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LEG 133 - NORTHEAST AUSTRALIA
[Co-Chief Scientists: P.J. Davies, J.A. McKenzie]

SAFETY PACKAGE

by

D.A. Feary[1], C.J. Pigram[2], P.J. Davies[1], P.A. Symonds[1]
A.W. Droxler[3], F. Peerdeman[2],

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BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS
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LEG 133 - NORTHEAST AUSTRALIA
[Co-Chief Scientists: P.J. Davies, J.A. McKenzie]

OCEAN DRILLING PROJECT - LEG 133 SAFETY PACKAGE

by

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NOTE

The second printing of this record follows the February/March 1990 review of ODP Leg 133 drilling sites by both the ODP Pollution Prevention and Safety Panel and the TAMU Safety Panel. The sites described in this updated document are those considered and accepted by these panels.

CONTENTS

SECTION 1:

NORTHEAST AUSTRALIA - REGIONAL SETTING

1.1 Introduction

The passive continental margin off northeastern Australia extends over a distance of some 200 km and an area of 9300km^2. It is comprised of the coast and shelf occupied by the Great Barrier Reef and a number of carbonate-dominated marginal plateaus and troughs (Fig. 1.1). Generalised sediment thickness patterns over the offshore area are shown in Fig. 1.2).

1.2 Onshore Geology

The coastal regions of Queensland are underlain by rocks of the Paleozoic Tasman Fold Belt, which extends from Tasmania in the south to Papua New Guinea in the north (Brown and others, 1968). The western border of the fold belt consists of Precambrian metamorphics which, in the north at least, are separated from the Paleozoic sediments to the east by a major fault - the Palmerville Fault (Willmott and others, 1973) (Fig. 1.3). 'Geosynclinal' sedimentation commenced in the early Devonian in the Hodgkinson Basin and continued through to the Carboniferous, interrupted by a number of orogenies. Relative to the width of the New England and Lachlan Fold Belts to the south, an extensive area of the Tasman Fold Belt in northern Queensland appears to be absent. This has led to the interpretation that the missing Middle-Upper Paleozoic rocks lie beneath the Queensland Plateau (M. Ewing and others, 1970).

Packham (1973) has interpreted the development of the eastern Australian region in terms of a stepwise easterly growth of the continent, outward from the Precambrian nucleus by development and accretion of Andean-type continental margins during the Ordovician-Permian. The easternmost portion of the fold belt off southeastern Australia has since been dismembered by sea-floor spreading in the Tasman Sea during the Late Cretaceous.

The Mesozoic-Recent geological history of Queensland is one of terrestrial to marginal marine sedimentation in basins and troughs bordering the Queensland coast. Principal among these are the Maryborough (Ellis, 1966; 1976), Styx (Benstead, 1976), Capricorn (Ericson, 1976), Hillsborough (Clarke and others, 1971; Gray, 1976) and Laura (De Keyser and Lucas, 1968; Day, 1976) Basins (Fig. 1.3). A major hiatus is present in all onshore basins separating Early Cretaceous sediments from Late Tertiary-Recent terrestrial deposits which infill depressions in the old land surface. The only known possible Late Cretaceous deposits are found in the offshore Capricorn Basin (Ericson, 1976). A thick section of non-marine sediments was deposited during the Early Tertiary in the Hillsborough Basin, and similar age sediments containing oil shales are found near Gladstone (Fig. 1.3). In the Capricorn Basin this sequence is unconformably overlain by late Oligocene marginal marine quartzose sands, which are in turn overlain by a Miocene-Recent marine, calcareous shelf facies, including coral reefs.

1.3 Offshore Physiography

The area of interest for Leg 133 (Fig. 1.1) is the southwestern part of the Coral Sea, seaward of the Great Barrier Reef. The main regional physiographic elements are the Great Barrier Reef and adjacent slope, the Queensland and Marion Plateaus, the Queensland and Townsville Troughs, the Cato Trough, and the Capricorn Channel (Figs 1.1, 1.4).

The continental shelf is dominated by the Great Barrier Reef, and reaches a maximum width of about 350 km in the southernmost part of the region at about 22°S. The shelf break occurs at 100-200 m. The slope of the Great Barrier Reef is steeply dipping and canyoned in the northern part of the area, particularly adjacent to the Ribbon Reefs; the slope decreases in the vicinity of Townsville and becomes very gentle adjacent to the Marion Plateau.

The Queensland Plateau is the largest marginal plateau of the Australian continental margin, being nearly twice as large as the Exmouth Plateau. The plateau is roughly triangular with its western margin striking north-northwest, its northeastern margin facing the Coral Sea Basin and striking northwest, and its southern margin striking east-west. The western and southern margins are both bounded by linear troughs. Many valleys and canyons lead from the plateau surface into the bounding troughs and the Coral Sea Basin. The plateau surface lies at a medium depth of 1100 m, and away from reef areas is generally very smooth and flat. It exhibits a very gentle northwest tilt, its surface being most deeply submerged around Osprey Reef. Fairbridge (1950) observed that the Queensland Plateau reefs grow from as much as 1500 m below sea level, well beyond the normal ecological limit of reef growth, and this led him to suggest that the plateau had subsided to its present depth from an initial elevation close to sea level, with reef growth keeping pace with subsidence.

The Queensland Trough occupies the region between the continental shelf and the Queensland Plateau between 14°S and 17°30'S, adjacent to the Great Barrier Reef. Its western margin is much steeper than its eastern margin, with gradients up to 1:3 (at 15°S). The trough has a smooth, flat floor which gently deepens to the north-northwest from about 1100 m at its junction with the Townsville Trough. It joins the Osprey Embayment region at a depth of about 3000 m between the Queensland and Eastern Plateaus. The strike of the trough is that of the dominant structural grain of the Tasman Fold Belt in northern Queensland (Hill and Denmead, 1960).

The Townsville Trough has no clear relation to any known structure onshore, being roughly perpendicular to the main Tasman Fold Belt trend. Falvey (1972) suggested that part of the trough appears to be an offshore continuation of onshore Devonian to Carboniferous trends. Mutter (1977) pointed out that it is equally possible that the trough reflects trends such as those of the Mellish Rise to the east. The trough has a symmetric U-shaped profile which is maintained over most of its length. At its eastern end, at about 154oE, a bifurcation sends one branch south into the Cato Trough and the other winding sinuously north into the Coral Sea Basin. Mutter (1977) speculated that sediment derived from the Queensland Plateau or mainland Queensland could reach the deep ocean floor via the Townsville Trough.

The 77 000 km^2 area of the Marion Plateau lies directly east of the central Great Barrier Reef and is bounded along its northern margin by the Townsville Trough and along its eastern margin by the Cato Trough (Figs 1.1 , 1.4). The present plateau surface forms a deeper water extension of the Australian continental shelf, with water depths ranging from 100 m along the western border to 500 m along the eastern margin. At present, reef growth is restricted to Marion Reef on the northeastern corner and Saumarez Reef at the south-eastern extremity of the plateau (Fig. 1.1). The plateau may be considered to extend south of Saumarez Reef to include the Capricorn Channel area (Marshall, 1977). Its eastern margin is formed by the slope leading down to the Cato Trough. This margin has a moderate grade and is cut by numerous canyons.

1.4 Offshore Stratigraphic Control

Geophysical and geological data coverage over northeast Australia are summarised in Figs 1.5 to 1.8. The most important sources of stratigraphic control in the region are the petroleum and scientific wells drilled at Anchor Cay, Michaelmas Cay, Aquarius 1, Capricorn 1A, Wreck Island, Heron Island and DSDP Sites 209, 210, and 287 (Fig. 1.3).

The Anchor Cay No 1 well was drilled to a depth of 3623.5 m (11 888 ft.) by Tenneco-Signal in 1969. A summary of the well completion report (Oppel, 1969) is in Appendix 1. Two major unconformities representing the early Oligocene and the Middle to Late Miocene separate three carbonate sequences, ie. temperate Eocene limestones, subtropical late Oligocene to Early Miocene limestones, and tropical Late Miocene/Pliocene limestones. The Quaternary is comprised of mixed prograding fluvioclastics and carbonates.

Wreck Island-1, in the Capricorn Basin, reached a total depth of 579 m after penetrating 31 m of siliceous volcanic conglomerates. The most significant result was the identification of Miocene carbonates and clastics - proof of a Tertiary marine basin in the area. Two petroleum exploration wells (Capricorn 1A and Aquarius 1) were drilled in the Capricorn Basin, adjacent to the southern Marion Plateau (Fig. 1.4). Basement consists of Cretaceous volcanics in Capricorn 1A (at 1710 m) and indurated ?Paleozoic shale and siltstone in Aquarius 1 (at 2658 m). In both wells, basement is overlain in turn by Paleocene to middle Oligocene basal polymictic conglomerate and arkosic red beds, by shallow marine glauconitic and carbonaceous sandstones, and by Miocene to Recent claystone and marl (Fig. 1.10) (Ericson, 1976).

The most important deep sea geological data are the three drill sites of the Deep Sea Drilling Project, drilled during Legs 21 and 30. DSDP site 209 was drilled on the eastern Queensland Plateau in 1428 m of water and penetrated three lithologic units (Fig. 1.10). It bottomed in upper bathyal to neritic late Middle Eocene glauconite-bearing bioclastics and foraminifera-rich sediment. The overlying unit (latest Middle Eocene to Late Eocene) is comprised of terrigenous detritus and foraminiferal ooze indicating subsidence of the margin. A major hiatus extends from Late Eocene to late Oligocene and is probably the result of non-deposition and/or slight submarine erosion. This was followed by further subsidence to the present mid-bathyal depths and the deposition of almost pure foraminiferal and nannofossil ooze from the late Oligocene to the present, although with a period of non-deposition or erosion during the Middle Miocene.

The most important points to emerge from the data are:

. the site clearly records the history of subsidence of the Queensland Plateau from shallow water (neritic) in the late Middle Eocene, to the present depth at the site of 1428 m (mid-bathyal);

. sediments are dominantly foraminiferal ooze throughout with terrigenous content in the cores reducing in the upper units, particularly from Middle to Late Eocene;

. a major period of non-deposition or submarine erosion spans most of the Oligocene. After this hiatus the sedimentary regime is almost purely pelagic carbonate ooze; and

. the effects of submarine current activity are well recorded.

The Eocene/Oligocene hiatus has been attributed to submarine erosion caused by either a major change in circulation patterns following the final separation of Australia from Antarctica in the early Eocene (Kennett and others, 1972), or by the commencement of a significant equatorial circulation pattern (Taylor and Falvey, 1977). Winnowing is evident in the post-hiatus sediments, suggesting bottom current activity. Depositional patterns (Mutter, 1977; Taylor and Falvey, 1977) also suggest the influence of currents on sedimentation.

DSDP sites 210 and 287 in the central Coral Sea Basin penetrated essentially the same lithologic sequences. The more complete section was intersected at site 210. The bottom part of the section is comprised of Early to Late Eocene detrital clays and biogenic pelagic sediment which accumulated above the foram solution depth. The clays are thought to have been derived from high grade metamorphics and volcanics to the west (Burns and others, 1973). Deposition was interrupted in the Late Eocene to early Oligocene by an erosional/non-depositional hiatus which is of regional extent and was caused by a marine bottom water current (Kennett and others, 1972; Edwards, 1975). Middle Oligocene nanno-oozes deposited near the carbonate compensation depth overlie the unconformity, and are followed by a late Oligocene to Early Miocene period of non-deposition and/or erosion. Overlying this unconformity is an Early-Mid Miocene abyssal clay indicating deepening of the sea floor to below the compensation depth. The clays are thought to have been derived from the Papuan area to the northwest (Burns and others, 1973). During the Late Miocene to late Pleistocene, turbidity currents deposited graded cycles of silt and clays with the sediment again being derived from sources in Papua New Guinea.

Nearly 700 core and dredge stations have been occupied over the northeast Australian margin, mostly by BMR. They show that the deep water parts of the margin are currently receiving pelagic sedimentation. Some areas near the Great Barrier Reef and near large reefs on the Queensland Plateau currently receive reef-derived debris. The Coral Sea, the Moresby Trough, and the Papuan Platform receive terrigenous sediment at present, largely deposited as turbidites. Along the slope of the Great Barrier Reef, low sea level sedimentation is dominantly siliciclastic.

The Miocene to Pleistocene sedimentary record of the slopes and trough is usually thin. Sedimentation rates are shown in Table 1.1. At the proposed ODP Sites 1-4, an unusually thick and high resolution sedimentary record occurs.

1.5 Tectonostratigraphic Framework

1.5.1 Townsville and Queensland Troughs

Structural style and seismic sequence geometries determined from the 1985/87 BMR and company data are consistent with the following tectonic history:

Pre-Breakup Development - Jurassic to Early Cretaceous

In the Jurassic to Early Cretaceous the northeast Australian continental margin, incorporating the present marginal plateaus and parts of Papua New Guinea, lay adjacent to the Pacific Plate. Continental to marginal marine sediments of this age were deposited throughout the region in intracratonic downwarps (e.g. Laura Basin and the older part of the Papuan Basin). One of these elongate troughs or 'infrarift' basins may have extended along the Queensland Trough and into the Townsville Trough to form the locus of future rifting. During the Early to Late Cretaceous (pre-Cenomanian) and possibly during the Late Jurassic (syn-rift phase), northwest-southwest extension resulted in the low-angle normal faulting and block rotation which initiated the Townsville Trough rift basin. Associated wrenching, and possible transtensional pull-apart basin development produced the Queensland Trough. The tectonism was probably accompanied by uplift in adjacent regions and by volcanism.

Continental Breakup - Late Cretaceous to Paleocene

In the Late Cretaceous, prior to the Paleocene-Eocene opening of the Coral Sea Basin, a northeast-southwest extensional event was probably superimposed on the region resulting in reactivation and overprinting of the older basin-forming structures. During the period of Cretaceous extensional/rift tectonism, continental, marginal marine and perhaps areas of very restricted shallow marine sediments were deposited in developing half grabens of the Townsville Trough. From the Late Cretaceous to early Paleocene (late rift phase), movement on the normal faults continued but at a greatly reduced level. Some of the tilt blocks were capped and buried by late rift phase sedimentation, which exhibits flexural drape and thinning over the block corners. Increased marine influence in the Townsville Trough probably followed Campanian breakup and seafloor spreading in the Tasman Basin and Cato Trough. Restricted shallow marine sediments were deposited in the centre of the Townsville Trough, grading to marginal marine and continental sedimentation on its flanks and on the adjacent emergent Queensland and Marion Plateaus.

Post-Breakup Subsidence - Paleocene to Oligocene

During the Paleocene to Eocene episode of seafloor spreading in the Coral Sea Basin to the north, only minor reactivation and structuring occurred in the Townsville Trough enhancing flexural and compaction drape in the early post-breakup sediments. At this time, partially restricted shallow marine conditions probably existed in the trough, with paralic to shallow shelf environments on the trough margins. In post-Middle Eocene time slow regional subsidence during the post-breakup sag phase of continental margin development resulted in shallow marine conditions being established on the Queensland and Marion Plateaus, although parts of both these features were probably still emergent until at least the end of the Eocene. During the Middle to Late Eocene the Townsville Trough received neritic to deepwater high and low energy deposits which probably consisted mainly of terrigenous and calcareous turbidites. During the early Oligocene a widespread unconformity resulted from the start of initiation of a significant equatorial circulation pattern over the subsiding margin and basins is reflected by a widespread unconformity (Taylor and Falvey, 1977). In post-early Oligocene times, as a consequence of subsidence, pelagic ooze, turbidites and slump deposits became the major components of trough sedimentation.

1.5.2 Carbonate Platforms

The Great Barrier Reef

The major geological characteristics of the Great Barrier Reef are summarised in schematic form in Fig. 1.11. In the northern Great Barrier Reef and Gulf of Papua, the occurrence of subsurface reefs are well documented by seismic data and drill holes (Tanner, 1969; Tallis, 1975; Fig. 1.12). Miocene reefs occur in the subsurface of the Gulf of Papua (Fig. 1.12), and Pliocene reefs and Miocene limestones containing algal rhodoliths occur at the northern end of the Great Barrier Reef (Marshall, 1983) in Anchor Cay 1. Seismic data acquired by the Bureau of Mineral Resources (Davies and others, 1989) in the northern area confirm both the presence of buried reefs and the existence of a thick reef section. Our seismic data indicate that a major reef structure occurs in the continental-slope sequence on the western margin of the Pandora Trough (Fig. 1.12) between Portlock and Boot Reefs. The data show that these modern reefs are constructed on a more extensive Miocene and Pliocene reef complex as thick as 1.5 km.

On the adjacent shelf, (?)Miocene-Pliocene buried reefs may be precursors of the modern shelf-edge ribbon reefs. A seismic profile across one of these features (Fig. 1.12) shows episodic reef growth through a 1 500 m section. A prominent forereef slope with shallow-dipping beds appears to have developed concurrently with the reef complex. The forereef slope sequence is overlain by a thick Pliocene and younger fluvio-deltaic sequence. In contrast, Quaternary buried and partially buried, relict shelf-edge reefs as thick as 100 m occur along the easterly-trending section of the outer Papuan shelf (Fig. 1.12). Therefore, in the northern Great Barrier Reef and Gulf of Papua, seismic and drill hole data indicate that a reef sequence of varying thickness and age started to develop in the Miocene.

On the outer continental shelf of the central Great Barrier Reef region, the 250 to 300 m thick reef complex (Fig. 1.13) is composed of a series of reef slices separated by low sea level-generated unconformities (Davies, 1983; Symonds and others, 1983). The reef complex forms only the uppermost part of a thick outer-shelf sequence that is dominated by prograding fluvio-deltaic and onlapping slope sediments overlying a rifted basement (Symonds and others, 1983). The reef thickness and a tie to DSDP Site 209 in the Coral Sea indicate a probable Pliocene age for initiation of reef growth in this region. A borehole on Michaelmas Cay (Fig. 1.10) shows 100 m of (?)Plio-Pleistocene reef facies overlying siliciclastic sediments.

The boreholes on Heron Island and Wreck Bay (Fig. 1.10) at the southern end of the Great Barrier Reef show that less than 150 m of reef overlies quartz sand, and that reef growth began in the Plio-Pleistocene (Lloyd, 1973; Palmieri, 1971, 1974).

The principal conclusions derived from studies of the Great Barrier Reef carbonate platform are that the reef sequence thins dramatically and the age of initial reef growth becomes younger from north to south. The Great Barrier Reef is a mixed carbonate-siliciclastic province, with reefs forming a discontinuous wedge largely enclosed within terrigenous fluvio-deltaic deposits.

Queensland Plateau

The Queensland Plateau (Fig. 1.4) is the largest marginal plateau of the Australian continental margin, extending over an area of about 154 000 km2. It is one of the largest features of its type in the world and is approximately the same size as the Bahama Platform. Approximately half of the plateau surface lies above the 1 000 m isobath, with living reef systems at or near present sea-level forming 10 to 15% of the surface. The largest modern reef complexes are Tregrosse and Lihou Reefs, lying along the southern margin of the plateau (Fig. 1.1). Both these complexes are nearly 100 km long from east to west and 50 to 25 km wide, respectively, from north to south. The other major areas of modern reef growth are the Coringa, Willis, and Diana complexes, which are aligned north to south in the centre of the plateau, and the large isolated pinnacles of Flinders, Holmes, Bougainville, and Osprey Reefs, which lie along the western margin of the plateau (Fig. 1.1). In addition, drowned reefs have been reported from at least 25 different locations (Taylor, 1977; Mutter, 1977; Davies and others, 1989). Away from reef areas, the plateau surface is generally smooth and slopes northward. A distinct terrace at approximately 450 to 500 m depths occurs between Willis and Diana reefs, and also between Tregrosse, Lihou, and Coringa reefs.

The major characteristics of the Queensland Plateau carbonate platform, as deduced from analysis of extensive airgun and sparker seismic data combined with sampling data, are summarised on schematic sections across the plateau (Fig. 1.14). The ages of the stratigraphic sequences visible on the seismic data have been deduced by correlation with DSDP Site 209 (Burns and others, 1973), located on the northeastern margin of the plateau.

Basement on the Queensland Plateau is represented by a series of fault blocks, composed of probable Paleozoic rocks, which form a basement surface that dips northeast toward the Coral Sea Basin (Mutter, 1977; Taylor, 1977). Basement beneath the western one-third of the plateau is progressively downfaulted toward the Queensland Trough (Figs 1.14 and 1.15). South of Tregrosse and Lihou Reefs, the basement surface slopes gently south toward the northern boundary fault of the Townsville Trough. Large parts of the basement surface were exposed and planated during the Cretaceous-Oligocene. From the Early Eocene, this surface was progressively submerged and overlain first by shallow marine siliciclastic sediments, and then by deeper water pelagic sediments (Burns and others, 1973). A period of non deposition or submarine erosion occurred from the Late Eocene until the Late Oligocene. The sedimentary sequence reflects constant gradual subsidence until the Late Miocene, followed by an increased subsidence rate until the present.

Along the western margin of the Queensland Plateau, steep-sided pinnacles 1-2 km across rise from depths of as much as 1 200 m to within 10 m of sea level (e.g. Fig. 1.15). Dredged samples indicate that the flanks of these features are composed of reefal framework containing larger Miocene-Pliocene foraminiferids (Davies and others, 1989). Seismic data show that at least some of these pinnacles have developed on the raised corners of fault blocks.

In addition to the carbonate buildups on the plateau margins noted earlier, seismic data indicate that a thick carbonate platform sequence was deposited on the central part of the plateau (Fig. 1.15). At least two phases of separate but superimposed reef and periplatform facies (QR1 and QR2; Figs 1.14 and 1.15) form the core of the carbonate platforms. Dredge samples from this complex on the southern slope of the Queensland Plateau between 1 000 and 1 300 m depth consist of Middle Miocene to Pliocene reefal material (Davies and others, 1989). The presence of shallow-water sediments at these depths confirms that there has been unusually rapid subsidence of the plateau since the Middle Miocene. The deeper water areas between reef complexes are the sites of hemipelagic sedimentation.

A terrace that occurs at 450 to 500 m depths represents the end of QR2 reef growth (Figs 1.14 and 1.15). A third, more restricted phase of reef growth (QR3) developed on this surface, with associated periplatform sedimentation in front of the reef (Fig. 1.15). This reefal platform grew to sea level, and, as a result of relative sea-level rise, now forms another terrace at approximately 50 m depth.

The most recent reef complexes (QR4) developed on the 50 m terrace and are even more restricted than previous phases. Descriptions of the modern coral faunas (Orme, 1977; Done, 1982) suggest that the modern reefs are oceanic equivalents of high-energy reefs present in the Great Barrier Reef. It is therefore likely that throughout their evolution, the different phases of Queensland Plateau reef development have all been products of high-energy oceanic conditions as a result of their exposed oceanic location.

Marion Plateau

Little detailed subsurface structure and facies distribution information exists for the Marion Plateau (Mutter and Karner, 1980). The results of a study in progress, based on extensive airgun, watergun, and sparker seismic data combined with sampling data, are summarised on schematic sections across the plateau (Figs 1.15 and 1.16).

The plateau is bounded on three sides by rifts: the Cato Trough to the east; the Townsville Trough to the north; and a series of north-south-oriented, narrow half-grabens, which separate the plateau from the continent to the west (Fig. 1.14). During the Tertiary, siliciclastic shelf sediments prograded eastward across these half-grabens and onto the western Marion Plateau. The most northern of these half-grabens appears to join the confluence of the Townsville and

Queensland Troughs. Therefore, the Marion Plateau formed a separate marginal plateau during the Early Tertiary. To the south, the Marion Plateau is separated from the Capricorn Basin by a northwest-trending basement ridge (the Swains Reef High; see Fig. 1.4).

The basement beneath the Marion Plateau is a planated surface which dips gently toward the northeast. The only disruption to this surface occurs in the northeast corner of the plateau, where a basement high forms the pedestal on which Marion Reef developed. Basement beneath the plateau margins is steeply down-faulted into the troughs to the north and east. The slope sequences on the northern and eastern margins of the plateau are both onlapping and progradational. Small reef complexes overlie some of these progradational sequences along the northern margin (Fig. 1.16).

The basement surface was completely transgressed during the (?)Early Miocene, resulting in development of an extensive carbonate platform (MR1; see Fig. 1.14). The top of this platform presently lies at 450 to 500 m depth. Shelf-edge barrier reefs (Fig. 1.16) and platform reefs separated by lagoons and interreef areas (Fig. 1.16) can be identified over the northwestern two-thirds of the platform. Barrier reefs formed a distinct rimmed margin only along the northern edge of the plateau. The second phase of platform development (MR2) was more restricted and was confined to the southern one-third of the plateau. This phase was initiated at a level considerably below the top of the earlier phase. The top of the MR2 platform presently lies at 350 to 400 m below sea level. The third phase of reef growth on the Marion Plateau (MR3) is represented by small platform areas that have grown on the 350 to 400 m surface. Toward the southern Marion Plateau, part of the Great Barrier Reef overlies the third phase of carbonate platform growth. The final, very restricted, phase of growth on the Marion Plateau (MR4) is represented by Marion and Saumarez Reefs. Therefore, the successive phases of carbonate platform growth have been progressively more restricted in area (Fig. 1.14).

At present, the top of the Marion Plateau is swept by moderately strong currents with the result that, away from the areas of modern reef growth, only thin hemipelagic sediments are accumulating in restricted areas.

1.6 Principal Post-rift Factors Affecting the Stratigraphic and Sedimentological Evolution of Northeast Australia

1.6.1 Subsidence

Quantitative subsidence data has been derived from geohistory analysis (Van Hinte, 1978; Falvey and Deighton, 1982) of Anchor Cay 1, DSDP Site 209, Capricorn 1A and Aquarius 1 (Fig. 1.17). The subsidence data from these wells indicate that northeast Australia has not subsided wholly as a result of uniform post-rift thermal cooling, but that subsidence pulses have occurred at different times.

The pre-Eocene portion of the subsidence curve for Anchor Cay 1, at the northern end of the Great Barrier Reef (Fig. 1.14), is not reproduced here, as it is difficult to ascertain how much section has been removed at the major unconformity (Fig. 1.17A). The accelerated subsidence of 50 m/million years which affected this region in the Miocene (25-5 Ma) increased to 140 m/million years in the Pliocene (Fig. 1.17A).

DSDP Site 209, provides the only source of quantitative subsidence data for the Queensland Plateau. The subsidence history of the plateau at this site was characterised by progressively increased rates of subsidence (Fig. 1.17B). An initial slow rate (20 m/million years) was succeeded by a markedly increased rate (40 m/million years) after the Middle Miocene (11 Ma).

The geohistory curves for Aquarius 1 (Fig. 1.17C) and Capricorn 1A show similar subsidence patterns. A Cretaceous to middle Oligocene (88-30 Ma) slow subsidence phase (20 m/million years) was succeeded by increased subsidence (75 m/million years) until the Middle Miocene (11 Ma). Decreased subsidence followed by uplift during the Late Miocene and Early Pliocene was succeeded by a final increased subsidence pulse (75 m/million years) from the middle Pliocene.

1.6.2 Plate Motion and Paleoclimate/Paleoceanography

Hotspot (Duncan, 1981; Wellman, 1983) and magneto-stratigraphic studies (Idnurm, 1985, 1986) provide a reconstruction of Indian-Australian Plate movement through the Cenozoic. These studies show that since the end of the Eocene, when northeast Australia was located between 29oS and 44orS, the region has moved almost directly northwards to its present location between 9oS and 24oS. On this basis the Cenozoic paleolatitudes for the northeast Australia region may be determined (Fig. 1.18). This latitudinal motion would have resulted in profound climatic changes along the east Australian shelf, particularly since plate movement was essentially normal to developing climatic zones. Since surface-water temperatures are critical to carbonate platform development, we have examined data primarily derived from geochemical and petrographic analyses of DSDP cores from the western Pacific and produced a synthesis describing Cenozoic surface-water temperature variability for the northeast Australian region (see Fig. 1.19). This oceanic surface-water temperature curve for northeast Australia (Fig. 1.19) allows us to draw the following conclusions:

- Temperatures in the earliest Middle Eocene were briefly warm enough for coral reef growth. Corroboration is provided by the identification of early Middle Eocene larger foraminiferids from the northwestern margin of the Queensland Plateau (Chaproniere, 1984), indicating sea surface temperatures of 18-27^{o}C (Murray, 1973).

. Temperatures from the late Middle Eocene to the middle Early Miocene were not conducive to tropical carbonate platform development. Climates at paleolatitudes of 23-46°S were probably temperate or cool temperate, and accordingly there would have been no significant coral reef growth.

