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# ODP DRILLING IN THE CORAL SEA: SEALEVEL VARIATION, PALEOCEANOGRAPHY, AND FLUID FLOW



BY

A. R. ISERN, C. J. PIGRAM,
P. K. SWART AND D. KROON



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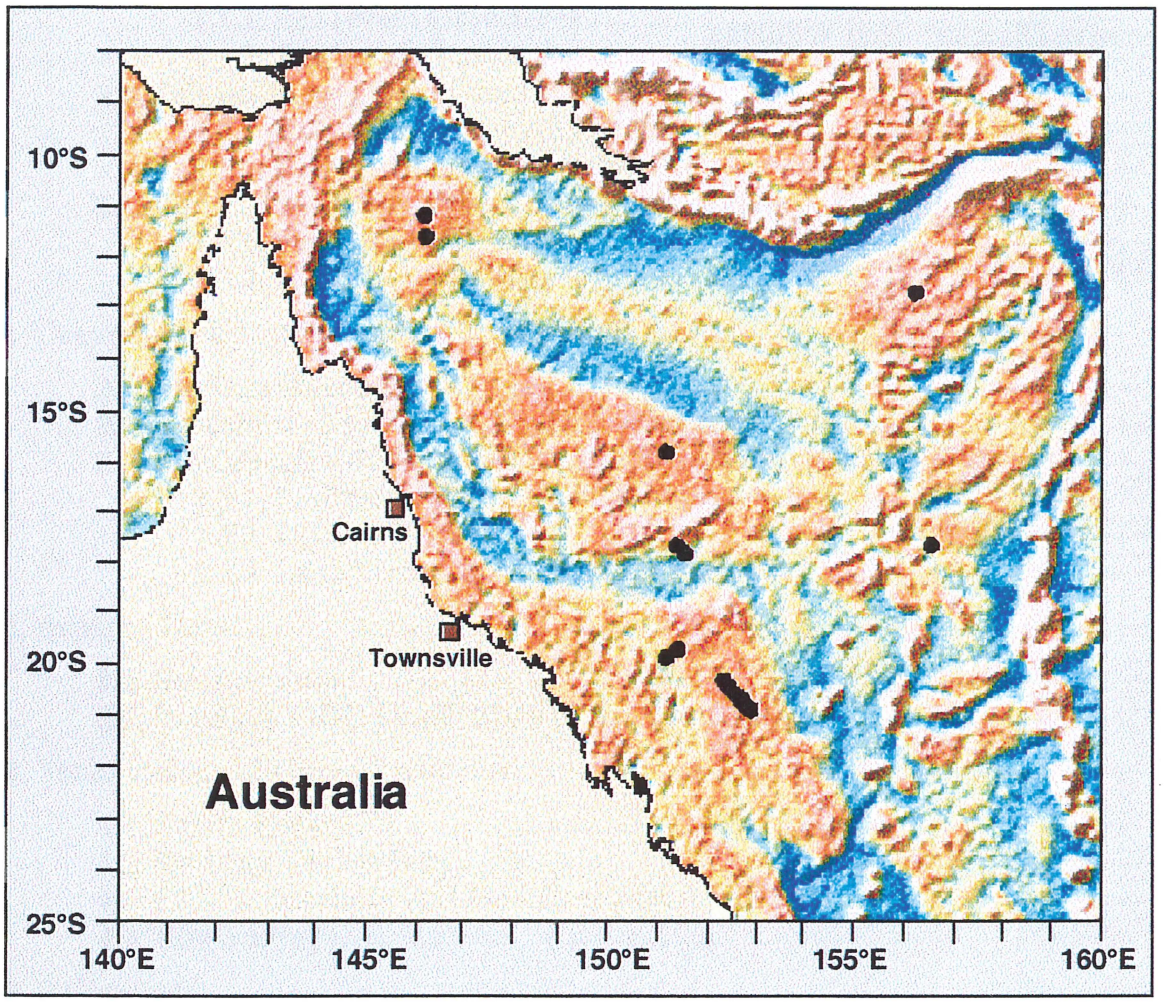


**A. R. Isern[@], C. J. Pigram[#], P. K. Swart[%], and D. Kroon[&]**

[@] Department of Geology and Geophysics, University of Sydney, Sydney, NSW 2006, Australia
[#] Australian Geological Survey Organisation, Canberra, ACT 2601, Australia
[%] Marine Geology and Geophysics, RSMAS, 4600 Rickenbacker Causeway, Miami FL 33149
[&] Department of Geology and Geophysics, University of Edinburgh, Edinburgh, EH9 3JW, Scotland, UK

**DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY**

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# ABSTRACT

The proposed multi-objective series of drillholes in the Coral Sea provide a superb opportunity to address three of the major themes identified as important for understanding the dynamics of the Earth's environment, as outlined in the ODP Long Range Plan; namely, the causes, effects, and magnitude of sealevel change, climatic and paleoceanographic change in tropical and sub-tropical environments, and fluid flow and diagenesis within carbonate platforms.

Cretaceous rifting in the western Coral Sea formed continental fragments which are now capped by carbonate platforms. The location and water depth of these platforms, and the nature of the sediment capping them, provide ideal drilling targets to investigate these themes. Coral Sea drilling will build on the achievements of earlier ODP/DSDP drilling in the region (Legs 21, 30, 133), and accordingly will be able to more specifically target sequences capable of resolving these major scientific problems with a high likelihood of success.

We propose to investigate the following:

- **Causes, effects, and magnitude of sealevel change**
  - to calibrate the amplitude of the major Middle Miocene (N12-N14) sealevel fall;
  - to refine the Miocene eustatic sealevel curve;
  - to study the effects of sealevel variations on carbonate platform development.

- **Climatic and paleoceanographic change in tropical and sub-tropical environments**
  - To describe variations in surface and intermediate water circulation occurring in the Coral Sea since the Oligocene, particularly that related to restriction of circulation in the western Pacific with northward movement of the Indo-Australian Plate;
  - To describe the environmental results of the transition from sub-tropical to tropical climatic regimes as a result of northward movement of the Indo-Australian Plate;
  - To understand the development and variability of the western Pacific warm water pool since the Miocene;
  - To describe the development and variability of the northwest monsoon climatic system;
  - To determine the influence of paleoceanographic events occurring in the Coral Sea on the development of carbonate platforms and reefs off northeast Australia and Papua New Guinea;

- **Fluid flow and diagenesis within carbonate platforms**
  - To determine the factors controlling fluid flow and the rates at which it is occurring within the Queensland Plateau;
  - To infer flow pathways within the Queensland Plateau carbonate platform;
  - To determine the role of sediment physical properties as controls on fluid movement;
  - To determine the importance of fluid flow in relation to the extensive diagenesis which has occurred within this platform.

## 1. SCIENTIFIC RATIONALE AND OBJECTIVES

Scientific drilling in the Coral Sea (Fig. 1) provides a superb opportunity to address three of the major themes identified as important for understanding the dynamics of the Earth's environment, as outlined in the Long Range Plan (JOIDES Planning Committee, 1996). These themes form the main aims of this proposal:

- To describe the magnitude of sealevel change in the Miocene, and its effects on carbonate platform sedimentation;
- To describe climatic and paleoceanographic change in tropical and sub-tropical environments;
- To describe fluid flow and diagenesis within a carbonate platform environment.

### 1.1. Absolute sealevel variations

#### 1.1.1. Sealevel : Objectives

The principle sealevel objectives are:

- to calibrate the amplitude of the major Middle Miocene (N12-N14) sealevel fall;
- to refine the Miocene eustatic sealevel curve;
- to determine the effects of sealevel variations on carbonate platform development.

These objectives will be accomplished on the Marion Plateau which has several attributes that make it an excellent location to test sealevel concepts, as a component of the global strategy to test sealevel. These attributes include:

- a well-preserved shallow water sequence on a marginal plateau in water depths of 300 - 500m;
- an apparently simple subsidence regime since the Oligocene;
- an excellent data set, including extensive seismic data complimented by earlier ODP drilling (Leg 133) in the region;
- Leg 133 experience and a shallow basement indicate no safety problems.

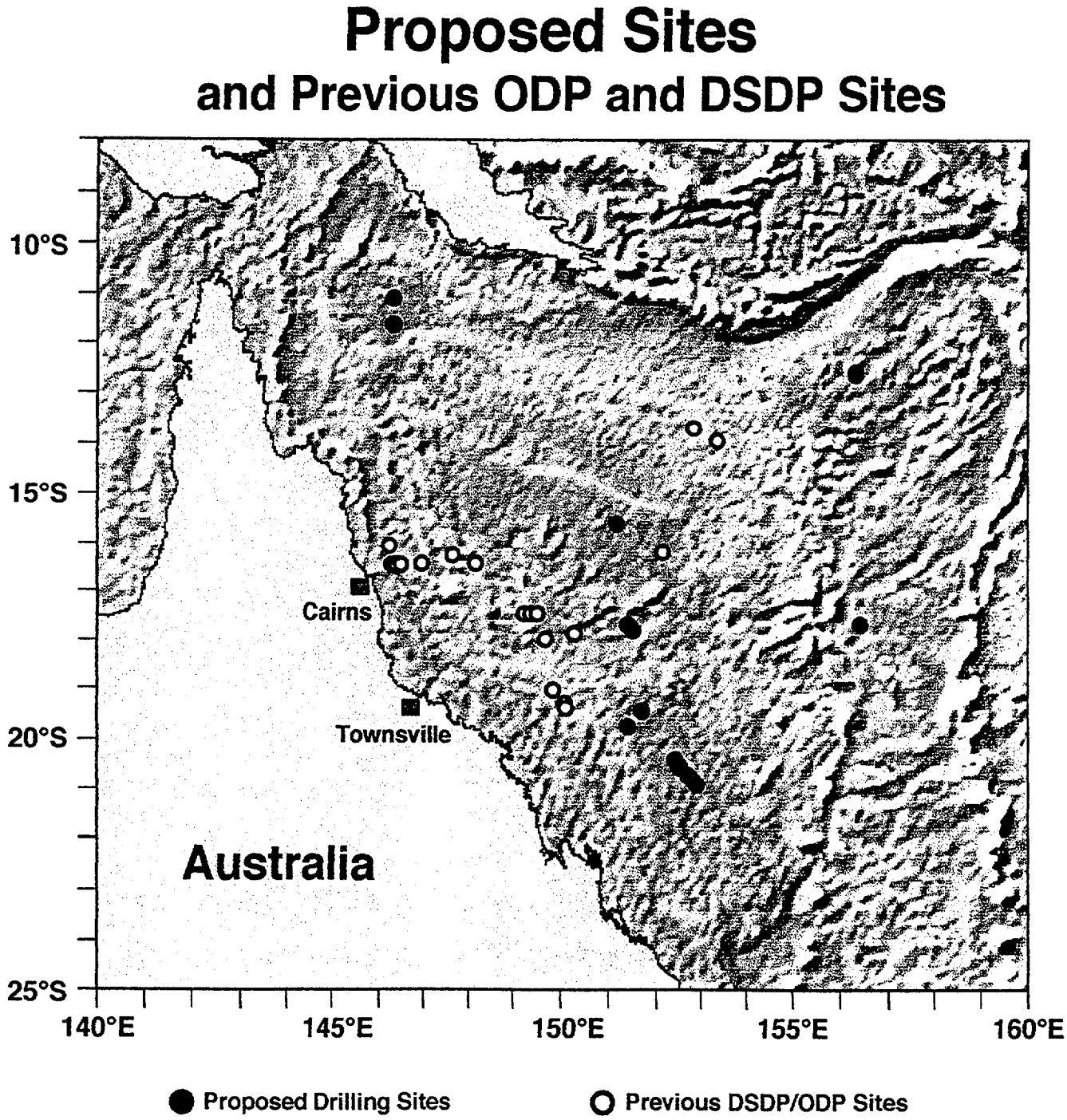


Figure 1. Gravity data in the western Coral Sea, together with proposed and previous drillsites in the area. Black dots are the sites proposed here, and the white dots are previous DSDP/ODP sites.

### 1.1.2. Sealevel : Rationale

Measuring the amplitude and timing of eustatic sealevel fluctuations has proved to be a difficult problem, whose resolution is essential to the establishment of an accurate eustatic sealevel curve for the Phanerozoic. Several attempts have been made to determine the amplitude of glacioeustatic fluctuations, including passive-margin sequence stratigraphy (Vail et al., 1977; Vail and Hardenbol, 1979; Haq et al., 1987, 1988); modeling of sedimentary depositional regimes (Watts and Thorne, 1984); calibration of the oxygen isotope curve (Majors and Mathews, 1983; Miller et al., 1987; Williams, 1988); and analysis of the depositional history of carbonate sediments on atolls (Schlanger and Premoli-Silva, 1986; Halley and Ludwig, 1987; Moore et al., 1987; Lincoln and Schlanger, 1987, 1991). These analyses yield a wide range of results, but as Sahagian and Watts (1991) have pointed out, "While there is often agreement between independent data sets regarding the timing of sealevel events, there is little precision or even agreement about the magnitude of these events."

The establishment of a eustatic sealevel curve has major implications for global stratigraphic correlation and basin analysis, and defining the amplitude of such a curve remains one of the major challenges in sealevel research (COSOD II, 1987; Sahagian and Watts, 1991; JOIDES Planning Committee, 1996). In this proposal, we suggest that the excellent record of Miocene sealevel fluctuations preserved in the carbonate platforms of the Marion Plateau in the southern Coral Sea, provides an opportunity to test sealevel models and curves.

To determine the sealevel event stratigraphy it will be necessary to establish:

1. the depositional history of the Miocene carbonate platforms of the Marion Plateau by:
   - establishing a detailed chronostratigraphy for each platform phase;
   - determining the depositional environment of each platform phase;
   - determining the age and duration of each unconformity;
   - inferring the paleo water depth of each phase; and
   - establishing the total thickness of each platform.

2. the amplitude of the Middle Miocene (N14-N12) sealevel fall by:
   - determining the age, depth and paleo-water depth of the older (MP2) platform (Fig. 2);
   - determining the age, depth and paleo-water depth of the initial phase of the younger (MP3) platform.

Figure 2 shows a compilation of stratigraphic events that are recorded by the Miocene and Pliocene carbonate platforms of the Marion Plateau. These events are assumed to be fundamentally controlled by sealevel fluctuations. There appears to be a good correspondence between the event stratigraphy (that is, the number and inferred ages of platform phases) and the number of cycles proposed by Haq et al., (1987) for this interval of the Miocene (Fig. 3). The older (MP2) platform (early-middle Miocene) has four platform phases, and each is assumed to be related to a rising and highstand sealevel event. Four highstand events (MP2a - MP2d) occur between N7 and N10 time. A further highstand event (MP2e) during N12 is seen below the MP2d event. This inferred highstand occurred after the first stage of Middle to Late Miocene eustatic sealevel fall (based on neritic N12 sediments intersected at ODP Site 815). The sealevel curve for the Late Miocene is shown with four cycles (MP3a-MP3d), based on the number of growth phases recognized within both MP3 and other platforms on the northern margin of the plateau (Pigram, 1993). MP3d corresponds to the last phase of platform growth, and records a rapid relative rise in the early Pliocene that led to the drowning of most of the plateau.

The MP2 and MP3 platform growth phases preserve the critical relationship that records the amplitude of the Miocene eustatic sealevel fall. The MP2 platform formed as a series of transgressive and highstand system tracts, whereas MP3 began to form during the following second-order lowstand - i.e., the initial shallow-water phase of MP3 was deposited on the bathyal outer slope sediments of MP2. The MP3 phase subsequently evolved into a series of highstand systems tracts, but remained structurally lower than the top of MP2 for most of its history (Fig. 2). It is this highstand-lowstand relationship between the MP2 and MP3 phases of platform development that records the major global fall in sealevel during the Late Middle to Late Miocene. This approximately 200m offset between

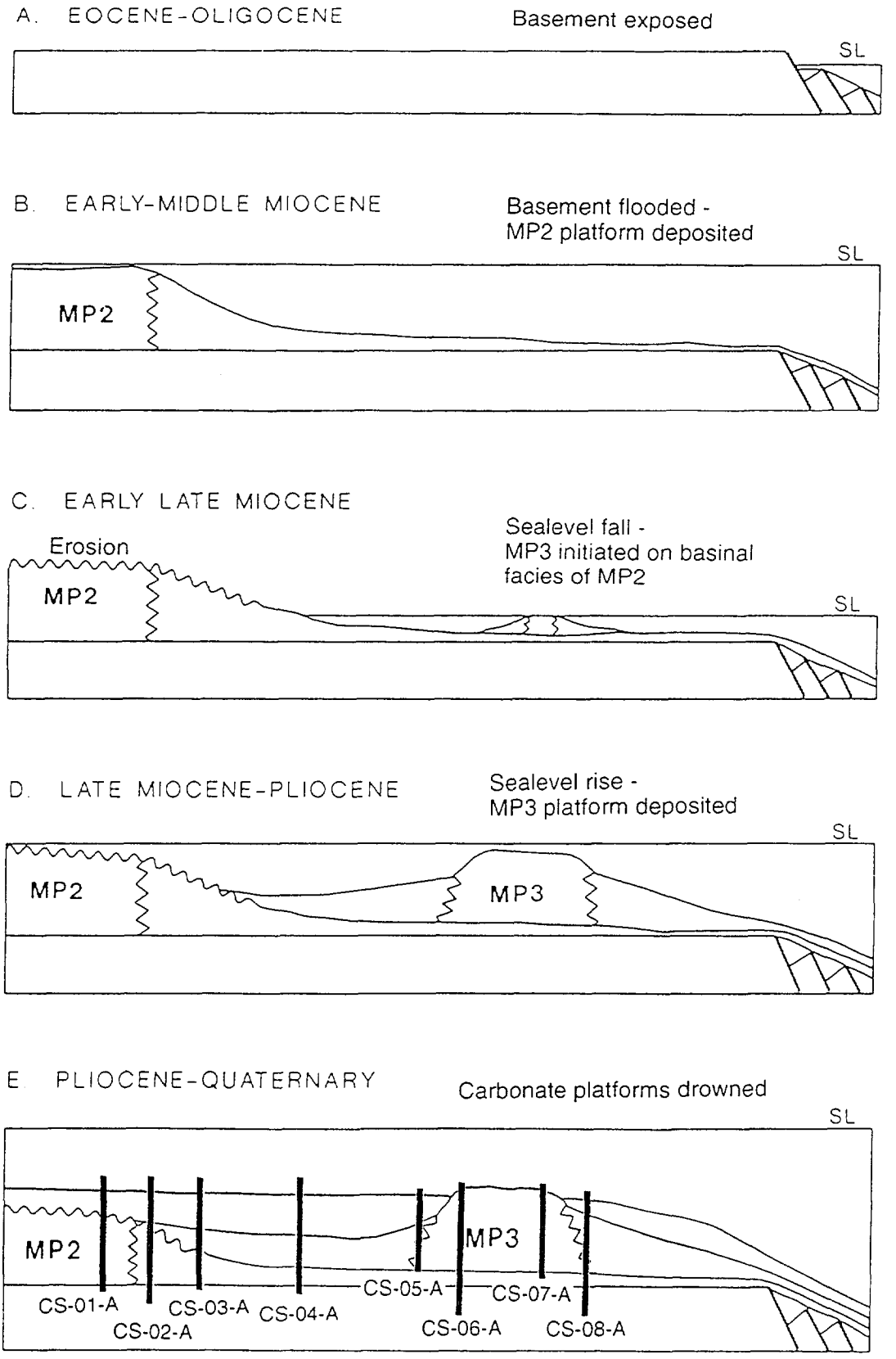


**Figure 2** Schematic depositional history for MP2 and MP3 phases of Miocene to Pliocene carbonate platform development on the Marion Plateau illustrating the lowstand nature of the initial MP3 phase. Proposed drilling sites are marked on E.

