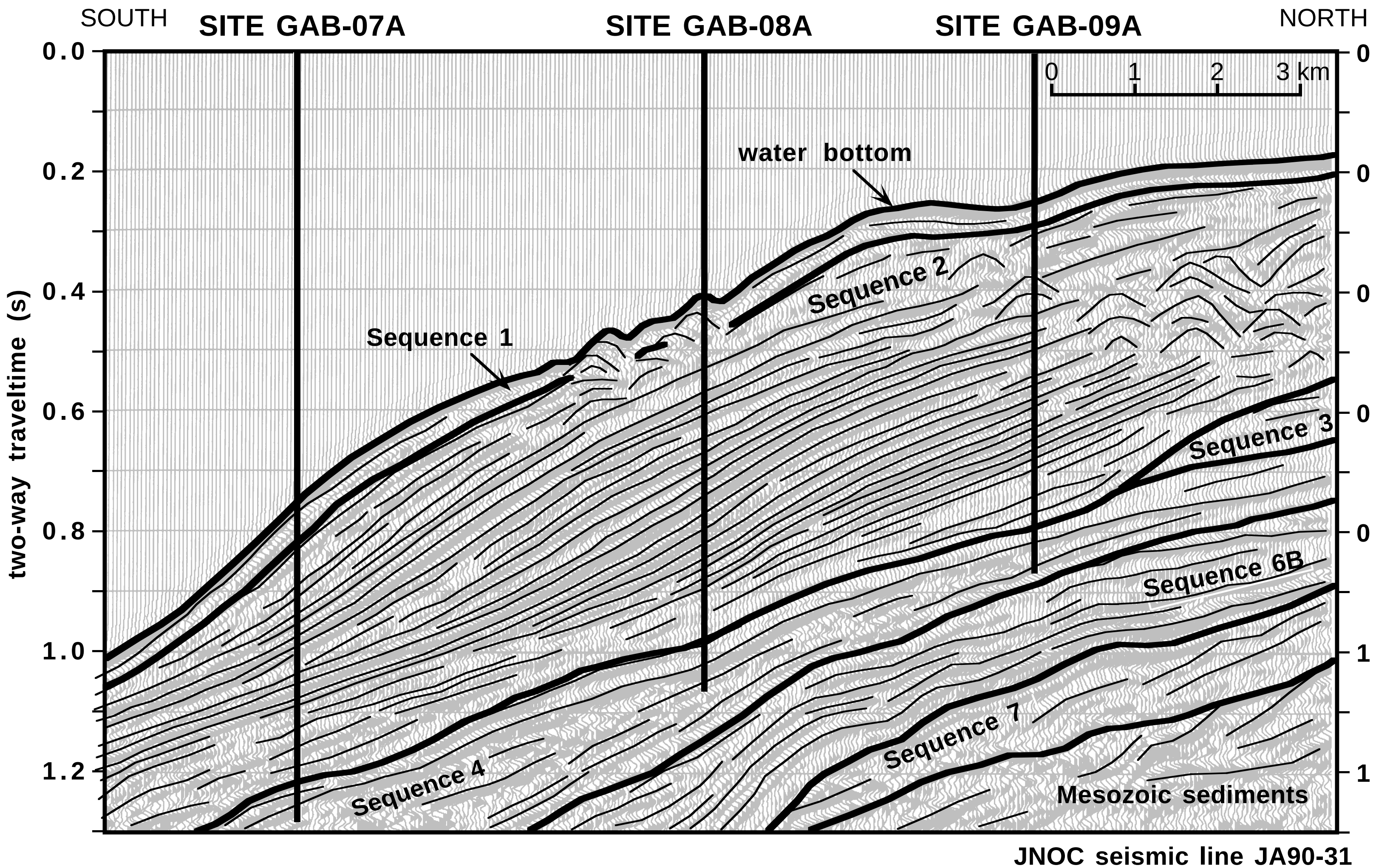
2. Obtain a high-resolution record of late Neogene paleoceanographic variation within a shelf-edge setting, as a component of the shelf-to-basin paleoceanographic transect.

3. Evaluate the diagenetic history of calcitic sediments deposited within a high-energy environment below storm wave base, for comparison with the lower energy environments at Sites GAB-07A and GAB-08A.