. During the Early Miocene, the northeast Australia region was bathed in surface waters marginal for supporting coral reefs, i.e. probably comparable to those off northern New South Wales and southern Queensland today. While some reef growth may have been possible in the extreme north, it is most likely that prolific growth throughout much of the northern region began with the initiation of tropical climatic conditions in the early Middle Miocene.

. The Late Miocene climatic cooling would have prevented extensive reef growth in the southern part of the region, situated near the subtropical/tropical climatic boundary.

. During the Pliocene, temperatures suitable for reef growth extended into the southern parts of the northeast Australian province.

The paleoclimatic and paleoceanographic data substantiate and refine the major conclusions deduced from plate motion studies. The consequences of this interpretation are that the Great Barrier Reef tropical shelf carbonate facies thin and young to the south and overlie temperate facies (Davies and others, 1987); that reefs grew first in the north, probably within the developing foreland basin; that this early reef growth was closely followed by reef growth on the Queensland and Marion Plateaus; and that reefal development occurred later in the central and southern Great Barrier Reef. Facies diachroneity must be a fundamental factor in platform evolution where plate motion has produced movement either towards or away from the tropics.

The above conclusions can be tested by a comparison of present-day facies variations along the east Australian margin with the vertical facies sequence observed in cores from the Gulf of Papua. The present-day sediment distribution on the east Australian outer continental shelf is comprised of three distinct facies (Marshall and Davies, 1978), which contain a clear climate-related signature:

. tropical carbonate and clastic sediments, dominated by coral and *Halimeda* debris, north of 24°S;

. subtropical rhodolith/encrusting foram/bryozoan facies between 24°S and 28°S, with bioherms dominated by this association occurring over large parts of the outer shelf;

. temperate, branching bryozoan/foram/mollusc facies south of 28°S.

A similar facies sequence occurs vertically in the Borabi No 1 drill hole (Fig. 1.10) in the Gulf of Papua (Fig. 1.4). This sequence shows the development from a temperate open shelf in the Eocene and Oligocene; to a subtropical shallow outer shelf in the Early Miocene; to a tropical reef-dominated shelf in the Middle Miocene; and finally to a fluvioclastic-dominated shelf in the Pliocene. The vertical carbonate facies variations mirror those which occur laterally on the present-day shelf and which are clearly climate-related. Horizontal plate motion, with its attendant climatic and oceanographic effects, has therefore exerted a fundamental control on the sedimentary evolution of northeast Australia (Davies and others, 1987).

Further refinements arise from a consideration of local physical and chemical oceanographic factors. The progressive development of the east Australian current would have intensified from the Early-Middle Miocene (15-20 Ma), as the northern edge of the Australian craton began to disrupt the strong equatorial current flow (Kennett and others, 1985). Continuing northward plate motion, the elevation of New Guinea, and the closure of the east Indonesian seaway in the Late Miocene would have further restricted westerly current flow and caused diversion of warm tropical waters to the south into the northeast Australia region.

Chemical oceanographic factors will also have affected the Neogene development of carbonate platforms in northeast Australia. The late Early Miocene to early Middle Miocene apparently represented a time of increased ocean fertility commensurate with a postulated 2-3 orders of magnitude increase in oceanic phosphate levels (Riggs, 1984). This "phosphate spike" (Fig. 1.19) is thought to have produced extensive phosphatisation of continental margin sediments throughout the world. Phosphatic facies of this approximate age occur on the northern New South Wales outer shelf (Cook and Marshall, 1981), immediately south of the northeast Australian region. This event would have had considerable effect on carbonate deposition in northeast Australia, as increased oceanic phosphate levels inhibit the growth of coral reefs and promote a large increase in biomass production (Kinsey and Davies, 1979). This should be reflected in considerably restricted coral reef growth during this period, with the high ocean fertility resulting in high organic carbon production and the consequent formation of petroleum source rocks in selected environments.

1.6.3 Sea level Variation

The effects of sea level variation on carbonate platform development have been established by detailed analysis of the nature and distribution of siliciclastic and carbonate facies on the central Great Barrier Reef shelf.

High sea level deposition on the central Great Barrier Reef shelf occurred either as progradation of prodeltaic sediments on the inner shelf, primarily concentrated on wave-dominated deltas; or as aggradation of the mid to outer shelf as a result of reef growth and inter-reef sedimentation (Fig. 1.17A). Reef facies reflect both the high physical energy of the system and the transgressive/stillstand history of the Quaternary sea level rises (Marshall and Davies, 1982, 1984; Davies, 1983; Davies and Hopley, 1983; Davies and others, 1985). The reefs are composite features, comprised of stacked reef facies which grew as a consequence of successive high sea level growth phases, separated by unconformities representing low sea level erosion. The high physical energy of the reef environment restricted reef expansion to the leeward or backreef direction.

In the inter-reef areas on the mid to outer shelf, high sea level platform aggradation is represented by bioherms (Davies and Marshall, 1985), biostromes, and a sediment blanket of varying thickness (<1 m - 10 m) deposited on the previously exposed shelf surface. This sediment blanket is composed of a lower, terrigenous (mud- and quartz-rich; carbonate-poor), transgressive facies, and an upper, carbonate-rich (less mud; little quartz), stillstand facies (based on studies in progress). At the present time, after 10,000 years of transgression and stillstand, there has been little high sea level progradation of coastal terrigenous facies onto the inner shelf. It seems likely that the terrigenous/carbonate facies couplet that occurs over wide areas of the mid to outer shelf is probably representative of high sea level sedimentation on the Great Barrier Reef platform throughout most of the Plio-Pleistocene.

Low sea level sedimentation occurred both as aggradation of fluvial sediments on the mid to outer shelf (Fig. 1.20B), and as progradational shelf-edge deltas composed of terrigenous sand and sandy mud beneath the outer shelf and upper slope (Fig. 1.13).

Rising and high sea level periods in the central Great Barrier Reef were therefore characterised by both reefal and inter-reef carbonate deposition, with restriction of siliciclastic deposition largely to the inner shelf. In contrast, falling and low sea level periods were characterised by fluvial or shallow marine siliciclastic deposition, with siliciclastic progradation on the present upper slope. The marginal plateaus are essentially isolated from terrigenous input, and accordingly their facies response to sea level variation must have been different. Although high sea level periods in these areas are also marked by carbonate aggradation, low sea level periods are characterised by unconformities representing exposure of the previous reef surfaces. This response to sea level variation can be used to interpret the evolutionary history of the Cenozoic sequences on the marginal plateaus by attributing unconformities within the carbonate platforms to low sea level episodes, and reef sequences to periods of high sea level. In the absence of a specific Cenozoic sea level curve for northeast Australia, the global sea level curve proposed by Haq and others (1987) can be used. On this basis, episodes of reef growth during the early Middle Miocene (QR1, MR1 - see Fig. 1.9), the

Middle to Late Miocene (QR2, MR2), the Plio-Pleistocene (QR3, MR3), and the Quaternary (QR4, MR4) are separated by unconformities representing erosion during the late Middle Miocene (1-2), late Late Miocene (2-3), and the Quaternary (3-4).

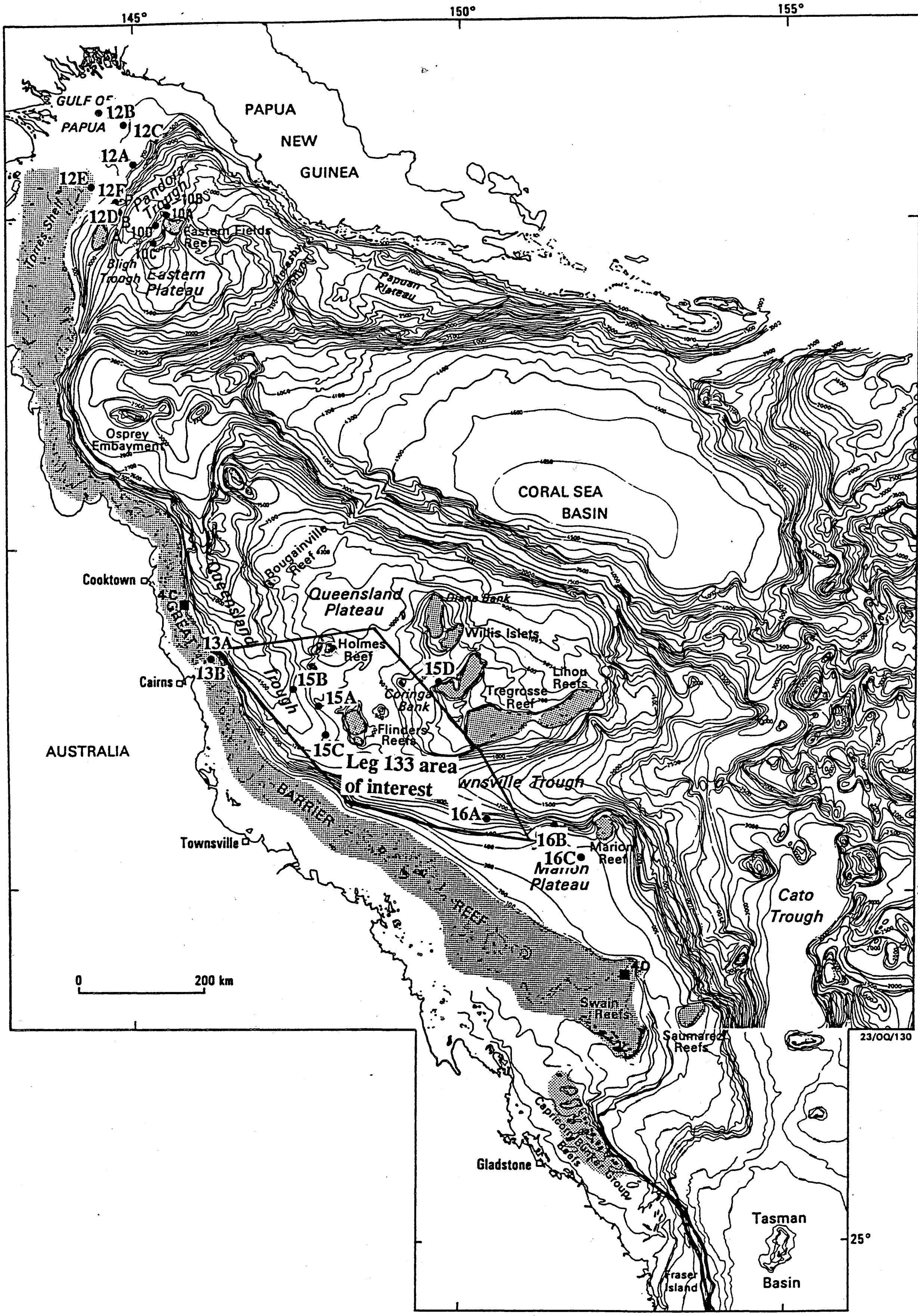


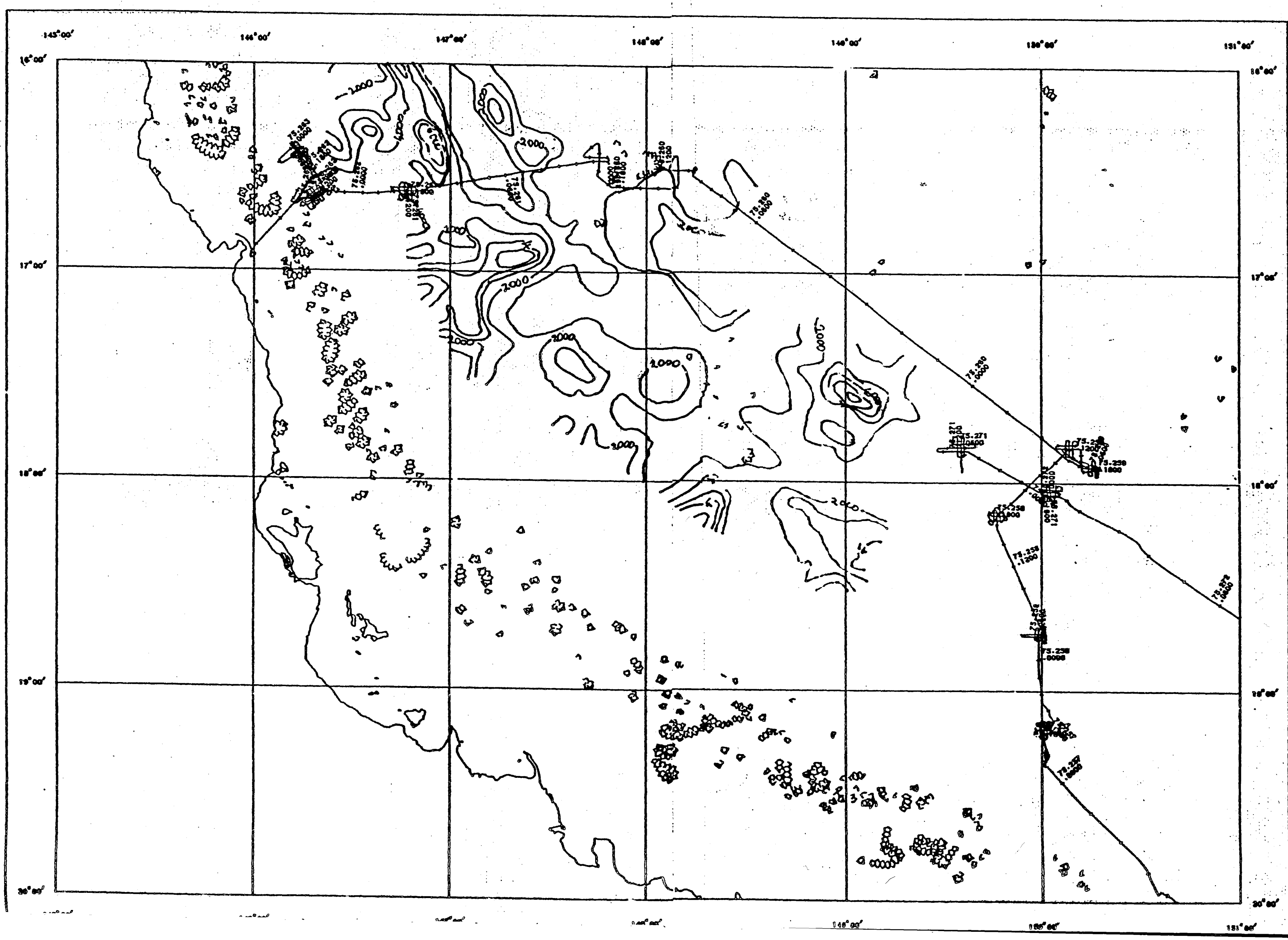
Figure 1.1. Locality map showing the main bathymetric features of northeast Australia. Areas of modern reef are screened. The area of direct Leg 133 interest is outlined.

NORTHEAST AUSTRALIA ODP SITES

SCALE 1:2000000

EDITION OF 1989/03/30

Figure 1.2. Total sediment thickness map for the region of the ODP transects.



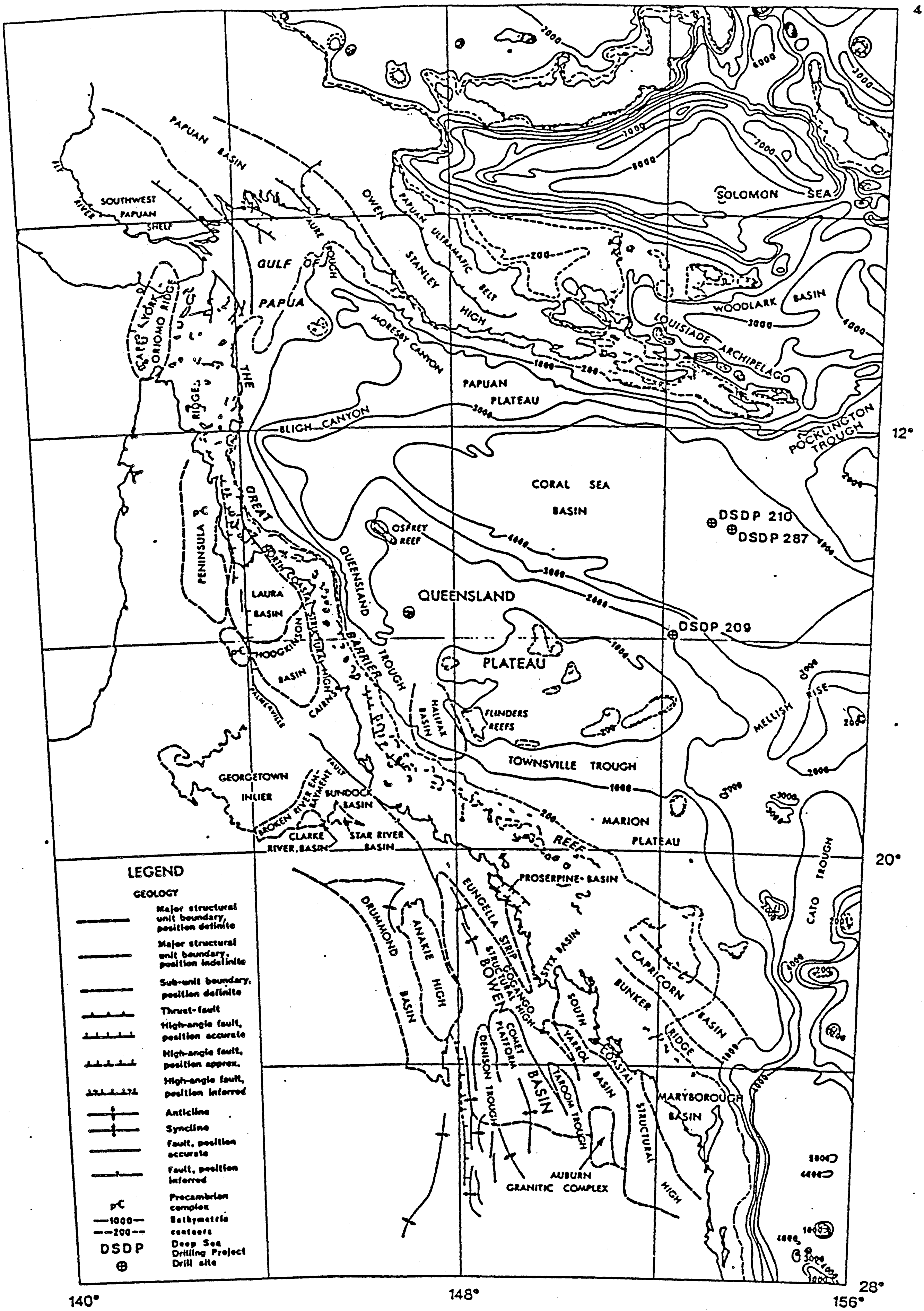


Figure 1.3. Regional setting and location of the main sedimentary basins offshore northeast Australia.

KILOMETRES

Bathymetric contours in metres

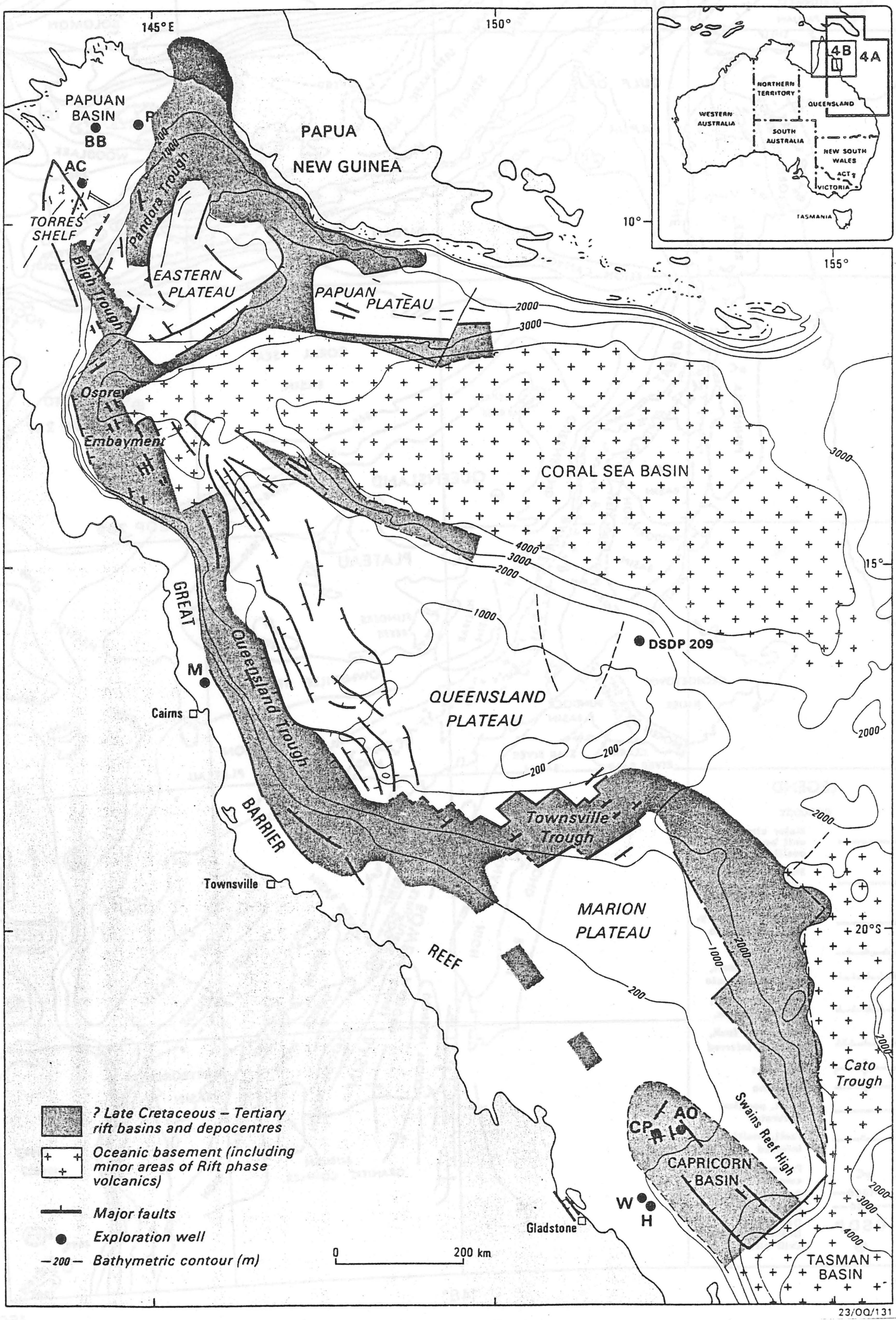


Figure 1.4 . Map showing the major structural features offshore northeast Australia. The location of exploration and other drill holes are shown: BB=Borabi; P=Pasca; AC=Anchor Cay; M=Michaelmas Cay; AQ=Aquarius; CP= Capricorn; W=Wreck; H=Heron.

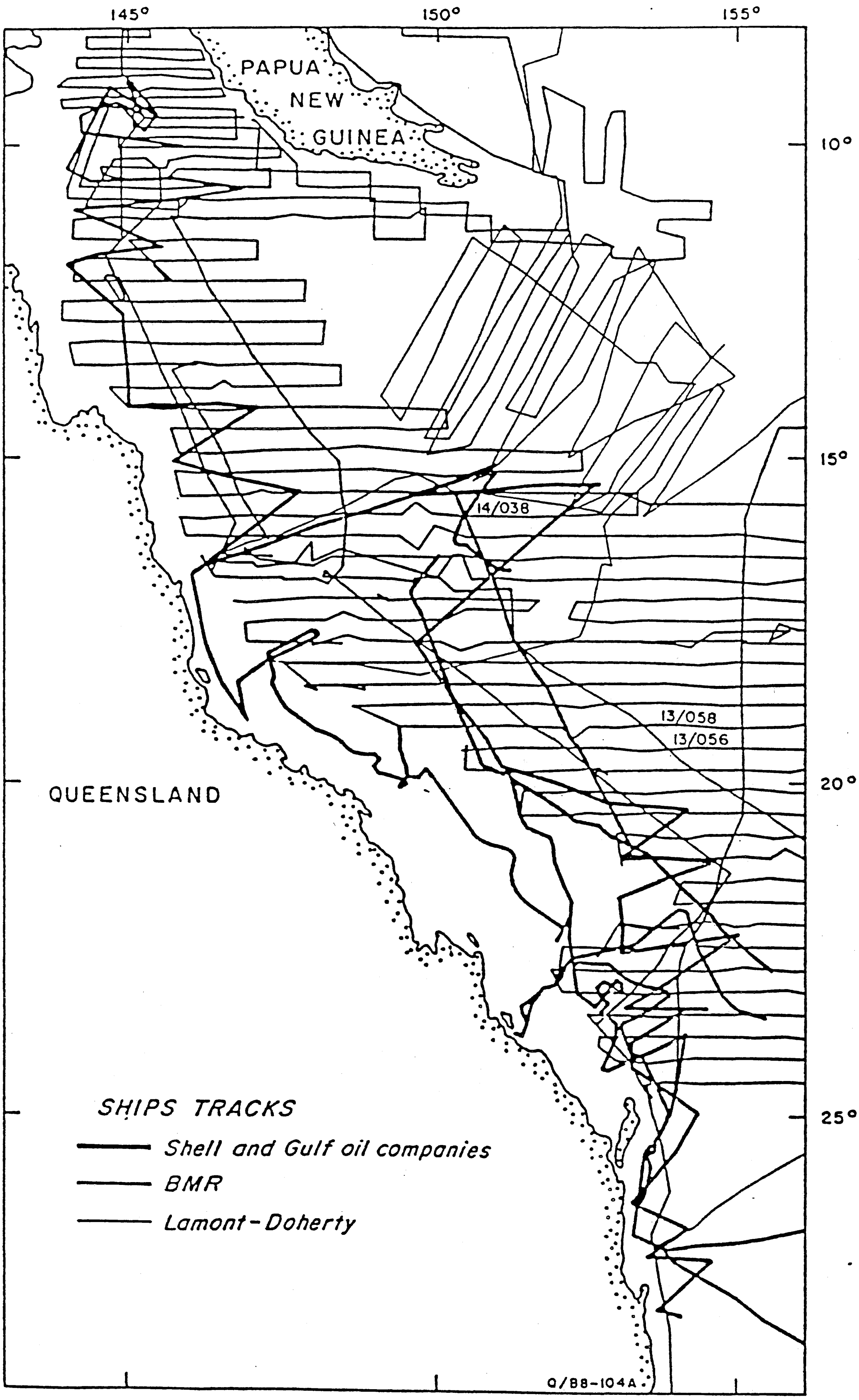


Figure 1.5. Distribution of 1970 to 1978 seismic data in Northeast Australia by BMR, Shell, Gulf and Lamont-Doherty.