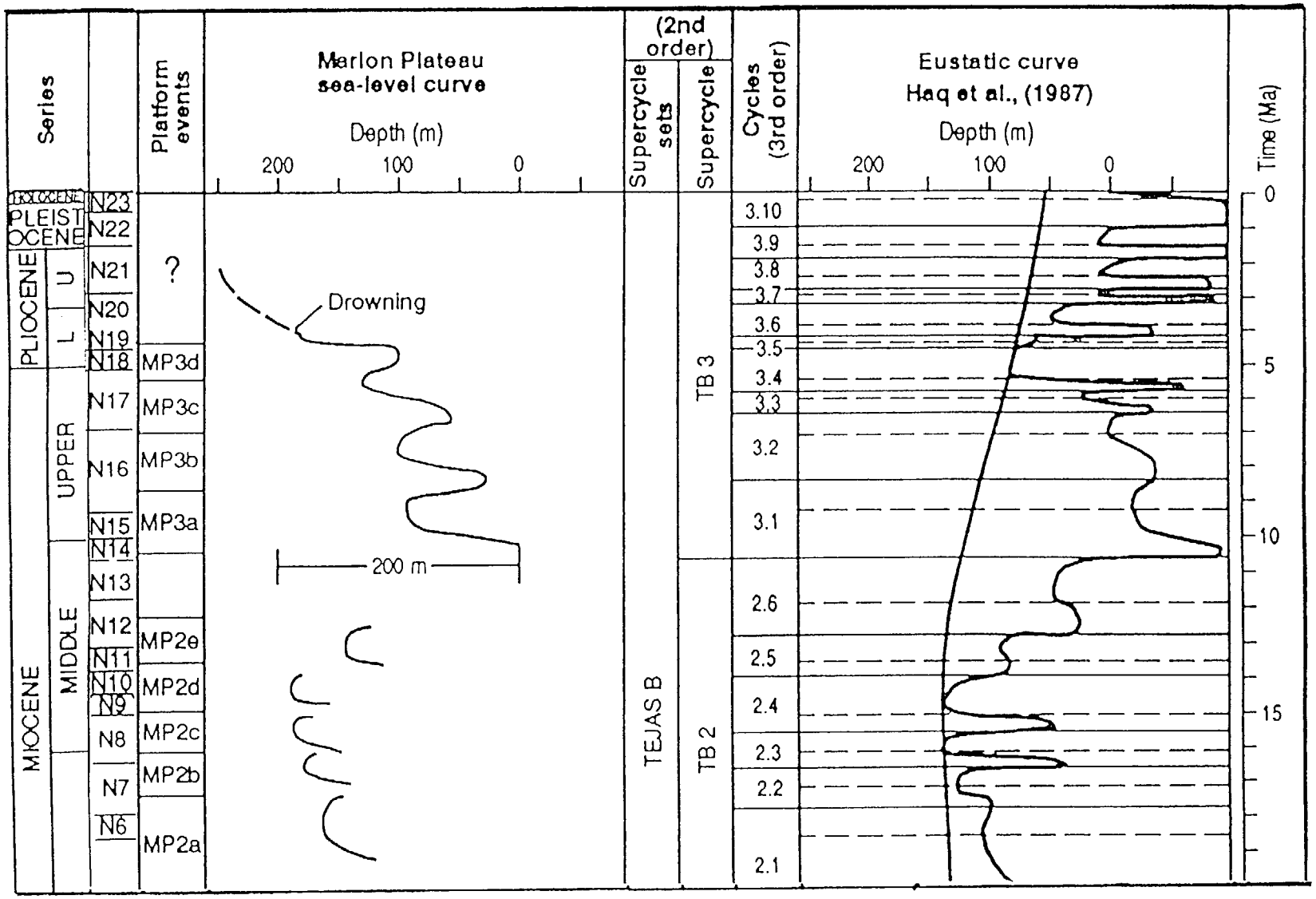


**Figure 3** Marion Plateau sealevel events vs age compared to those from Haq et al., 1987.

the MP2d and MP3a events (Pigram et al., 1992) is of similar magnitude to the middle to early late Miocene eustatic fall in sealevel recorded elsewhere (e.g. Haq et al., 1987).

## 1.2. Paleoceanography of the Coral Sea

### 1.2.1. Paleoceanography: Objectives

Specific paleoceanographic objectives of this proposal are:

- To describe variations in surface and intermediate water circulation occurring since the Oligocene in the Coral Sea, particularly with respect to restriction of circulation in the western Pacific with northward movement of the Indo-Australian Plate;
- To describe the environmental results of the transition from sub-tropical to tropical climatic regimes as a result of northward movement of the Indo-Australian Plate;
- To understand the development and variability of the western Pacific warm water pool since the Miocene;
- To describe the development and variability of the northwest monsoon climatic system;
- To determine the influence of paleoceanographic events occurring in the Coral Sea on the development of carbonate platforms and reefs off northeast Australia and Papua New Guinea;

### 1.2.2. Paleoceanography: Rationale

The sites proposed here will fill a significant gap in the latitudinal transect in the western Pacific from the Southern Ocean to the Ontong Java Plateau. The western Pacific is an important component of the global climate and circulation system, and the completion of the transect will permit and enhanced understanding of variations in these systems through time.

• <u>Variations in circulation patterns with northward movement of the Australian Plate</u> - Circulation patterns in the western Pacific were modified both by the movement of continental fragments resulting from local rifting events, and also by the northward movement of the Indo-Australian Plate and its collision with the Asian Plate. Throughout the early to middle Cenozoic, the Indonesian Seaway was open between northern Australia and Asia (Fig. 4) permitting relatively unrestricted exchange of surface and deep waters between the Pacific and Indian Oceans. As Australia moved north, this flow became increasingly constricted. By

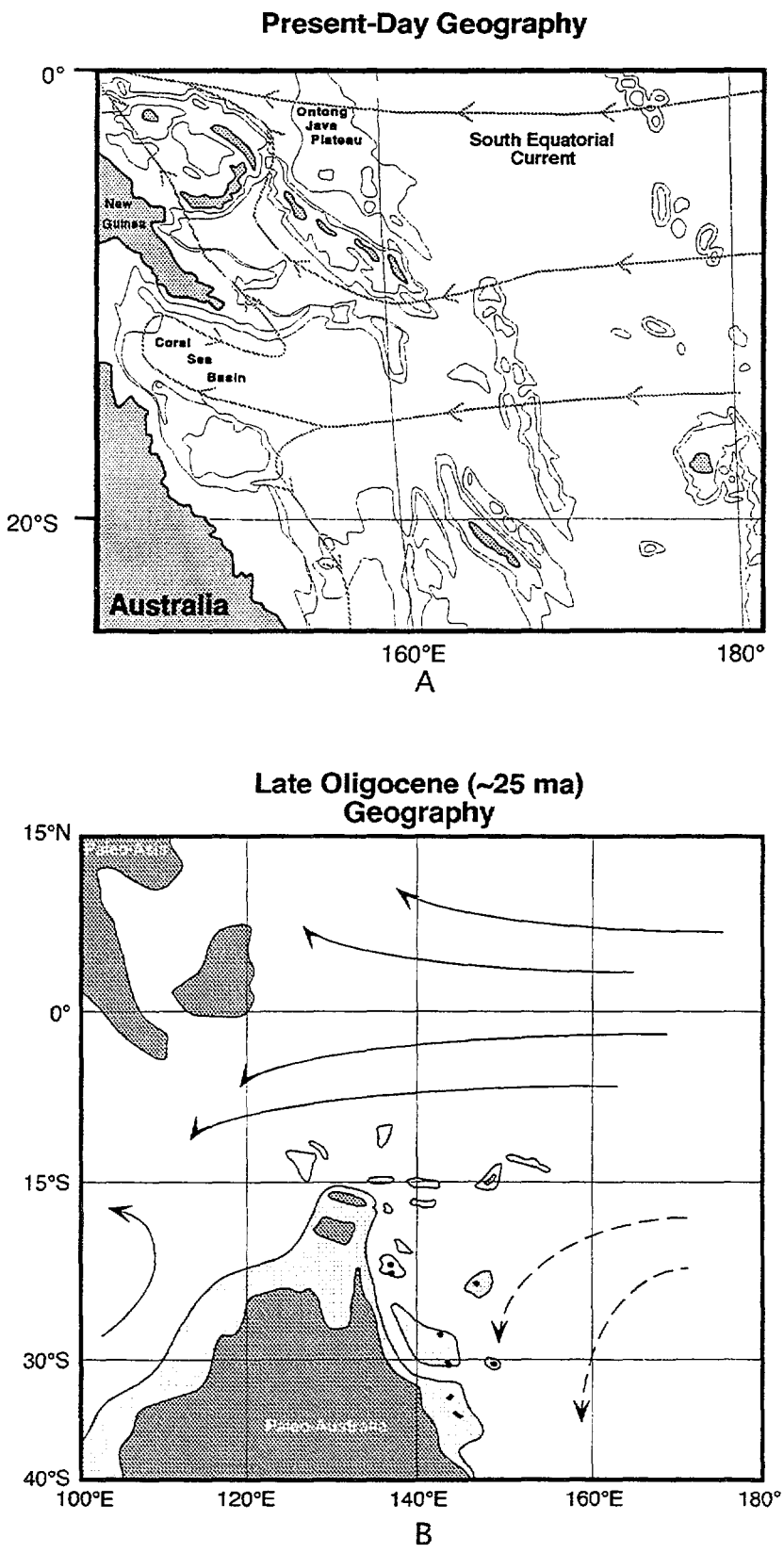


**Figure 4**

**A**. Present-day geography of the western Pacific with the flow path of the South Equatorial Current shown in grey.

**B**. Paleogeography of the western Pacific in the late Oligocene. Dark gray areas are exposed landmasses, light gray areas are shallow marine. Arrows indicate possible current paths for the paleo-South Equatorial Current. Dashed arrows indicate currents which were likely to have been weak, slow moving, and cooler than at present. Black dots show proposed drilling sites.

21 Ma the seaway was closed to deep-water flow, and by 12 Ma surface water flow was highly restricted (Romine and Lombari, 1986). The constriction of surface water flow greatly changed the pattern of circulation in the western Pacific. When the seaway was open, it is likely that the flow to the Indian Ocean would have been on the order of 40-50 Sv/yr, resulting in most of the warm South Equatorial Current water remaining at low latitudes. With reduced flow of surface water from the Pacific to the Indian Ocean, greater amounts of warm water were diverted north and south into the Pacific Ocean gyres, thus affecting regional sea surface temperatures. This diverted flow also greatly increased the strength of the western boundary currents.

At present, surface water flow from the Pacific Ocean north of Australia to the Indian Ocean is an important component of the global conveyor belt of circulation, with a seasonal maximum flow of approximately 12-20 Sv/yr and a minimum flow of 2-5 Sv/yr (Tomczak and Godfrey, 1994). In addition, these warm surface waters play an important role in ENSO events.

It is an important aim of the paleoceanography component of this drilling proposal to describe the evolution of western Pacific circulation arising from the sequential restriction of the Indonesian seaway, as a necessary complement to existing data from the Ontong-Java Plateau and Lord Howe Rise. These oceanographic changes will then be related to on changing depositional environments in the Coral Sea as recorded by carbonate platform and rift trough sediments.

• Changes in climate resulting from plate motion and global climate change -

Northward movement of the Indo-Australian caused significant variations in climate due to movement across climatic boundaries. These changes, in addition to global climatic variations had dramatic influences on the depositional environments in the Coral Sea which today are dominated by tropical carbonates. It is an important aim of this proposal to describe how these climatic variations have affected in depositional environments. In particular, defining the Miocene to Recent history of Eastern Fields Reef, which lies north of the Great Barrier Reef, will provide an important addition to what is known about the development of the reefs and carbonate platforms off northeast Australia.

• Development of the western Pacific warm water pool - The warmest waters in the ocean can be found in the western Pacific, or Indonesian, warm pool. Surface waters here have an annual mean temperature of 29.5°C (Tomczak and Godfrey, 1994). High sea surface temperatures, along with a high influx of heat to the surface waters and substantial freshwater gain, have significant effects on regional and global climate and circulation. This warm water pool is an important element in global climate, as shown by its role in El Niño/Southern Oscillation (ENSO) events.

The Indonesian warm pool sequentially developed due to closure of the Indonesian seaway from the middle Miocene, resulting in a "build-up" of water in the western Equatorial Pacific that was unable to be entirely removed due to the weak poleward currents in the region. It is unclear how and at what rate the warm pool expanded in the Neogene. Data from Leg 133 show that during the Quaternary, SST's increased from approximately 22°-23°C near 0.5 Ma to modern temperatures of 26-28°C (Isern et al., 1996; Peerdeman et al., 1993). With the small spatial distribution of Leg 133 sites, it is unclear whether this warming was connected to changes seen in the large Indonesian warm pool north of New Guinea, or whether the warming was a local change seen in the westernmost Coral Sea.

In order to investigate the development of the warm water pool in the Coral Sea, we propose to drill sites on the Eastern, Louisiade, and Mellish Plateaus (Fig. 1). These sites will fill the major gap in the western Pacific transect established by Legs 21, 90, and 133. In addition, the proposed Coral Sea sites have a wider spatial distribution, sample more open ocean conditions, and are likely to be in environments with a lower diagenetic potential due to the lack of reefal detritus compared with those sampled by Leg 133.

• Development of the Northwest Monsoon - During the Australian summer, the low pressure area over the Australian continent results in the development of monsoonal circulation in the northern Coral Sea (Tomczak and Godfrey, 1994). During the winter (June-September), the northern Coral Sea is dominated by the Southeast Trade Winds. In the summer (December-March), there is a change in

wind direction from the trade wind dominated southeasterly to the Northwest Monsoon dominated northwesterly. The Northwest Monsoon reaches Torres Strait in mid December, and moves south until the middle of February before moving north (Brandon, 1973).

Although the Northwest Monsoon, is not as dominant as the Indian Southwest Monsoon it still has significant environmental effects on the northern Coral Sea. One aim of this proposal is to determine the development history of the Northwest Monsoon, such as when it initiated, and how it has varied in strength over time with regional and local climatic changes.

## 1.3. Fluid flow through the Queensland Plateau

### 1.3.1. Fluid flow: Objectives

Fluid movement is significant for elemental geochemical cycles due to the uptake and removal of various elements during the diagenetic alteration of sediments, combined with other reactions occurring in interstitial waters. Investigations of fluid flow have been highlighted as a critical element of ODP's Long Range Plan, in recognition of the global importance of this process.

The Queensland Plateau is one of very few areas of carbonate sedimentation where fluid flow has been conclusively shown to be occurring (Elderfield et al., 1993). This area therefore provides an ideal location to study fluid circulation within a carbonate platform, and its relationship to diagenetic processes and geochemical cycles. Tropical to sub-tropical carbonate sediments have a high diagenetic potential due to the presence of metastable carbonate minerals, thus fluid circulation within the platform would have been a critical control on the physical and chemical alteration of this sediment.

The primary fluid flow objectives are:

- To determine the factors controlling fluid flow and the rates at which it is occurring within the Queensland Plateau;
- To infer flow pathways within the Queensland Plateau carbonate platform;
- To determine the role of sediment physical properties as controls on fluid movement;
- To determine the importance of fluid flow in relation to the extensive diagenesis which has occurred within this platform.

### 1.3.2. Fluid flow: Rationale

The mechanisms, rates, and distributions of fluid transport through carbonate platforms and reef structures are critical to the understanding of diagenetic processes (Buddemeier and Oberdorfer, 1986) and the geochemical cycling of many elements. Fluids have the ability to chemically alter the mineralogic composition of sediment by converting metastable minerals such as high Mg calcite and aragonite to more stable low Mg-calcite and dolomite (Mullins et al., 1984; Simms, 1984). Alteration of carbonate sediments to dolomite has been

significant in both the Bahamas carbonate platform (Varenkamp et al., 1991) and those off northeast Australia (McKenzie et al., 1993; Davies, McKenzie, and Palmer-Julson, 1991). Recent studies have shown that carbonate sediments off northeast Australia were dolomitized by multi-generational fluids flowing through the platforms (McKenzie et al., 1993). Fluid movement through the Queensland Plateau was demonstrated using $^{87}Sr/^{86}Sr$ isotopic ratios and the Sr composition of interstitial waters (Elderfield et al., 1993).

Fluid flow is also significant in that it can alter the sedimentary structure, permeability, and porosity of a sediment deposit. This has important effects on flow pathways and reservoir potential and therefore is of critical interest to the petroleum industry.

Although the existence of fluid flow has been described in tropical carbonate platforms such as the Queensland Plateau (Elderfield et al., 1993) and the Great Bahama Bank (Melim et al., 1994; Eberli, Swart, Malone et al., 1996), the mechanisms causing this flow are neither well documented nor understood. Numerous theories have been put forward to explain fluid flow through carbonate platforms (Whitaker and Smart, 1990):

- Variations in hydraulic head across a carbonate platform: Hydraulic head differences can be caused by tides, waves, or ocean currents. Generally, these processes would be significant only on shallow platforms.
- Variations in fluid density between waters within and around the carbonate platform:
    - Buoyant circulation - during banktop emergence, the fresh meteoric lens will mix with underlying seawater. These mixed waters then flow seaward which necessitates an inflow of saline water at depth.
    - Reflux - on a shallow carbonate bank, high rates of evaporation on the platform surface result in very dense water, which can then flow into the platform and displace less dense water.