Drilling Program: Triple APC, XCB

Logging and Downhole Operations: Triple combo, FMS/Sonic, WST

Nature of Rock Anticipated: Wackestone and grainstone; minor foram-nanno ooze and chalk


SOUTH
SITE GAB-07A
SITE GAB-08A
SITE GAB-09A
NORTH
0 1 2 3 km
water bottom
Sequence 1
Sequence 2
Sequence 3
Sequence 4
Sequence 6B
Sequence 7
Mesozoic sediments
two-way traveltime (s)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
JNOC seismic line JA90-31

Site: GAB-13B

Priority: 2
Position: 34°45.4940´S, 127°35.4358´E
Water Depth: 4465 m
Sediment Thickness: >3.5 km
Approved Maximum Penetration: 800 m
Seismic Coverage: Intersection of AGSO Lines 169/08 (SP 3987.5) and 169/09 (SP 3457.5)

Objectives: The objectives of GAB-13B are to

1. Recover pelagic ooze from the middle continental rise to construct a Cenozoic and Late Cretaceous paleoceanographic record of the opening of the Southern Ocean and development of the Circum-Antarctic Current.

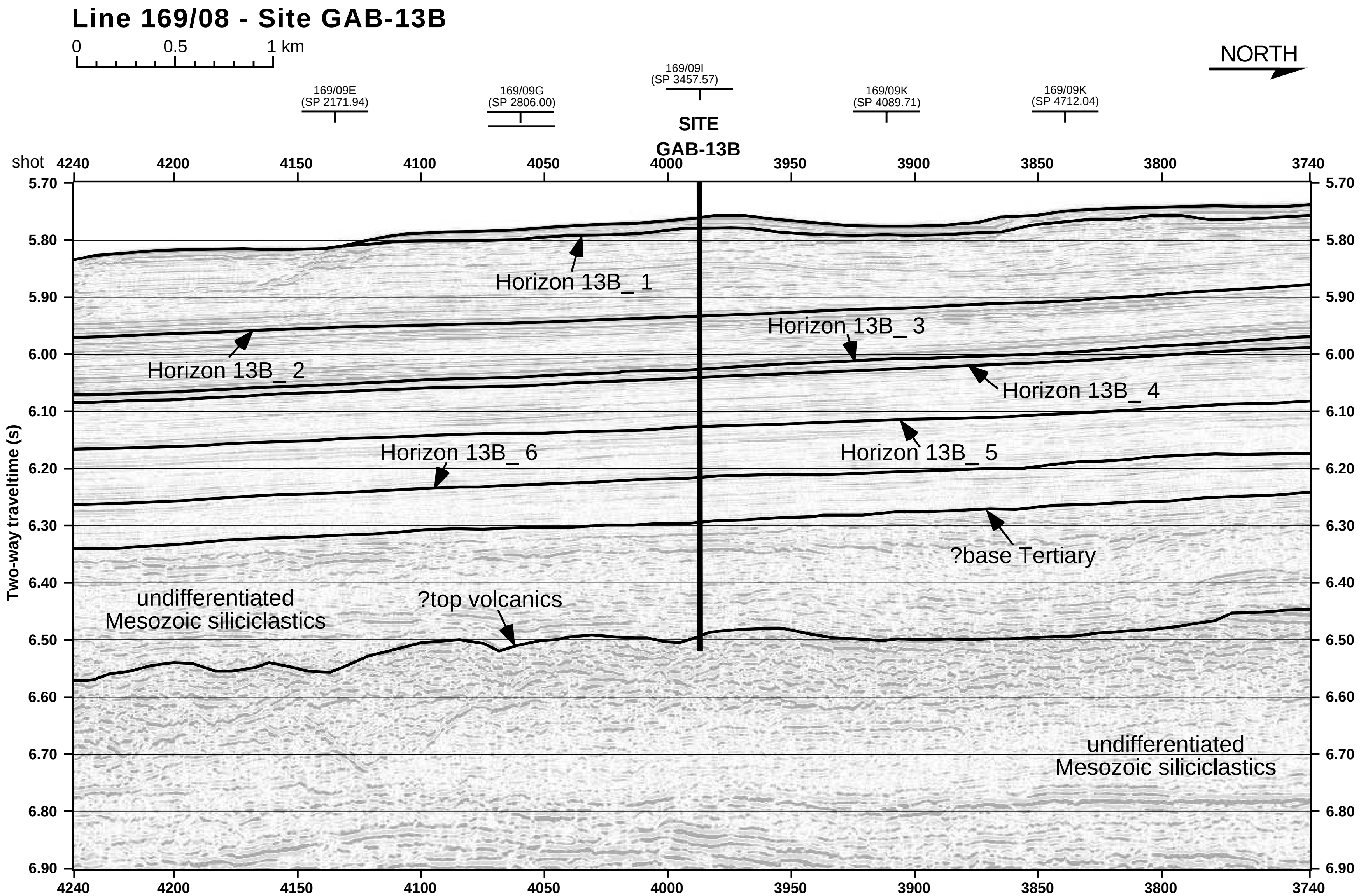
2. Determine the history of Cenozoic and Late Cretaceous CCD fluctuations and deep-water mass variations during the evolution of the Southern Ocean (in conjunction with Sites GAB-01C and GAB-02B).