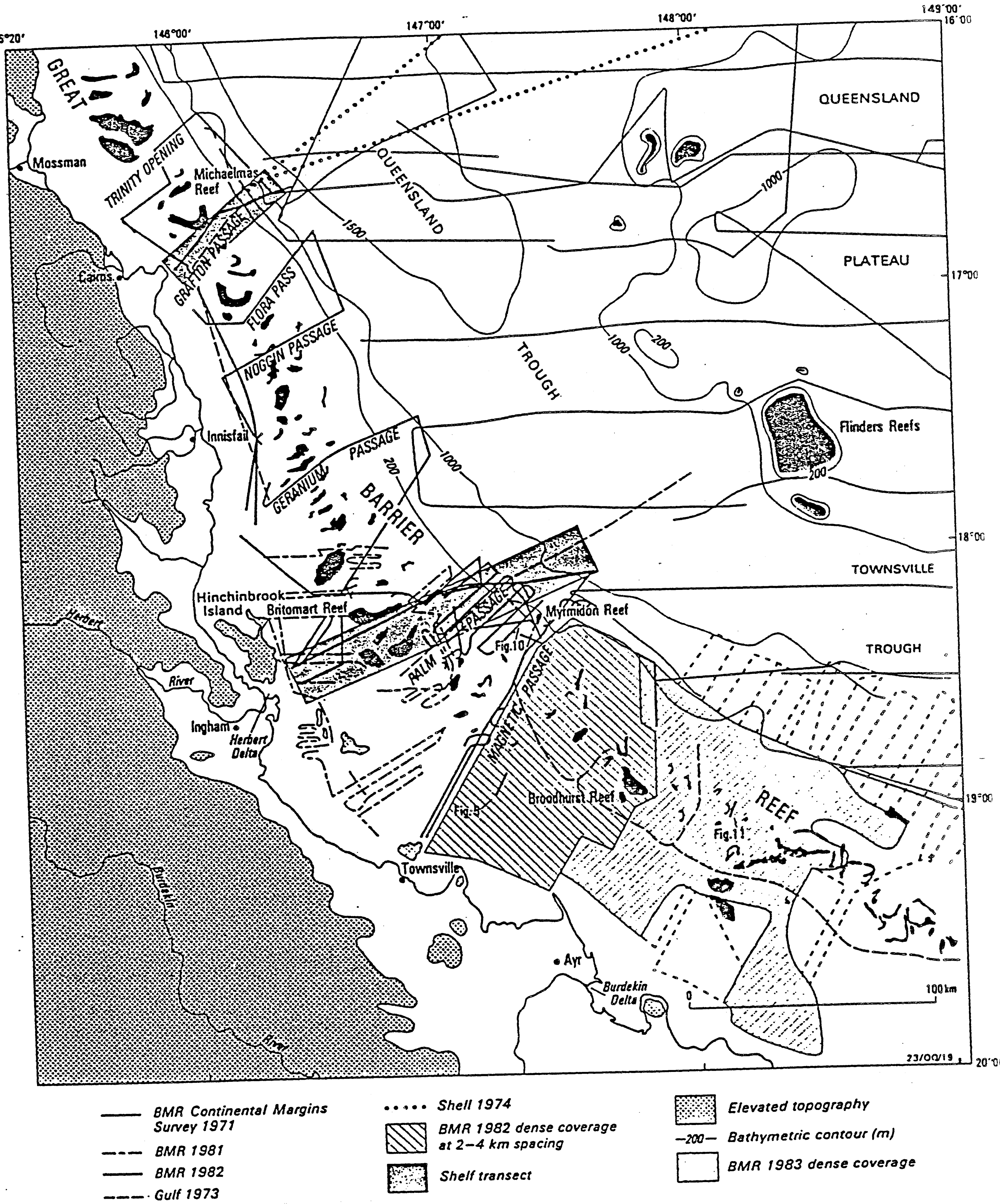


Figure 1.6. Distribution of BMR, Shell and Gulf seismic data in the western area of Leg133.

LINE LOCATION MAP

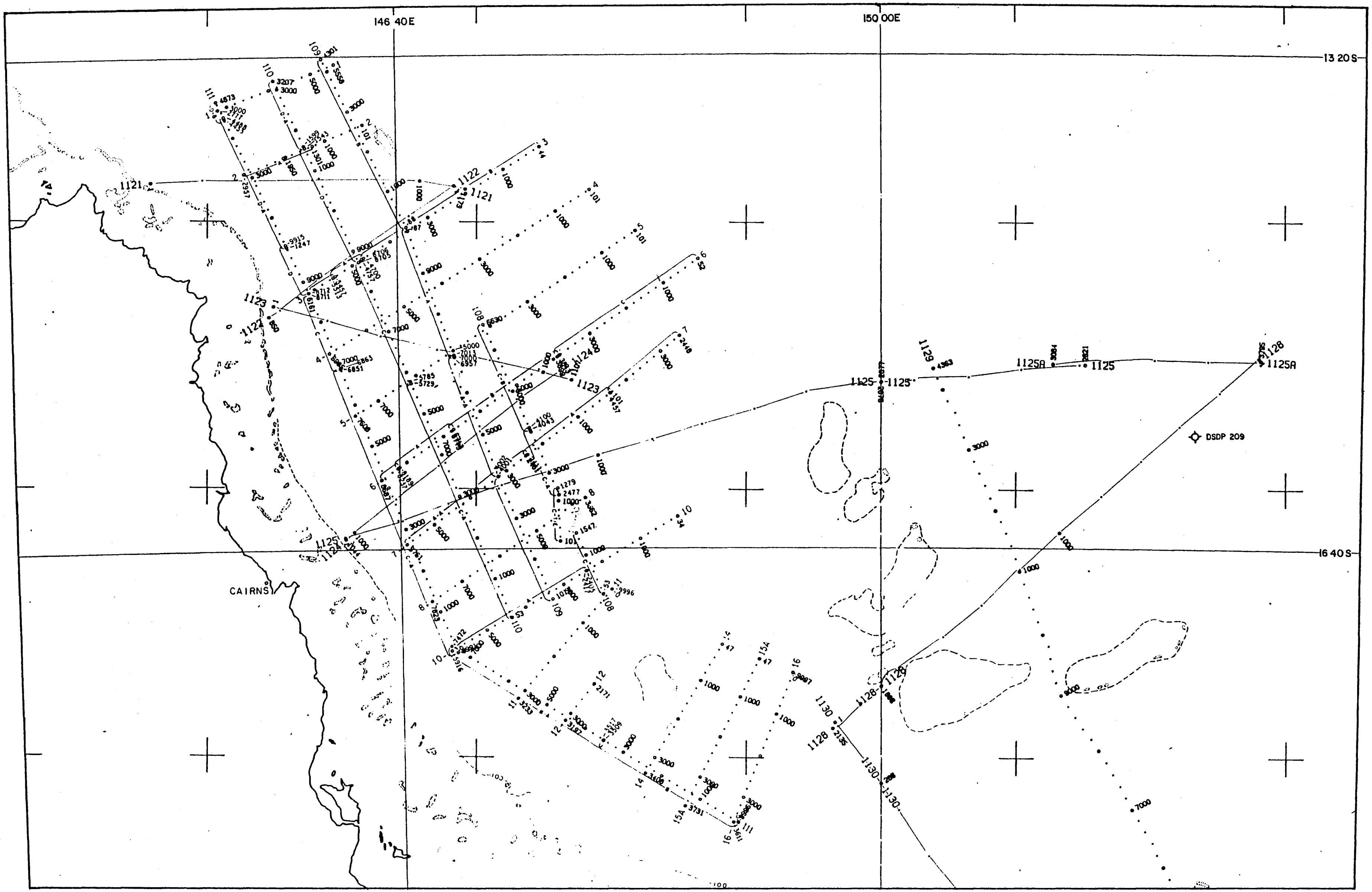


Figure 1.7. Location of the GSI group shoot seismic lines over the Queensland Trough and Queensland Plateau.

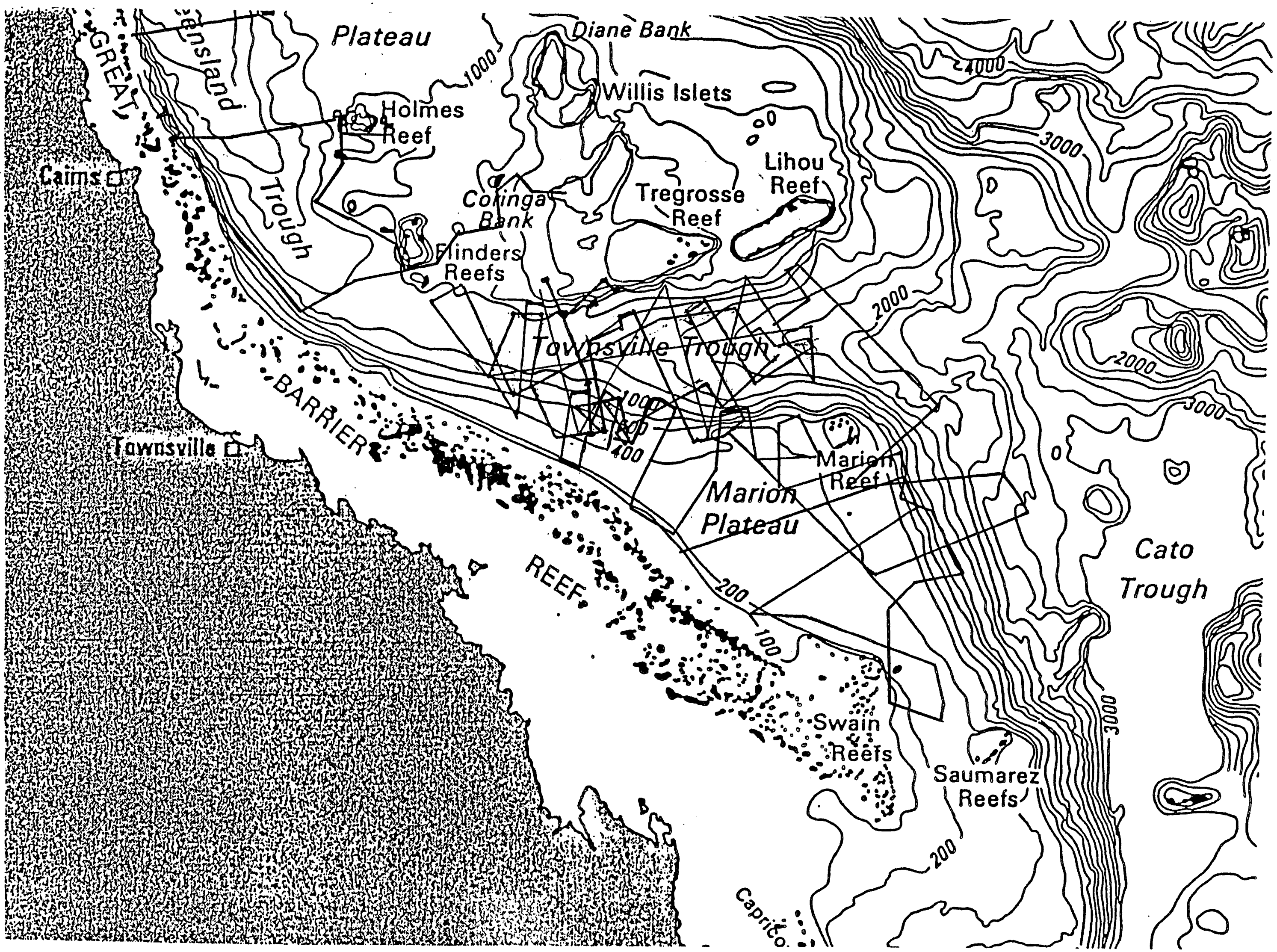


Figure 1.8. Location of the 1985 and 1987 BMR seismic grid in the Townsville Trough.

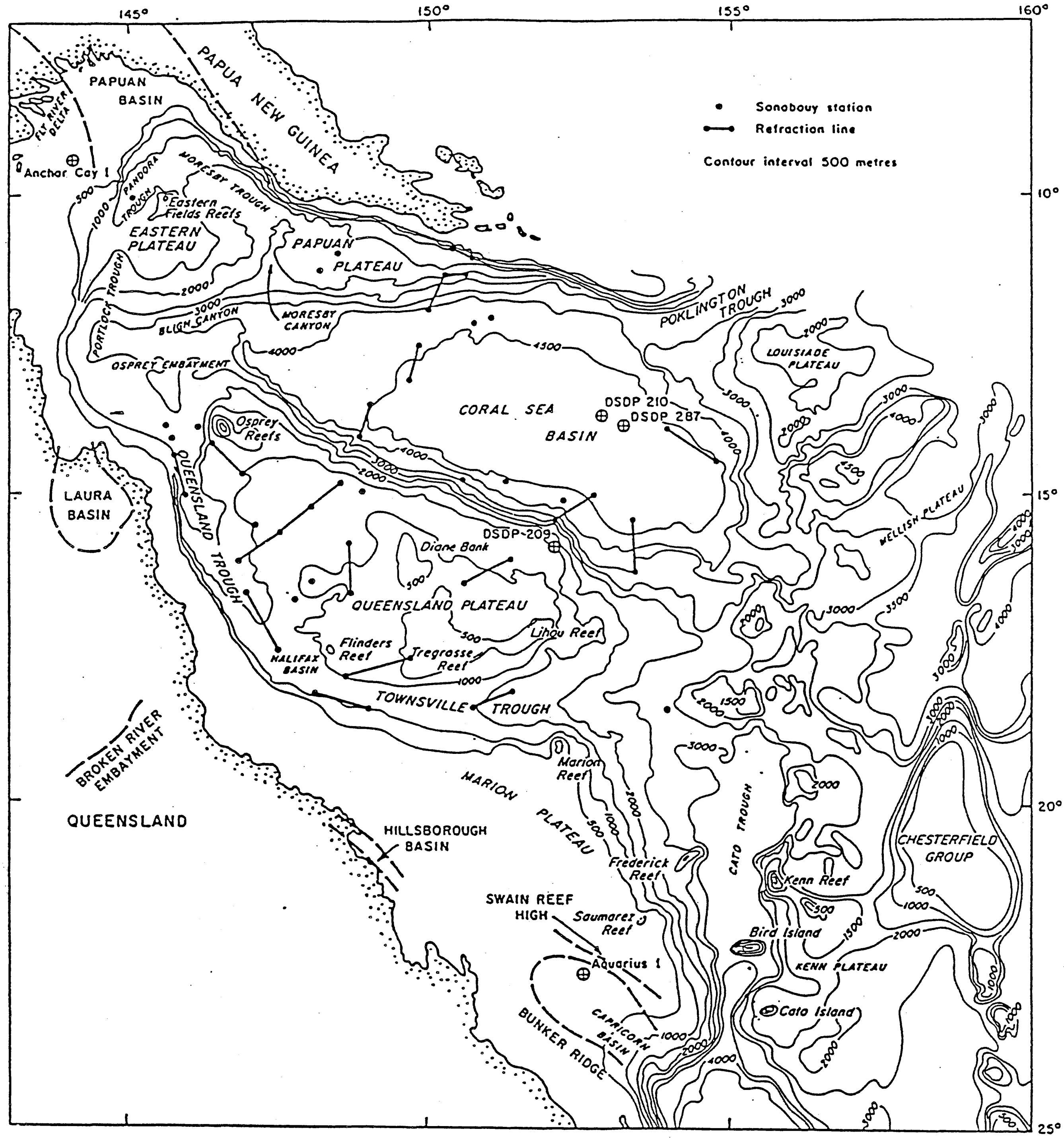


Figure 1.9. Location of crustal refraction profiles in the western Coral Sea.

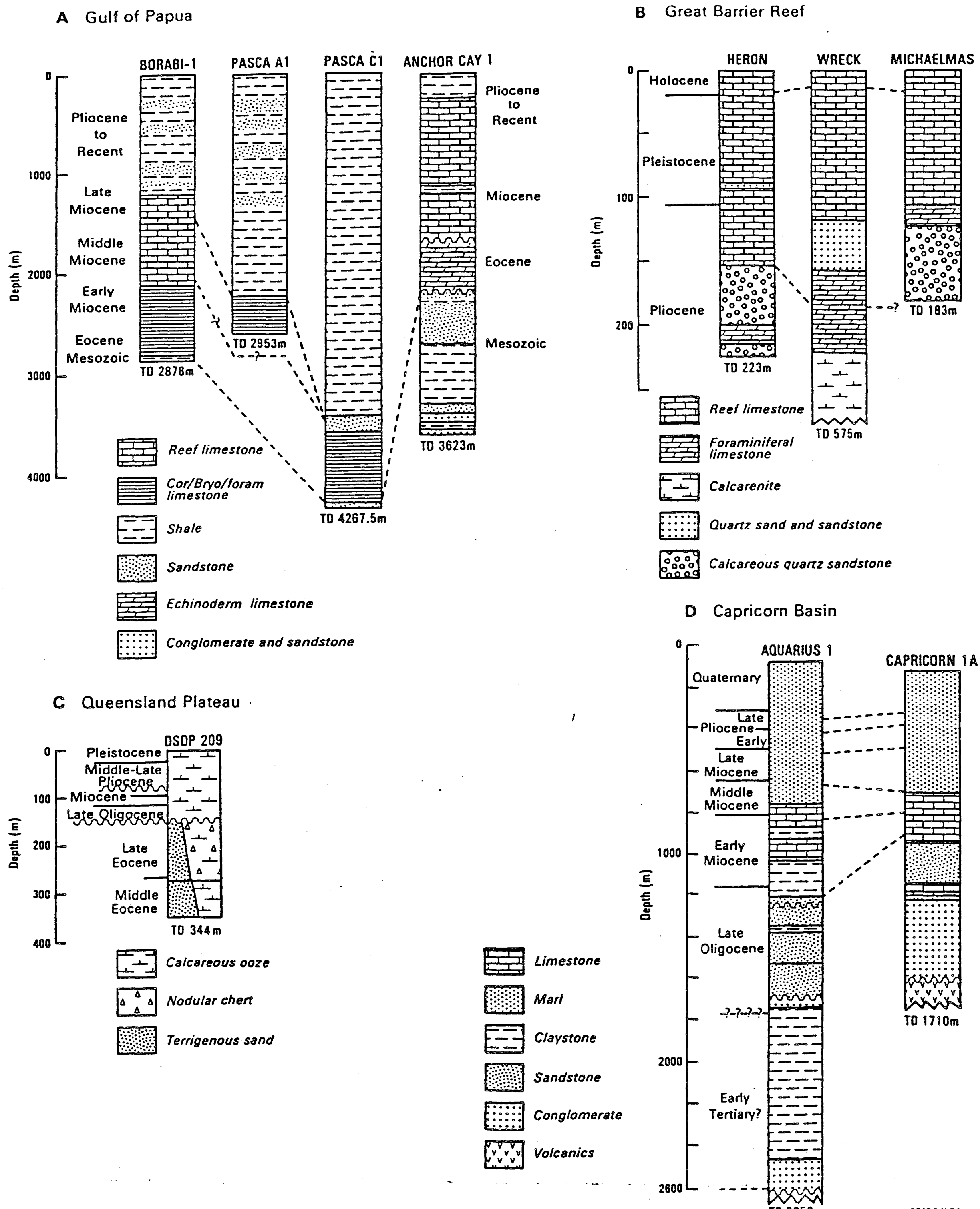


Figure 1.10. Summary lithostratigraphic logs from drill holes in the Gulf of Papua (A), Queensland Plateau (B), Great Barrier Reef (C), and Capricorn Basin (D). Location of drill holes are shown on Figure 1.4.

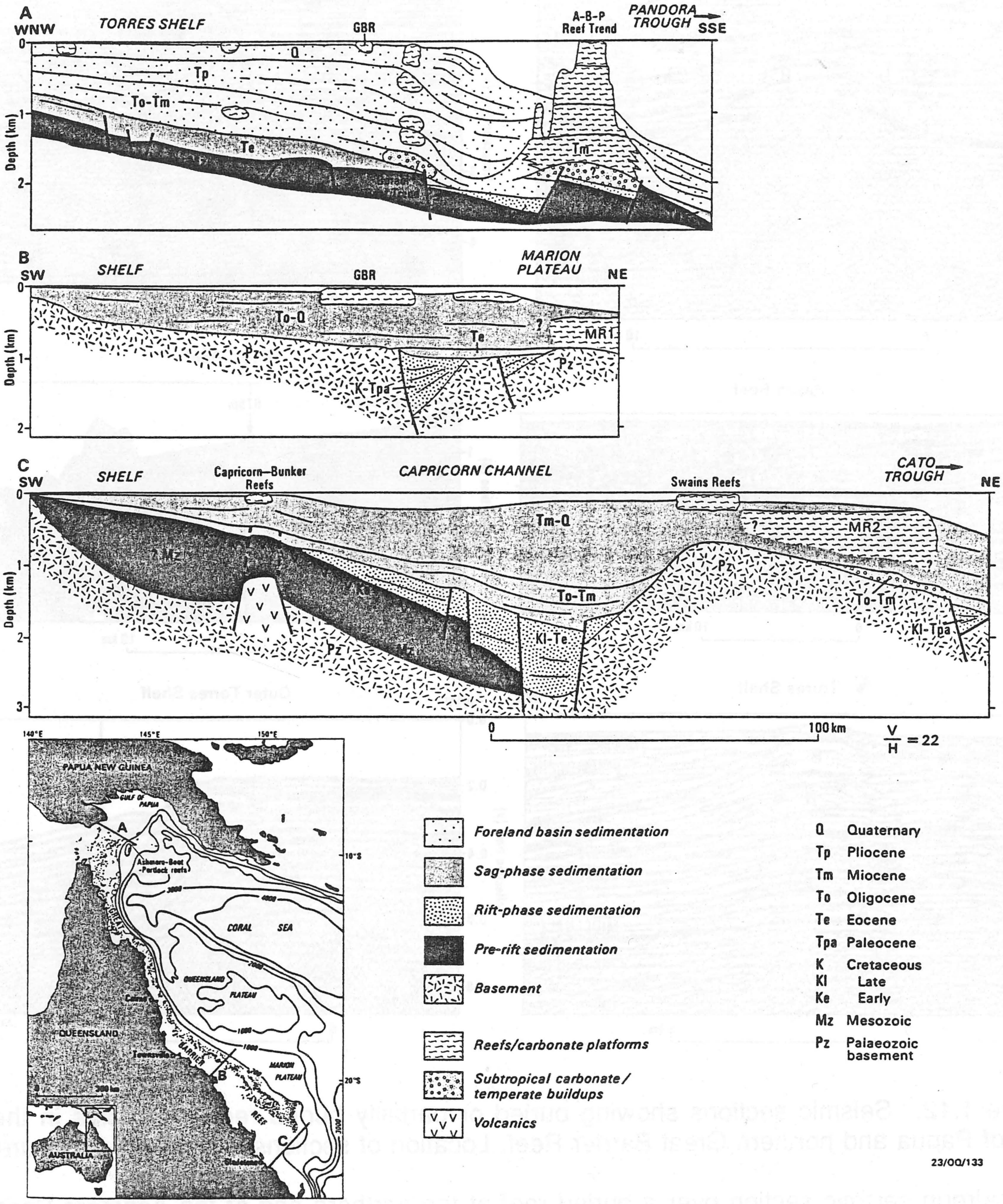


Figure 1.11. Schematic section showing the generalised structure and sedimentary geometry beneath the northern (A), central (B), and southern (C) Great Barrier Reef province. Note MR1 and MR2 refer to different phases of reef growth beneath the Marion Plateau as shown in Figures 1.14 and 1.15.

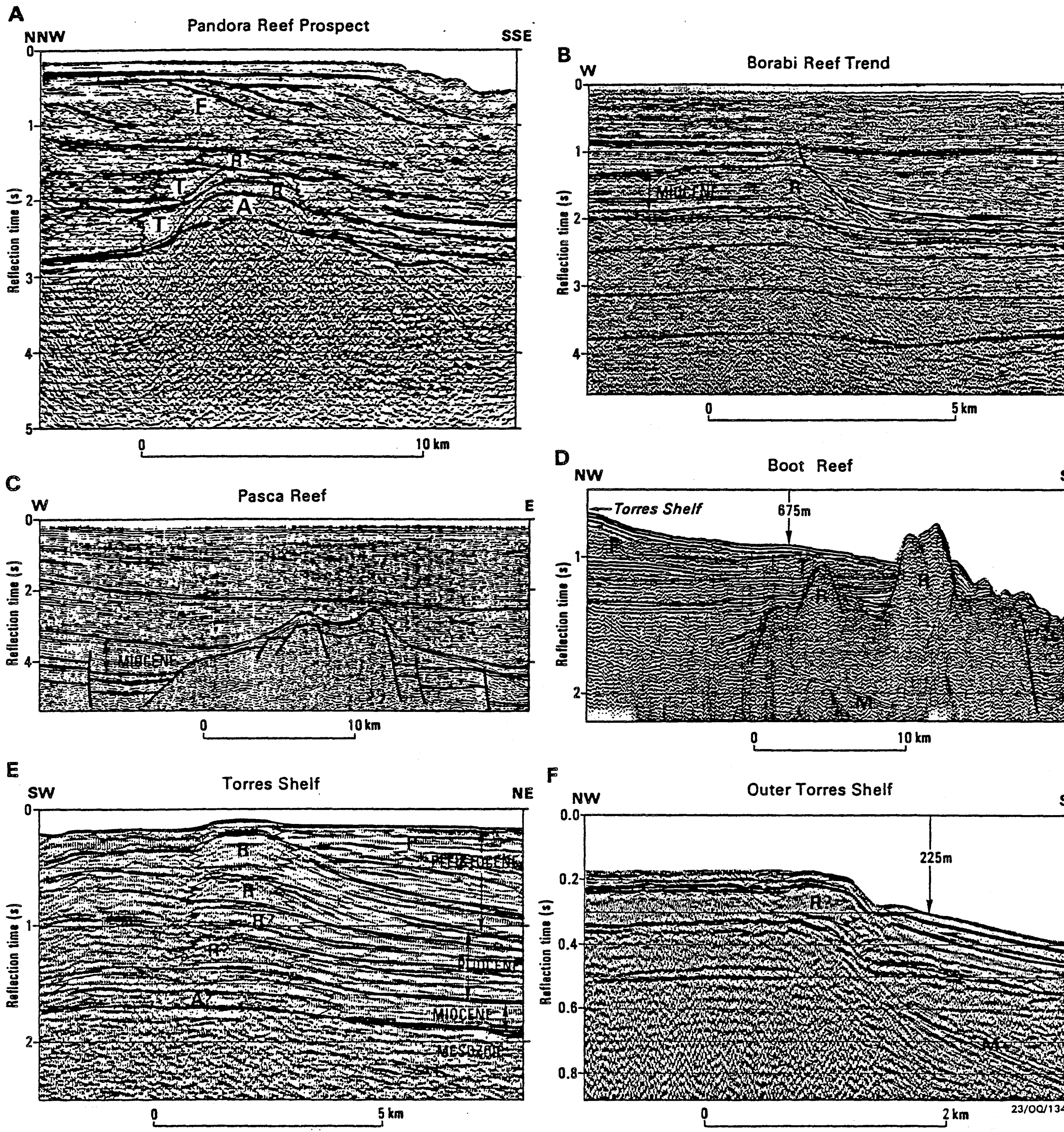


Figure 1.12. Seismic sections showing buried or partially buried reef complexes in the Gulf of Papua and northern Great Barrier Reef. Location of sections are shown on Figure 1.1.

A = Airgun seismic section over a buried reef at the northern end of the Ashmore-Boot-Portlock reef complex.

B = Seismic section across the Borabi reef trend in the Gulf of Papua.

C = Seismic section across the Miocene Pasca reef complex in the Gulf of Papua.

D = Sparker section across the saddle between Boot and Portlock reefs showing buried and partly buried reefs.

E = Airgun seismic section across the edge of the Torres shelf showing the buried northern extension of the present shelf edge ribbon reefs.

F = Sparker section across the outer Torres shelf showing a 100m thick Pleistocene (?) reef (R) partially buried by terrigenous sediment.

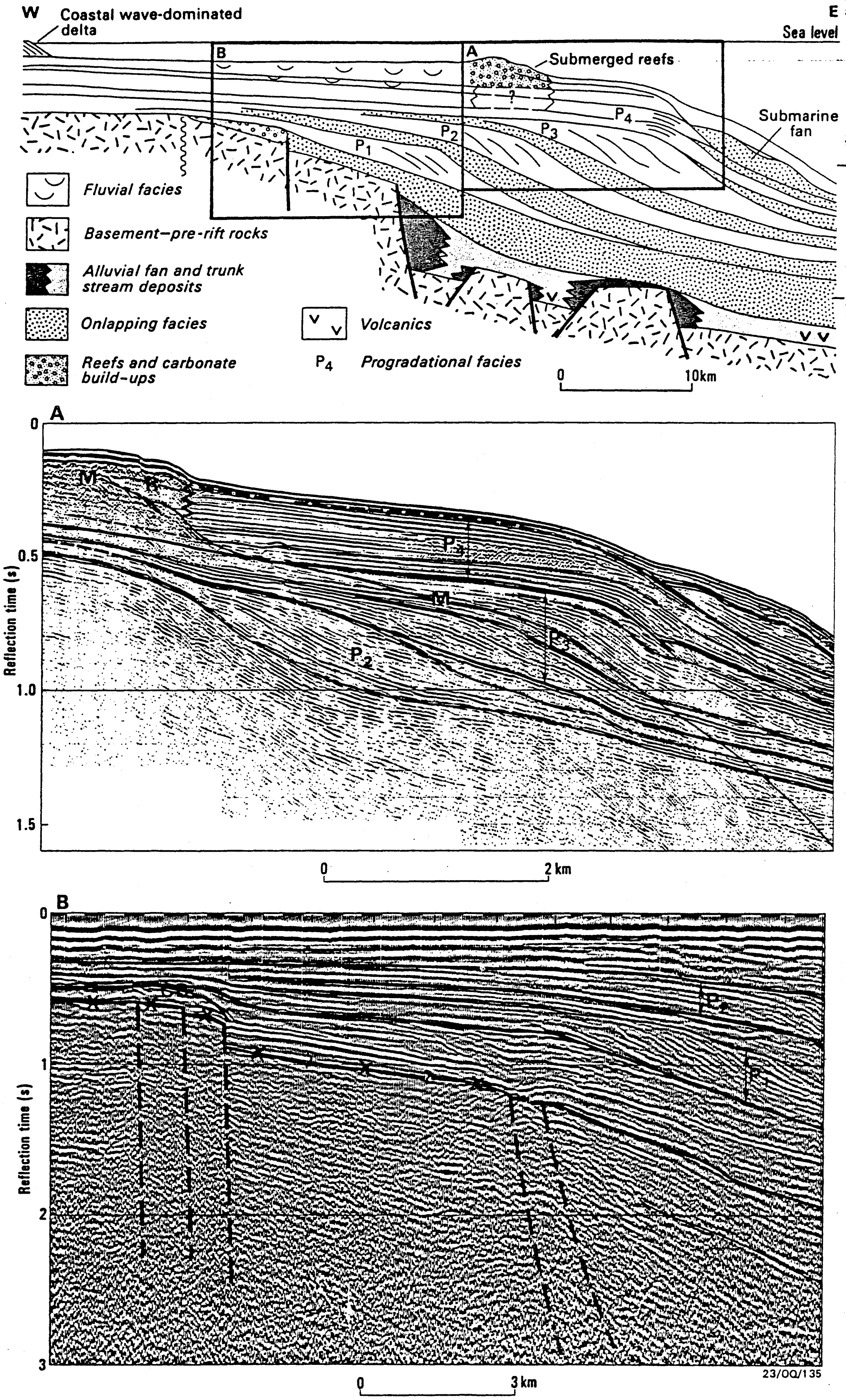


Figure 1.13. Carbonate-terrigenous facies geometry on the upper slope and outer shelf of the central Great Barrier Reef. Inset A is a sparker seismic in the vicinity of ODP Sites 1-4 showing a submerged reef at the seabed (R) and siliciclastic prograding units (P2-P4). Inset B is an aquapulse seismic section showing the position of the outer shelf sequences, particularly the two lower prograding units P1+P2, with respect to underlying basement.