  As with variations in hydraulic head, variations in fluid density are generally believed to only be significant on shallow platforms.
- Fluid flow resulting from geothermal heat flux (Kohout Convection): when the fluids surrounding a carbonate platform are cooler than those heated by geothermal heat fluxes within the platform, the temperature difference may be

significant enough to generate thermal convection. In this scenario, cold waters are drawn into the platform at depth and then heated. This heating lowers the fluid density, and the waters rise and discharge along the platform margin.

Of the mechanisms listed above, we believe that fluid flow resulting from geothermal heat flux is presently the most important process occurring within the Queensland Plateau, as the other mechanisms require a shallow platform surface whereas the Queensland Plateau surface is generally too deep (averaging ~1000 m). Yet, as the surface of the plateau has been shallow and exposed at various intervals in the past, it is possible that one or more of the other mechanisms operated previously.

Recent modeling using seismic data, together with permeability and porosity data from cores on the Great Bahama Bank, showed that geothermal convection is the most significant mechanism responsible for fluid movement in such platforms. In addition, these modeling results predict fluid recharge along the platform margins, and therefore a net movement of water inward towards the platform center. This modeling was supported by data collected on Leg 166, which drilled the flanks of Great Bahama Bank. Using a combination of geochemical and geothermal measurements, Leg 166 data showed that there is an a upper zone in the sediments in which active advection of bottom seawater was taking place. A closely spaced transect of holes near the margin of the Great Bahama Bank platform revealed that this water was penetrating into the platform.

We propose to investigate fluid flow on the Queensland Plateau by drilling a transect of two holes to the southeast down the southern slope of the Queensland plateau. These cores will greatly add to the limited fluid flow dataset collected during Leg 133, as we propose to sample a wider range of seafloor depths and slope steepness. In addition, we propose to drill a hole for CORK borehole investigations near the location of ODP Site 812, where fluid flow through the Queensland Plateau was previously documented.

# 2. OCEANOGRAPHY AND GEOLOGIC BACKGROUND

## 2.1. Modern Oceanography

Surface-water circulation in the western Coral Sea is dominated most of the year by the South Equatorial Current (SEC) (Tomczak and Godfrey, 1994; Pickard et al., 1977). This current enters the western Coral Sea and diverges (Tomczak and Godfrey, 1994); the southern branch becomes the East Australian Current between 20°-25°S (Pickard et al., 1977), while the northern branch flows into the Solomon Sea (Tomczak and Godfrey, 1994; Pickard et al., 1977; Wyrtki, 1960). The SEC is greatly influenced by the strength and location of the Southeast Trade Winds, the dominant air mass in the area, which flows to the northwest. These winds are stable from April to December, and strong from August to October (Tomczak and Godfrey, 1994; Pickard et al., 1977).

In the austral summer, the influence of the Northwest Monsoon results in increased southerly surface-water flow near the northeast Australian margin (Tomczak and Godfrey, 1994; Pickard et al., 1977). Because of monsoonal flow, current directions change from generally W-SW to S-SE and wind directions change from the NW to the SE in the mid-summer (January-March) (Pickard et al., 1977).

The main deep water mass at the sites to be drilled is Antarctic Intermediate Water (AAIW; Pickard et al., 1977; Wyrtki, 1962). AAIW is a major water mass found throughout the Pacific, with the core of the watermass generally occurring between depths of 650 to 1100 m in the Coral Sea (Tomczak and Godfrey, 1994).

## 2.2. Tectonics of northeast Australia and the Coral Sea

Cretaceous rifting in the Coral Sea basin created numerous continental fragments which are now capped by carbonate platforms (Fig. 1). Rifting in the Coral Sea was an extension of late Cretaceous (80 Ma) seafloor spreading in the Tasman Basin, which extended to the north to form the Cato Trough and the Coral Sea Basin by 65 Ma (Fig. 5) (Weissel and Hayes, 1971; Weissel, 1977; Hayes, 1973; Shaw, 1978). Spreading is believed to have ceased along the length of the system by the earliest Eocene (56 Ma). Thus, the main physical elements of the western Coral Sea were likely to have been in place in the early Tertiary (Davies et al., 1989). Although the exact structural style and development history of the rift

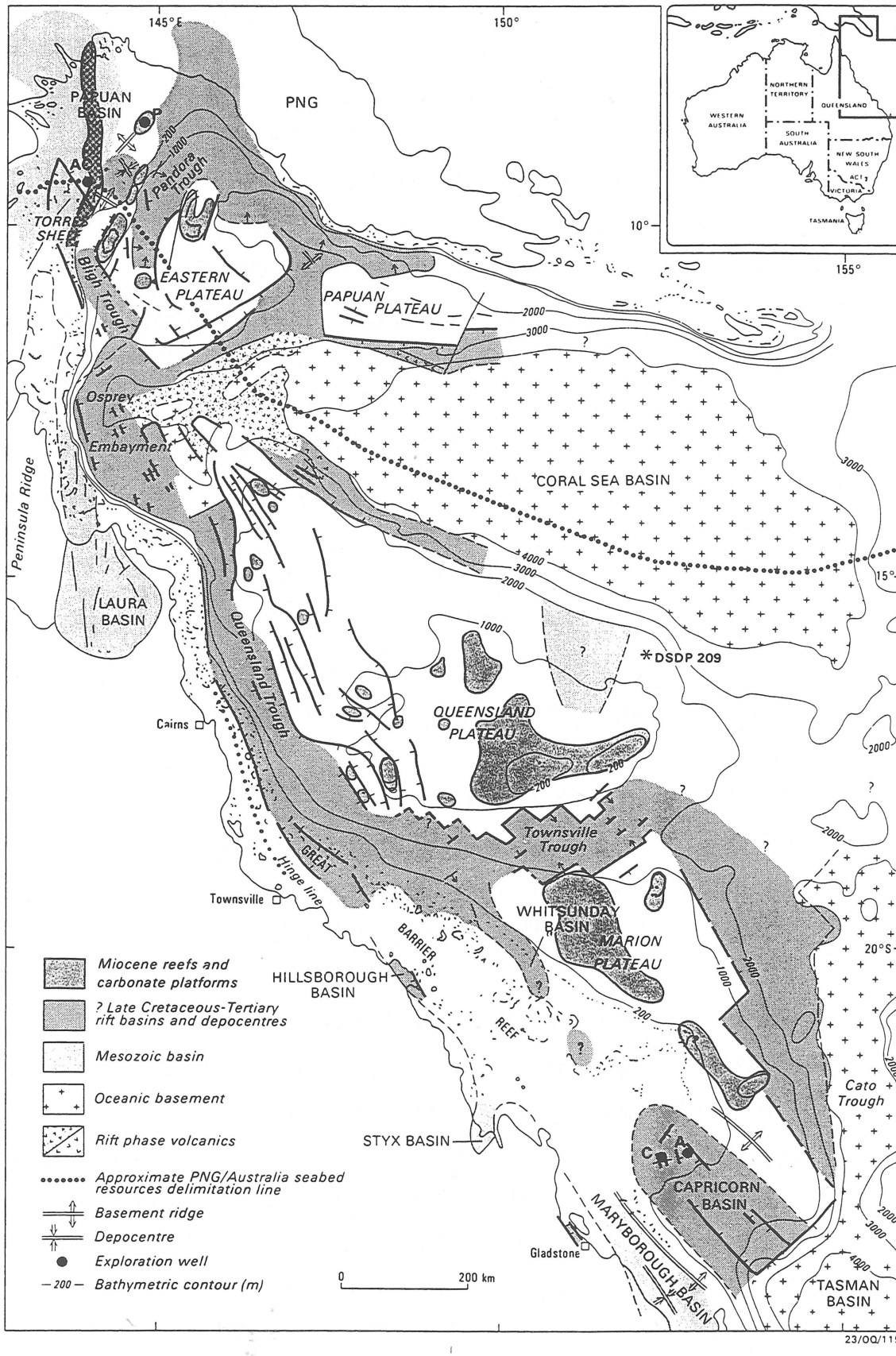


**Figure 5** Map showing the major structural features of the Coral Sea

system is still not completely understood, it is clear that rifting controlled the gross architecture of the margin in addition to the form of the high standing structural elements on which the numerous carbonate platforms in the area are standing.

With the exception of the Eastern Plateau, the tectonic histories of the plateaus on which we propose to drill are simple, with gradual subsidence over time. The Eastern Plateau has a more complex history as it underwent a phase of deformation in the late Oligocene and Miocene caused by the New Guinea orogen to the north (Pigram and Davies, 1987). This late phase structure produced a distinct Neogene topography which is not seen on the other Coral Sea plateaus.

## 2.3. Stratigraphy of the western Coral Sea Plateaus: evidence from prior drilling

### 2.3.1. Queensland and Marion Plateaus

Stratigraphies for the Queensland and Marion Plateaus were obtained during DSDP Leg 21 and ODP Leg 133 (Fig. 6) and both of these plateaus have been extensively surveyed with seismic data (Figs. 7 and 8). These cores have allowed the general description of the depositional history for these two plateaus. Initiation of shallow marine carbonate sedimentation on the central Queensland Plateau began during the late Eocene or early Oligocene, as the sea transgressed across the metasedimentary basement of the plateau (Davies, McKenzie, Palmer-Julson, et al., 1991). Sedimentary facies and correlation to seismic profiles indicate that tropical reef development was initiated on the Queensland Plateau in the early Miocene and, by the middle Miocene, there was extensive reef growth on both the Queensland and Marion Plateaus (Davies, McKenzie, Palmer-Julson et al., 1991). In the late middle Miocene, carbonate bank productivity rapidly diminished on both the Queensland and Marion Plateaus, as shown by a diminished fine-grained, bank-derived component in the slope sediments. On the Marion Plateau, the decline was the result of subaerial exposure resulting from a sealevel regression. A subsidence pulse prior to this regression prevented the Queensland Plateau from being exposed, and evidence from Leg 133 shows that sea surface temperature changes were also a critical control on the diminished carbonate sedimentation.

During the transition from the late Miocene to early Pliocene, sedimentation rates continued to decrease in the margin and slope sediments of

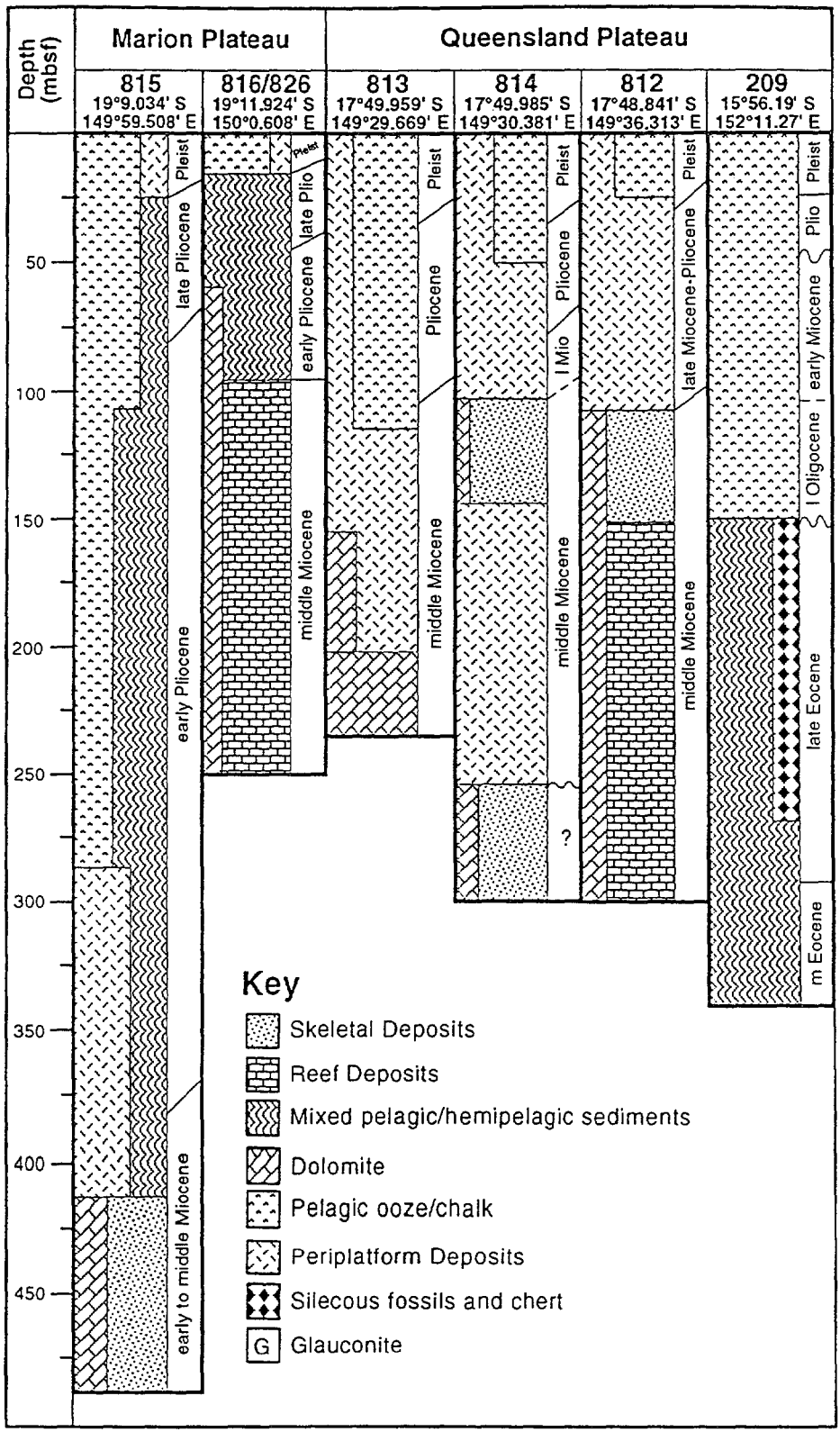


**Figure 6** Stratigraphic summary of sites near proposed drilling areas. All sites were drilled during Le133 except for Site 209 which was drilled during DSDP Leg 21.