3. Determine depositional and diagenetic facies on the middle continental rise.

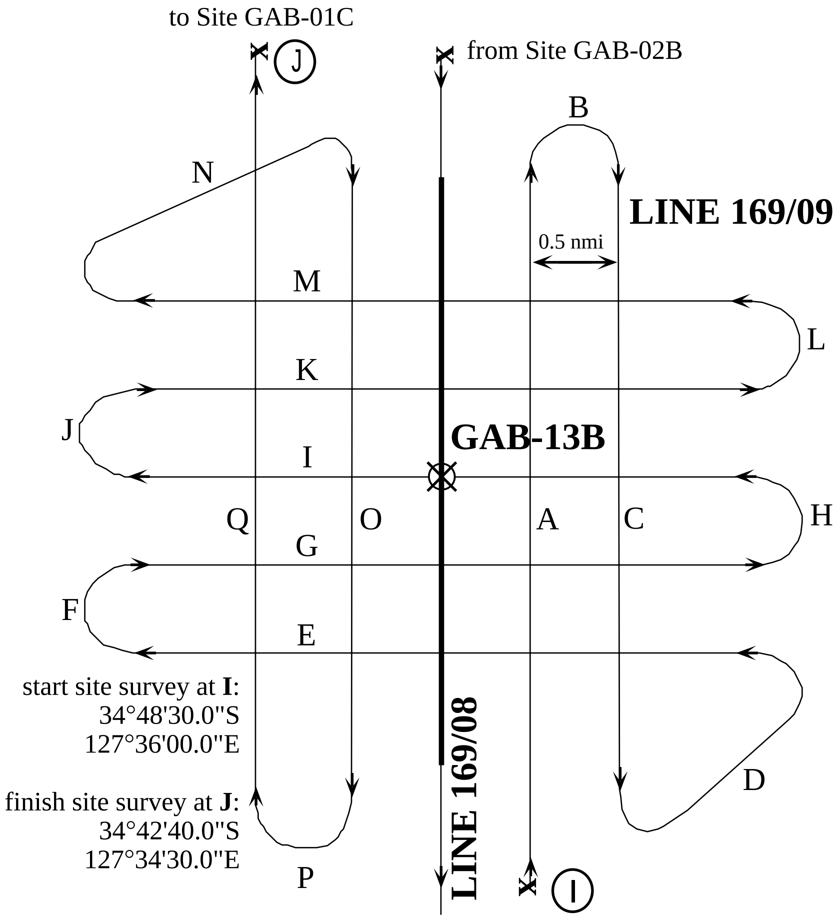
Drilling Program: Triple APC, XCB, RCB

Logging and Downhole Operations: Triple combo, FMS/Sonic, GHMT, WST

Nature of Rock Anticipated: Nanno-foram ooze and chalk (610 m), calcareous mudstone (375 m)



Line 169/08 - Site GAB-13B
0
0.5
1 km
NORTH
169/09E (SP 2171.94)
169/09G (SP 2806.00)
169/09I (SP 3457.57)
169/09K (SP 4089.71)
169/09K (SP 4712.04)
SITE GAB-13B
shot
4240
4200
4150
4100
4050
4000
3950
3900
3850
3800
3740
5.70
5.80
5.90
6.00
6.10
6.20
6.30
6.40
6.50
6.60
6.70
6.80
6.90
Two-way traveltime (s)
Horizon 13B_ 1
Horizon 13B_ 2
Horizon 13B_ 3
Horizon 13B_ 4
Horizon 13B_ 5
Horizon 13B_ 6
?base Tertiary
?top volcanics
undifferentiated Mesozoic siliciclastics
undifferentiated Mesozoic siliciclastics



to Site GAB-01C
J
from Site GAB-02B
B
N
LINE 169/09
0.5 nmi
M
L
K
J
GAB-13B
I
H
Q
O
A
C
G
F
E
start site survey at **I**:
34°48'30.0"S
127°36'00.0"E
LINE 169/08
D
finish site survey at **J**:
34°42'40.0"S
127°34'30.0"E
P
I

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*Science party is pending. Science personnel are subject to change.