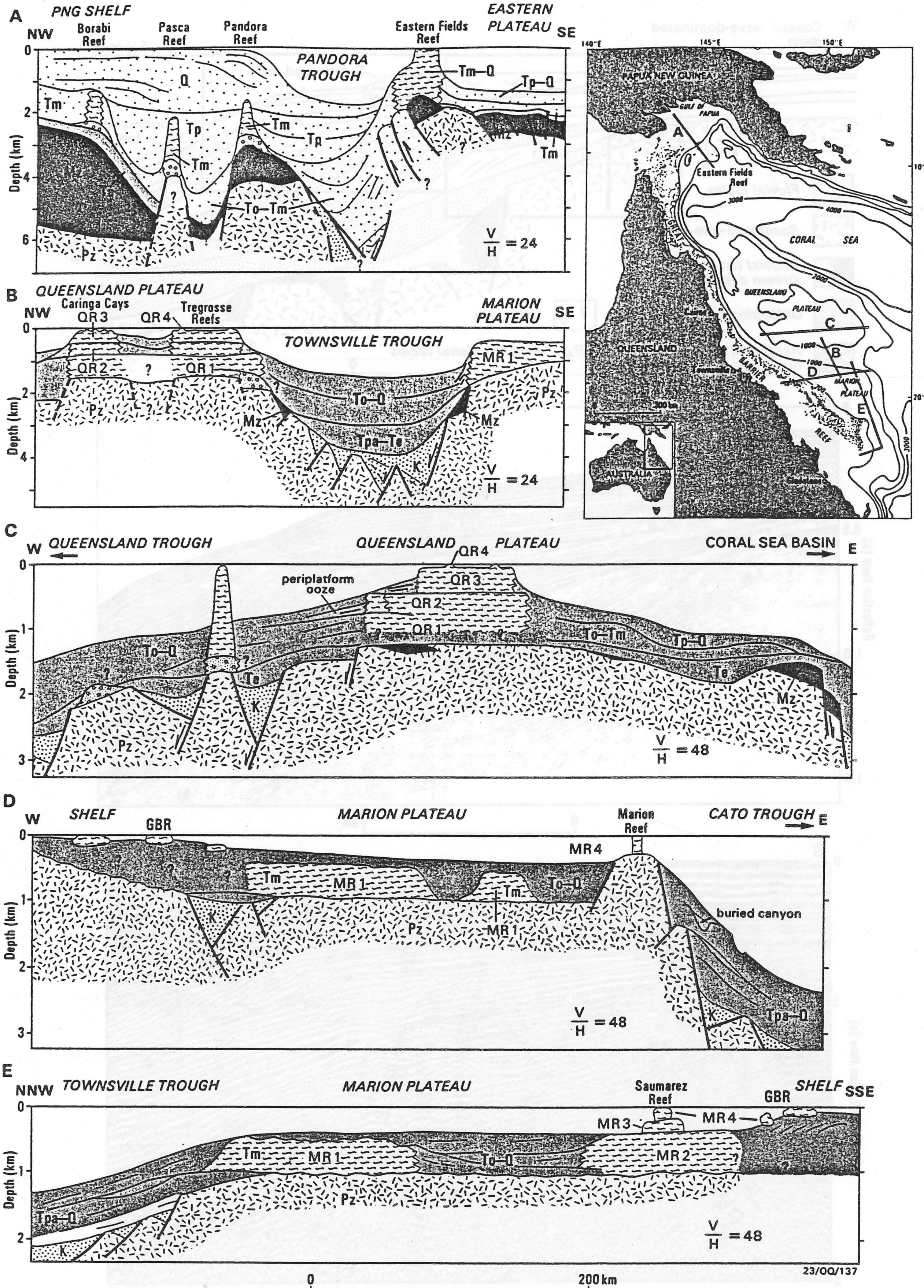


Figure 1.14. Schematic sections showing the generalised structure and sedimentary sequences on the Eastern (A), Queensland (B+C) and Marion (B,D+E) plateaux. QR1 to QR4 and MR1 to MR4 denote phases of carbonate platform growth on the Queensland and Marion plateaux. Symbols and legend as for Figure 1.11.

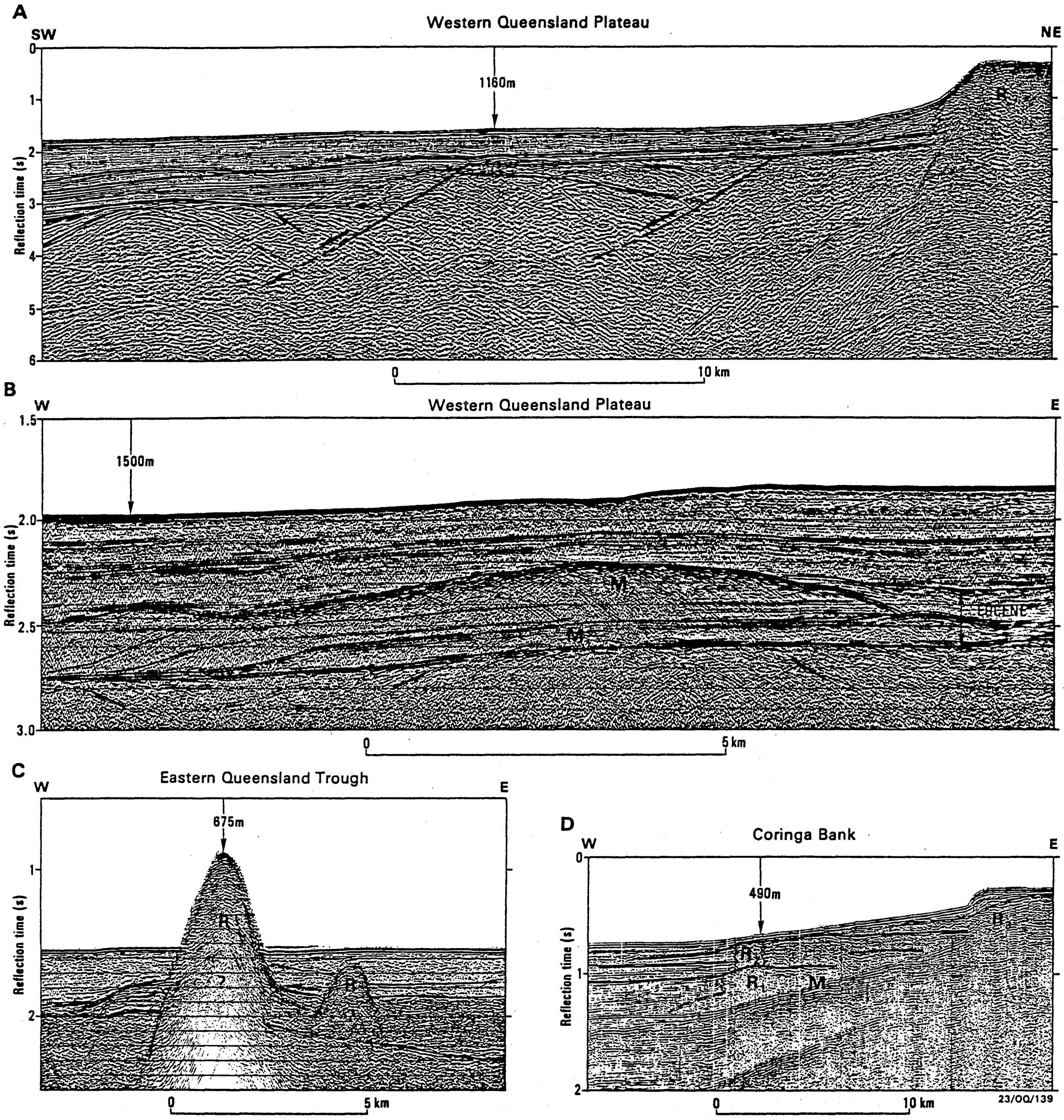


Figure 1.15. Schematic sections across the Queensland Plateau carbonate platforms. Location of sections are shown in Figure 1.1.

A = airgun section across the western Queensland Plateau showing fault bounded tilt blocks and half graben and overlying carbonate bank (R).

B = sparker section showing mounded features (M1+M2), possibly temperate Eocene banks, overlying basement on the western flank s of the Queensland Plateau.

C = sparker section over a steep sided pinnacle (R) rising from 1200m to 675m on the western side of the Queensland Plateau. M iocene and Pliocene reef framework has been dredged from the flanks of this pinnacle.

D = sparker section showing the three major phases of platform reef growth (QR1 to QR3) at Coringa Bank on the central part of the Queensland Plateau.

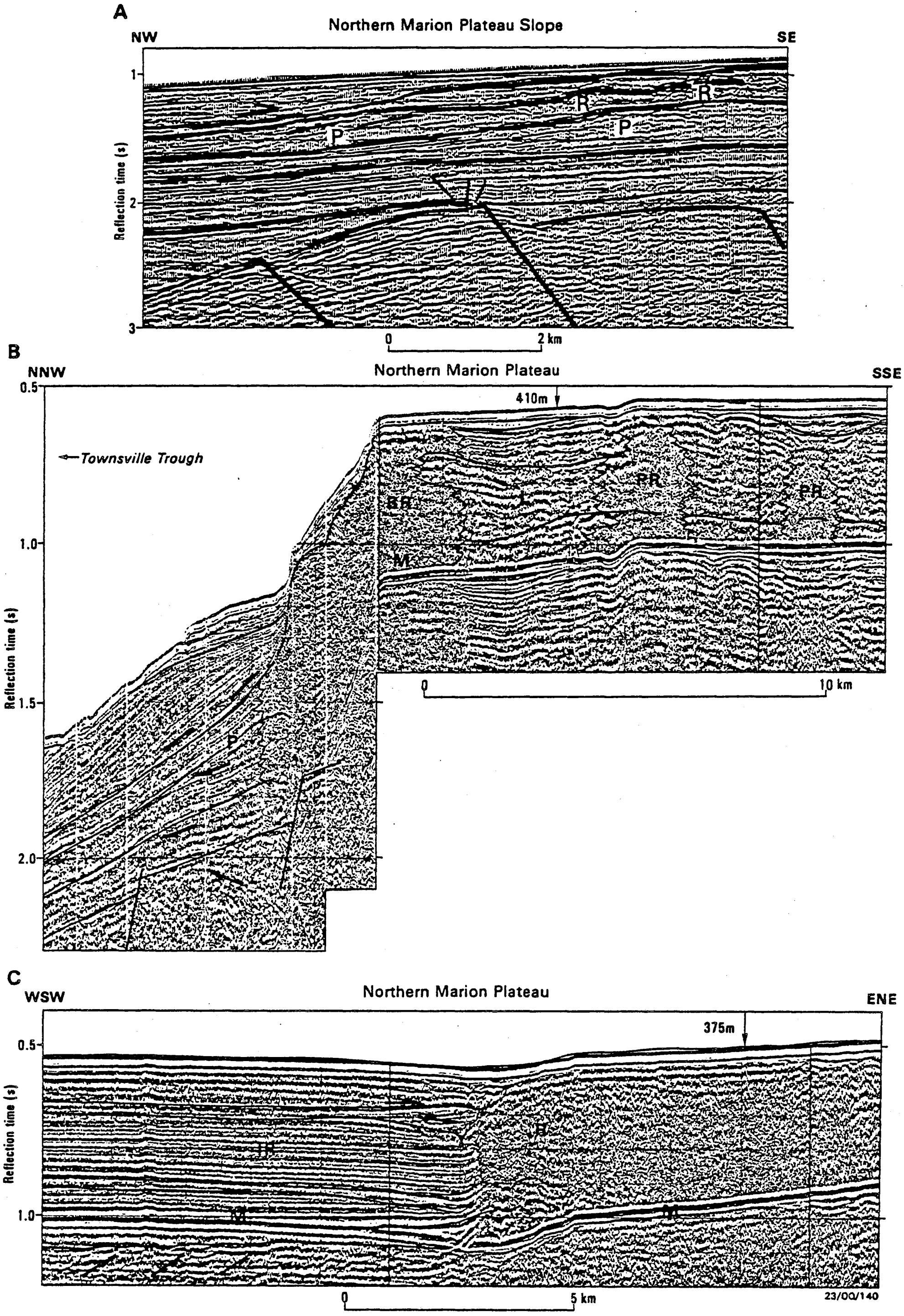


Figure 1.16. Seismic sections across the Marion Plateau to show the carbonate platforms and northern slope of the plateau. Location of sections are shown in Figure 1.1.
A = airgun section across the northern slope of the Marion Plateau showing buried reefs overlying a prograding sequence (P).
B = watergun section showing the MR1 platform in the vicinity of ODP sites 13 & 14 adjacent to the Townsville Trough. Note the reflection free, barrier reef (BR) and patch reef (P) facies, forereef periplatform facies (P) and back barrier, bedded lagoonal facies (L). Note that some reflectors pass into and through the reef facies and may represent low sealevel erosional surfaces.
C = watergun section across the northeastern Marion Plateau showing the development of the platform.

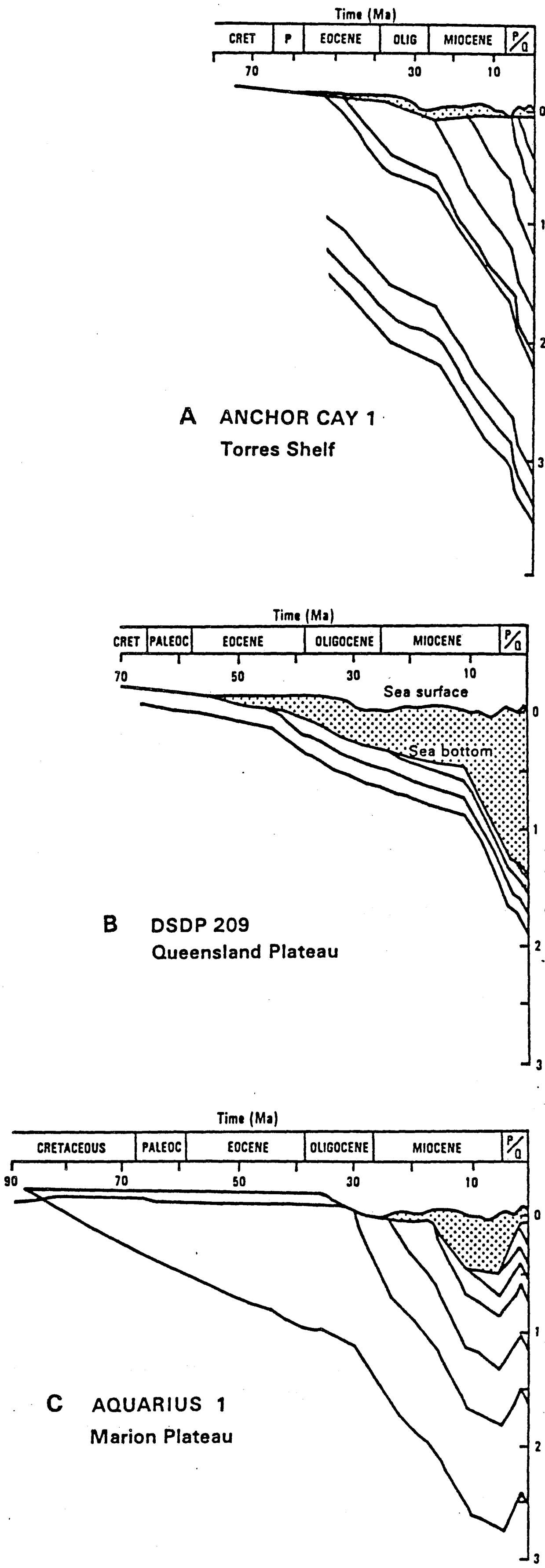


Figure 1.17. Geohistory plots for wells in the northeast Australian region.
A = Anchor Cay on the northern Great Barrier Reef .
B = DSDP site 209 on the Queensland Plateau.
C = Aquarius 1A in the Southern Great Barrier Reef region.
Location of the drill holes are shown in Figure 1.4. Summary logs are shown in Figure 1.10.

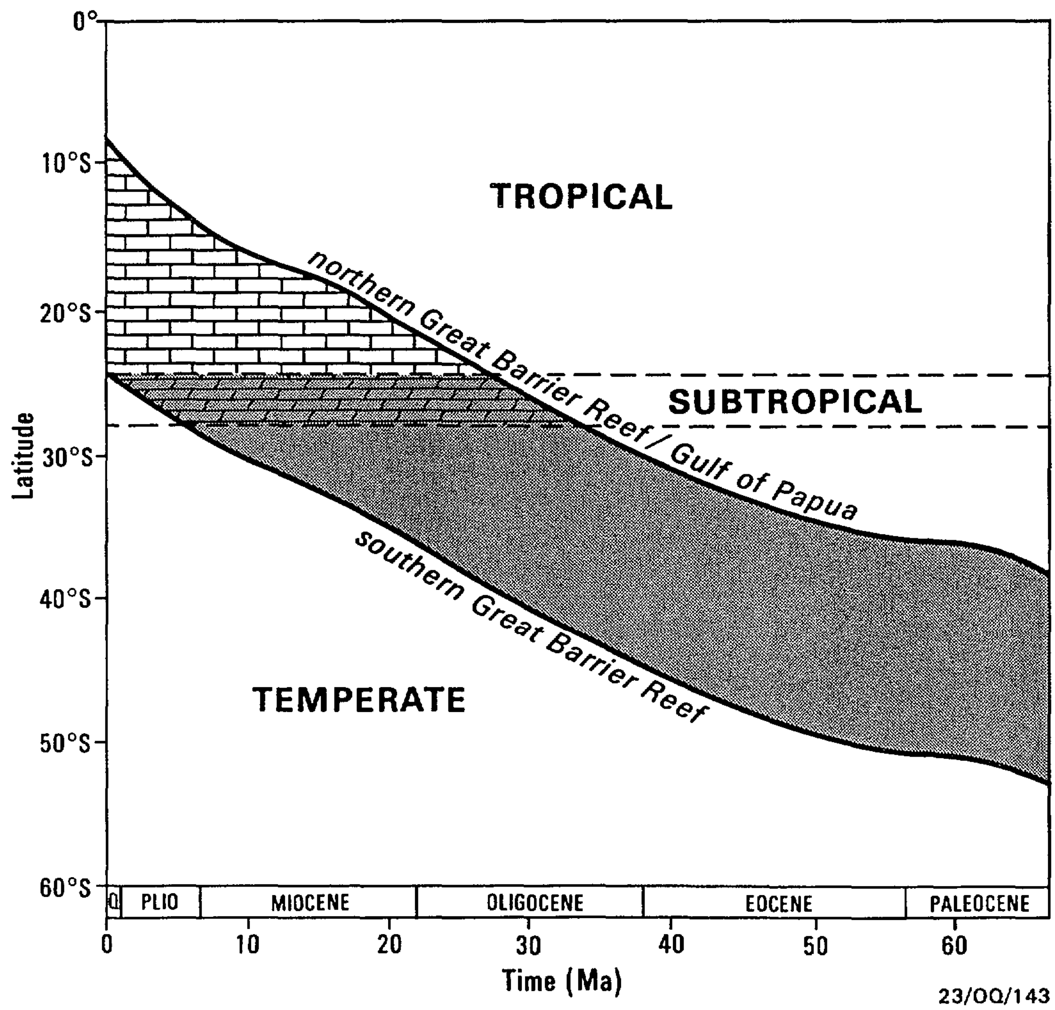


Figure 1.18. Projected latitudinal movement of the northeast Australian region through the Cenozoic, based on hot spot and palaeomagnetic data. The northern boundary corresponds to Anchor Cay (latitude 9°30'S) and the southern boundary corresponds to Heron Island (latitude 24°S).

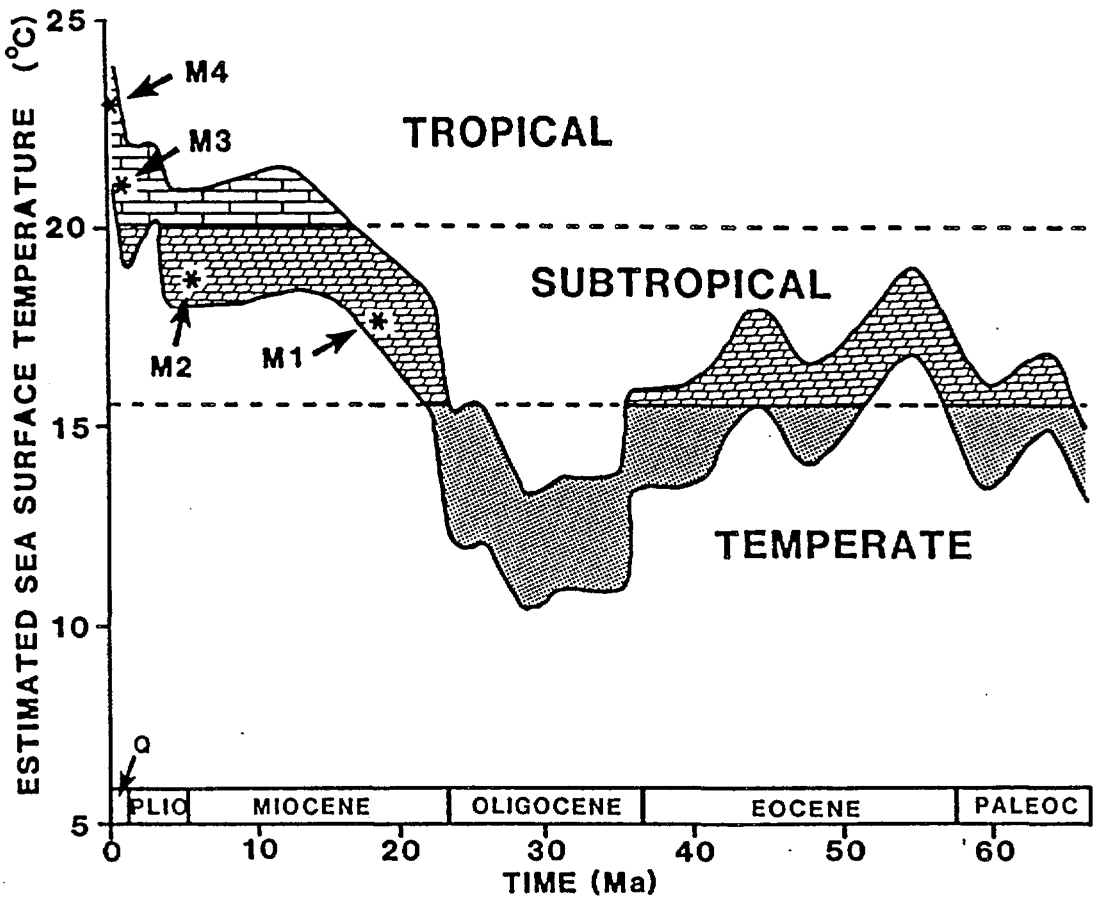


Figure 1.19. Envelope of surface water temperature variation for the northern and southern Great Barrier Reef region throughout the Cenozoic obtained from oxygen isotope data. M1 to M4 represent stages of carbonate platform growth on the Marion Plateau (Feary and others 1990). A possible Miocene "phosphate spike" which may have inhibited reef growth is also shown.

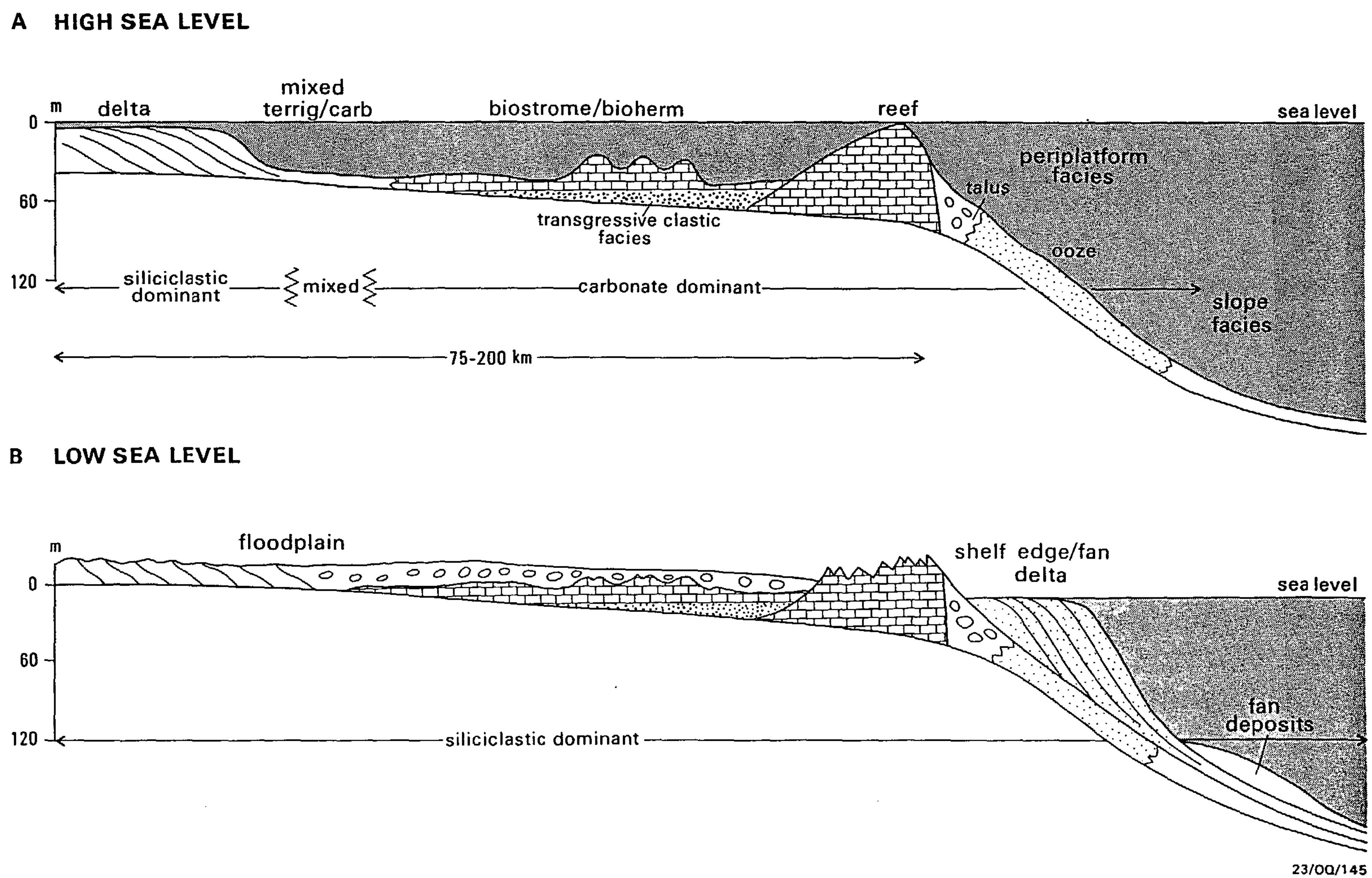


Figure 1.20. Schematic sections illustrating high (A) and low (B) sealevel control on the structural and sedimentary geometry of the shelf facies along the slope of the Great Barrier Reef in the vicinity of ODP sites1-3. Note the predominance of siliciclastics in the low sealevel situation.