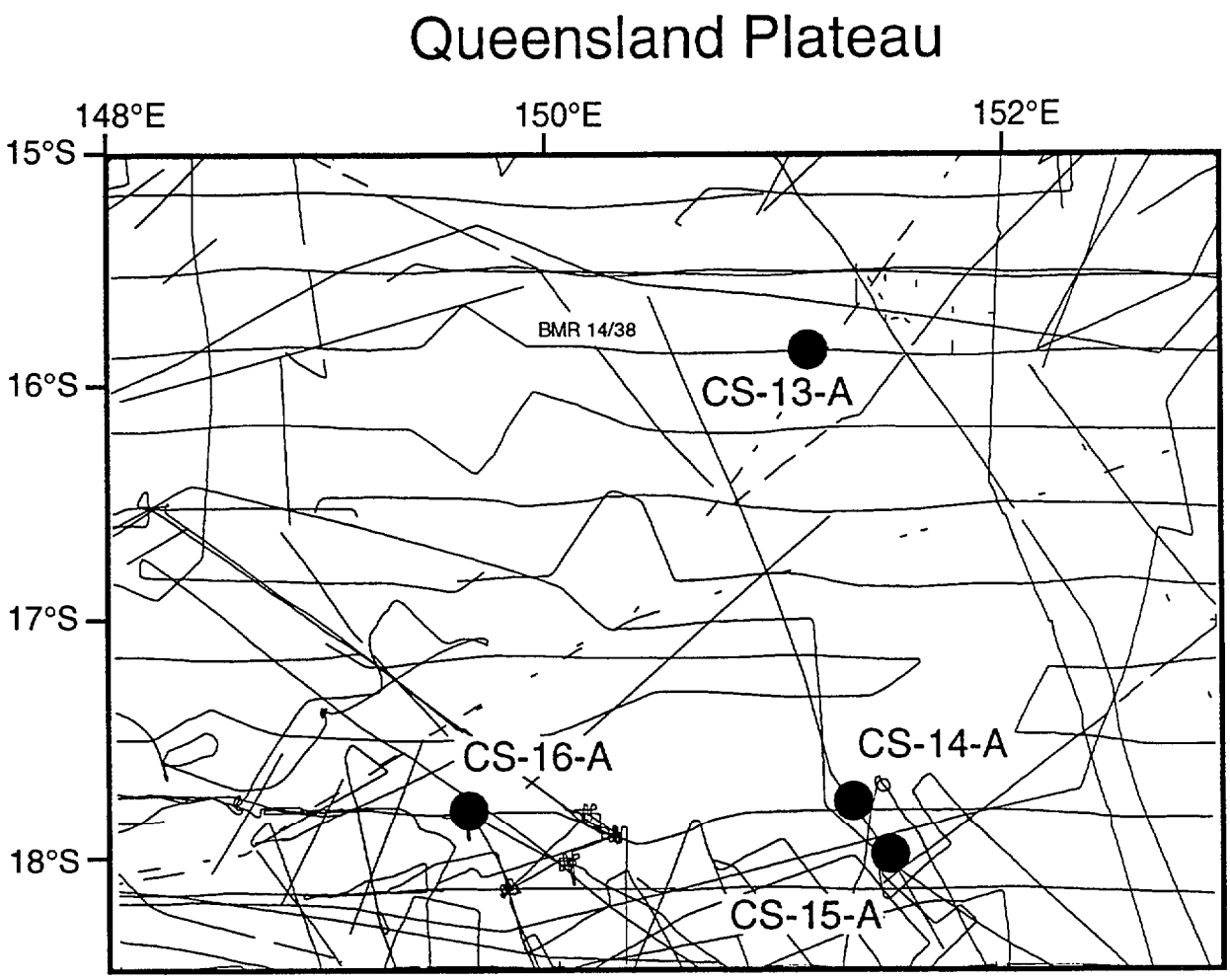


**Figure 7** Navigation tracks of available seismic data with proposed sites

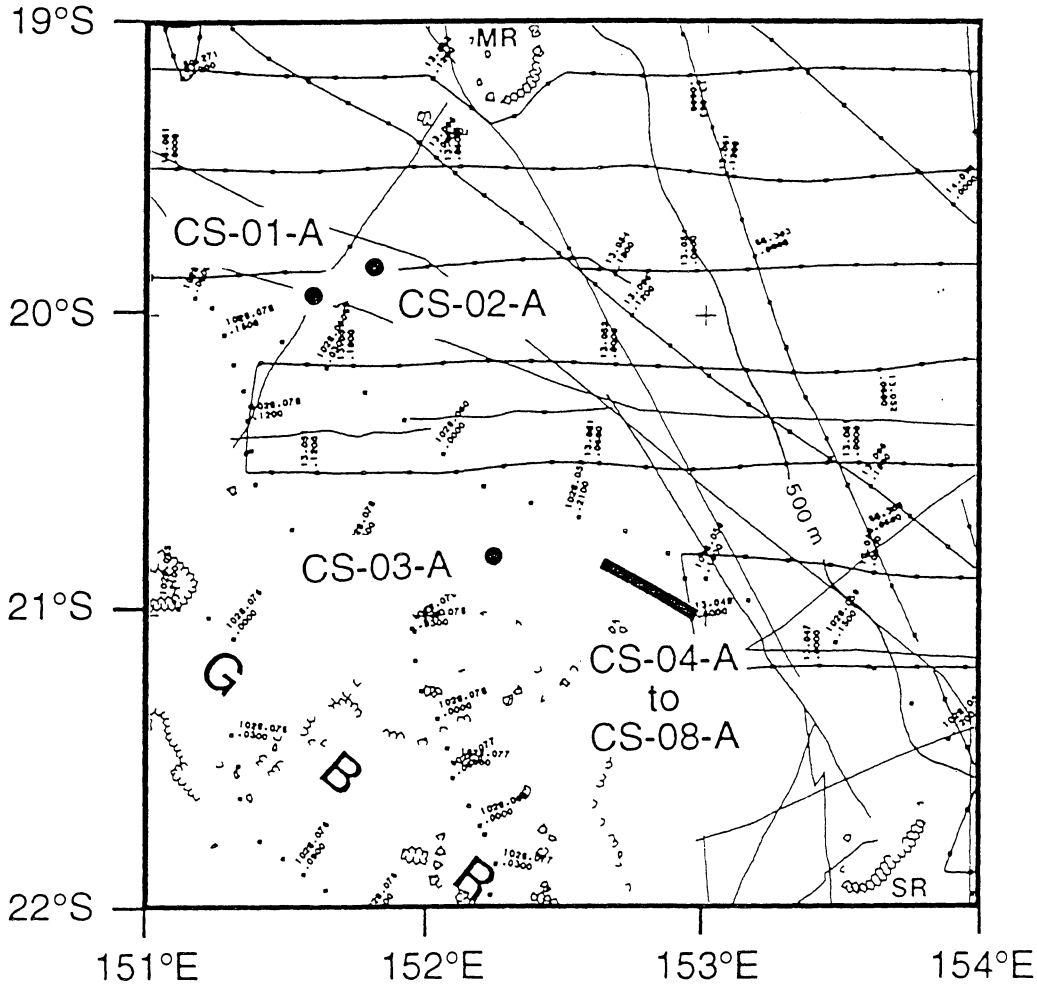


**Figure 8** Track map of the Marion Plateau region showing pre-1987 seismic data and proposed drillsites.

the Queensland Plateau, and condensed sequences developed on shallower areas of the plateau. The ratio of pelagic to bank-derived carbonate in the slope sediments increased at this time, indicating continued decline of shallow carbonate bank productivity. Increased slumping and debris flows into the deeper waters of the Queensland Trough during the Miocene/Pliocene transition record the release of unstable sediments from nearby slopes during rearrangements of shorelines resulting from sealevel variations (Betzler et al., 1995).

Reef growth on the Queensland Plateau did not reappear again until the late Pliocene but, by this time, a majority of the plateau surface had subsided below the photic zone and reef growth was restricted to a few isolated locations on the platform top. Renewed reefal development on the Marion Plateau was even more limited, as increased terrigenous input from the Australian continental margin in the late Neogene produced increased turbidity in the water column, preventing coral growth.

The sedimentary history of the eastern margin of the Queensland Plateau is only known from DSDP Site 209 which had excellent preservation but poor recovery due to rotary drilling. Site 209 recovered a condensed section of Eocene to recent pelagic sedimentation with increased amounts of terrigenous detritus in the Eocene (Fig. 6). A lengthy hiatus is present from the late Eocene to the late Oligocene (Burns, Andrews, et al., 1973).

### 2.3.2. Eastern Plateau

The stratigraphy of the Eastern Plateau is based on limited well data, extensive high quality seismic lines (Fig. 9), and some dredge samples. These data show that the sedimentary sequence consists of:

- rifted Eocene sediments of varying thickness, probably composed of terrigenous detritus, pelagic ooze and turbidites;
- overlying these sediments are approximately 200-250 m of early Oligocene to Middle Miocene oozes and turbidites;
- the uppermost unit consists of approximately 400 m of late Miocene to Recent pelagic oozes and turbidites.

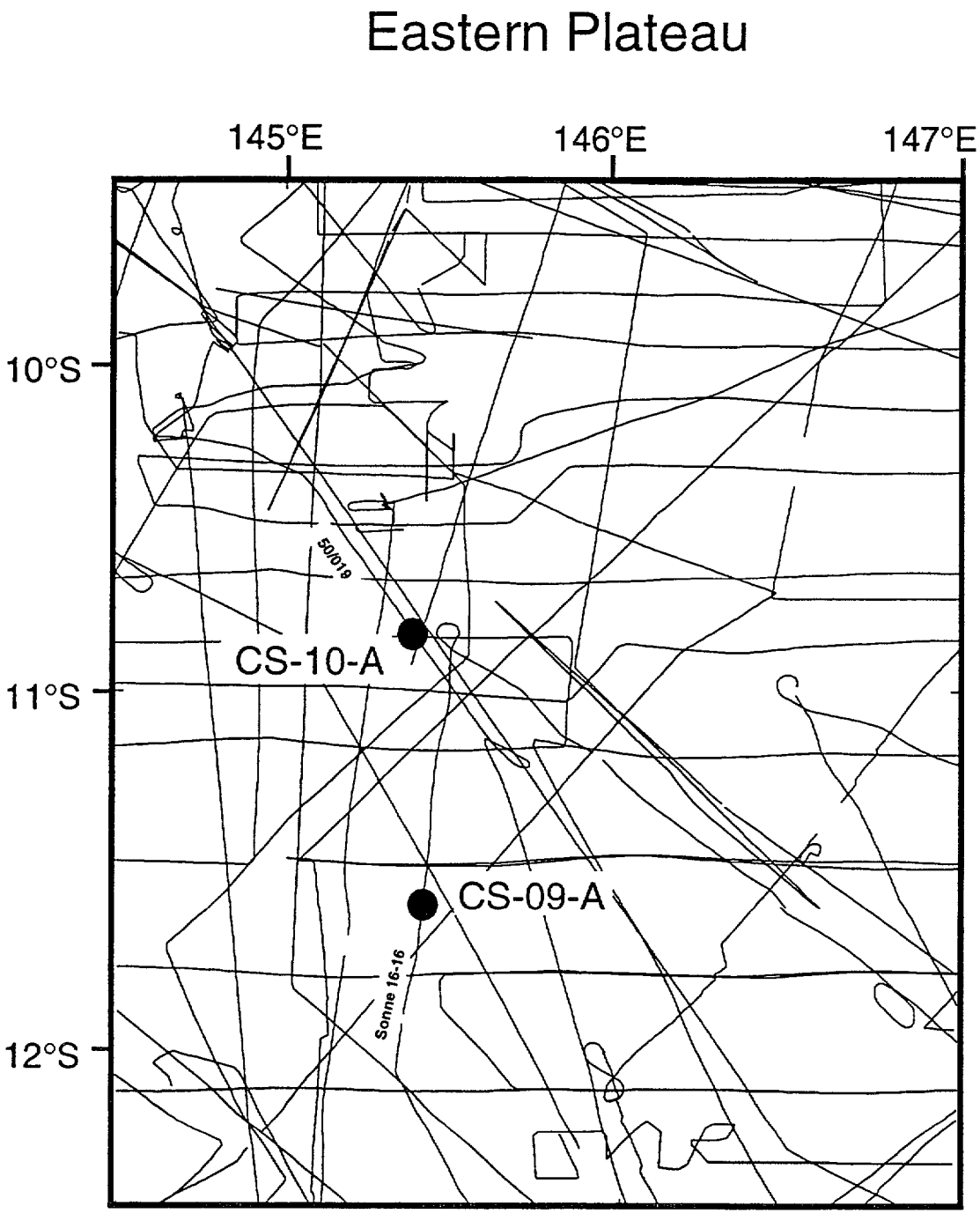


**Figure 9** Navigation tracks of available seismic data with proposed sites

### 2.3.3. Mellish and Louisiade Plateaus

Little is known about sedimentation on the Mellish and Louisiade plateaus. There have been no drillholes or wells on either of these plateaus. Seismic data on the Louisiade Plateau is limited and of poor quality (Fig. 10) but, nevertheless indicate that there is approximately 510 m of sediment overlying the basement surface. It is likely that this sediment is dominantly pelagic ooze.

There is an extensive seismic grid over the Mellish Plateau (Fig. 11). This plateau is not as large as many of the other Coral Sea plateaus, and actually consists of a group of smaller oceanic plateaus (Fig. 1). Seismic data indicates that the thickness of the sediment cover is variable, depending on water depth and surrounding topography. Modern sediments are likely to be pelagic oozes, whereas the presence of numerous drowned reefal platforms indicate that older sediments may be a combination of pelagic and periplatform oozes depending on their proximity to reefs.

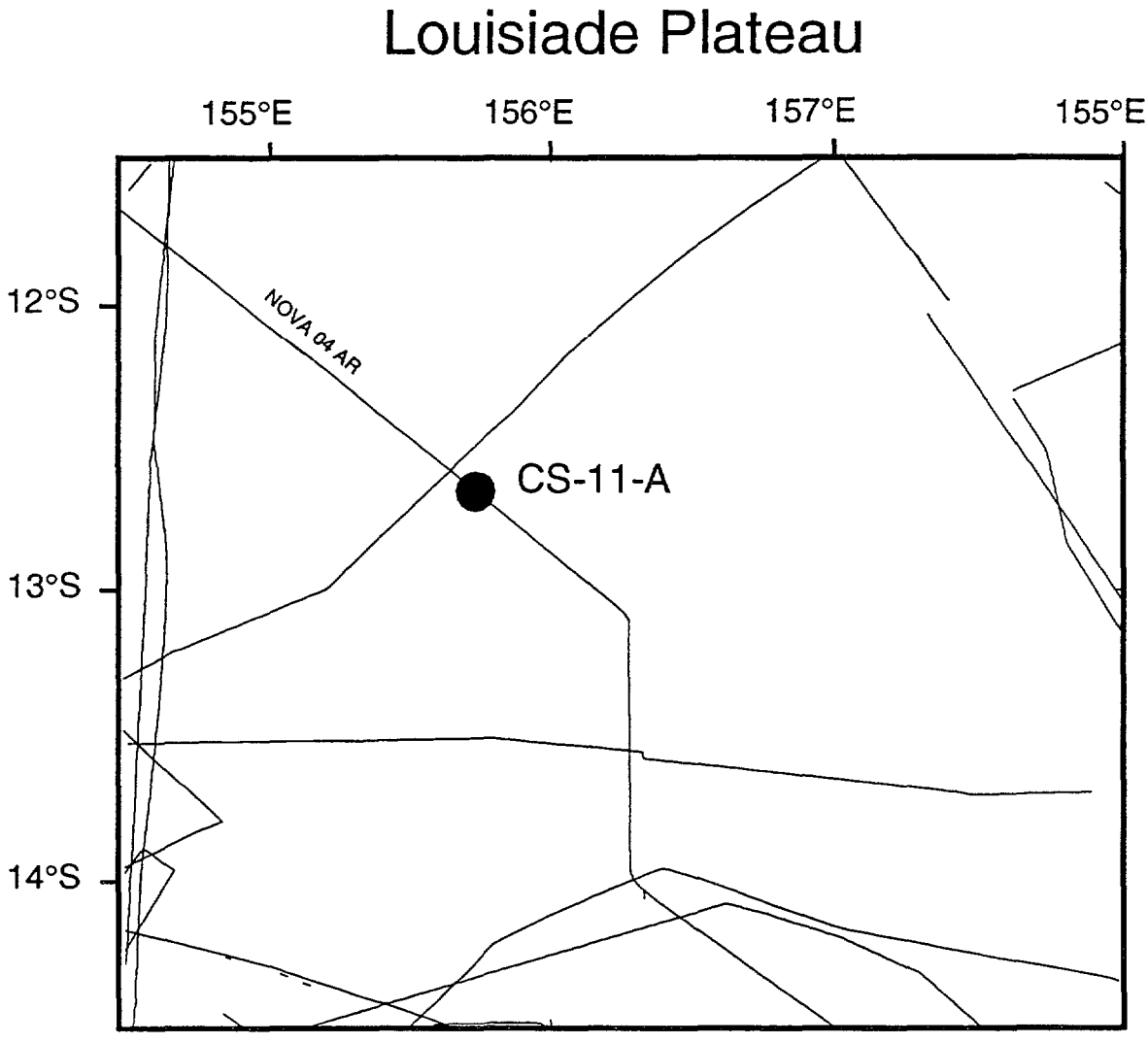


**Figure 10** Navigation tracks of available seismic data with proposed site

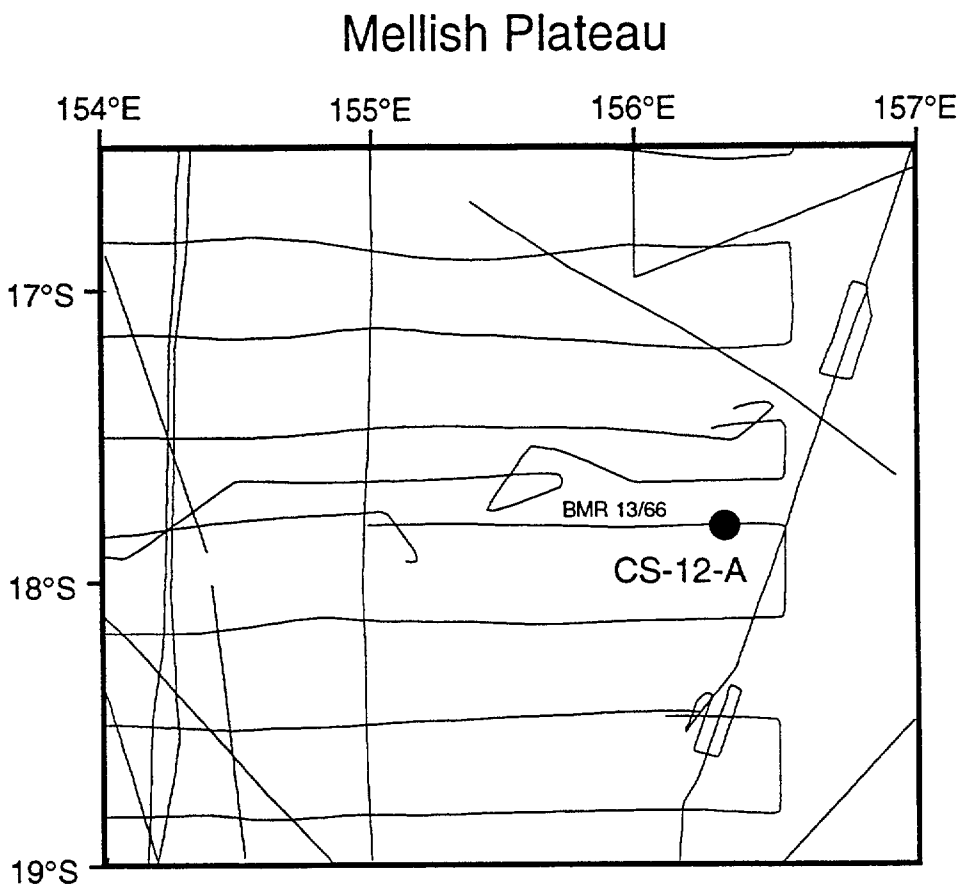


**Figure 11** Navigation tracks of available seismic data with proposed site

# 3. EXISTING DATA

## 3.1. Seismic data

### Marion, Queensland, Eastern, and Mellish Plateaus

The oldest seismic data sets on these plateaus are poor quality sparker and airgun data acquired by both Scripps (NOVA02HO) and Lamont-Doherty Earth Observatory (V2407, V2408). In the early 1970's, poor to moderate quality 6-channel sparker data was collected by the Australian Bureau of Mineral Resources (now AGSO) continental margin survey. In the 1970's and early 1980's, higher quality multi-channel airgun data were collected by the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) and the Bureau of Mineral Resources. In addition to these data sets, there are also high-resolution watergun data for Leg 133 site surveys collected by the Bureau of Mineral Resources on both the Queensland and Marion Plateaus.

### Louisiade Plateau

Very limited seismic data is available for the Louisiade Plateau. Only two lines intersect over the plateau (Fig. 10). These lines are good quality analogue data recorded by Scripps Institute of Oceanography (NOVA02HO, NOVA04AR) which a sufficient to give a firsthand account of plateau sedimentation.

The seismic data sets which are available for all of the plateaus proposed to be drilled are sufficient to identify sites, but high resolution (multiple GI gun) site surveys will be needed for final site location.

## 3.2. Previous ODP/DSDP Sites in the Coral Sea

There have been 18 previous sites drilled in the Coral Sea (Fig. 1). The stratigraphy for some of these holes has been summarized in section 2.3 (Fig. 6). Fifteen sites were drilled in two transects in the far western Coral Sea Basin during Leg 133 (Sites 811-826), primarily to study the evolution of the carbonate platforms off northeast Australia. The two sites drilled in the deep Coral Sea Basin (Sites 210 and 287) were drilled to study the age, history and biostratigraphy of the Coral Sea. Site 209 on the eastern Queensland Plateau was drilled during Leg 21 to examine the age and structural history of the Queensland Plateau.

# 4. TECHNICAL AND SAFETY CONSIDERATIONS

## 4.1. Safety issues

Previous drilling during ODP Leg 133 and DSDP Leg 21 have demonstrated that there are no significant safety concerns for drilling on either the Queensland or Marion Plateaus. There also do not appear to be any issues of concern involved with the drilling on the Mellish or Louisiade Plateaus. The area north of the Eastern Plateau in the Gulf of Papua and Pandora Trough does have gas generation due to the high influx of terrigenous sediments in these areas. However, there is no evidence that there are gas accumulations on the Eastern Plateau, as terrigenous sediments are blocked from the plateau area by the Pandora Trough.

## 4.2. Drilling Technology

The completion of the drilling proposed here will require technology currently available (APC, XCB, and RCB). It is expected that the sediments drilled at the sites for the paleoceanography objectives will generally be unindurated pelagic and periplatform oozes. The presence of variably-cemented carbonate horizons on some of the Marion Plateau sites will make it beneficial to have the MDCB available during drilling.

## 4.3. CORK Borehole and Heatflow Measurements

In addition to porewater sampling of recovered sediments at the fluid flow sites, the achievement of the fluid flow objectives will be dependent on the use of CORK borehole technology. The use of a CORK will provide us with the ability to monitor geothermal gradients, sediment physical properties, and chemical gradients within the Queensland Plateau. Additional high resolution geothermal heatflow measurements will be taken using the ADARA tool between each core.

## 4.4. Site Surveys

If this proposal receives a sufficiently high ranking from ODP scientific panels, the Australian Geological Survey Organisation will be approached to schedule a site survey cruise in the Coral Sea to refine site locations and identify alternative sites.

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# 6. PROPOSED DRILL SITES

## 6.1. Drilling Strategy for Sealevel Objectives

The Marion plateau basement is overlain by a Miocene to Holocene carbonate platform comprised of several shallow-water accretion phases separated by unconformities (Fig. 2). The oldest and most extensive shallow-water phase (MP2) occupies the northern part of the plateau and is of early (?) to middle Miocene age (N7? to N10-12) (Chaproniere and Pigram, 1993). Two Leg 133 sites drilled on the Marion Plateau intersected the top of the MP2 platform (Davies, McKenzie and Palmer-Julson, et al., 1991). The late Miocene (N16? to N17) second phase of platform development (MP3) is confined to the eastern side of the plateau (Fig. 2). The MP3 phase has been sampled by dredging along the northern edge of the southern platform and consists of latest Miocene age rhodolith-bearing wackestone.

The establishment of a sealevel curve for the Miocene in the Coral Sea Region is critically dependent on determining the facies and age of each of the MP2 and MP3 platforms. Typically, precise dating of warm shallow water carbonate platforms is not possible due to the broad stratigraphic range of larger foraminifers and diagenetic alteration of the sediments. Therefore, the drilling strategy described here involves paired drillholes chosen so that one is located within predicted shallow water facies and a second is located downslope to obtain facies in which planktonic forms are preserved for high resolution dating.

To accomplish the sealevel objectives, eight sites have been chosen following the strategy outlined above. All sites are to be drilled to basement and form a transect from a position within the shallow facies of MP2, across the platform edge and down slope to MP3. Several sites between the two shallow phases of platform facies are designed to establish whether lowstand signals can be detected in slope sediments. If such signals can be seen, it may be possible to establish rates and amplitudes of sealevel fluctuation.

Site CS-01-A: This site is positioned near the eastern edge of the early to middle Miocene MP2 platform in order to intersect all four platform phases of MP2.

The following objectives will addressed at Site CS-01-A:

- to determine the age of each phase of platform development, particularly the initial phase of MP2 platform;
- to determine the age and duration of the unconformities separating each platform phase;
- to determine the total thickness of MP2;
- to determine the age of initial marine transgression;
- to determine the age and nature of the basement.

Site CS-02-A: This site is positioned near the eastern edge of the early to middle Miocene MP2 platform on the inner slope facies to intersect the proximal slope facies of all four platform phases of MP2. The site presents the best opportunity for the development of a high quality MP2 chronostratigraphy.

The following objectives will addressed at Site CS-02-A:

- to determine the age and facies of each phase of platform development, particularly the initial phase of MP2 platform;
- to determine the age and duration of the unconformities separating each platform phase;
- to determine the age of initial marine transgression;
- to determine the age and nature of the basement.

Site CS-03-A: This site is located to intersect the distal slope facies of both the MP2 and MP3 platforms. Site CS-02-A will enable the identification of low stand sealevel signals and provide the opportunity to measure rates of sealevel fluctuations in an environment where there should be a complete sedimentary record for the Miocene.

The following objectives will addressed at Site CS-03-A:

- to determine the complete age range for the MP2 and MP3 platforms. The record here should be complete whereas sites CS-01-A & CS-02-A will have gaps and unconformities;
- to determine the age of initial marine transgression;
- to determine the age and nature of the basement.

Site CS-04-A: This site intersects the distal slope facies of both the MP2 and MP3 platforms, and is approximately mid way between the southern edge of the shallow water phase of MP2 and the western edge of shallow water phase of MP3. The site is situated to identify sealevel lowstand signals and to provide the opportunity to measure rates of change in sealevel fluctuation in an environment where there should be a complete sedimentary record for the Miocene.

The following objectives will addressed at Site CS-04-A:

- to determine the complete age range for the MP2 and MP3 platforms. The record here should be complete whereas the record at sites CS-01-A & CS-02-A will have gaps and lost section due to unconformities.;
- to determine the age of initial marine transgression;
- to determine the age and nature of the basement.

Site CS-05-A: This site is located west of MP3 to intersect the distal slope facies of both MP3 and the condensed section equivalent to the MP3 platforms. Site CS-05-A will enable the identification of low stand sealevel signals and provide the opportunity to measure rates of sealevel fluctuations in an environment where there should be a complete sedimentary record for the Miocene. This site is approximately mid way between the southern edge of the shallow water phase of MP2 and the western edge of shallow water phase of MP3.

The following objectives will addressed at Site CS-05-A:

- to determine the age of each phase of platform development, particularly the initial phase of MP3 platform;
- to determine the age and duration of the unconformities separating each platform phase;
- to determine the age of the initial phase of MP3;
- to determine the age and nature of the condensed section equivalent to MP2;
- to determine the age and nature of the basement.

Site CS-06-A: This site is located near the western edge of the late Miocene MP3 platform and will intersect all four platform phases of MP3.

The following objectives will addressed at Site CS-06-A:

- to determine the age and facies of each phase of platform development, particularly the initial phase of MP3 platform;
- to determine the palaeowater depth of the initial phase of MP3;
- to determine the age and duration of the unconformities separating each platform phase;
- to determine the total thickness of MP3;
- to determine the age and nature of the condensed section equivalent to MP2;
- to determine the age and nature of the basement.

Site CS-07-A: This site is located near the eastern edge of the late Miocene MP3 platform to intersect all four platform phases of MP2.

The following objectives will addressed at Site CS-07-A:

- to determine the age and facies of each phase of platform development; particularly the initial phase of MP3 platform;
- to determine the palaeowater depth of the initial phase of MP3;
- to determine the age and duration of the unconformities separating each platform phase;
- to determine the total thickness of MP3;
- to determine the age and nature of the condensed section equivalent to MP2;
- to determine the age and nature of the basement.

Site CS-08-A: This site is located east of MP3 to intersect the proximal slope facies of MP3 and the condensed section equivalent to the MP2 platforms.

The following objectives will addressed at Site CS-08-A:

- to determine the age of each phase of platform development, particularly the initial phase of MP3 platform;
- to determine the age and duration of the unconformities separating each platform phase;
- to determine the age and nature of the condensed section equivalent to MP2;
- to determine the age and nature of the basement

## ODP Site Summary Form 6/93 Fill out one form for each proposed site and attach to proposal

| | |
|---|---|
| Title of Proposal: | The Coral Sea: Sea Level Variations, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | • age of each phase of platform development, particularly the initial phase of MP2 platform;<br>• age and duration of the unconformities separating each platform phase<br>• total thickness of MP2<br>• age of initial marine transgression; age and nature of the basement |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | Coral Sea-01-A: (CS-01-A) | |
| Area: | Marion Plateau, Coral Sea, NE Australia | |
| Lat./Long.: | 19°55.6S, 151° 36.2E | |
| Water Depth: | 354m | |
| Sed. Thickness: | 540 msec TWT; 684 m | |
| Total penetration: | 694 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 540 msec TWT; = 684m | 10 m |
| Lithology(ies): | 60 m ooze, 624 m dolomitized framestone; packstone | ?Palaeozoic phyllite and slate |
| Coring (check): | 1✓-2-3-APC VPC* XCB ✓ MDCB* PCS RCB ✓ DCS* Re-entry | |
| Downhole measurements: | full downhole logging suite | |

**Target(s)**:(see Appendix of Proposal Submission Guidelines6/93) A B✓ C D E F G✓ (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS deep penetration | | |
| 02 | SCS High Resolution | | |
| 03 | MCS and velocity | ✓ | watergun MCS available; high res MCS to be collected during site surveys |
| 04 | Seismic grid | | to be collected during site surveys |
| 05 | Refraction | | |
| 06 | 3.5 or 12 kHz | ✓ | both 3.5 and 12 kHz data to be collected during site surveys |
| 07 | Swath bathymetry | | |
| 08 | H.-res side-looking sonar | | |
| 09 | Photography/video | | |
| 10 | Heat flow | | |
| 11 | Magnetics/gravity | ✓ | available |
| 12 | Coring | | gravity coring to be collected during site survey |
| 13 | Rock sampling | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone Season (November - May); optimum weather time is June to October

Territorial Jurisdiction: Australia (Queensland)

Other Remarks: region drilled during Leg 133; Site is located on BMR Line 75/25 @256:1440 (Julian time)

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponents: | Dr A. R. Isern, Dept. Geology & Geophysics, University of Sydney, Sydney 2006, Australia. | ph: 612 93513998; fax 612 93510184<br>email: aisern@es.su.oz.au |
| | Dr C J Pigram, Australian Geological Survey, PO Box 378 Canberra, ACT Australia. | ph: 616 2499327; Fax: 616 2499965<br>email: cpigram@agso.gov.au |

# ODP Site Summary Form6/93 Fill out one form for each proposed site and attach to proposal

| | |
|---|---|
| Title of Proposal: | The Coral Sea: Sea Level Variations, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | • age and facies of each phase of platform development, particularly the initiation of MP2;<br>• age and duration of the unconformities separating each platform phase<br>• age of initial marine transgression<br>• age and nature of the basement |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-02-A | |
| Area: | Marion Plateau, Coral Sea, NE Australia | |
| Lat./Long.: | 19° 49.8S, 151° 54.7E | |
| Water Depth: | 363 m | |
| Sed. Thickness: | 540 msec TWT; 616 m | |
| Total penetration: | 626 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 540 msec TWT; 616 m | 10 m |
| Lithology(ies): | 160 m ooze, wackestone; 372 m wackestone<br>84 m sandstone, mudstone | ?Palaeozoic phyllite and slate |
| Coring (check): | **1✓2-3-APC** VPC* **XCB✓** MDCB* PCS **RCB✓** DCS* Re-entry | |
| Downhole measurements: | full downhole logging suite | |

**Target(s)**:(see Appendix of Proposal Submission Guidelines6/93) A **B✓** C D E F **G✓** (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS deep penetration | | |
| 02 | SCS High Resolution | | |
| 03 | MCS and velocity | ✓ | water gun MCS available; high-res MCS to be collected during site surveys |
| 04 | Seismic grid | | to be collected during site surveys |
| 05 | Refraction | | |
| 06 | 3.5 or 12 kHz | ✓ | to be collected during site surveys |
| 07 | Swath bathymetry | | |
| 08 | H.-res side-looking sonar | | |
| 09 | Photography/video | | |
| 10 | Heat flow | | |
| 11 | Magnetics/gravity | ✓ | available; additional data to be collected during site surveys |
| 12 | Coring | | gravity coring to be collected during site surveys |
| 13 | Rock sampling | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone Season (November - May); optimum weather time is June to October

Territorial Jurisdiction: Australia (Queensland)

Other Remarks: region drilled during Leg 133; site located on 75/25 @ 256:1100 (Julian time)

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponents: | Dr A. R. Isern, Dept. Geology & Geophysics,<br>University of Sydney, Sydney 2006, Australia.<br>Dr C J Pigram, Australian Geological Survey,<br>PO Box 378 Canberra, ACT Australia. | ph: 612 93513998; fax 612 93510184<br>email: aisern@es.su.oz.au<br>ph: 616 2499327; Fax: 616 2499965<br>email: cpigram@agso.gov.au |

## ODP Site Summary Form6/93 Fill out one form for each proposed site and attach to proposal

| | |
|---|---|
| Title of Proposal: | The Coral Sea: Sea Level Variations, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | • complete age range for the MP2 and MP3 platforms.<br>• age of initial marine transgression<br>• age and facies of lowstand deposits<br>• age and nature of the basement |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-03-A | |
| Area: | Marion Plateau, Coral Sea, NE Australia | |
| Lat./Long.: | 20° 48.0S, 152° 17.7E | |
| Water Depth: | 318 m | |
| Sed. Thickness: | 520 msec TWT: 590 m | |
| Total penetration: | 600 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 590 m | 10 m |
| Lithology(ies): | 230m ooze, wackestone; 260 m wackestone<br>100m sandstone, mudstone | ?Palaeozoic phyllite and slate |
| Coring (check): | **1✓-2-3-APC** VPC* **XCB ✓** MDCB* PCS **RCB ✓** DCS* Re-entry | |
| Downhole measurements: | full downhole logging suite | |

**Target(s)**:(see Appendix of Proposal Submission Guidelines6/93) A **B✓** C D E F **G✓** (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS deep penetration | | |
| 02 | SCS High Resolution | | |
| 03 | MCS and velocity | ✓ | watergun MCS available; high res MCS to be collected during site surveys |
| 04 | Seismic grid | | |
| 05 | Refraction | | |
| 06 | 3.5 or 12 kHz | ✓ | both to be collected during site surveys |
| 07 | Swath bathymetry | | |
| 08 | H.-res side-looking sonar | | |
| 09 | Photography/video | | |
| 10 | Heat flow | | |
| 11 | Magnetics/gravity | ✓ | additional mag/gravity to be collected during site surveys |
| 12 | Coring | | gravity core to be collected during site surveys |
| 13 | Rock sampling | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone Season (November - May); optimum weather time is June to October

Territorial Jurisdiction: Australia (Queensland)

Other Remarks: region drilled during Leg 133; site located on BMR line 75/64; @ 274:0200 (Julian time)

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponents: | Dr A. R. Isern, Dept. Geology & Geophysics,<br>University of Sydney, Sydney 2006, Australia.<br>Dr C J Pigram, Australian Geological Survey,<br>PO Box 378 Canberra, ACT Australia. | ph: 612 93513998; fax 612 93510184<br>email: aisern@es.su.oz.au<br>ph: 616 2499327; Fax: 616 2499965<br>email: cpigram@agso.gov.au |

# ODP Site Summary Form6/93 Fill out one form for each proposed site and attach to proposal

| | |
|---|---|
| Title of Proposal: | The Coral Sea: Sea Level Variations, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | • complete age range for the MP2 and MP3 platforms.<br>• age of initial marine transgression<br>• age and facies of lowstand deposits<br>• age and nature of the basement |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-04-A | |
| Area: | Marion Plateau, Coral Sea, NE Australia | |
| Lat./Long.: | 20° 55.7S, 152° 37.8E | |
| Water Depth: | 319 m | |
| Sed. Thickness: | 540 msec TWT: 600 m | |
| Total penetration: | 610 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 600 m | 10 m |
| Lithology(ies): | 240m ooze, wackestone; 360 m wackestone | ?Palaeozoic phyllite and slate |
| Coring (check): | **1✓-2-3-APC** VPC* **XCB ✓** MDCB* PCS **RCB ✓** DCS* Re-entry | |
| Downhole measurements: | full downhole logging suite | |

**Target(s):**(see Appendix of Proposal Submission Guidelines6/93) A **B✓** C D E F **G✓** (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS deep penetration | | |
| 02 | SCS High Resolution | | |
| 03 | MCS and velocity | ✓ | watergun MCS available; high res MCS to be collected during site surveys |
| 04 | Seismic grid | | |
| 05 | Refraction | | |
| 06 | 3.5 or 12 kHz | ✓ | both to be collected during site surveys |
| 07 | Swath bathymetry | | |
| 08 | H.-res side-looking sonar | | |
| 09 | Photography/video | | |
| 10 | Heat flow | | |
| 11 | Magnetics/gravity | ✓ | additional gravity and magnetics data to be collected during site surveys |
| 12 | Coring | | gravity core to be collected during site surveys |
| 13 | Rock sampling | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone Season (November - May); optimum weather time is June to October

Territorial Jurisdiction: Australia (Queensland)

Other Remarks: region drilled during Leg 133; site located 75/64 274:0410 (Julian time)


| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponents: | Dr A. R. Isern, Dept. Geology & Geophysics, University of Sydney, Sydney 2006, Australia. | ph: 612 93513998; fax 612 93510184<br>email: aisern@es.su.oz.au |
| | Dr C J Pigram, Australian Geological Survey, PO Box 378 Canberra, ACT Australia. | ph: 616 2499327; Fax: 616 2499965<br>email: cpigram@agso.gov.au |

# ODP Site Summary Form6/93 Fill out one form for each proposed site and attach to proposal

| | |
|---|---|
| Title of Proposal: | The Coral Sea: Sea Level Variations, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | • age of each phase of platform development, particularly the initiation of MP3;<br>• age and duration of the unconformities separating each platform phase;<br>• age and nature of the condensed section equivalent to MP2;<br>• age and nature of the basement |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-05-A | |
| Area: | Marion Plateau, Coral Sea, NE Australia | |
| Lat./Long.: | 20° 58.1S, 152° 44.6E | |
| Water Depth: | 309 M | |
| Sed. Thickness: | 530 msecs: 560 m | |
| Total penetration: | 570 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 530 msecs: 560 m | 10 m |
| Lithology(ies): | 280 m pelagic ooze; 150 m wackestone, packstone; 100 m wackestone, sandstone | ?Palaeozoic phyllite and slate |
| Coring (check): | **1✓-2-3-APC** VPC* **XCB✓** MDCB* PCS **RCB✓** DCS* Re-entry | |
| Downhole measurements: | full downhole logging suite | |