Western Slope		Trough		Eastern Slope	
Northern Transect, Latitude 15°41'S					
Depth	Sedimentation	Depth	Sedimentation	Depth	Sedimentation
444 m	22 mm.10^{-3} yrs	1020 m	2.2 mm.10^{-3} yrs	1871 m	3.0 mm.10^{-3} y
850 m	2.2 mm.10^{-3} yrs	1030 m	2.5 mm.10^{-3} yrs	1630 m	2.6 mm.10^{-3} y
946 m	2.3 mm.10^{-3} yrs	1800 m	2.5 mm.10^{-3} yrs	1590 m	0.1 mm.10^{-3} y
1024 m	2.3 mm.10^{-3} yrs	2080 m	2.1 mm.10^{-3} yrs	1545 m	1.0 mm.10^{-3} y
		2060 m	1.8 mm.10^{-3} yrs		
		1871 m	3.0 mm.10^{-3} yrs		
Central Transect, Latitute 18°10'S					
Depth	Sedimentation	Depth	Sedimentation	Depth	Sedimentation
230 m	1.0 mml0.$^{-3}$ yrs	1105 m	1.6 mm.$^{-3}$ yrs		
355 m	1.3 mm.10^{-3} yrs	1198 m	1.8 mm.10^{-3} yrs		
550 m	3.0 mm.10^{-3} yrs	1252 m	1.5 mm.10^{-3} yrs		
690 m	1.9 mm.10^{-3} yrs	1220 m	2.0 mm.10^{-3} yrs		
896 m	2.0 mm.10^{-3} yrs	1145 m	3.4 mm.10^{-3} yrs		
1105 m	1.6 mm.10^{-3} yrs	1150 m	2.0 mm.10^{-3} yrs		
		1190 m	2.6mm.10^{-3}		
		1036 m	2.5 mm.10^{-3} yrs		
		1190 m	3.4 mm.10^{-3} yrs		
Southern Transect, Latitute 18°26'S					
Depth	Sedimentation	Depth	Sedimentation	Depth	Sedimentation
327 m	25.0 mm.10^{-3} yrs				
598 m	25.0 mm.10^{-3} yrs				
740 m	2.3 mm.10^{-3} yrs				
895 m	5.0 mm.10^{-3} yrs				
1034 m	1.0 mm.10^{-3} yrs				
1180 m	1.6 mm.10^{-3} yrs				

Table 1.1. Sedimentation rates on the Queensland continental slope and adjacent trough.

SECTION 2:

SAFETY RISKS AND STRATEGIES

2.1 Safety Strategy

Our proposed safety strategy is two-pronged: (1) to ensure that the terminal depth of each drill site is well above the calculated depth of thermal maturity at each hole; we have, therefore, not attempted to define general regional thermal maturity models based on thermal gradients comparable to those calculated in the Safety Package prepared for the Japan Sea Legs; and (2) to ensure that each hole is sighted off closures or other structural features which may lead to migration and trapping of hydrocarbons developed at greater depth.

In analysing the depth of mature section, none of the holes proposed for drilling during Leg 133 terminate at depths even remotely close to the depth of any calculated oil window. Thus any hydrocarbons at the terminal depths at these sites will have had to migrate long distances and been trapped structurally or stratigraphically. To avoid structural traps, none of the sites are located proximal to closures or faults. At Sites 1, 2 and 3, stratigraphic traps and pinchouts cannot be avoided; however, such sediments are so high in the section, the bodies are of such limited lateral extent, outcrop on the slope, and overlie no recognisable migration pathway, that it is extremely unlikely that they contain hydrocarbons migrated from a depth of greater than two kilometres. However, at these sites and at all others, high quality seismic data have been examined for the presence of subtle angular relationships, other potential pathways of updip migration, direct hydrocarbon indicators and amplitude anomalies. In addition, during the course of drilling, it is intended to monitor for hydrocarbons at all sites, according to the procedures outlined in the JOIDES Safety Manual (Claypool 1986).

2.2 Heatflow, Thermal Maturity and Hydrocarbons off Northeast Australia.

BMR studies off northeast Australia (Table 2.1; Choi, Stagg and others, 1987) define heatflow values ranging from 33 to 86 mW/m^2 with an average value of about 60 mW/m^2. Thermal conductivity measurements range from 0.78 to 0.97 W/m/K and thermal gradients from 37-107$^oC/K$.

In general, heatflow values in the Queensland Trough are close to the world average (Jessop and others, 1976). The new BMR data show that there is a general correlation between basement structure and heatflow: where the basement is shallow and has thin sediment cover, the heatflow values are higher than those areas with thick sediment. Heatflow values generally decrease towards the centre of the basin.

We have not attempted to construct general thermal maturity models for the region based on various thermal gradients and comparable, therefore, to those calculated in the Safety Package prepared for the Japan Sea Legs. Instead, we have adopted the more site specific approach of defining the maturity for specific sites and offering these as examples of thermal maturity in specific site areas. In these calculations, we have followed the methodology of Lopatin (1971) and Waples (1980). For ODP drill sites in northeast Australia the following assumptions have been made:

1. The rate of maturation, based on the Arrhenius equation, doubles for every 10°C rise in temperature (r=2).

2. Thermal gradients for Sites 2, 5 and 11 are constant throughout the sections. Values of thermal gradients are based on measurements made by BMR and reported in Choi, Stagg and others (1987).

3. Thermal maturity occurs at TTI=15.

4. Age versus depth relations have been obtained from BMR, Gulf and Shell seismic data interpreted through ties to DSDP 209.

2.2.1 Sites 1, 2 and 3 - Western Margin of the Queensland Trough

As Sites 1, 2 and 3 are very close together, we have developed a maturation model for Site 2 and propose that it also applies to Sites 1 and 3. In the geohistory diagram (Fig. 2.1), interpreted depths of the Pliocene/Miocene, late Middle Miocene and the Oligocene/Eocene have been used to reconstruct the age/depth relations. It is assumed that paleowater depth has not varied significantly over the time for the experiment. Sea level-induced changes of 100 m or so will not have significantly affected the final conclusions. For calculating the depths of thermal maturity, a thermal gradient of 55°C/K was used as measured at heatflow station 53-CH-HF06 (Choi, Stagg et al., 1987). Bottom water temperatures of around 10°C (Choi, Stagg et al., 1987) are assumed to have been relatively constant. Using the depth and velocity plots and the internal velocities for Site 2 (Fig. 2.2), the depths to the above specified key horizons are defined.

It is clear from Figure 2.1 that both the Middle Miocene and the Oligocene/Eocene reflectors display total TTI values far less than those necessary (TTI=15) for the onset of oil generation, assuming that source rocks were present in the first place. However, it is also clear that the picked Paleocene reflector has a total TTI value (2825) higher than the limit necessary for the occurrence of wet gas. The estimated depths of maturity, assuming the presence of the necessary source rocks, are between 191 and 2172 m (Fig. 2.3), equivalent to a depth of 1.8

and 1. 9 secs. This represents the late Paleocene to Early Eocene sections. Most of the Paleocene section is indeed overmature.

Drilling at Sites 1, 2 and 3 are proposed to depths of 300-400 m. These are some 1500-1600 m higher than the top of the oil window and clearly define no calculable drilling risk.

Analysis of the seismic data define facies geometrics and variation which could act as traps. Such features are, however, discontinuous and not structurally disposed. They are not connected in any recognisable way to any deep-seated 'kitchen'.

2.2.2 Site 5 - Queensland Trough

Construction of the geological history of Site 5 has been attempted by identifying the late Middle Miocene, the Oligocene/Eocene, and the Paleocene. However, the calculation is complicated because we are unsure of the age of some key reflectors. The seismic section across the Queensland Trough shows a major basement high which makes tying to DSDP 209 somewhat difficult. We have in fact carried the tie but are left with two alternatives for the depth of the Oligocene/Eocene reflector; at 3.37 secs or 2.98 secs. The thermal gradient is 74^{o}C/K as measured at heatflow station 53-CH-HF01 (Choi, Stagg and others, 1987), and the bottom temperature as reported in the same publication is 2.5^{o}C. It is assumed to have remained constant throughout the experiment. The results for both cases are shown in Figures 2.4-2.9. In the case where the Oligocene/Pliocene is picked at 3.37 secs, the calculated TTI values of late Middle Miocene, Early Miocene and Oligocene/Eocene are less than 15 (Figs 2.4, 2.5). In this case the estimated depth of maturity shown in Figure 2.6 is calculated as 1644 m (=3.504 secs).

In the case where the Oligocene/Miocene is picked at 2.98 secs, TTI values of all horizons down to the Oligocene/Eocene boundary are less than 15 (Fig. 2.7). The estimated depth of maturity shown in Figures 2.7 and 2.9 is calculated at 1620 m (=3.49 secs).

Both cases show that the depth of the possible oil window is significantly deeper than the 900 m proposed as the target depth for Site 5. In addition, analysis of the seismic data shows no structuring. All the reflectors are very flat-lying. Migration of any hydrocarbons generated from depths of 3.5 secs is, therefore, extremely unlikely. Drilling at Site 5 represents negligible safety risk.

2.2.3 Site 11 - Townsville Trough

For the construction of the geological history of Site 11, reflectors interpreted as Late Miocene, Early Miocene and Oligocene have been used to determine the age/depth relation (Fig. 2.11). As the thermal gradient for the proposed site location is unknown, TTI values for the

Oligocene/Eocene reflector are calculated for three different maturation models, with thermal gradients of 64°C/K (DSDP 209), 75°C/K, and 100°C/K. The bottom temperature is estimated at 5°C and is assumed to be constant throughout the experiment.

Maturity models for both thermal gradients of 63°C/K and 75°C/K display total TTI values less than 15 (Figs 2.10, 2.12) for the Oligocene/Eocene reflector. This is below the termination depth. For this reason, estimation of depth of maturity is not carried out, as the basement directly underlies the Oligocene/Eocene reflector.

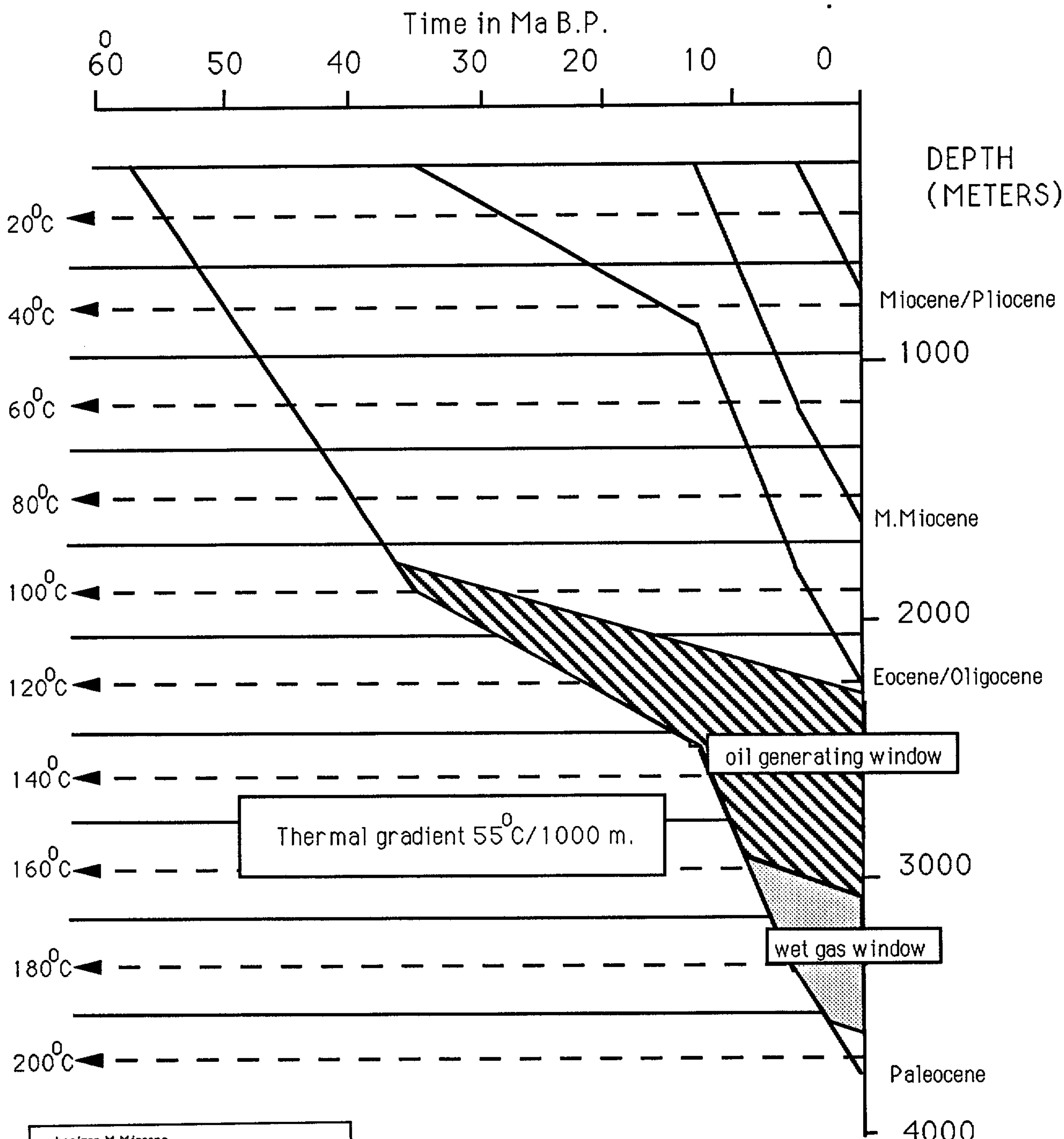
In the case where the thermal gradient is 100°C/K (Fig. 2.13), the Oligocene/Eocene reflector has a total TTI value (22) within the values necessary for the onset of oil generation. The estimated depth of maturity in this case is between 1340 and 1240 m, equivalent to depths of 2.35-2.29 secs. Drilling at Site 11 is proposed to a depth of 750 m. In the case of a thermal gradient as high as 100°C/K, the maximum depth of drilling will still be approximately 500 m higher than the top of the oil window.

All three alternative cases show depths of maturity deeper than the 750 m drill-depth, as proposed at Site 11.

Examination of the seismic data shows small basement faults. In view of the low TTI values, calculated from thermal gradients of 63°C/K-75°C/K (the most reasonable cases) it is unlikely that oil generation above basement would utilise these as migration pathways. It is concluded, therefore, that the drill site as proposed is safe although movement of the site away from the faulted basement zone can be considered.

2.2.4 Analysis of DSDP Site 209

At DSDP Site 209 on the Queensland Plateau, organic carbon values ranged from 0% at the surface to 0.8% at a depth of 337 m (Table 2.2). Heatflow measurements define the thermal gradient as 63°C/K. Drilling reports make no mention of gas or drilling difficulties associated with gas. The data suggests that for the section drilled on the Queensland Plateau, source rocks were not present and maturity was not achieved in the sediments.



horizon M.Miocene

	r^n	time (my)	interval TTI
10-20	2^{-9}	1.86	3.6 E-3
20-30	2^{-8}	1.86	7.2 E-3
30-40	2^{-7}	1.86	1.4 E-2
40-50	2^{-6}	1.86	2.9 E-2
50-60	2^{-5}	1.86	5.8 E-2
60-70	2^{-4}	2.35	1.5 E-1
70-80	2^{-3}	2.35	2.9 E-1
80-90	2	1.00	0.25
		total time 15 Ma	total TTI: 0.80

horizon Eocene/oligocene

		time (my)	interval TTI
10-20	2^{-9}	6.5	1.3 E-2
20-30	2^{-8}	6.5	2.5 E-2
30-40	2^{-7}	6.5	5.1 E-2
40-50	2^{-6}	2.16	3.4 E-2
50-60	2^{-5}	1.86	5.8 E-2
60-70	2^{-4}	1.86	1.2 E-1
70-80	2^{-3}	1.86	2.3 E-1
80-90	2^{-2}	1.86	4.6 E-1
90-100	2^{-1}	1.9	9.5 E-1
100-110	2^{0}	2.0	2
110-120	2^{1}	2.0	4
		total time 35 Ma	total TTI: 7.94

Horizon Paleocene	r^n	time (my)	interval TTI
10-20	2^{-9}	2.56	5.0 E-3
20-30	2^{-8}	2.56	1.0 E-2
30-40	2^{-7}	2.56	2.0 E-2
40-50	2^{-6}	2.56	4.0 E-2
50-60	2^{-5}	2.56	8.0 E-2
60-70	2^{-4}	2.56	1.6 E-1
70-80	2^{-3}	2.56	3.2 E-1
80-90	2^{-2}	2.56	6.4 E-1
90-100	2^{-1}	2.56	1.28
100-110	2^{0}	6.5	6.5
110-120	2^{1}	6.5	13
120-130	2^{2}	6.5	26
130-140	2^{3}	3.27	26.16
140-150	2^{4}	1.86	29.76
150-160	2^{5}	1.86	59.52
160-170	2^{6}	1.86	119.04
170-180	2^{7}	1.86	238.08
180-190	2^{8}	2.0	512
190-200	2^{9}	2.0	1024
200-210	2^{10}	0.75	768
		total time 58 Ma	total TTI: 2824.6

Figure 2.1. Thermal and burial history diagram (for a thermal gradient of 55°C/1000 m) for site NEA 2 (Great Barrier Reef upper slope), based on the methods of Lopatin (1971) and Waples (1980).

depth (msec)	Int.Velocity	depth (meters)
0 MSEC		240 METERS
325 MSEC	1749 M/SEC	218.6 METERS
575 MSEC	2037 M/SEC	270 METERS
MIOCENE/PLIOCENE 840 MSEC		188.4 METERS
1025 MSEC	2560 M/SEC	192 METERS
1175 MSEC	3598 M/SEC	512 METERS
M.MIOCENE 1460 MSEC		611.6 METERS
EOCENE/OLIGOCENE 1800 MSEC		225 METERS
1925 MSEC	5885 M/SEC	1338.9 METERS
PALEOCENE 2380 MSEC		
2825		

depth Miocene / Pliocene : 488.6 meters
Late Middle Miocene : 1381 meters
Eocene / Oligocene : 1992.6 meters
Paleocene : 3556.5 meters

msec	m/sec	Int.Vel
325	1474	1749
575	1600	2037
1025	1805	2560
1175	1918	3598
1925	2700	5885
2825	4000	

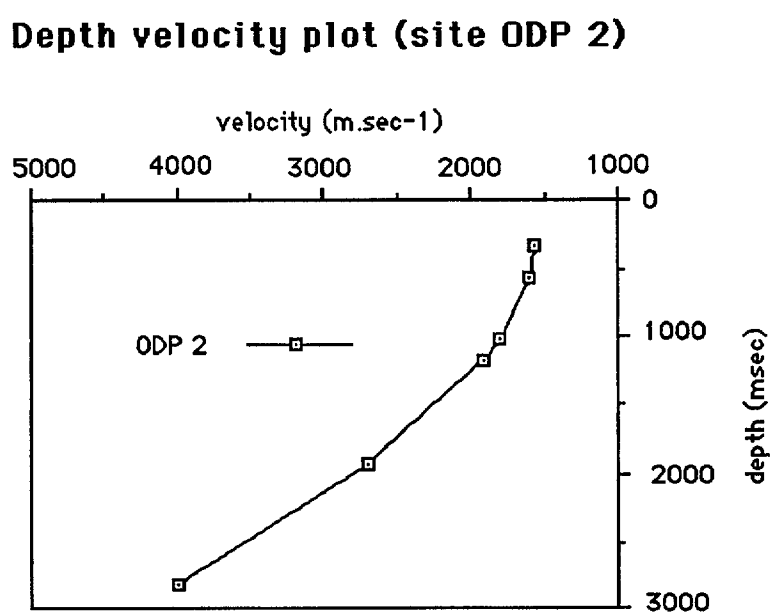
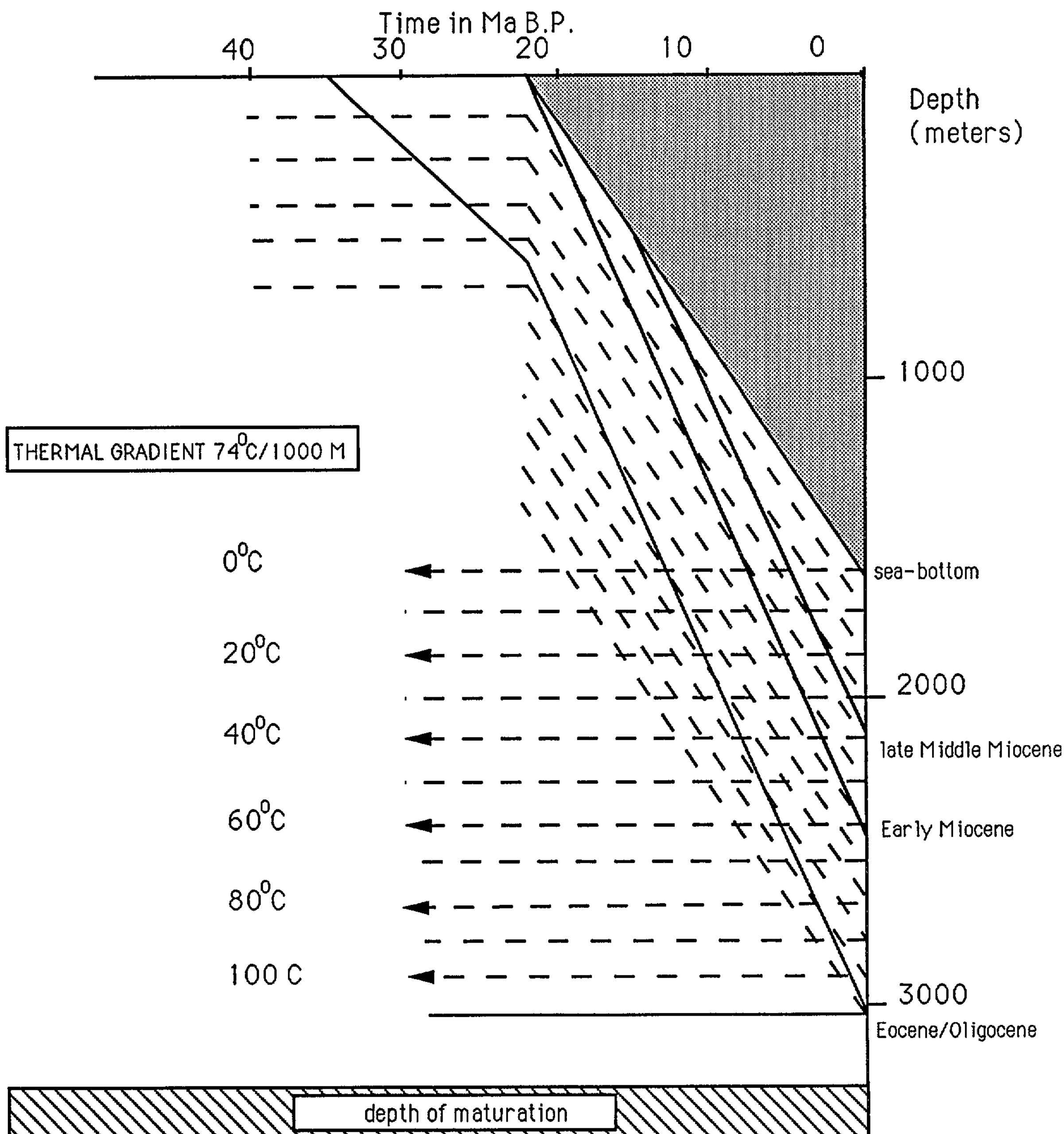


Figure 2.2. Time-depth conversion parameters for site NEA 2 (Great Barrier Reef upper slope) - based on seismic stacking velocities.

Horizon maturity	r^n	time (my)	interval TTI
10-20	2^{-9}	6.5	1.3 E-2
20-30	2^{-8}	6.5	2.5 E-2
30-40	2^{-7}	6.5	5.1 E-2
40-50	2^{-6}	6.5	1.0 E-1
50-60	2^{-5}	2.16	6.7 E-2
60-70	2^{-4}	1.86	1.2 E-1
70-80	2^{-3}	1.86	2.3 E-1
80-90	2^{-2}	1.86	4.6 E-1
90-100	2^{-1}	1.86	9.3 E-1
100-110	2^{0}	1.9	1.9
110-120	2^{1}	2.0	4
130-140	2^{2}	2.0	8
	total time	41.5 Ma	total TTI : 15.9

Time of maturation: approx. 41 Ma.
Depth of maturation: in between 1991 and 2172 meters (eq. 1799 and 1900 msec.)

Figure 2.3. Estimated depths for maturity at site NEA 2 (Great Barrier Reef upper slope).