**Target(s)**:(see Appendix of Proposal Submission Guidelines6/93) A **B✓** C D E F **G✓** (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS deep penetration | | |
| 02 | SCS High Resolution | | |
| 03 | MCS and velocity | ✓ | watergun MCS available; high res MCS to be collected during site surveys |
| 04 | Seismic grid | | |
| 05 | Refraction | | |
| 06 | 3.5 or 12 kHz | ✓ | to be collected during site surveys |
| 07 | Swath bathymetry | | |
| 08 | H.-res side-looking sonar | | |
| 09 | Photography/video | | |
| 10 | Heat flow | | |
| 11 | Magnetics/gravity | ✓ | additional magnetics/gravity to be collected during site surveys |
| 12 | Coring | | gravity core to be collected during site surveys |
| 13 | Rock sampling | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone Season (November - May); optimum weather time is June to October

Territorial Jurisdiction: Australia (Queensland)

Other Remarks: region drilled during Leg 133; Site located on BMR line 75/64; 274:0700

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponents: | Dr A. R. Isern, Dept. Geology & Geophysics, University of Sydney, Sydney 2006, Australia. | ph: 612 93513998; fax 612 93510184<br>email: aisern@es.su.oz.au |
| | Dr C J Pigram, Australian Geological Survey, PO Box 378 Canberra, ACT Australia. | ph: 616 2499327; Fax: 616 2499965<br>email: cpigram@agso.gov.au |

## ODP Site Summary Form6/93 Fill out one form for each proposed site and attach to proposal

| | |
|---|---|
| Title of Proposal: | The Coral Sea: Sea Level Variations, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | • age and facies of each phase of platform development, particularly the initiation of MP3<br>• paleowater depth of the initial phase of MP3; and the total thickness of MP3<br>• age and duration of the unconformities separating each platform phase<br>• age and nature of the condensed section equivalent to MP2 and the basement |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-06-A | |
| Area: | Marion Plateau, Coral Sea, NE Australia | |
| Lat./Long.: | 20° 58.6S, 152° 46.1E | |
| Water Depth: | 293 m | |
| Sed. Thickness: | 460 msec TWT: 710 m | |
| Total penetration: | 720 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 560 msecs TWT: 710 m | 10 m |
| Lithology(ies): | 10 m pelagic ooze; 600 m of framestone, packstone, wackestone; 100 m wackestone | ?Palaeozoic phyllite and slate |
| Coring (check): | **1✓-2-3-APC** VPC* **XCB✓** MDCB* PCS **RCB✓** DCS* Re-entry | |
| Downhole measurements: | full downhole logging suite | |

**Target(s)**:(see Appendix of Proposal Submission Guidelines6/93) A **B✓** C D E F **G✓** (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS deep penetration | | |
| 02 | SCS High Resolution | | |
| 03 | MCS and velocity | ✓ | watergun MCS available; high res MCS to be collected during site surveys |
| 04 | Seismic grid | | |
| 05 | Refraction | | |
| 06 | 3.5 or 12 kHz | ✓ | both to be collected during site surveys |
| 07 | Swath bathymetry | | |
| 08 | H.-res side-looking sonar | | |
| 09 | Photography/video | | |
| 10 | Heat flow | | |
| 11 | Magnetics/gravity | ✓ | additional magnetics/gravity to be collected during site surveys |
| 12 | Coring | | gravity core to be collected during site surveys |
| 13 | Rock sampling | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone Season (November - May); optimum weather time is June to October
Territorial Jurisdiction: Australia (Queensland)
Other Remarks: region drilled during Leg 133; site located on BMR line 75/64; 274:0720 (Julian time)

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponents: | Dr A. R. Isern, Dept. Geology & Geophysics, University of Sydney, Sydney 2006, Australia. | ph: 612 93513998; fax 612 93510184<br>email: aisern@es.su.oz.au |
| | Dr C J Pigram, Australian Geological Survey, PO Box 378 Canberra, ACT Australia. | ph: 616 2499327; Fax: 616 2499965<br>email: cpigram@agso.gov.au |

# ODP Site Summary Form6/93 Fill out one form for each proposed site and attach to proposal

| | |
|---|---|
| Title of Proposal: | The Coral Sea: Sea Level Variations, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | • age and facies of each phase of platform development, particularly the initiation of MP3<br>• paleowater depth of the initial phase of MP3 and the total thickness of MP3<br>• age and duration of the unconformities separating each platform phase<br>• age and nature of the condensed section equivalent to MP2 and basement |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-07-A | |
| Area: | Marion Plateau, Coral Sea, NE Australia | |
| Lat./Long.: | 21° 03.7S, 153° 01.6E | |
| Water Depth: | 326 m | |
| Sed. Thickness: | 500 msec TWT: 600 m | |
| Total penetration: | 610 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 500 msec TWT: 600 m | 10 m |
| Lithology(ies): | 45 m pelagic ooze; 455 m of framestone, packstone, wackestone; 100 m wackestone | ?Palaeozoic phyllite/slate |
| Coring (check): | **1✓-2-3-APC** VPC* **XCB✓** MDCB* PCS **RCB✓** DCS* Re-entry | |
| Downhole measurements: | full downhole logging suite | |

**Target(s):**(see Appendix of Proposal Submission Guidelines6/93) A **B✓** C D E F **G✓** (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS deep penetration | | |
| 02 | SCS High Resolution | | |
| 03 | MCS and velocity | ✓ | watergun MCS available; high res MCS to be collected during site surveys |
| 04 | Seismic grid | | |
| 05 | Refraction | | |
| 06 | 3.5 or 12 kHz | ✓ | both to be collected during site surveys |
| 07 | Swath bathymetry | | |
| 08 | H.-res side-looking sonar | | |
| 09 | Photography/video | | |
| 10 | Heat flow | | |
| 11 | Magnetics/gravity | ✓ | additional magnetics/gravity to be collected during site surveys |
| 12 | Coring | | gravity core to be collected during site surveys |
| 13 | Rock sampling | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone Season (November - May); optimum weather time is June to October

Territorial Jurisdiction: Australia (Queensland)

Other Remarks: region drilled during Leg 133; site located on BMR line 75/64; 274:1000 (Julian time)

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponents: | Dr A. R. Isern, Dept. Geology & Geophysics, University of Sydney, Sydney 2006, Australia. | ph: 612 93513998; fax 612 93510184<br>email: aisern@es.su.oz.au |
| | Dr C J Pigram, Australian Geological Survey, PO Box 378 Canberra, ACT Australia. | ph: 616 2499327; Fax: 616 2499965<br>email: cpigram@agso.gov.au |

## ODP Site Summary Form6/93 Fill out one form for each proposed site and attach to proposal

| | |
|---|---|
| Title of Proposal: | The Coral Sea: Sea Level Variations, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | • age of each phase of platform development, particularly the initiation of MP3<br>• paleowater depth of the initial phase of MP3;<br>• duration of the unconformities separating each platform phase;<br>• age and nature of the condensed section equivalent to MP2 and basement |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-08-A | |
| Area: | Marion Plateau, Coral Sea, NE Australia | |
| Lat./Long.: | 21° 04..3S, 153° 03.2E | |
| Water Depth: | 326 m | |
| Sed. Thickness: | 560 msec TWT: 570 m | |
| Total penetration: | 580 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 560 msec TWT : 570 m | 10 m |
| Lithology(ies): | 70 m pelagic ooze; 400 m wackestone, packstone; 100 m wackestone, sandstone | ?Palaeozoic phyllite, slate |
| Coring (check): | **1✓2-3-APC** VPC* **XCB✓** MDCB* PCS **RCB✓** DCS* Re-entry | |
| Downhole measurements: | full downhole logging suite | |

**Target(s)**:(see Appendix of Proposal Submission Guidelines6/93) A **B✓** C D E F **G✓** (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS deep penetration | | |
| 02 | SCS High Resolution | | |
| 03 | MCS and velocity | ✓ | watergun MCS available; high res MCS to be collected during site surveys |
| 04 | Seismic grid | | |
| 05 | Refraction | | |
| 06 | 3.5 or 12 kHz | ✓ | both to be collected during site surveys |
| 07 | Swath bathymetry | | |
| 08 | H.-res side-looking sonar | | |
| 09 | Photography/video | | |
| 10 | Heat flow | | |
| 11 | Magnetics/gravity | ✓ | additional magnetics/gravity data to be collected during site surveys |
| 12 | Coring | | gravity cores to be collected during site surveys |
| 13 | Rock sampling | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone Season (November - May); optimum weather time is June to October

Territorial Jurisdiction: Australia (Queensland)

Other Remarks: region drilled during Leg 133; site located on BMR line 75/64 274:1020

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponents: | Dr A. R. Isern, Dept. Geology & Geophysics, University of Sydney, Sydney 2006, Australia. | ph: 612 93513998; fax 612 93510184<br>email: aisern@es.su.oz.au |
| | Dr C. J. Pigram, Australian Geological Survey, PO Box 378 Canberra, ACT Australia. | ph: 616 2499327; Fax: 616 2499965<br>email: cpigram@agso.gov.au |

## 6.2. Drilling strategy for paleoceanographic objectives

### 6.2.1. Eastern Plateau

Drillsites on the Eastern Plateau provide an opportunity to investigate the changes in both surface and intermediate water circulation which have occurred in the Coral Sea as a result of the northward movement of the Indo-Australian Plate. These sites will also provide information on how circulation changes have affected tropical carbonate production (both reefal and non-reefal) in the area.

The Eastern Plateau is the northernmost marginal plateau occurring in the western Coral Sea (Fig. 1). The surface of Eastern Plateau has an average depth of 1500 m with a gently convex shape (Davies et al., 1989). There is one site of active reef growth, Eastern Fields Reef, on the northern margin of the Plateau, with submerged and buried reefs extending northeast from this area into the Moresby Trough. As the plateau is surrounded by troughs, it is generally free of terrigenous sediments. The northern and southern margins of the plateau are controlled by normal faults and the western margin has a complex structure which may involve thrust faulting (Davies et al., 1989). The plateau is underlain by a complex series of tilt blocks, some of which have undergone complex deformation believed to have occurred in the late Oligocene and Miocene during the development of the New Guinea orogen to the north (Pigram and Davies, 1989). Sediments on the Eastern Plateau are a mix of Miocene to Recent calcareous ooze and periplatform detritus (Taylor, 1977) (Fig. 12).

Site CS-09-A: This site is located near the southern margin of the plateau away from active areas of reef growth, to minimize the effect of reefal detritus from Eastern Fields Reef and thus reduce the diagenetic potential of the sediment (Figs. 9 and 13).

The following objectives will addressed at Site CS-09-A:

- to determine the variations in surface and intermediate water circulation near Torres Strait resulting from northward movement of the Indo-Australian Plate;
- to determine the environmental changes as a result of northward movement of the Indo-Australian Plate;

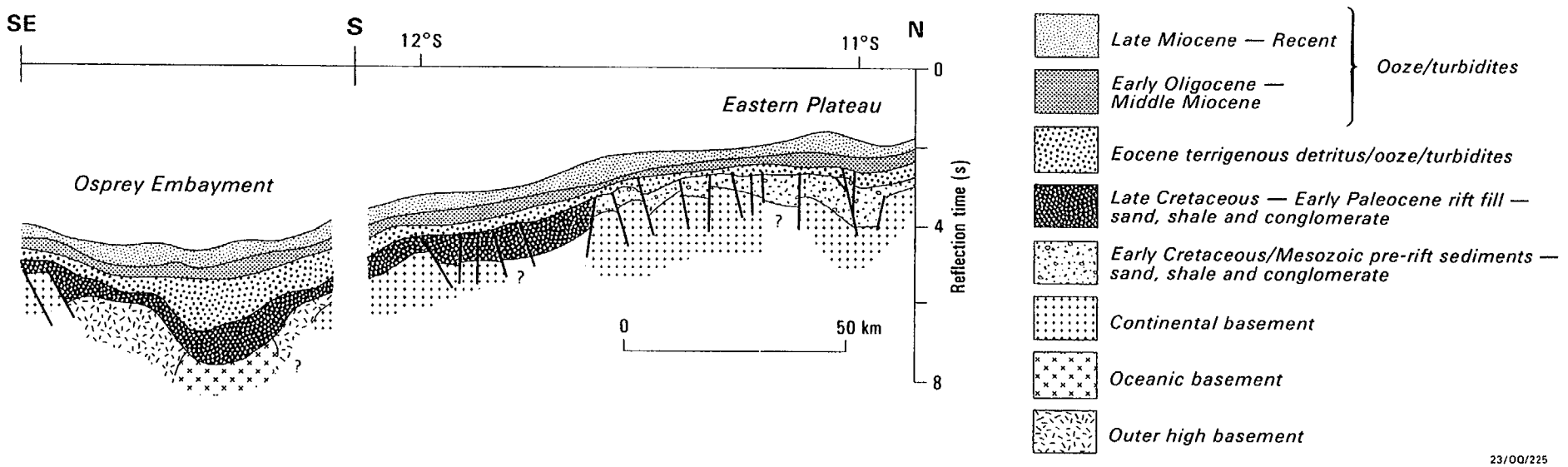


**Figure 12** Schematic section showing the generalized structure and sedimentary sequences beneath the northeast Osprey Embayment and southern Eastern Plateau (Symonds et al., 1991).

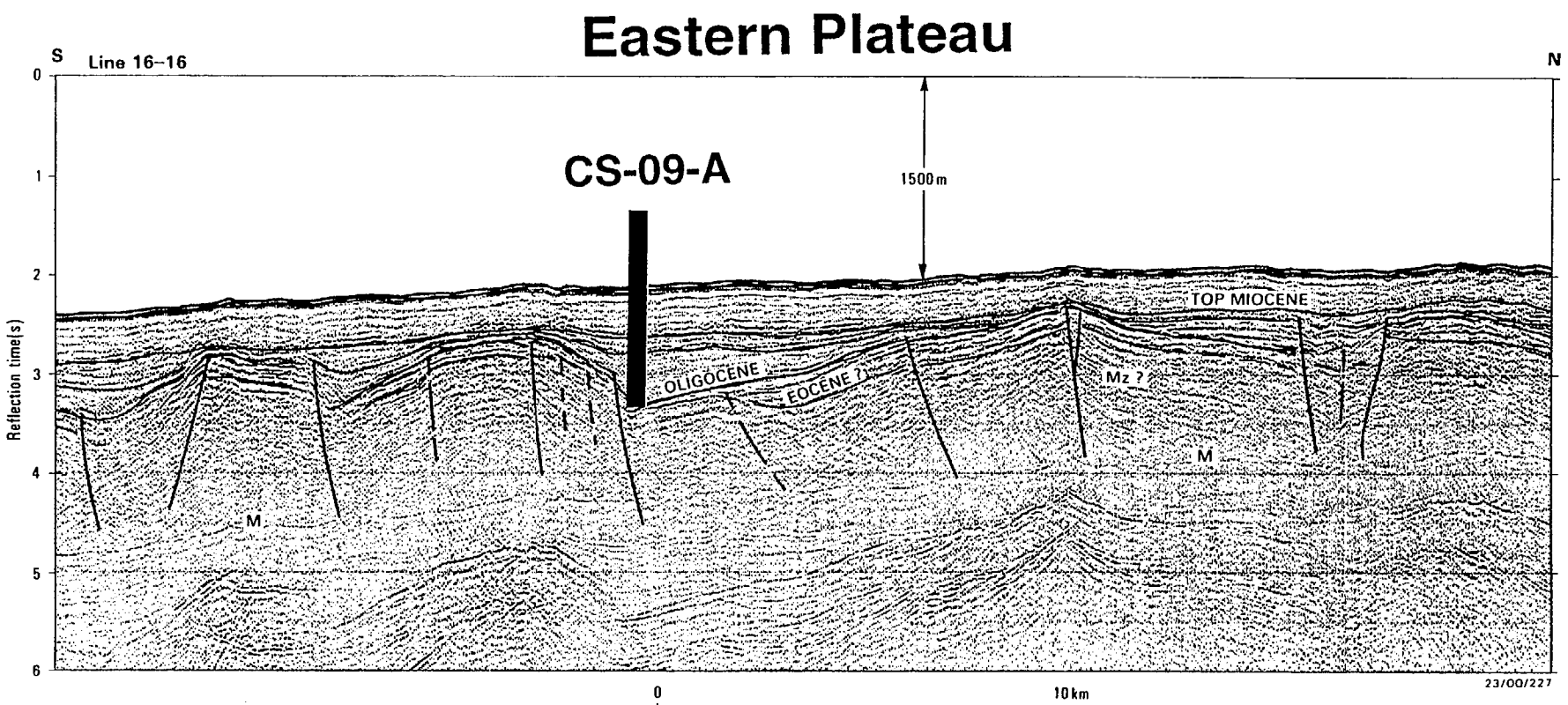


**Figure 13** Interpreted SONNE seismic line 16-16 across the southern Eastern Plateau with the location of Site CS-09-A shown.

- to determine the variations in the temperature and size of the western Pacific warm water pool;
- to determine the temporal development of the Northwest Monsoon.

Site CS-10-A: This site is located proximal to the Eastern Fields Reef pinnacle.

The following objectives will addressed at Site CS-10-A (Figs. 9 and 14):

- to determine the changes in carbonate production as a result of changing environmental conditions and circulation patterns in the western Coral Sea;
- to determine the effects of sealevel variations on carbonate production;
- to determine the temporal development of the Northwest Monsoon.

Many of the specific objectives which are targeted at CS-09-A will also be viewed at this site, but it is likely that increased bank-derived carbonate in the sediment at Site CS-10-A may hinder paleoceanographic reconstructions in some intervals. Despite this, Sites CS-09-A and CS-10-A together will provide information which will be used to reconstruct paleoceanographic variations in the northwest Coral Sea and enable these changes to be correlated to their impacts on carbonate bank production.

### 6.2.2. Louisiade Plateau

There is little detailed information available about the Louisiade Plateau despite its ideal location to observe low latitude paleoceanographic variations. The plateau lies in water depths of approximately 1700 m at a latitude of 12.5°-13.5°S and a longitude of 155.5°-157°E), and there is approximately 510 m of pelagic sediment overlying the platform surface (Figs. 10 and 15).

Site CS-11-A:

The following objectives will addressed at Site CS-11-A:

- to determine the variations in surface and intermediate water circulation resulting from northward movement of the Indo-Australian Plate;
- to determine the environmental changes as a result of northward movement of the Indo-Australian Plate;

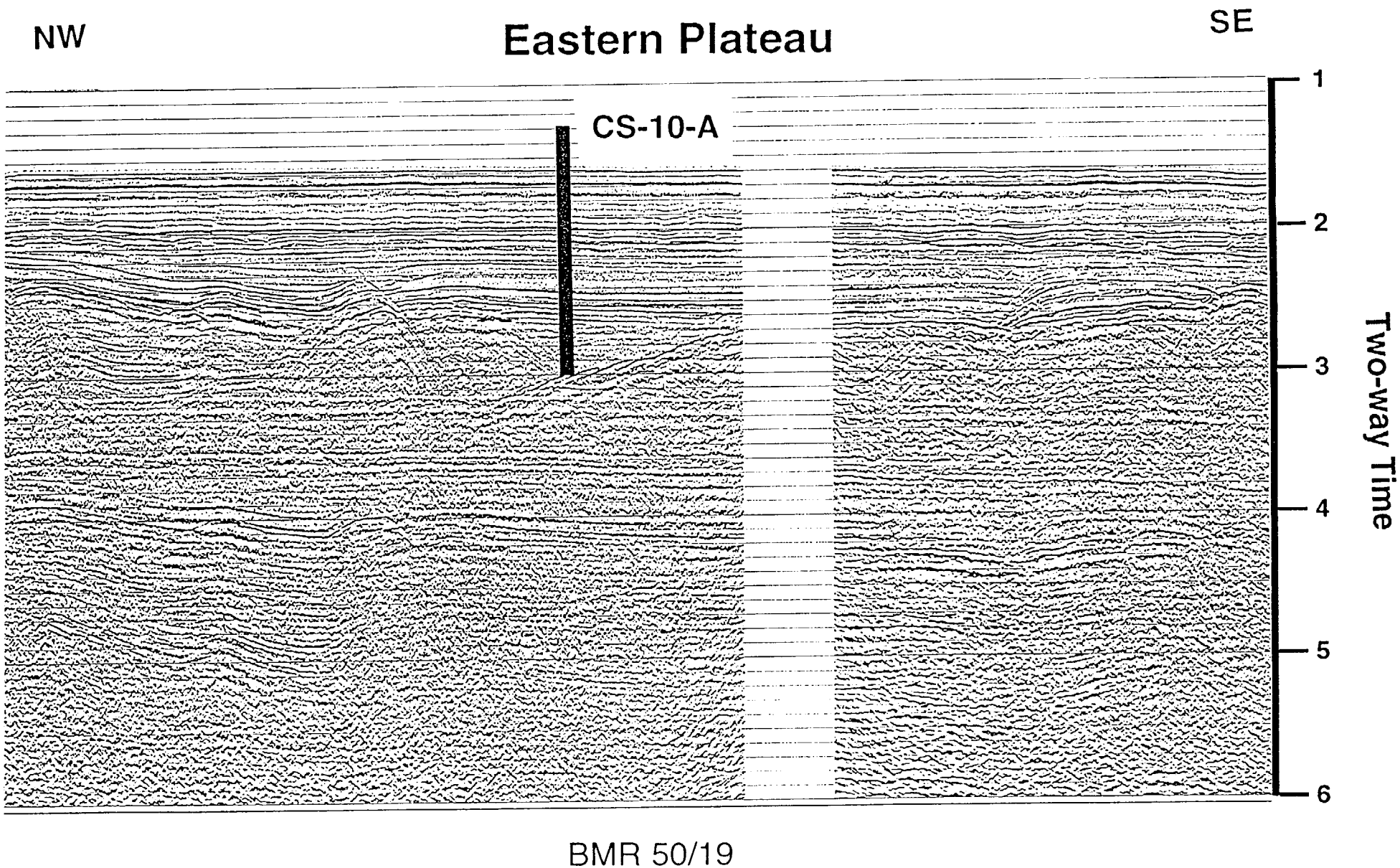


**Figure 14** BMR seismic line 50/019 from northwest to southeast across the Eastern Plateau with the location of Site CS-10-A shown.

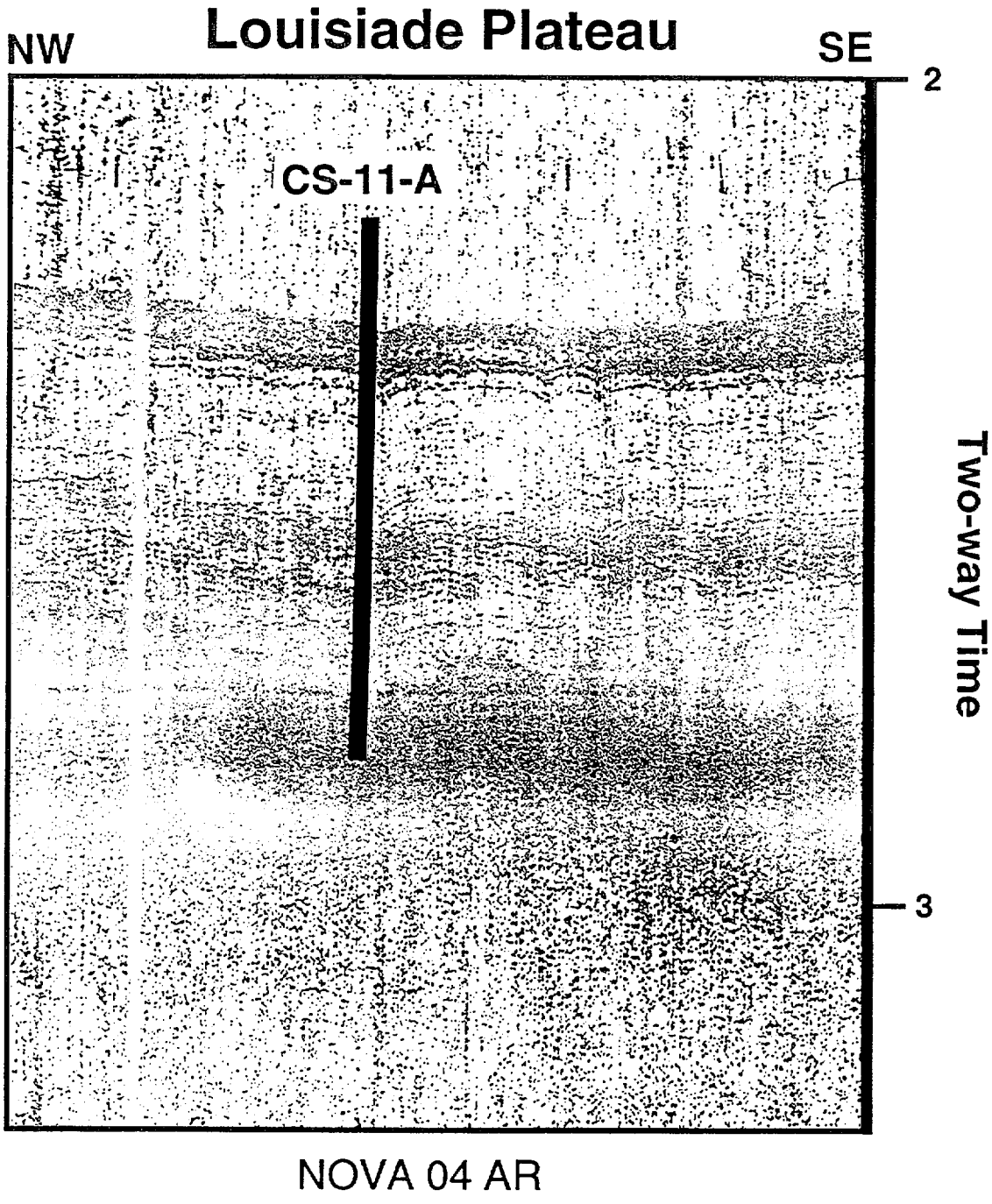


**Figure 15** NOVA04AR seismic line across the Louisiade Plateau with the location of Site CS-11-A shown.

- to determine the development history of the warm pool in the Coral Sea;
- to provide a low latitude record of paleoceanographic variations;
- to continue the DSDP Leg 90 longitudinal transect northward as close as possible to drillsites sites on the Ontong Java Plateau.

### 6.2.3. Mellish Plateau

The Mellish Plateau (also known as the Mellish Rise) is a series of small drowned carbonate platforms existing on a larger elevated basement structure. There has been no sediment sampling in the area, but because of the surrounding plateaus, the sediments are likely to be a combination of pelagic and periplatform oozes of varying thickness, with the pelagic component of the sediment increasing over time as sediment production from the carbonate platforms decreases (Figs. 11 and 16).

Site CS-12-A: This site is located on the eastern edge of the plateau away from the active areas of reef growth.

The following objectives will addressed at Site CS-12-A:

- to determine the variations in surface and intermediate water circulation resulting from northward movement of the Indo-Australian Plate;
- to determine environmental changes resulting from northward movement of the Indo-Australian Plate at a site presently in the tropics/sub-tropics;
- to determine the development history of the warm pool in the Coral Sea;
- to determine the changes in carbonate production as a result of changing environmental conditions and circulation patterns in the Coral Sea;
- to continue the DSDP Leg 90 longitudinal transect northward.

### 6.2.4. Queensland Plateau

The Queensland Plateau has an areal extent of 165,000 $km^2$. One half lies above 1000m water depth, and 10-15% supports modern reef growth, the largest modern reef complex occurs on the southern margin (Tregrosse and Lihou Reefs; Fig. 1) (Davies et al., 1989). The metasedimentary basement is composed of fault blocks that form a surface which dips to the northeast towards the Coral Sea basin (Mutter, 1977; Taylor, 1977) (Figs. 7 and 17).

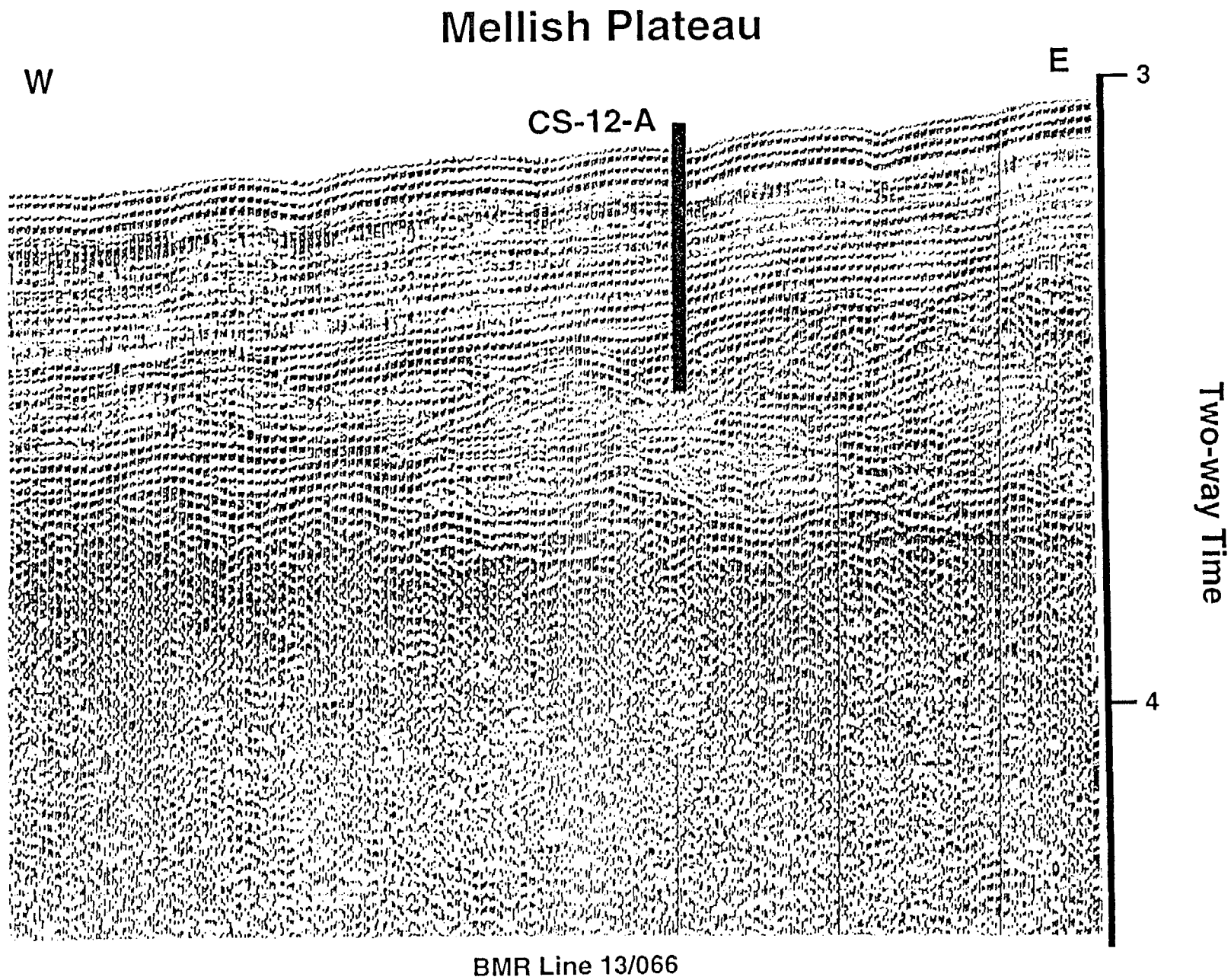


**Figure 16** BMR seismic line 13/066 from west to east across a portion of the Mellish Plateau with the location of Site CS-12-A shown.

# Queensland Plateau

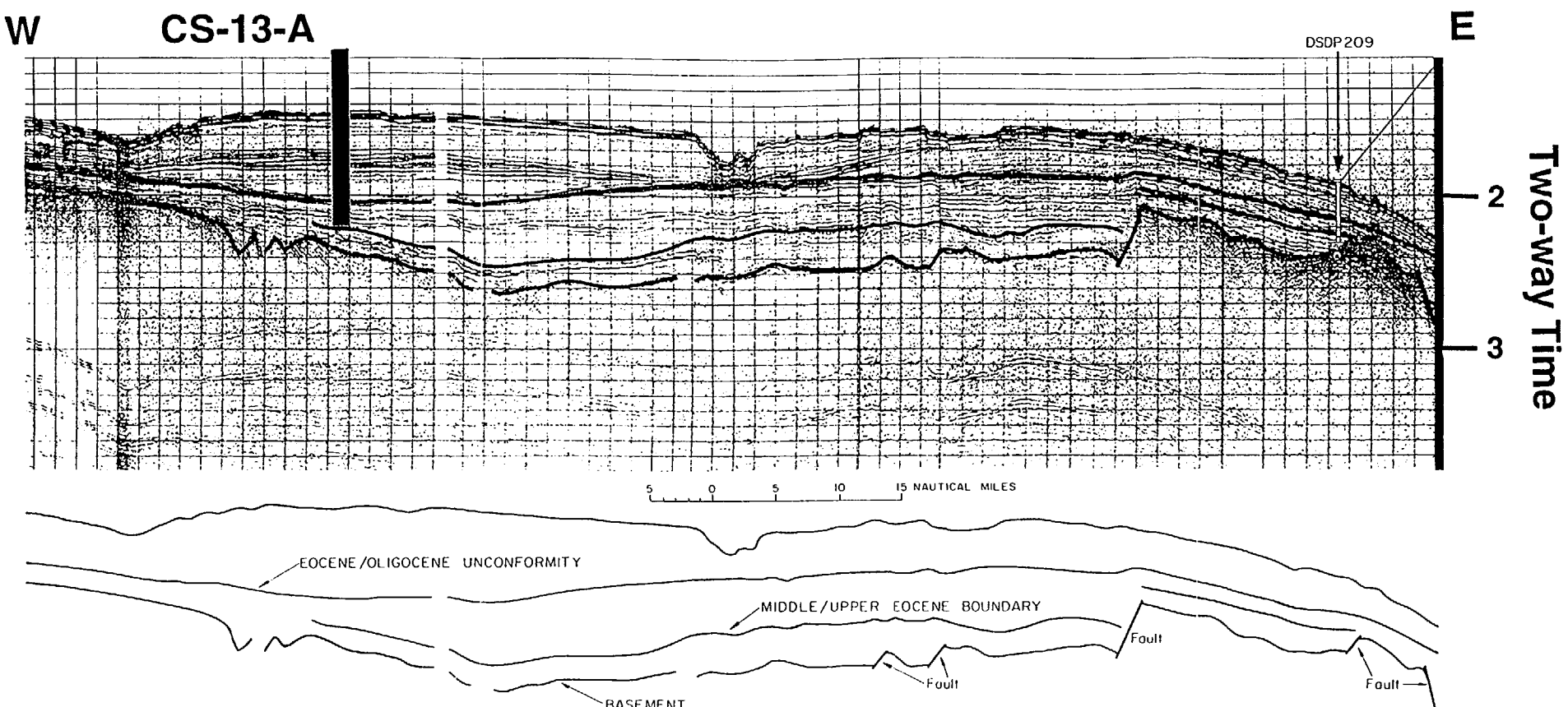


**Figure 17** Interpreted BMR seismic line 14/038 showing a west to east line on the Queensland Plateau across a sediment drift to DSDP Site 209. The location of Site CS-13-A is shown.

Site CS-13-A: This site is positioned on a sediment drift northeast of DSDP Site 209 on the western side of the Plateau (Fig. 17). This thick layer of sediment has presumably resulted from the flow of Antarctic Intermediate Water around the shallower portions of the Plateau. Site 209 sampled the thinner distal part of the drift (Fig. 17), but we propose to drill to the NE where the sequence is approximately 500 m thicker. Sediments recovered from Site 209 are mainly foraminifer and nannofossil oozes (Burns, Andrews, et al., 1973) with excellent microfossil preservation (Isern et al., 1993), as the site is away from areas of reef growth and therefore has only minor amounts of metastable carbonate. This will be a great advantage for paleoceanographic reconstructions, compared with many of the Leg 133 sites which had moderate to large amounts of metastable carbonate.

The following objectives will addressed at Site CS-13-A:

- to determine the variations in surface and intermediate water circulation resulting from northward movement of the Indo-Australian Plate;
- to determine the environmental changes as a result of northward movement of the Indo-Australian Plate;
- to determine the development history of the warm pool in the Coral Sea;
- to determine the changes in carbonate production as a result of changing environmental conditions and circulation patterns in the Coral Sea;
- to continue the DSDP Leg 90 longitudinal transect northward.