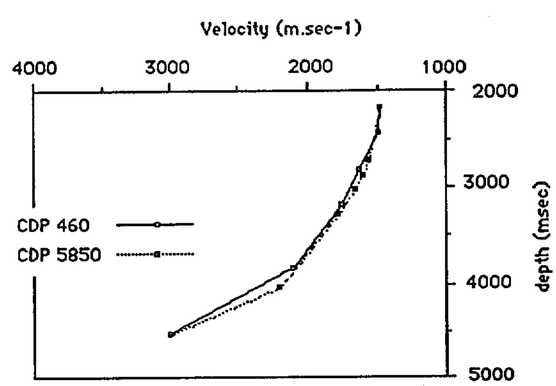
horizon Eocene/oligocene	r^n	time (my)	interval TTI	total TTI
0-10	2^{-10}	3.18	3.1 E-3	3.1 E-3
10-20	2^{-9}	3.18	6.2 E-3	9.3 E-2
20-30	2^{-8}	3.18	1.2 E-2	2.1 E-2
30-40	2^{-7}	3.18	2.5 E-2	4.6 E-2
40-50	2^{-6}	3.18	5.0 E-2	9.6 E-2
50-60	2^{-5}	3.18	9.9 E-2	1.9 E-1
60-70	2^{-4}	3.18	2.0 E-1	3.9 E-1
70-80	2^{-3}	3.18	4.0 E-1	7.9 E-1
80-90	2^{-2}	3.18	7.9 E-1	1.58
90-100	2^{-1}	3.18	1.59	3.17
100-110	2^{0}	3.18	3.18	6.35
		total time 35 Ma		total TTI : 6.35

Figure 2.4. Thermal and burial history diagram (for a thermal gradient of 74°C/1000 m) for site NEA 5 (west/central Queensland Trough), based on the methods of Lopatin (1971) and Waples (1980) where the Eocene/Oligocene unconformity is at 3.37 secs (TWT).

depth (msec)	Int.Velocity	depth (meters)
0 MSEC		
	1485 M/SEC	1615 meters
2175 MSEC		
	1598 M/SEC	199.75 meters
2425 MSEC		
	2301 M/SEC	316.4 meters
late middle miocene 2700 MSEC		143.8 meters
2825 MSEC		
	2485 M/SEC	192.6 meters
early miocene 2980 MSEC		242.3 meters
3175 MSEC		
	3333 M/SEC	325 meters
eocene / oligocene 3370 MSEC		
3825 MSEC		

DEPTH LATE MIDDLE MIOCENE : 516.4 METERS
EARLY MIOCENE : 852.8 METERS
EOCENE/OLIGOCENE : 1420.1 METERS

Depth velocity plot (site NEA 5)



CDP 460

msec	m/sec	Int.Vel
2175	1485	1598
2425	1479	2301
2825	1635	2485
3175	1749	3333
3825	2104	5830
4525	3000	

CDP 5850

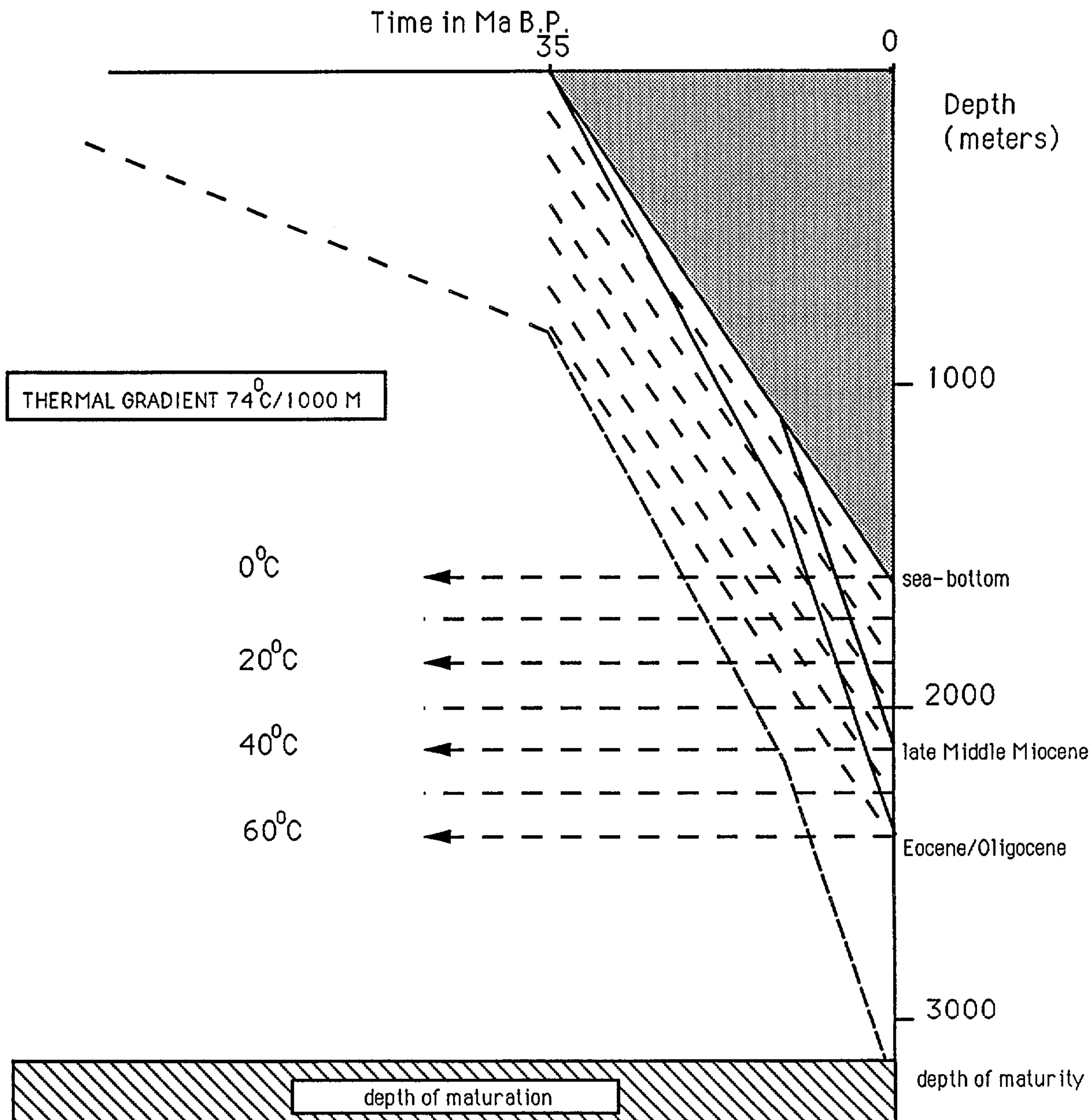
msec	m/sec
2175	1485
2725	1559
2875	1606
3025	1656
3275	1775
4025	2212
4525	3000

Figure 2.5. Time-depth conversion parameters for site NEA 5 (west/central Queensland Trough) for the case where the Eocene/Oligocene unconformity is at 3.37 secs (TWT)- based on seismic stacking velocities.

horizon maturation	r^n	time (my)	interval TTI	total TTI
0-10	2^{-10}	3.18	3.1 E-3	3.1 E-3
10-20	2^{-9}	3.18	6.2 E-3	9.3 E-2
20-30	2^{-8}	3.18	1.2 E-2	2.1 E-2
30-40	2^{-7}	3.18	2.5 E-2	4.6 E-2
40-50	2^{-6}	3.18	5.0 E-2	9.6 E-2
50-60	2^{-5}	3.18	9.9 E-2	1.9 E-1
60-70	2^{-4}	3.18	2.0 E-1	3.9 E-1
70-80	2^{-3}	3.18	4.0 E-1	7.9 E-1
80-90	2^{-2}	3.18	7.9 E-1	1.58
90-100	2^{-1}	3.18	1.59	3.17
100-110	2^{0}	3.18	3.18	6.35
110-120	2^{1}	3.18	6.36	12.71
120-130	2^{2}	0.57	2.29	15.0
	total time	38.73 Ma		total TTI : 15

Time of maturation : 38.73 Ma B.P.
Depth of maturation: 1644 meters (= 3504 msec)

Figure 2.6. Estimated depths for maturity at site NEA 5 (west/central Queensland Trough) for the case where the Eocene/Oligocene unconformity is picked at 3.37 secs (TWT).



horizon	Eocene/oligocene	r^n	time (my)	interval TTI	total TTI
0-10		2^{-10}	11.25	1.1 E-2	1.1 E-2
10-20		2^{-9}	11.25	2.2 E-2	3.3 E-2
20-30		2^{-8}	3.125	1.2 E-2	4.5 E-2
30-40		2^{-7}	3.125	2.4 E-2	6.9 E-2
40-50		2^{-6}	3.125	4.9 E-2	1.2 E-1
50-60		2^{-5}	3.125	9.7 E-2	2.2 E-1
		total time	35 Ma	total TTI : 0.22	

Figure 2.7. Thermal and burial history diagram (for a thermal gradient of 74°C/1000 m) for site NEA 5 (west/central Queensland Trough), based on the methods of Lopatin (1971) and Waples (1980) where the Eocene/Oligocene unconformity is at 2.98 secs (TWT).

depth (msec)	Int.Velocity	depth (meters)
0 MSEC 2175 MSEC	1485 M/SEC	1615 meters
2425 MSEC	1598 M/SEC	199.75 meters
late middle miocene 2700 MSEC	2301 M/SEC	316.4 meters
2825 MSEC		143.8 meters
eocene/oligocene 2980 MSEC	2485 M/SEC	192.6 meters
3175 MSEC		

DEPTH LATE MIDDLE MIOCENE : 516.4 METERS
EOCENE/OLIGOCENE : 852.8 METERS

CDP 460

msec	m/sec	Int.Vel
2175	1485	1598
2425	1479	2301
2825	1635	2485
3175	1749	3333
3825	2104	5830
4525	3000	

CDP 5850

msec	m/sec
2175	1485
2725	1559
2875	1606
3025	1656
3275	1775
4025	2212
4525	3000

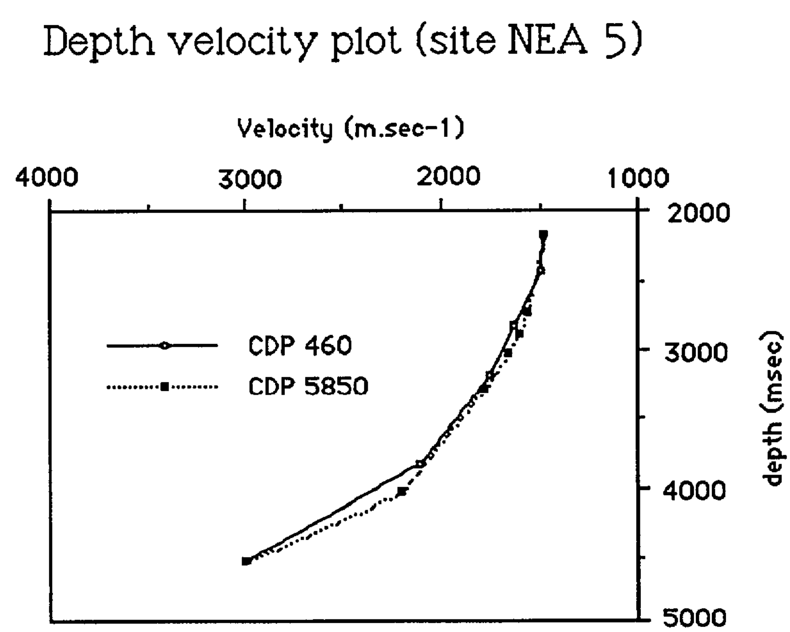
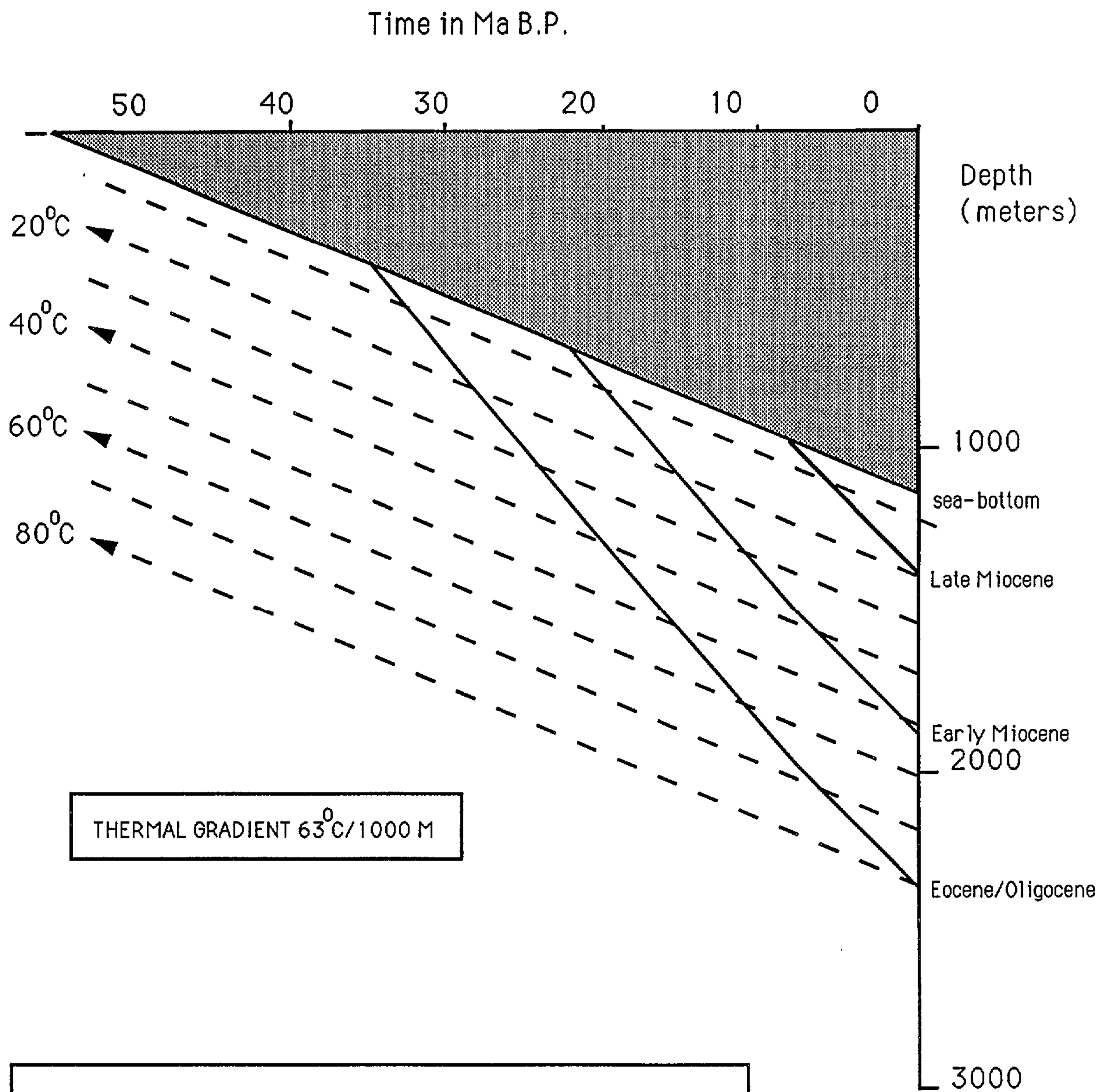


Figure 2.8. Time-depth conversion parameters for site NEA 5 (west/central Queensland Trough) for the case where the Eocene/Oligocene unconformity is at 2.98 secs (TWT)- based on seismic stacking velocities.

horizon maturation	r^n	time (my)	interval TTI	total TTI
0-10	2^{-10}	11.25	1.1 E-2	1.1 E-3
10-20	2^{-9}	11.25	2.2 E-2	3.3 E-2
20-30	2^{-8}	11.25	4.4 E-2	7.7 E-2
30-40	2^{-7}	11.25	8.8 E-2	1.6 E-1
40-50	2^{-6}	11.25	1.8 E-1	3.4 E-1
50-60	2^{-5}	11.25	3.5 E-1	7.0 E-1
60-70	2^{-4}	11.25	7.0 E-1	1.39
70-80	2^{-3}	11.25	1.41	2.80
80-90	2^{-2}	3.125	7.8 E-1	3.58
90-100	2^{-1}	3.125	1.56	5.14
100-110	2^{0}	3.125	3.125	8.27
110-120	2^{1}	3.125	6.25	14.52
		total time 102.5 Ma		total TTI : 14.52

Time of maturation : 102.25 Ma B.P.
Depth of maturaton : 1620 meters (=3490 msec)

Figure 2.9. Estimated depths for maturity at site NEA 5 (west/central Queensland Trough) for the case where the Eocene/Oligocene unconformity is picked at 2.98 secs (TWT).



horizon	Eocene/Oligocene	r^n	time (my)	interval TTI
0-10		2^{-10}	2.0	1.9 E-3
10-20		2^{-9}	4.2	8.2 E-3
20-30		2^{-8}	4.2	1.6 E-2
30-40		2^{-7}	4.4	3.4 E-2
40-50		2^{-6}	4.6	7.2 E-2
50-60		2^{-5}	4.6	1.4 E-1
60-70		2^{-4}	4.8	3.0 E-1
70-80		2^{-3}	6.2	7.7 E-1
		total time	35 Ma	total TTI : 1.34

Figure 2.10. Thermal and burial history diagram (for a thermal gradient of 63°C/1000 m) for site NEA 11 (northern Townsville Trough), based on the methods of Lopatin (1971) and Waples (1980).

depth (msec)		Int.Velocity	depth (meters)
0 MSEC			1035 METERS
1380 MSEC		2060 M/SEC	144.2 METERS
1520 MSEC		2210 M/SEC	209.95 METERS
LATE MIOCENE	1710 MSEC		44.2 METERS
1750 MSEC		2698 M/SEC	283.3 METERS
1960 MSEC			
EARLY MIOCENE	2060 MSEC	3376 M/SEC	168.8 METERS
EOCENE/OLIGOCENE	2350 MSEC		489.52 METERS
			16.88 METERS
2360 MSEC			

depth Late Miocene : 354.15 meters
Early Miocene : 850.45 meters
Eocene / Oligocene : 1339.97 meters

msec	m/sec	Int.Vel
1380	1500	2060
1520	1560	2210
1750	1660	2698
1960	1800	3376
2360	2150	3741
2640	2370	3367
4000	2750	5142
6000	3850	

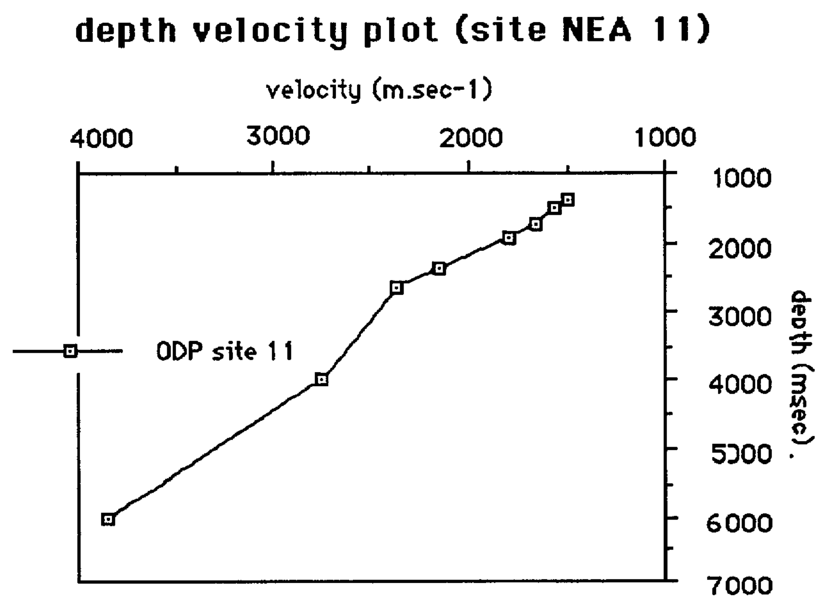
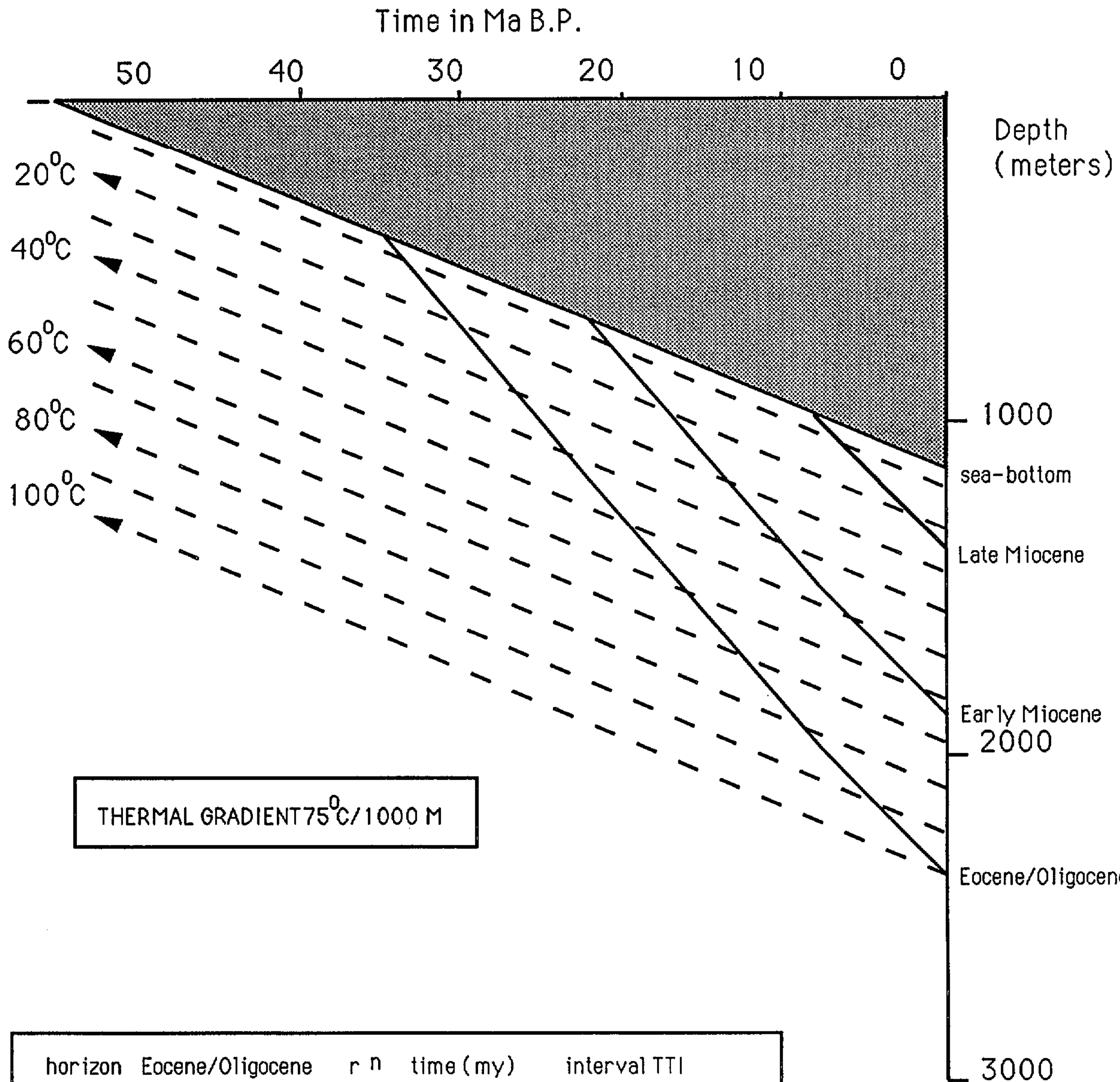
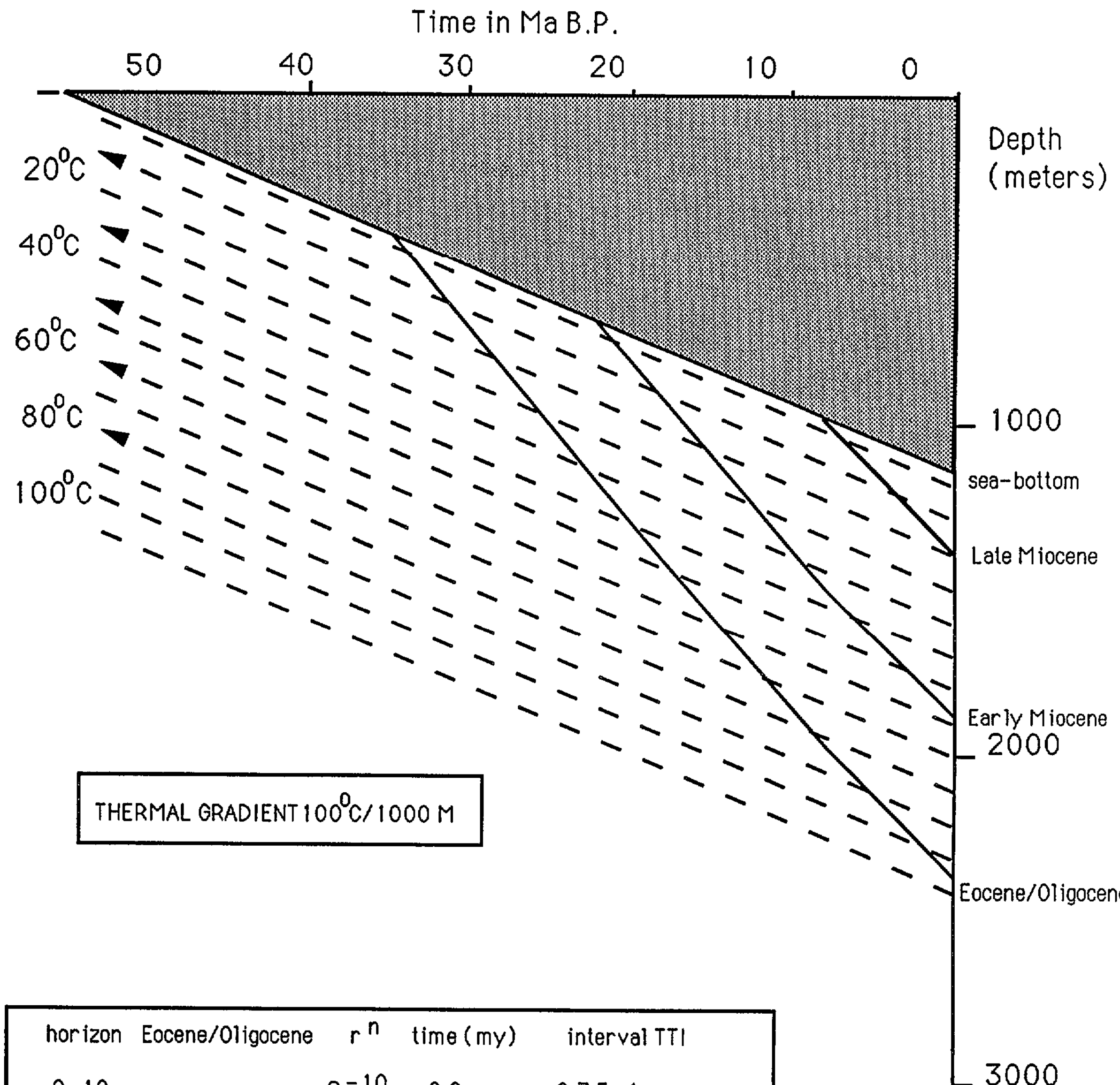


Figure 2.11. Time-depth conversion parameters for site NEA 11 (northern Townsville Trough) - based on seismic stacking velocities.



horizon	Eocene/Oligocene	r^n	time (my)	interval TTI
0-10		2^{-10}	0.9	8.7 E-4
10-20		2^{-9}	3.5	6.8 E-3
20-30		2^{-8}	3.5	1.4 E-2
30-40		2^{-7}	3.5	2.7 E-2
40-50		2^{-6}	3.55	5.5E-2
50-60		2^{-5}	3.65	1.1 E-1
60-70		2^{-4}	3.65	2.3 E-1
70-80		2^{-3}	3.65	4.6 E-1
80-90		2^{-2}	4.4	1.1
90-100		2^{-1}	4.7	2.35
		total time	35 Ma	total TTI : 6.0

Figure 2.12. Thermal and burial history diagram (for a thermal gradient of 75°C/1000 m) for site NEA 11 (northern Townsville Trough), based on the methods of Lopatin (1971) and Waples (1980).



horizon	Eocene/Oligocene r^n	time (my)	interval TTI
0-10	2^{-10}	0.9	8.7 E-4
10-20	2^{-9}	2.7	5.3 E-3
20-30	2^{-8}	2.7	1.0 E-2
30-40	2^{-7}	2.7	2.1 E-2
40-50	2^{-6}	2.7	4.2 E-2
50-60	2^{-5}	2.9	9.0 E-2
60-70	2^{-4}	2.9	1.8 E-1
70-80	2^{-3}	2.9	3.6 E-1
80-90	2^{-2}	2.9	7.2 E-1
90-100	2^{-1}	2.9	1.45
100-110	2^{0}	3.2	3.2
110-120	2^{1}	3.2	6.4
120-130	2^{2}	2.4	9.6
		total time 35 Ma	total TTI : 22.0

Figure 2.13. Thermal and burial history diagram (for a thermal gradient of 100°C/1000 m) for site NEA 11 (northern Townsville Trough), based on the methods of Lopatin (1971) and Waples (1980).

Location Name	Latitude	Longitude	Depth	Heat Flow
V24-128	15-15.0S	146-51.0E	1756m	99.7.
V24-129	16.33.0S	146-24.0E	1405m	93.0.
V24-131	17-22.0S	151-33.0E	1326m	62.0.
V24-132	15-27.0S	153-34.0E	4660m	79.1.
V24-135	15-17.0S	148-03.0E	1182m	66.6.
V24-136	16-20.0S	146-52.0E	1783m	56.1.
V24-145	15-49.0S	148-49.0E	1053m	67.8.
V24-146	17-31.0S	147-30.0E	1368m	64.1.
V24-148	15-20.0S	146-15.0E	2206m	88.8.
NOVA26	21-23.0S	164-03.0E	3561m	42.7.
CH100-4	18-28.5S	166-04.8S	4440m	116.
CH100-7	18-13.5S	166041.7E	4420m	13.0.
CH100-11	18-32.0S	167-16.0E	4665m	159.
CH100-12	18-03.0S	167-11.0E	4135m	73.2.
CH100-15	16-16.0S	166-12.0E	4550m	59.0.
PROA-24	20-18.0S	166-51.0E	3360m	84.6.
PROA-25	21-58.0S	167-51.0E	2020m	53.2.
PROA-26	20-35.0S	167-34.0E	3920m	79.6
PROA-27	20-34.0S	167-33.0E	3800m	193.
DSDP-209	15-56.2S	152-11.3E	1428m	82.1.
DSDP-210	13-46.0S	152-53.8E	4640m	95.0
53-CSH01	17-22.0S	147-04.3E	1355m	65.
53-CSH02	17-11.5S	147-15.9E	1463m	61.
53-CSH03	17-10.6S	147-19.3E	1441m	61.
53-CSH06	16-37.0S	146-42.9E	1628m	48.
53-CSH07	16-37.3S	146-43.0E	1623m	33.
53-CSH08	16-33.0S	146-52.1E	1694m	52.
53-CSH09	16-25.8S	146-59.4E	1737m	52.
53-CSH10	16-25.5S	146-59.1E	1734m	36.
53-CSH12	15-55.6S	146-25.9E	1894m	48.
53-CSH13	15-56.6S	146-27.4E	1890m	61.
53-CSH14	15-51.7S	146-24.1E	1957m	41.
53-CSH15	15-46.9S	146-22.9E	1981m	79.
53-CSH17	15-26.1S	146-14.8E	2089m	38.
53-CSH18	15-06.7S	146-06.6E	2093m	75.
53-CSH19	14-52.5S	146-06.9E	2509m	51.
53-CSH20	14-52.7S	146-07.9E	2511m	52.
53-CSH21	14-10.3S	146-02.5E	2416m	40.
53-CSH23	14-09.9S	145-52.2E	2823m	57.
53-CSH24	13-55.2S	145-45.2E	2880m	52.
53-CSH25	13-19.7S	145-38.2E	3060m	86.