# ODP Site Summary Form6/93

| | |
|---|---|
| Title of Proposal: | ODP Drilling in the Coral Sea: Sea Level Variation, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | To penetrate Oligocene to Recent oozes in order to determine variations in circulation and sea surface temperature associated with climate change and plate movement |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-09-A | |
| Area: | Southern part of the Eastern Plateau | |
| Lat./Long.: | 11°41' S; 145°24' E | |
| Water Depth: | 1500 m | |
| Sed. Thickness: | 1.33 sec. TWT; ~1463 m | |
| Total penetration: | 1 sec. TWT; ~1100 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 1 sec. TWT; ~1100 m | None |
| Lithology(ies): | Pelagic ooze with some periplatform sediment | |
| Coring (check): | 1-**2√**-3-**APC√** VPC* **XCB√** MDCB* PCS RCB DCS* Re-entry | |
| Downhole measurements: | Full logging | |

*Systems currently under development

**Target(s)** :(see Appendix of Proposal Submission Guidelines6/93) **A√** B C D E F **G√** (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS deep penetration | | |
| 02 | SCS High Resolution | | |
| 03 | MCS and velocity | √ | BMR (1985) and BGR (SONNE; 1980); additional data to be collected during site surveys |
| 04 | Seismic grid | | |
| 05 | Refraction | | |
| 06 | 3.5 or 12 kHz | √ | Some data is available now; more will be collected during site surveys |
| 07 | Swath bathymetry | | |
| 08 | H.-res side-looking sonar | | |
| 09 | Photography/video | | |
| 10 | Heat flow | | |
| 11 | Magnetics/gravity | √ | Some data is available from BMR (AGSO) and BGR; additional will be collected during site surveys |
| 12 | Coring | | Cores will be collected during site surveys |
| 13 | Rock sampling | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: No problems

Territorial Jurisdiction: Papua New Guinea

Other Remarks: Site is located on seismic line SONNE 16-16; 1030

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponent: | Dr. Alexandra Isern<br>Department of Geology and Geophysics<br>University of Sydney<br>Sydney, NSW 2006, Australia | ph: 61-2-9351-3998<br>fax: 61-2-9351-0184<br>email: aisern@es.su.oz.au |

# ODP Site Summary Form6/93

| | |
|---|---|
| Title of Proposal: | ODP Drilling in the Coral Sea: Sea Level Variation, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | To penetrate Oligocene to Recent sediments in order to determine paleoceanographic variations and their effects on carbonate production on Eastern Fields Reef |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-10-A | |
| Area: | Eastern Plateau near reef pinnacle | |
| Lat./Long.: | 10°49' S; 145°18' E | |
| Water Depth: | 1200 m | |
| Sed. Thickness: | 1.5 sec. TWT; ~1650 m | |
| Total penetration: | 0.89 sec. TWT; ~979 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 0.89 sec. TWT; ~979 m | None |
| Lithology(ies): | Pelagic and periplatform ooze | |
| Coring (check): | 1-2√-3-APC√ VPC* XCB√ MDCB* PCS RCB DCS* Re-entry | |
| Downhole measurements: | Full logging with FMS | |

*Systems currently under development

**Target(s)** :(see Appendix of Proposal Submission Guidelines6/93) A√ B C D E F G√ (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS deep penetration | | |
| 02 | SCS High Resolution | | |
| 03 | MCS and velocity | √ | BMR (1985) and BGR (SONNE; 1980); additional data to be collected during site surveys |
| 04 | Seismic grid | | |
| 05 | Refraction | | |
| 06 | 3.5 or 12 kHz | √ | Some data is available now; more will be collected during site surveys |
| 07 | Swath bathymetry | | |
| 08 | H.-res side-looking sonar | | |
| 09 | Photography/video | | |
| 10 | Heat flow | | |
| 11 | Magnetics/gravity | √ | Some data is available from BMR (AGSO) and BGR; additional will be collected during site surveys |
| 12 | Coring | | Sediment cores will be collected during site surveys |
| 13 | Rock sampling | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: No problems

Territorial Jurisdiction: Papua New Guinea

Other Remarks: Site is located on BMR seismic line 50/019; 281:1330 (Julian time)

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponent: | Dr. Alexandra Isern<br>Department of Geology and Geophysics<br>University of Sydney<br>Sydney, NSW 2006, Australia | ph: 61-2-9351-3998<br>fax: 61-2-9351-0184<br>email: aisern@es.su.oz.au |

# ODP Site Summary Form6/93

| | |
|---|---|
| Title of Proposal: | ODP Drilling in the Coral Sea: Sea Level Variation, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | To penetrate the pelagic oozes overlying the Louisiade Plateau and provide a record of paleoceanographic variations in the low latitude Coral Sea |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-11-A | |
| Area: | Louisiade Plateau | |
| Lat./Long.: | 12°40' S; 155°44' E. | |
| Water Depth: | 1780 m | |
| Sed. Thickness: | 0.46 sec. TWT; ~510 m | |
| Total penetration: | 0.36 sec. TWT; ~400 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 0.36 sec. TWT; ~400 m | None |
| Lithology(ies): | Pelagic ooze | |
| Coring (check): | 1-2√-3-APC√ VPC* XCB√ MDCB* PCS RCB DCS* Re-entry | |
| Downhole measurements: | Full logging | |

*Systems currently under development

**Target(s)** :(see Appendix of Proposal Submission Guidelines6/93) A√ B C D E F G√ (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS deep penetration | √ | Limited data available; more data will be collected during site surveys |
| 02 | SCS High Resolution | | |
| 03 | MCS and velocity | | |
| 04 | Seismic grid | | |
| 05 | Refraction | | |
| 06 | 3.5 or 12 kHz | √ | Some data is available; more will be collected during site surveys |
| 07 | Swath bathymetry | | |
| 08 | H.-res side-looking sonar | | |
| 09 | Photography/video | | |
| 10 | Heat flow | | |
| 11 | Magnetics/gravity | | Data will be collected during site surveys |
| 12 | Coring | | Sediment cores will be collected during site surveys |
| 13 | Rock sampling | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone season (November to May)

Territorial Jurisdiction: Papua New Guinea

Other Remarks: Site is located on seismic line NOVA14AR; 23 July, 0130

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponent: | Dr. Alexandra Isern<br>Department of Geology and Geophysics<br>University of Sydney<br>Sydney, NSW 2006, Australia | ph: 61-2-9351-3998<br>fax: 61-2-9351-0184<br>email: aisern@es.su.oz.au |

# ODP Site Summary Form6/93

| | |
|---|---|
| Title of Proposal: | ODP Drilling in the Coral Sea: Sea Level Variation, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | To penetrate pelagic oozes on the Mellish plateau and provide a record of paleoceanographic change in the Coral Sea at sub-tropical/tropical latitudes |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-12-A | |
| Area: | Mellish Plateau | |
| Lat./Long.: | 17°49 S; 156°19' E | |
| Water Depth: | 2330 m | |
| Sed. Thickness: | 0.39 sec. TWT; ~425 m | |
| Total penetration: | 0.30 sec. TWT; ~326 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 0.30 sec. TWT; ~326 m | None |
| Lithology(ies): | Pelagic ooze | |
| Coring (check): | 1-2√-3-APC√ VPC* XCB√ MDCB* PCS RCB DCS* Re-entry | |
| Downhole measurements: | Full logging | |

*Systems currently under development

**Target(s)** :(see Appendix of Proposal Submission Guidelines6/93) A√ B C D E F G√ (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS deep penetration | √ | Limited data available; more data will be collected during site surveys |
| 02 | SCS High Resolution | | |
| 03 | MCS and velocity | | |
| 04 | Seismic grid | | |
| 05 | Refraction | | |
| 06 | 3.5 or 12 kHz | √ | Some data is available; more will be collected during site surveys |
| 07 | Swath bathymetry | | |
| 08 | H.-res side-looking sonar | | |
| 09 | Photography/video | | |
| 10 | Heat flow | | |
| 11 | Magnetics/gravity | | Data will be collected during site surveys |
| 12 | Coring | | Sediment cores will be collected during site surveys |
| 13 | Rock sampling | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone season (November to May)

Territorial Jurisdiction: Australia

Other Remarks: Site is located on BMR seismic line 13/066; 17:2120 (Julian time)

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponent: | Dr. Alexandra Isern<br>Department of Geology and Geophysics<br>University of Sydney<br>Sydney, NSW 2006, Australia | ph: 61-2-9351-3998<br>fax: 61-2-9351-0184<br>email: aisern@es.su.oz.au |

# ODP Site Summary Form 6/93

| | |
|---|---|
| Title of Proposal: | ODP Drilling in the Coral Sea: Sea Level Variation, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | To penetrate Oligocene to Recent pelagic oozes on the eastern Queensland Plateau in order to provide a record of paleoceanographic change in the western Coral Sea |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-13-A | |
| Area: | Eastern Queensland Plateau | |
| Lat./Long.: | 15°42'36" S 151°07'30" E | |
| Water Depth: | 975 m | |
| Sed. Thickness: | 0.93 sec TWT; ~1027 m | |
| Total penetration: | 0.6 sec TWT; ~660 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 0.6 sec TWT; ~660 m | None |
| Lithology(ies): | Pelagic ooze | |
| Coring (check): | 1-2√-3-APC√ VPC* XCB√ MDCB* PCS RCB DCS* Re-entry | |
| Downhole measurements: | Full logging | |

*Systems currently under development

**Target(s)** :(see Appendix of Proposal Submission Guidelines6/93) A√ B C D E F G√ (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines 6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS High Resolution | | |
| 02 | MCS and velocity | √ | BMR (1985) data is available; additional data will be collected during site surveys |
| 03 | Seismic grid | | |
| 04 | Refraction | | |
| 05 | 3.5 or 12 kHz | √ | Some data is available now; more will be collected during site surveys |
| 06 | Swath bathymetry | | |
| 07 | H.-res side-looking sonar | | |
| 08 | Photography/video | | |
| 09 | Heat flow | | |
| 10 | Magnetics/gravity | √ | Some data is available from BMR (AGSO); additional will be collected during site surveys |
| 11 | Coring | | Cores will be collected during site surveys |
| 12 | Rock sampling | | |
| 13 | Current meter | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone season (November to May)

Territorial Jurisdiction: Australia

Other Remarks: Site is located on BMR seismic line 14/038

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponent: | Dr. Alexandra Isern<br>Department of Geology and Geophysics<br>University of Sydney<br>Sydney, NSW 2006, Australia | ph: 61-2-9351-3998<br>fax: 61-2-9351-0184<br>email: aisern@es.su.oz.au |

### 6.3. Drilling strategy for fluid flow objectives

Although previous studies have demonstrated the presence of fluid flow within the Queensland Plateau (Leg 133; Elderfield et al., 1993), the information collected did not allow any estimate of the extent of the flow or the driving mechanism. To complete this objective, we plan to use the following approach:

- To drill a transect of holes across the eastern Queesnsland Plateau carbonate platform
- High resolution heatflow measurements will also be measured using the ADARA tool at a spacing of one every core over the upper 100 m of the holes.
- High resolution pore fluid geochemistry (one sample every core) on sediment samples will be used to:
  - trace the fluid source, pathway and residence times of fluids within the platform
  - determine the relationship between pore fluids and sedimentary diagenesis
- Petrographic and geochemical analyses of retrieved sediments will be used to:
  - determine the original mineralogy, texture, and composition of the sediments
  - enable the determination of temporal variations in diagenetic patterns

The following two sites will be drilled in a transect to the southeast off the southern margin of the Queensland Plateau to study fluid movement through the carbonate plateau using the methods proposed above. Both sites have similar drilling objectives, and the achievement of the overall fluid flow objectives will depend on correlation between the sites.

Site CS-14-A: The site is positioned in on the upper slope of the platform south of Tregrosse and Lihou Reefs (Figs. 1 and 7).

Site CS-15-A: The site is positioned deeper on the platform slope southeast of CS-14-A on the southern margin of the Queensland Plateau south of Tregrosse and Lihou Reefs (Figs. 1 and 7).

An added benefit of the location chosen for the drilling transect is that it will allow for a better understanding of the controls on carbonate platform development in the western Coral Sea as the sediments will record variations in reefal shedding in a location near reefs which have most likely been active since the middle Miocene.

Site CS-16-A: The site is positioned on the Queensland Plateau near the location of Site 812 drilled during Leg 133. The purpose of this hole is to study fluid movement at a site where it was previously documented utilizing a CORK borehole assembly. With the CORK we propose to monitor geothermal gradients, sediment physical properties, and chemical gradients over a long time period.

# ODP Site Summary Form6/93

| | |
|---|---|
| Title of Proposal: | ODP Drilling in the Coral Sea: Sea Level Variation, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | To study fluid movement through the Queensland Plateau |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-14-A | |
| Area: | Southeastern Queensland Plateau | |
| Lat./Long.: | 17°46' S; 151°28' E | |
| Water Depth: | 575 m | |
| Sed. Thickness: | ~800 m | |
| Total penetration: | 350 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 350 m | None |
| Lithology(ies): | Pelagic and periplatform ooze | |
| Coring (check): | 1-2√-3-APC√ VPC* XCB√ MDCB* PCS RCB DCS* Re-entry | |
| Downhole measurements: | High resolution ADARA measurements | |

*Systems currently under development

**Target(s)** :(see Appendix of Proposal Submission Guidelines6/93) A√ B C D E F G√ (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS High Resolution | | |
| 02 | MCS and velocity | √ | BMR (1985) data is available; additional data will be collected during site surveys |
| 03 | Seismic grid | | |
| 04 | Refraction | | |
| 05 | 3.5 or 12 kHz | √ | Some data is available now; more will be collected during site surveys |
| 06 | Swath bathymetry | | |
| 07 | H.-res side-looking sonar | | |
| 08 | Photography/video | | |
| 09 | Heat flow | | |
| 10 | Magnetics/gravity | √ | Some data is available from BMR (AGSO); additional will be collected during site surveys |
| 11 | Coring | | Cores will be collected during site surveys |
| 12 | Rock sampling | | |
| 13 | Current meter | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone season (November to May)

Territorial Jurisdiction: Australia

Other Remarks: Site is located on BMR seismic line 14/003

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponent: | Dr. Alexandra Isern<br>Department of Geology and Geophysics<br>University of Sydney<br>Sydney, NSW 2006, Australia | ph: 61-2-9351-3998<br>fax: 61-2-9351-0184<br>email: aisern@es.su.oz.au |

# ODP Site Summary Form6/93

| | |
|---|---|
| Title of Proposal: | ODP Drilling in the Coral Sea: Sea Level Variation, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | To study fluid movement through the Queensland Plateau |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-15-A | |
| Area: | Southeastern Queensland Plateau | |
| Lat./Long.: | 17°53' S; 151°35' E | |
| Water Depth: | 700 m | |
| Sed. Thickness: | ~1000 m | |
| Total penetration: | 350 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 350 m | None |
| Lithology(ies): | Pelagic and periplatform ooze | |
| Coring (check): | 1-2√-3-APC√ VPC* XCB√ MDCB* PCS RCB DCS* Re-entry | |
| Downhole measurements: | High resolution ADARA measurements | |

*Systems currently under development

**Target(s)** :(see Appendix of Proposal Submission Guidelines6/93) A√ B C D E F G√ (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS High Resolution | | |
| 02 | MCS and velocity | √ | BMR (1985) data is available; additional data will be collected during site surveys |
| 03 | Seismic grid | | |
| 04 | Refraction | | |
| 05 | 3.5 or 12 kHz | √ | Some data is available now; more will be collected during site surveys |
| 06 | Swath bathymetry | | |
| 07 | H.-res side-looking sonar | | |
| 08 | Photography/video | | |
| 09 | Heat flow | | |
| 10 | Magnetics/gravity | √ | Some data is available from BMR (AGSO); additional will be collected during site surveys |
| 11 | Coring | | Cores will be collected during site surveys |
| 12 | Rock sampling | | |
| 13 | Current meter | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone season (November to May)

Territorial Jurisdiction: Australia

Other Remarks: Site is located on BMR seismic line 14/003

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponent: | Dr. Alexandra Isern<br>Department of Geology and Geophysics<br>University of Sydney<br>Sydney, NSW 2006, Australia | ph: 61-2-9351-3998<br>fax: 61-2-9351-0184<br>email: aisern@es.su.oz.au |

# ODP Site Summary Form6/93

| | |
|---|---|
| Title of Proposal: | ODP Drilling in the Coral Sea: Sea Level Variation, Paleoceanography, and Fluid Flow |
| Site-specific Objective(s) (List of general objectives must be inc. in proposal) | To study fluid movement through the Queensland Plateau using a CORK for long-term measurements |

| | Proposed Site | Alternate Site |
|---|---|---|
| Site Name: | CS-16-A | |
| Area: | Queensland Plateau | |
| Lat./Long.: | 17°48 S 149°36E | |
| Water Depth: | 460 m | |
| Sed. Thickness: | 1 sec TWT; ~1100 m | |
| Total penetration: | 300 m | |

| | Sediments | Basement |
|---|---|---|
| Penetration: | 300 m | None |
| Lithology(ies): | Pelagic and periplatform ooze | |
| Coring (check): | 1√-2-3-APC√ VPC* XCB√ MDCB* PCS RCB DCS* Re-entry | |
| Downhole measurements: | CORK | |

*Systems currently under development

**Target(s)** :(see Appendix of Proposal Submission Guidelines6/93) A√ B C D E F G√ (check)ß

**Site Survey Information** (see Appendix of Proposal Submission Guidelines6/93 for details and requirements):

| | | Check | Details of data available and data still to be collected |
|---|---|---|---|
| 01 | SCS High Resolution | | |
| 02 | MCS and velocity | √ | BMR (1985) data is available; additional data will be collected during site surveys |
| 03 | Seismic grid | √ | Seismic grid taken during Leg 133 Site Surveys |
| 04 | Refraction | | |
| 05 | 3.5 or 12 kHz | √ | Some data is available now; more will be collected during site surveys |
| 06 | Swath bathymetry | | |
| 07 | H.-res side-looking sonar | | |
| 08 | Photography/video | | |
| 09 | Heat flow | | |
| 10 | Magnetics/gravity | √ | Some data is available from BMR (AGSO); additional will be collected during site surveys |
| 11 | Coring | √ | Site 812 drilled near this location |
| 12 | Rock sampling | | |
| 13 | Current meter | | |
| 14 | Current meter | | |

Weather, Ice, Surface Currents: Cyclone season (November to May)

Territorial Jurisdiction: Australia

Other Remarks: Site is located on a seismic grid taken during Leg 133 site surveys

| | Name/Address | Phone/FAX/Email |
|---|---|---|
| Contact Proponent: | Dr. Alexandra Isern<br>Department of Geology and Geophysics<br>University of Sydney<br>Sydney, NSW 2006, Australia | ph: 61-2-9351-3998<br>fax: 61-2-9351-0184<br>email: aisern@es.su.oz.au |