Table 2.1. Heat flow data for the region off northeast Australia.

Carbon-Carbonate Determinations, Site 209

Core, Section, Top of Interval (cm)	Depth in Hole (m)	Carbon Total (%)	Organic Carbon (%)	$CaCO_3$ (%)
1-4,86.0	5.4	10.9	0.0	90
2-4,86.0	14.4	11.2	0.0	93
3-4,86.0	23.4	11.5	0.0	96
4-4,86.0	32.4	11.3	0.0	94
4-6,0	34.5	11.3	0.0	94
5-4,86.0	41.4	11.4	0.0	95
6-5,86.0	51.9	11.1	0.0	92
9-1,116.0	75.2	11.5	0.0	95
14-2,86.0	133.4	10.1	0.1	83
15-1,86.0	150.9	9.9	0.0	83
23-2,86.0	243.4	7.0	0.1	58
27-2,60.0	274.1	9.5	0.1	78
28-2,78.0	283.3	7.1	0.2	58
29-1,133.0	291.3	5.6	0.2	45
31-1,122.0	309.2	3.1	0.3	23
32-1,125.0	318.3	3.9	0.4	29
34-2,113.0	337.6	3.5	0.4	26

Thermal Conductivity Measurements, Site 209

Core, Section, Interval Below Top (cm)	Thermal Conductivity (mcal/°C cm sec)	Standard Deviation	Ambient Core Tempera-ture (°C)	Remarks
1-3,75	0.002771	0.005465	22.25	
2-3,75	0.002719	0.004725	23.61	
3-3,70	0.002783	0.004810	22.15	
4-3,70	0.002907	0.009094	21.76	
5-3,70	0.003016	0.008416	21.01	
6-3,70	0.002575	0.008451	23.61	

Table 2.2. Carbon - carbonate determinations and thermal conductivity measurements on cores from DSDP site 209, northern flank of Queensland Plateau.

SECTION 3:

LEG 133 SITE DESCRIPTIONS

3.01 Leg 133 Objectives

Scientific drilling off the Northeast Australian margin has two primary objectives:

1. To define the sedimentary response to global sea level changes in the late Cenozoic and Quaternary. Two approaches will be applied through the study of shelf margin progradational/onlap sequences and marginal plateau reef dipsticks. Along the margins of the Great Barrier Reef, low sea level, shelf-edge, deltaic, siliciclastic progradative and middle and toe of slope fans alternate with high sea level onlapping sequences and are overlain by high and low sea level aggradational couplets correlated to periods of reef growth. These sedimentary sequences are clearly visible on seismic sections and drilling will provide the ground truth essential for testing the major tenets of the global sea level hypothesis. Sites on the upper slope close to the margin hinge will define a shallow water sea level signal while those on the lower slope and in the Queensland Trough will define the related shelf to basin stratigraphy and deep water sea level signature.
Sites proposed for the Queensland and Marion Plateaus will drill into Miocene and Pliocene reefs which grew in oceanic situations. An absolute eustatic sea level fall of 150-200 m in the middle to late Miocene has recently been defined from these reefs (Pigram and others, submitted).

2. To define the influence of paleochemistry, paleoclimate and paleooceanography on the initiation, growth, and demise of carbonate platforms, and the effect of shifting from temperate to tropical latitudes or vice cersa, due to plate motion, on the biological and lithological facies types (the "Darwin Point" ; Grigg and Epp, 1989) in an environment analagous to the Jurassic eastern margin of the USA. These objectives are best achieved in pure carbonates where the climatic and oceanographic signatures are well preserved. Sites are proposed on the Queensland and Marion Plateaus aimed at the Neogene and Plio-Pleistocene reefal and peri-platform sequences. Sites in the adjacent troughs will define the relationship of facies to climate and oceanography throughout the late Paleogene and Neogene.

In addition to the primary objectives, the drill sites have been chosen (i) to define the slope to basin variations on both sides of a rift basin in order to evaluate facies and stratigraphic models of passive margin evolution; and (ii) to define the diagenetic history of contrasting mixed carbonate/ siliciclastic and pure carbonate margins in an environment undersaturated with respect to aragonite and high-magnesium calcite at relatively shallow water depths.

Drill sites have been located along two transects: one oriented east-west across the Queensland Trough (Fig. 3.1); and the other north-south across the Townsville Trough (Fig. 3.2).

Queensland Trough Transect

[See Fig. 3.1; note the gross vertical exaggeration on this section]

This schematic section is based on a series of tied east-west seismic profiles which extend across the Queensland Trough from the Great Barrier slope to the western flank of the Queensland Plateau. The section illustrates the general structural style of the trough and its margins. Shallow (1.7 s TWT) planated basement tilt blocks occur beneath the western Queensland Plateau (CDP's 200-1100) and are bounded by relatively steep, westerly-dipping rotational normal faults. Half grabens formed by these blocks contain easterly-dipping ?Late Cretaceous syn-rift section up to about 800 m thick. The tilt blocks, and in some places the syn-rift section, were eroded during the formation of the Paleocene `breakup' unconformity, which corresponds to the commencement of seafloor spreading in the Coral Sea Basin to the northeast. Beneath the eastern flank of the Queensland Trough (CDP's 1400-1700), the dip of the faults bounding the tilt blocks switch to the east and the corresponding syn and pre-rift sections dip to the west. Complex faulting beneath the eastern part of the trough (CDP's 1700-2000) may be related to wrenching and indicates that strike-slip movement probably played an important part in the development of the trough. A large planated basement block in the centre of the trough (CDP's 2000-2300) appears to be bounded by a major near-vertical fault on its eastern flank and a series of smaller high-angle normal faults on its western flank which progressively down-step basement to the west. This high can be identified on seismic data both north and south along the strike of the trough. West of this high, sediment thickness could be as much as 3000 m. In the centre of the trough (CDP's 2600-2900) another major half graben containing ?Cretaceous pre and syn-rift section occurs at a depth of 3.1 s TWT. Both this section and the underlying basement tilt block are planated by the Paleocene `breakup' unconformity. The western flank of the high is formed by a complex vertical fault system. Another planated basement high occurs beneath the western flank of the trough (CDP's 3600-3800) at a depth of 2.9 s TWT, and is bounded by high-angle faults. A broad anticline formed by flexural and compaction drape over this block extends to quite high levels (Late Miocene) within the section. The thickest sedimentary section within the trough occurs beneath its western flank, where it may be over 4000 m thick.

Pre-Oligocene mounds or buildups occur on the flanks of highs beneath the western part of the Queensland Trough, and are draped by the overlying Oligocene and Early Miocene section. Similar builups also occur on basement highs on the western margin of the Queensland plateau between sites 6 and 8. A major Early-Mid Miocene buildup occurs on top of the large basement high in the centre of the trough (CDP's 2000-2300), associated with a substantial debris apron extending westward into the deeper part of the trough. There is a marked change in depositional style across the late Middle Miocene unconformity from essentially conformable sequences to onlapping basin-fill sequences. On the western flank of the trough the Plio-Pleistocene section displays strong downlapping character and thins eastward. This thickest part of this section occurs in the prograding wedge beneath the slope of the Great Barrier Reef at sites 1 to 3.

The relatively thin Miocene and youger section covering the western Queensland Plateau (site 8) thins dramatically westward. The complexity of the sequence stratigraphy in the vicinity of site 6 is apparently due to the interaction between trough and plateau depositional processes.

Townsville Trough Transect

[See Fig. 3.2; note the vertical exaggeration on this section. The times and CDP's shown at the top of this section are indicative only and are shown to aid description of features on the profile.]

Most of this schematic section is based on two tied seismic profiles which extend across the Townsville trough from the Queensland Plateau in the north to the Marion Plateau in the south. The northernmost part of the section in the vicinity of site 10A is entirely schematic, and is based on a combination of seismic profiles. The section illustrates the general structural style of the Townsville Trough and places ODP sites NEA 10A, 11 13 and 14 within a regional structural and stratigraphic framework.

The northern margin of the Townsville Trough is underlain by a relatively flat `basement' platform, which exhibits small throw, down-to-the-north normal faults beneath the southern Queensland Plateau. In places southward-dipping reflectors occur within the `basement' platform and may represent Palaeozoic meta-sediments or pre-rift Mesozoic section. On this section the southern edge of the platform is basically a hinged margin which dips into the Townsville Trough and is only associated with minor down-to-basin faulting (time 269.2100-2200). Large tilt blocks, some with eroded and planated corners, occur beneath the main depo-centre of the trough, which is about 70 km wide. Beneath the northern part of the trough a large tilt block up to 12 km across (time 269.2150-2330) is bounded by several relatively steep northward-dipping rotational normal faults. The half graben to the south of this block contains southward-dipping ?Late Cretaceous syn-rift section up to about 1500 m thick. A switch in the direction of faulting occurs about a complex fault zone (transfer fault/accomodation zone) beneath the centre of the trough (time 269.2330-2340). Fault blocks to the south of this zone are bounded by southward-dipping normal faults and this style extends beneath the northern flank of the Marion Plateau. Thus on this schematic section the southern margin of the Townsville Trough is also a hinged or dip-slope margin formed by northward-tilted `basement' blocks bounded by southward-dipping rotational normal faults. The ?Late Cretaceous syn-rift section is considerably thicker beneath the southern part of the trough - up to 3000 m (1.6 s TWT) thick. Broad anticlines related to flexural and compaction drape over tilt blocks and the edges of the bounding `basement' platforms, particularly on the Queensland Plateau side, can in places extend to quite high levels (Early Miocene) within the section (e.g. time 269.2150-2230).

The sedimentary fill within the Townsville Trough can be broadly divided into three main units: a ?Late Cretaceous syn-rift section, which is restricted to the half grabens (as described above); a Paleocene-Eocene post-breakup section, which generally onlaps the syn-rift section and the flanks of the bounding `basement' platforms; and a Late Oligocene to Recent section, which covers both the trough and the adjacent platforms. The Paleocene-Eocene section is basically a basin-fill unit, which has a relatively uniform, conformable reflection character throughout the trough. It can be up to about 2000 m thick beneath the centre of the trough. The overlying ?Late Oligocene to Recent unit is much more variable in reflection character, both across the trough and up through the section. In the centre of the trough, where it can be up to 2000 m thick, this unit commonly contains chaotic, mounded and channelled facies, particularly towards its base, suggesting that along trough depositional processes have been important during post-Late Oligocene time. A possible Early Miocene shelf edge occurs beneath the southern part of the Townsville Trough (day 270 194.26), and the top of the main shelf edge sequence appears to correspond to the base of the `debris' facies in front of the carbonate platform at site 14. That is, the carbonate platform beneath the northern Marion Plateau (~ CDP 24 on section) appears to have built up on the inner edge of an Early Miocene shelf. The post-platform facies in this area have a prominent downlapping character and may correspond to a Late Miocene-Pliocene period of current controlled contourite deposition. An apparently older phase (Late Oligocene-Early Miocene) of carbonate platform development occurs beneath the southern slope of the Queensland Plateau on the northern flank of the Townsville Trough (time 269.1740-1840), and site NEA11 should intersect the distal facies shed into the trough in front of this platform. On the schematic section, the southern edge of the oldest part of the carbonate platform that forms the base to the modern Tregrosse reefal platform is shown. The `back-platform' facies east of the western edge of a younger portion of this platform will be drilled at site NEA10A. This is illustrated conceptually on the northern end of the schematic profile.

Drilling Plan

As of May 1989, 56 operational days are scheduled for Leg 133 to study the northeast

Australian margin. The cruise will depart Guam on 10th August 1990 and return to Brisbane on 11th October 1990. It is hoped that twelve sites will be occupied during the cruise. Leg 133 Co-Chief Scientists are Dr Peter J. Davies [Bureau Mineral Resources, Canberra, Australia] and Dr Judith A. McKenzie [Geological Institute, ETH, Zurich, Switzerland].

PROPOSED SITE OCCUPATION SCHEDULE -

DATE	TIME ON STATION	TRANSIT
Leg 133 departs Guam - 10 August 1990		7 days
Start drilling NEA 10/2 - 17 August	5 days	-
Start drilling NEA 10/1 - 22 August	2.6 days	0.5 days
Start drilling NEA 13 - 25 August	3.3 days	0.25 days .
Start drilling NEA 14 - 28 August	5.0 days	0.5 days
Start drilling NEA 11 - 3 September	6.7 days	0.5 days
Start drilling NEA 8 - 10 September	3.5 days	0.25 days
Start drilling NEA 6 - 14 September	4 days	0.75 days
Start drilling NEA 5 - 19 September	9.3 days	0.5 days
Start drilling NEA 4 - 29 September	3.6 days	0.25 days
Start drilling NEA 1 - 3 October	2.0 days	-
Start drilling NEA 2 - 5 October	3.5 days	-
Start drilling NEA 3 - 8 October	2 days	-
Transit to Townsville - 10 October		
Arrive Townsville - 11 October		

DETAILED SITE SPECIFICATIONS

Site 1
Water depth 206 m
APC/XCB to 400 m
Oriented Core
No logging

Total time - 2 days

Site 2
Water depth - 272 m
APC/XCB to 400 m
Oriented Core
Schlumberger logging suite
Vertical Seismic Profile
Water sample every 100 m
Total time - 3.5 days

Site 3
Water depth - 555 m
APC/XCB to 400 m
Oriented Core
No logging

Total time - 2 days

Site 4
Water depth - 960 m
APC/XCB to 400 m
Oriented Core
Schlumberger logging suite
Water Sample every 100 m
Total time - 3.6 days .

Site 5
Water depth 1638 m
APC to 100 m
Second APC to 200 m
XCB to 400 m
RCB to 1011 m
Oriented Core
Schlumberger logging suite
Total time - 9.3 days

Site 6
Water depth - 1000 m
APC/XCB RCB to 390 m

Schlumberger logging suite
Total time - 4 days

Site 8
Water depth - 934 m
APC to 209 m
XCB to 343
RCB to 400 m
Oriented core
No logging
Total time - 3.5 days

Site 9A
Water depth 739 m
APC/XPC to 265 m

RCB to 500 m

No logging
Total time - 3.5 days

Site 10A1

Water depth 455 m

APC/XCB to 200 m

RCB to 300 m

No logging

Water sample packer

Total time - 3.6 days

Site 10A2

Water depth 505 m

APC/XCB to 120 m

RCB to 500 m

Oriented Core

Schlumberger logging suite

Water sample packer

Total time - 5 days

Site 11

Water depth 1005 m

APC to 200 m

Second APC to 200 m

XCB to 405 m

RCB to 700 m

Oriented Core

Schlumberger Logging Suite

Vertical Seismic Profile

Total time - 6.7 days

Site 13

Water depth 426 m

APC to 60 m

XCB to 110 m

RCB to 250 m

No logging

Total time - 3.3 days

Site 14

Water depth - 456 m

APC to 55 m

Second APC to 55 m

XCB to 295 m

RCB to 400 m

Oriented Core

Schlumberger logging suite

Total time - 5.0 days

Table 3.1 - SUMMARY OF SITE OBJECTIVES

NEA 1. - To determine the composition and origin of the most landward of the prograding and aggrading units beneath the upper slope terrace, and to define the sealevel signal within them.

NEA 2 - To determine the composition and origin of the prograding and aggrading units beneath the outer part of the upper slope. This hole, in conjunction with NEA 1 will calibrate the abrupt seismic facies variations evident on the seismic lines.

NEA3 - To determine the nature of the most distal portions of the progradational and aggradational units beneath the upper slope terrace. To determine the age and origin of the eight seismic sequences at this site. This hole, in conjunction with NEA 1 & 2 will allow the investigation of a complete shelf margin series of prograding units.

NEA 4 - To define the relationship between lower slope carbonate/siliciclastic fan facies and the more proximal facies found at sites NEA 1-3, and to relate that to the sealevel signature extracted from sites 1-3.

NEA 5 - To obtain a complete basinal section for palaeoceanographic history and to correlate basin fill response between the continental margin and the Queensland Plateau.

NEA 6 - To understand slope processes in an exclusively carbonate system and to determine the age of the reef platform and timing of the onset of pelagic sedimentation. To determine the sealevel, oceanographic and climatic control in the Plio-Pleistocene periplatform sediments shedding from the western margin of the Queensland Plateau.

NEA 8 - To sample the periplatform sequence and to determine the sealevel and climatic signals for comparison with sites NEA 1-3. To determine the timing and mode of origin of the topmost reef horizons.

NEA 9A - To determine the composition and origin of the slope units immediately seaward of the Neogene carbonates of the southern margin of the Queensland Plateau. To compare history and processes operative on the mixed carbonate/siliciclastic continental margin sites.

NEA 10A1 and 10A2- To determine the origin of platform top carbonates, the history of drowning and the palaeoclimatic signal in the overlying periplatform ooze.

NEA 11 - To obtain stratigraphic and age data to tie event stratigraphy in the Townsville Trough. Further, to obtain palaeoclimatic data on the change from temperate to tropical climates as Australia drifted north in the Neogene. To determine the age and origin of carbonate deposition on the Queensland Plateau.

NEA 13 - To determine the nature and age of the buildups on the northern edge of the Marion Plateau, the minimum position and timing of the Middle Miocene sealevel fall, and to determine the cause(s) of demise of these buildups.

NEA 14 - To establish the composition and age of the fore-reef, the downlapping and the onlapping sediments that overlie the platform, and to establish the cause and timing of the demise of the platform. To establish the paleoclimatic history, and the facies response to climatic variation and the initiation of boundary current activity. To determine the composition and age of the pre-reef sediments.

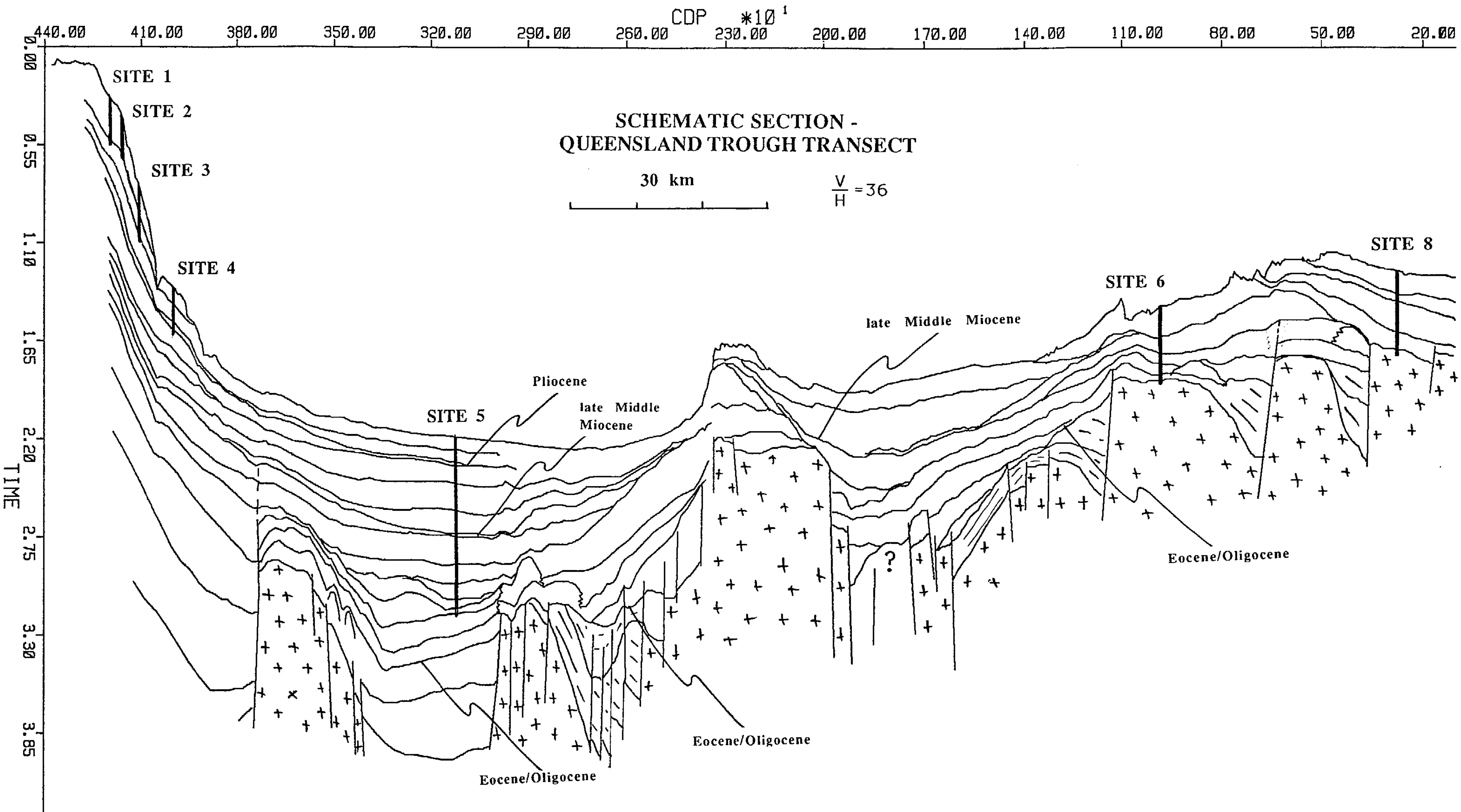


Figure 3.1 Schematic transect across the Queensland Trough

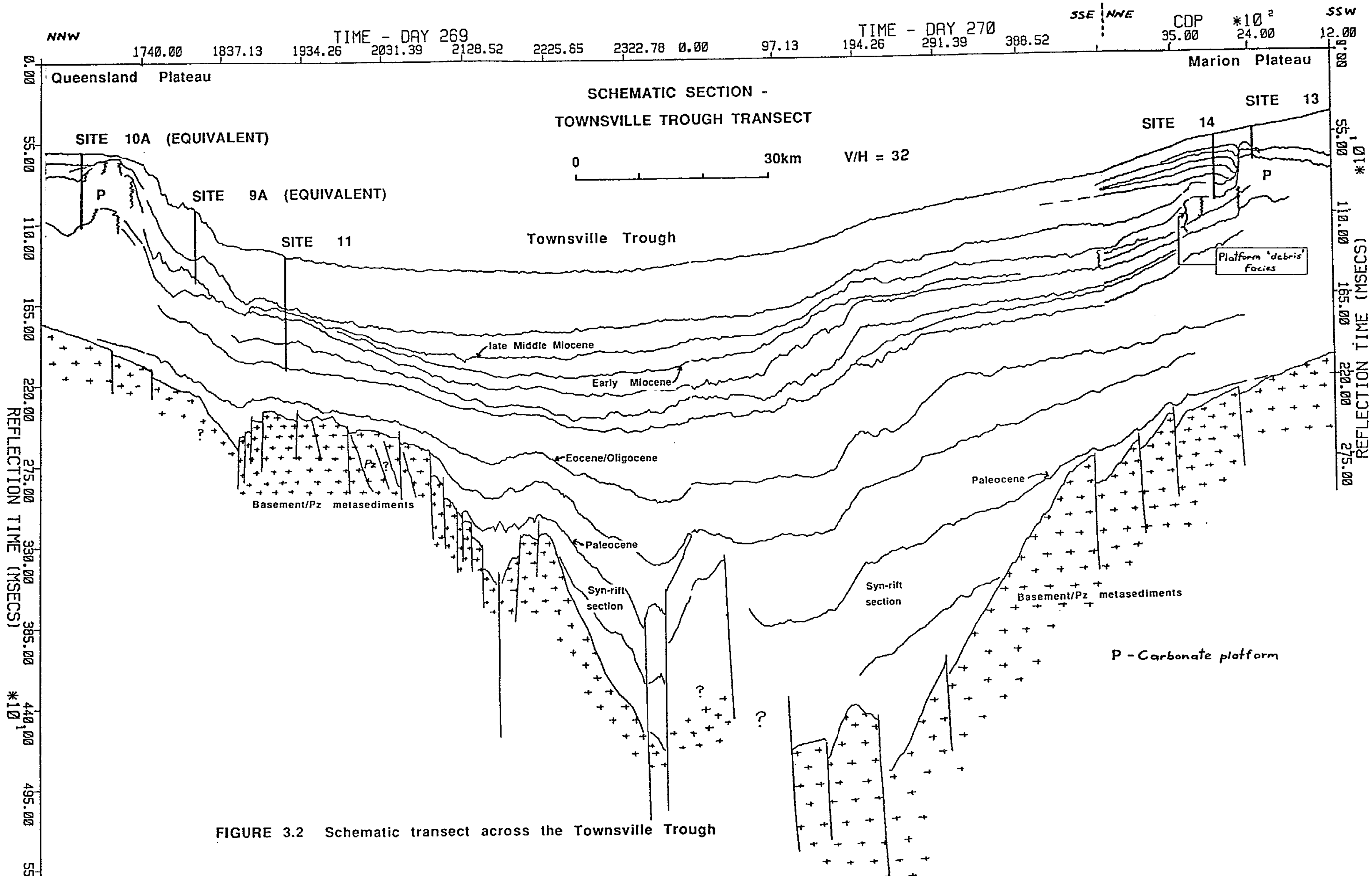


FIGURE 3.2 Schematic transect across the Townsville Trough

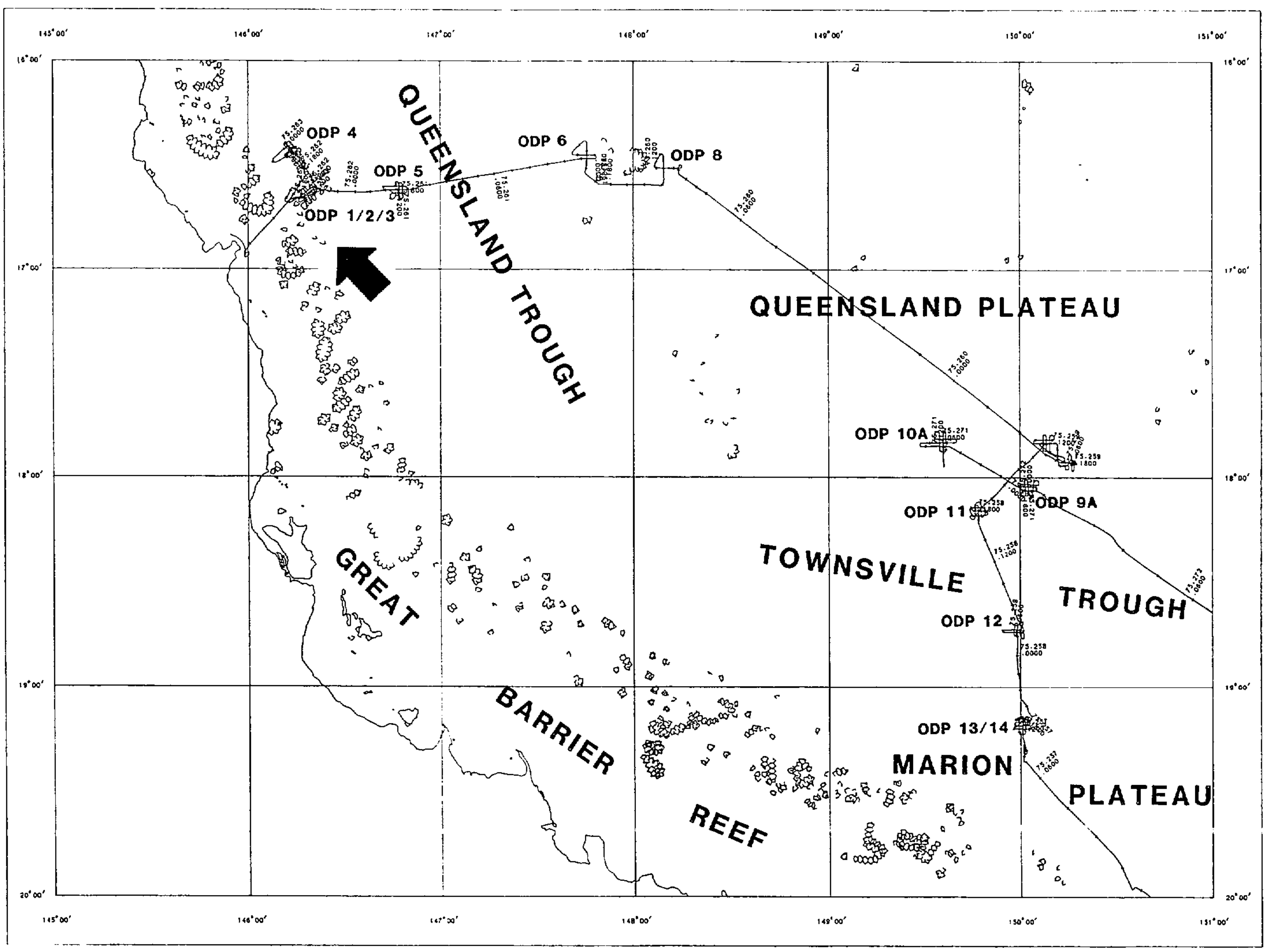
3.02 Sites NEA 1, 2 and 3

[THESE SITES WILL BE CONSIDERED TOGETHER AS THEY HAVE A COMMON SEISMIC GRID]

NORTHEAST AUSTRALIA ODP SITES

SCALE 1:2000000

EDITION OF 1989/03/30



AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT

TRACK MAP

NORTHEAST AUSTRALIA ODP SITES

OVERVIEW - SITES NEA1 TO NEA3

Sites 1 to 3 lie on the upper part of the continental slope, in front of the Great Barrier Reef. These sites are adjacent to Grafton Passage, a shipping channel through the barrier reef to the east of Cairns (Fig. 1.4). These sites will drill through a latest Miocene to Recent progradational - aggradational packages deposited on the continental margin largely prior to reef growth. The lower parts of the sequence are likely to be fluvio-deltaic siliciclastic deposits, with an increase in carbonate content in the upper part of the sequence representing the onset of reef growth on the nearby shelf edge. These holes have been sited to sample proximal, intermediate, and distal parts of both a latest Miocene/Pliocene progradational package and the overlying aggradational package.

These sites will sample different depositional levels within a mixed siliciclastic/carbonate shelf margin depositional system largely controlled by sea level fluctuations. The data from these sites, when combined with information from sites NEA4 and NEA5, will provide a test and/or refinement of the "Vail" sea level model. These sites will also provide a comparison with the purely carbonate systems sampled at sites NEA6, NEA8, NEA9A, and NEA10A.

OBJECTIVES - SITE 1
1. To determine the age and facies of the most proximal portions of the aggradational and progradational units immediately in front of the present day Great Barrier Reef.
2. To determine the relationship between sea level and depositional facies in order to extract the sea level signature.
3. To determine the timing and factors controlling the initiation of reef growth on the central Great Barrier Reef.
4. To understand the factors controlling the transition from progradative to aggradative depositional geometries.

PROGNOSIS - SITE 1
1. 234 m of Pliocene-Quaternary interbedded siliciclastic and carbonate sediment, with carbonate content increasing upward.
2. 166 m of latest Miocene to Pliocene siliciclastic sediments.

OBJECTIVES - SITE 2
1. To determine the age and facies of the central portions of the aggradational and progradational units immediately in front of the present day Great Barrier Reef.
2. To determine the relationship between sea level and depositional facies in order to extract the sea level signature.
3. To determine the timing and factors controlling the initiation of reef growth on the central Great Barrier Reef.
4. To understand the factors controlling the transition from progradative to aggradative depositional geometries.

PROGNOSIS - SITE 2
1. 233 m of Pliocene-Quaternary interbedded siliciclastic and carbonate sediment, with carbonate content increasing upward.
2. 167 m of latest Miocene to Pliocene siliciclastic sediments.

OBJECTIVES - SITE 3
1. To determine the age and facies of the most distal portions of the progradational units in front of the present day Great Barrier Reef.
2. To determine the relationship between sea level and depositional facies in order to extract the sea level signature.
3. To determine the timing and factors controlling the initiation of reef growth on the central Great Barrier Reef.

4. To determine the nature of the deeper water condensed section equivalent to the aggradational package deposited closer to shore.

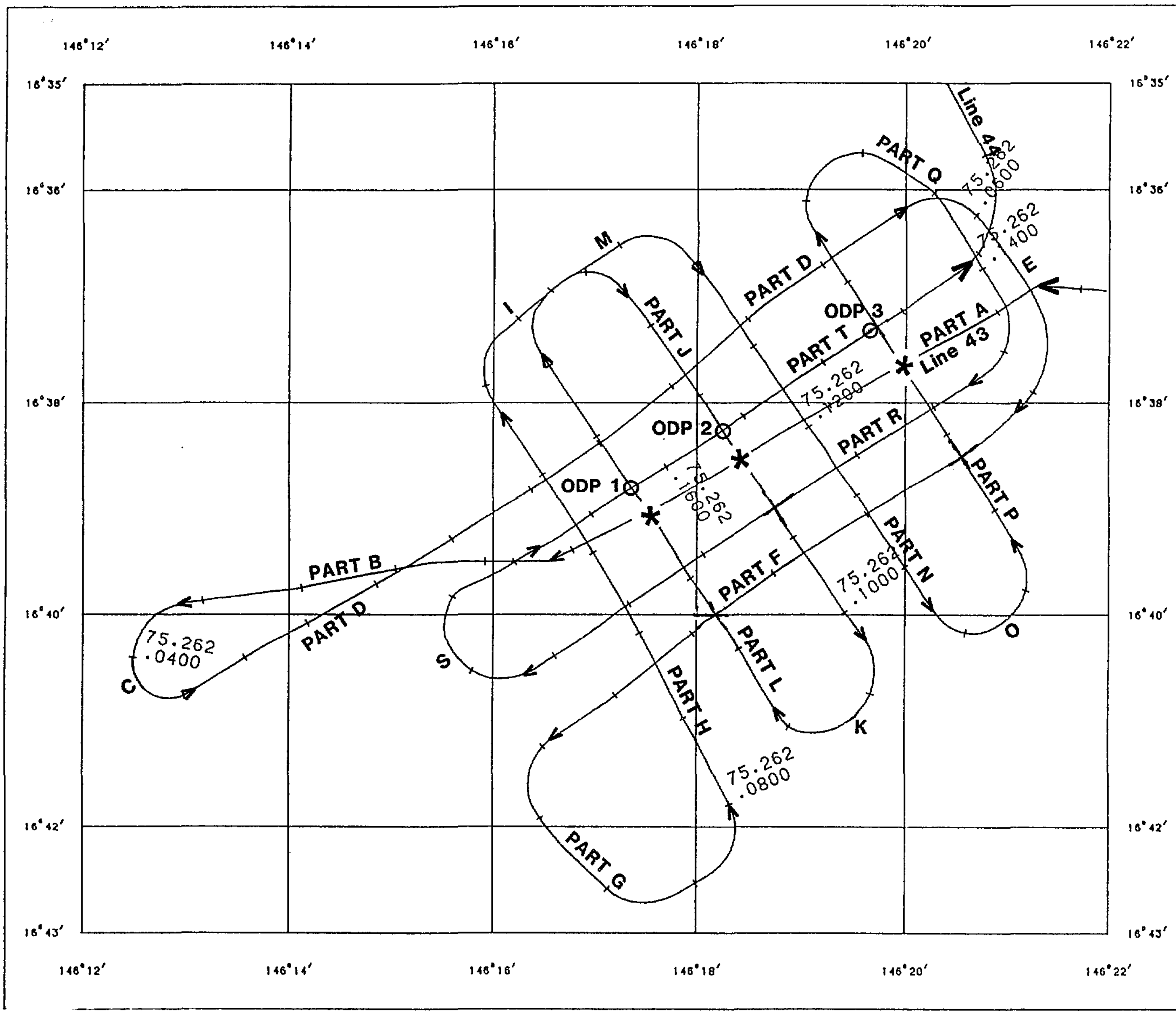
PROGNOSIS - SITE 3

1. 186 m of latest Pliocene-Quaternary interbedded siliciclastic and carbonate sediment, with carbonate content increasing upward.
2. 140 m of Pliocene siliciclastic sediment.
3. 74 m of latest Miocene to Pliocene siliciclastic mud.

SCALE 1:100000

ODP SITES 1,2,3

EDITION OF 1989/03/23



* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITES 1,2,3

COMPUTER DRAWN AT THE DIVISION OF
MARINE GEOSCIENCES & PETROLEUM GEOLOGY

KILOMETRES 2 0 2 4 6 8

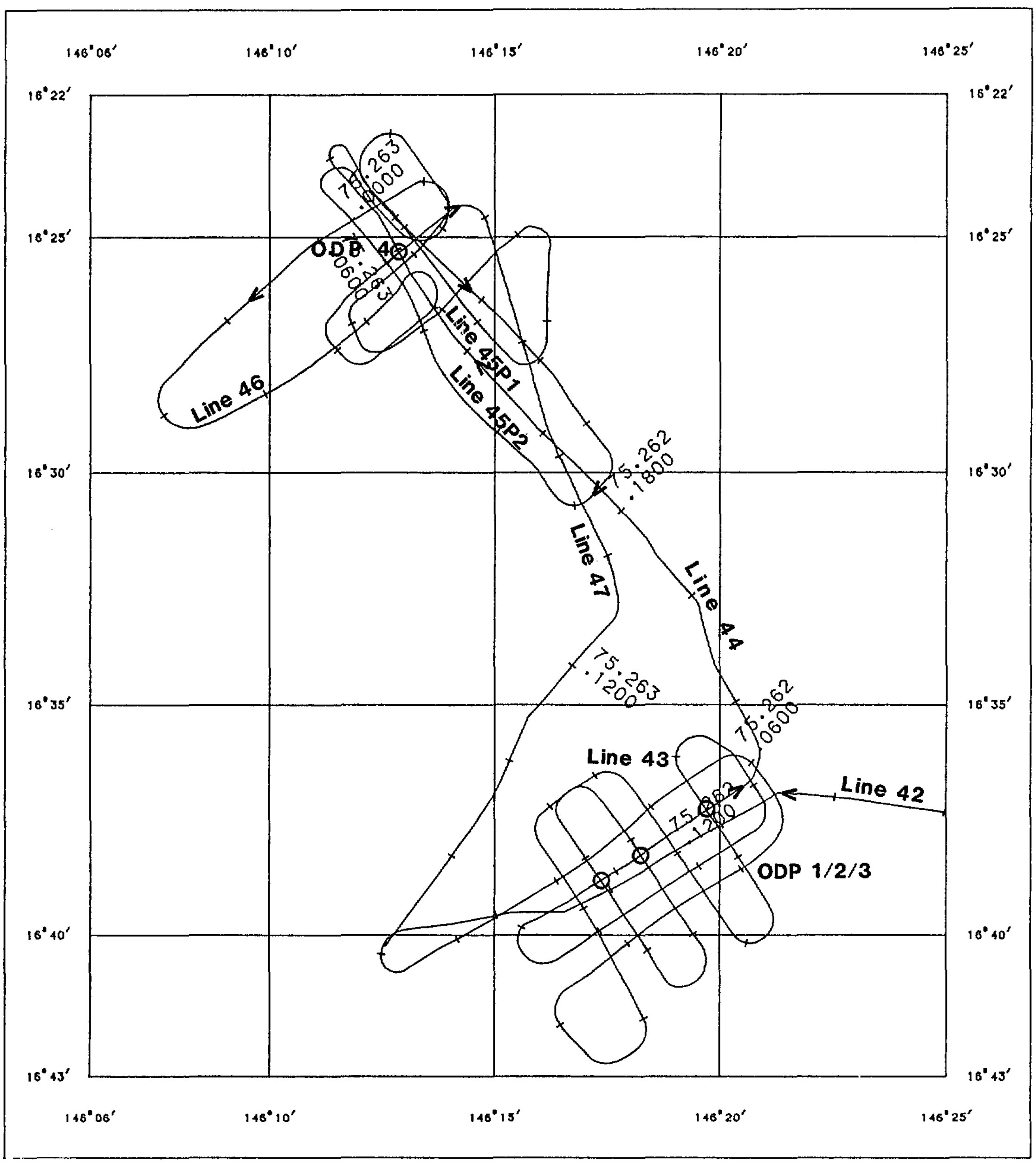
1 0 1 2 3 4 NAUTICAL MILES

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS AUSTRALIA

ODP SITES 1 TO 4

SCALE 1:250000

EDITION OF 1989/03/29



AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITES 1 TO 4

CHECK SHEET
JOIDES SAFETY REVIEW

Leg **133** *Site No.* **NEA 1** *Lat.* **16° 38.6'S** *Long.* **146° 17.3'E**

Water Depth:	*Dist. from Land:*	*Jurisdiction:*
206 m.	**25 n.mi.**	**AUSTRALIA**

General location or geomorphic province:
.GRAFTON PASSAGE, WESTERN SLOPE OF QUEENSLAND TROUGH

Upon what geophysical and/or geological data was this site selection made:
Seismic lines: **BMR LINE 75/043 (CROSSING 43L & 43T)**
Gravity cores: **75GC-01, 75GC-06**
DSDP holes: **NONE**
Other:

Proposed total penetration: **400 m.**
Probable sediment thickness: **2+ seconds TWT**

From previous DSDP drilling in this area, list all hydrocarbon occurrences of greater than background levels, give nature of show, age and depth of rock:
NO PREVIOUS DRILLING.

From available information, list all commercial drilling in this area that produced or yielded significant shows; give depths and ages of hydrocarbon bearing deposits:
NO COMMERCIAL DRILLING IN THIS AREA. NEAREST WELL IS APPROX. 460 n.mi. TO THE NORTH - NO HYDROCARBONS ENCOUNTERED. OIL SHALES OCCUR ONSHORE IN EARLY TERTIARY NONMARINE BASINS 220 n.mi. TO SOUTH.

Is there any indication of gas hydrates at this location:
NO INDICATION; NO BSR PRESENT.

Is there any reason to expect any hydrocarbon accumulation at this site? Please comment.
NO. ABSENCE OF STRUCTURE AND THERMALLY IMMATURE SECTION PRECLUDES POSSIBILITY OF HYDROCARBON OCCURRENCE.

What is your proposed drilling program?
APC/XCB TO 400 m.

What is your proposed logging program?
NO LOGGING.

What "special" precautions will be taken during drilling?
STANDARD HYDROCARBON MONITORING.

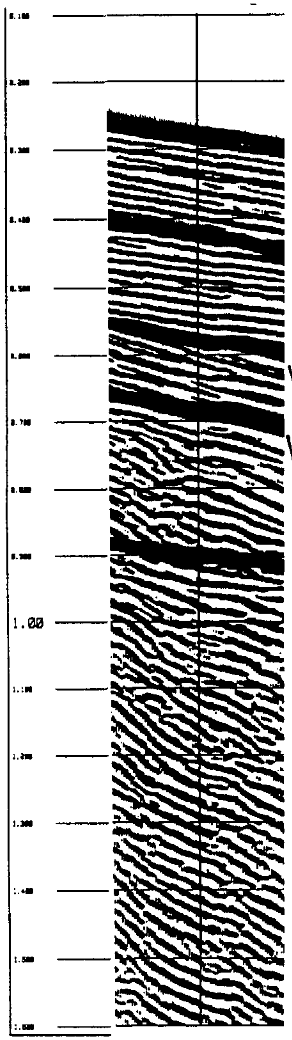
What abandonment procedures do you plan to follow? (see Safety Manual, Sec. VIII, p. 22)
STANDARD PROCEDURES.

SUMMARY: What do you consider to be the major risks in drilling at this site?
NO MAJOR RISKS. SLIGHT CHANCE OF MINOR BIOGENIC GAS.

Please answer each question as carefully as possible, using extra pages if need be. The information you provide here will be an important factor in the Safety Review.

GRAPHIC SUMMARY: SITE NEA 1

Key Reflectors



Depth (m)	Age	Velocity (km/sec)	Lithology	Paleoenvironment	Sedim. Rate	Comments
0–100	Quaternary	1.54	interbedded finegrained siliciclastic & carbonate sediments; possibly some hardgrounds	upper slope	63 m/my	high resolution sealevel signature from siliciclastic /carbonate couplets
200	[127] Pliocene and Pleistocene [234]	1.94	siliciclastic sand and mud with increasing carbonate content toward the top	outer shelf to shelf edge	54 m/my	initiation of shallow water carbonate sedimentation
300	Pliocene	1.94	siliciclastic sand and mud; low carbonate content	shelf edge fan delta	51 m/my	
400	[336] latest Miocene to Pliocene	2.05	as above	as above		
500	TD					

Site NEA 2

CHECK SHEET
JOIDES SAFETY REVIEW

Leg **133** *Site No.* **NEA 2** *Lat.* **16° 38.3'S** *Long.* **146° 18.3'E**

Water Depth:	*Dist. from Land:*	*Jurisdiction:*
272 m.	**26 n.mi.**	**AUSTRALIA**

General location or geomorphic province:
GRAFTON PASSAGE - WESTERN QUEENSLAND TROUGH ADJACENT TO GBR

Upon what geophysical and/or geological data was this site selection made:
Seismic lines: **BMR LINE 75/043 (CROSSING 43J & 43T)**
Gravity cores: **75GC-02, 75GC-07**
DSDP holes: **NONE**
Other:

Proposed total penetration: **400 m.**
Probable sediment thickness: **2 seconds + TWT**

From previous DSDP drilling in this area, list all hydrocarbon occurrences of greater than background levels, give nature of show, age and depth of rock:
NO PREVIOUS DRILLING.

From available information, list all commercial drilling in this area that produced or yielded significant shows; give depths and ages of hydrocarbon bearing deposits:
NO COMMERCIAL DRILLING IN THIS AREA. NEAREST WELL IS APPROX. 460 n.mi. TO THE NORTH - NO HYDROCARBONS ENCOUNTERED. OIL SHALES OCCUR ONSHORE IN EARLY TERTIARY NONMARINE BASINS 220 n.mi. TO SOUTH.

Is there any indication of gas hydrates at this location:
NO INDICATION; NO BSR PRESENT.

Is there any reason to expect any hydrocarbon accumulation at this site? Please comment.
NO. ABSENCE OF STRUCTURE AND THERMALLY IMMATURE SECTION PRECLUDES POSSIBILITY OF HYDROCARBON OCCURRENCE.

What is your proposed drilling program?
APC/XCB TO 400 m.

What is your proposed logging program?
SCHLUMBERGER LOGGING SUITE; VERTICAL SEISMIC PROFILE; WATER SAMPLE EVERY 100 m.

What "special" precautions will be taken during drilling?
STANDARD HYDROCARBON MONITORING.

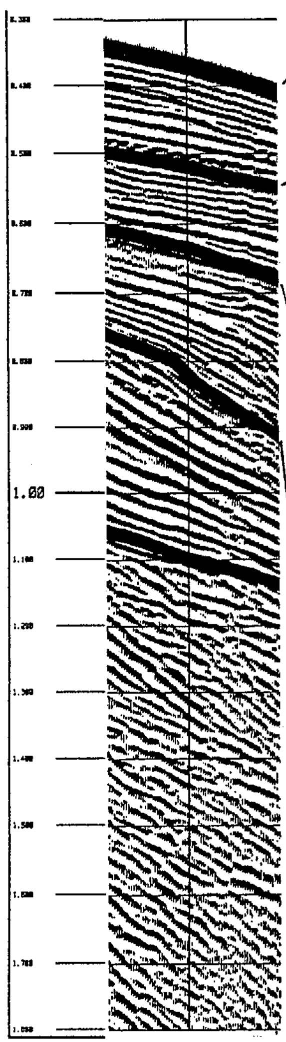
What abandonment procedures do you plan to follow? (see Safety Manual, Sec. VIII, p. 22)
STANDARD PROCEDURES.

SUMMARY: What do you consider to be the major risks in drilling at this site?
NO MAJOR RISKS. SLIGHT CHANCE OF MINOR BIOGENIC GAS.

Please answer each question as carefully as possible, using extra pages if need be. The information you provide here will be an important factor in the Safety Review.

GRAPHIC SUMMARY: SITE NEA 2

Key Reflectors



Depth (m)	Key reflector	Age	Velocity (km/sec)	Lithology	Paleoenvironment	Sedim. Rate	Comments
0	H4	Quaternary	1.61	interbedded finegrained silici. & carb. sediments.	upper slope	62 m/my	high resol. sealevel signature in siliciclastic/carbonate couplets
100, 200	H6	[124] Pliocene to Pleistocene	1.98	siliciclastic sand and mud with increasing carbonate content toward the top.	fluviodeltaic - outer shelf to shelf edge	55 m/my	initiation of shallow water carbonate sedimentation
300, 400	H10	[233] Latest Miocene to Pliocene	2.65	siliciclastic sand and minor mud	shelf edge fan delta	50 m/my	sand-prone topsets and upper foresets
500	TD	[432]					

CHECK SHEET
JOIDES SAFETY REVIEW

Leg **133** *Site No.* **NEA 3** *Lat.* **16° 37.3'S** *Long.* **146° 19.6'E**

Water Depth: **555 m.** *Dist. from Land:* **28 n.mi.** *Jurisdiction:* **AUSTRALIA**

General location or geomorphic province:
.GRAFTON PASSAGE - WESTERN QUEENSLAND TROUGH

Upon what geophysical and/or geological data was this site selection made:
Seismic lines: **BMR LINE 75/043 (43T)**
Piston cores: **75PC-01 (Gravity cores 75GC-03, 75GC-08)**
DSDP holes: **NONE**
Other:

Proposed total penetration: **400 m.**
Probable sediment thickness: **2+ seconds TWT**

From previous DSDP drilling in this area, list all hydrocarbon occurrences of greater than background levels, give nature of show, age and depth of rock:
NO PREVIOUS DRILLING.

From available information, list all commercial drilling in this area that produced or yielded significant shows; give depths and ages of hydrocarbon bearing deposits:
NO COMMERCIAL DRILLING IN THIS AREA. NEAREST WELL IS APPROX. 460 n.mi. TO THE NORTH - NO HYDROCARBONS ENCOUNTERED. OIL SHALES OCCUR ONSHORE IN EARLY TERTIARY NONMARINE BASINS 220 n.mi. TO SOUTH.

Is there any indication of gas hydrates at this location:
NO INDICATION; NO BSR PRESENT.

Is there any reason to expect any hydrocarbon accumulation at this site? Please comment.
NO. ABSENCE OF STRUCTURE AND THERMALLY IMMATURE SECTION PRECLUDES POSSIBILITY OF HYDROCARBON OCCURRENCE.

What is your proposed drilling program?
APC/XCB TO 400 m.

What is your proposed logging program?
NO LOGGING.

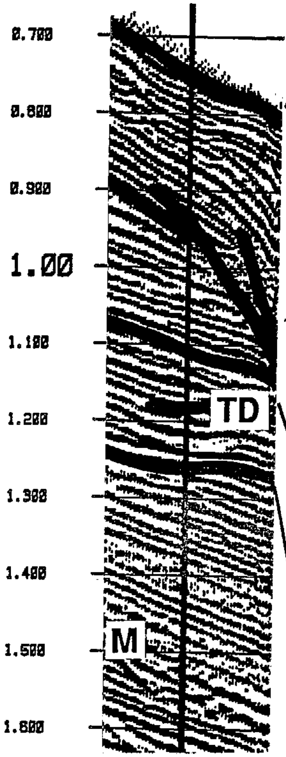
What "special" precautions will be taken during drilling?
STANDARD HYDROCARBON MONITORING.

What abandonment procedures do you plan to follow? (see Safety Manual, Sec. VIII, p. 22)
STANDARD PROCEDURES.

SUMMARY: What do you consider to be the major risks in drilling at this site?
NO MAJOR RISKS. SLIGHT CHANCE OF MINOR BIOGENIC GAS.

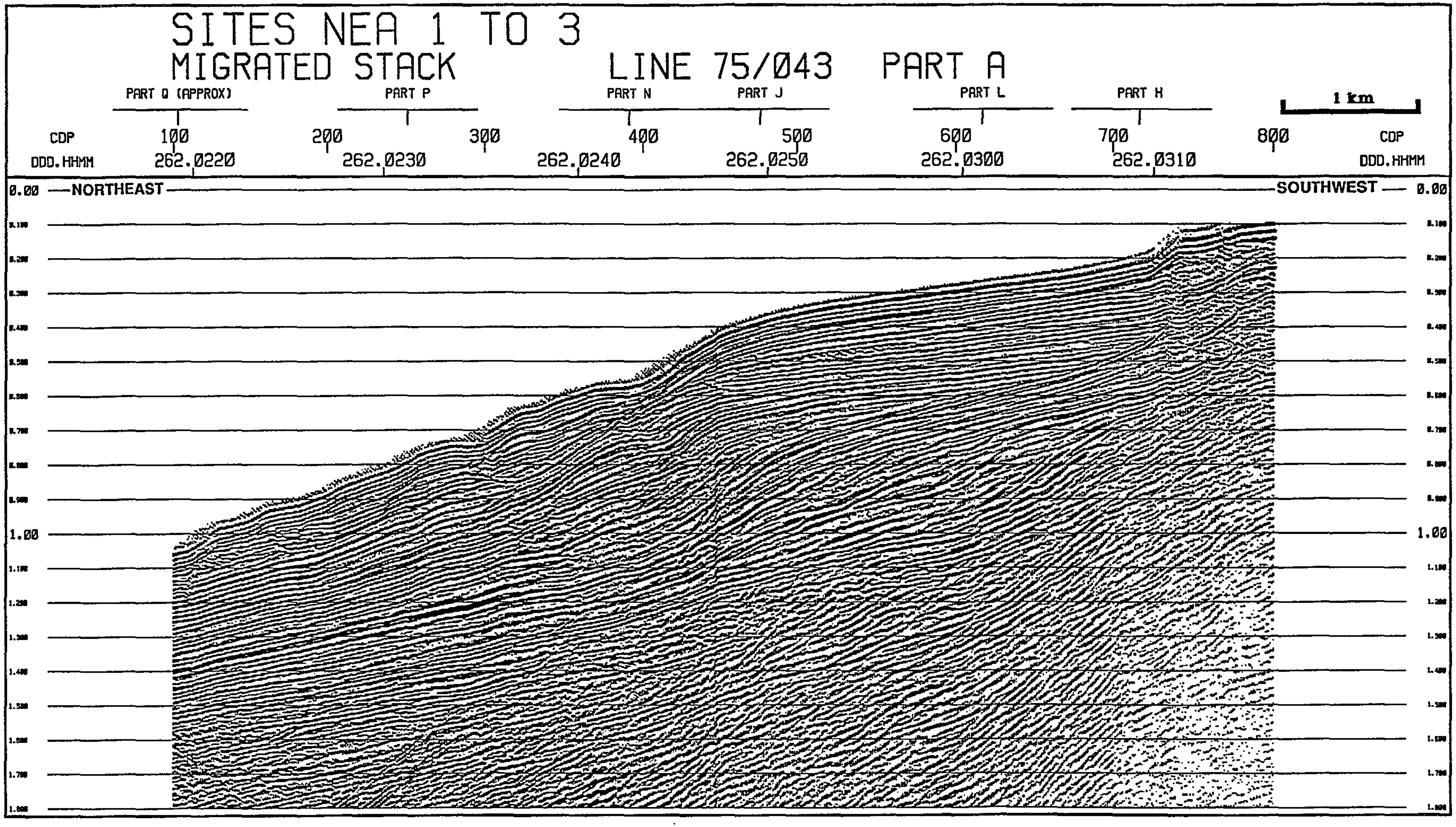
Please answer each question as carefully as possible, using extra pages if need be. The information you provide here will be an important factor in the Safety Review.

GRAPHIC SUMMARY: SITE NEA 3



Key Reflectors	Depth (m)		Age	Velocity (km/sec)	Lithology	Paleoenvironment	Sedim. Rate	Comments
	0–100		Latest Pliocene to Quaternary	1.59	interbedded siliciclastic and carbonate sand and mud.	upper slope - hemipelagic	50 m/my	upper part of section is slumped - some parts of section missing. Sequence contains 1or more slump surfaces
	100		[99]	1.92				
H6	200		[186] Pliocene	2.00	siliciclastic mud.	upper slope - hemipelagic	56 m/my	distal progadation mud-prone bottomsets
H10	300		[326] Latest Miocene to Pliocene	2.09	siliciclastic mud.	upper slope - hemipelagic	50 m/my	as above
H14	400	TD	[439]					
	500							

JOIDES Safety Review Check Sheet - Site NEA 3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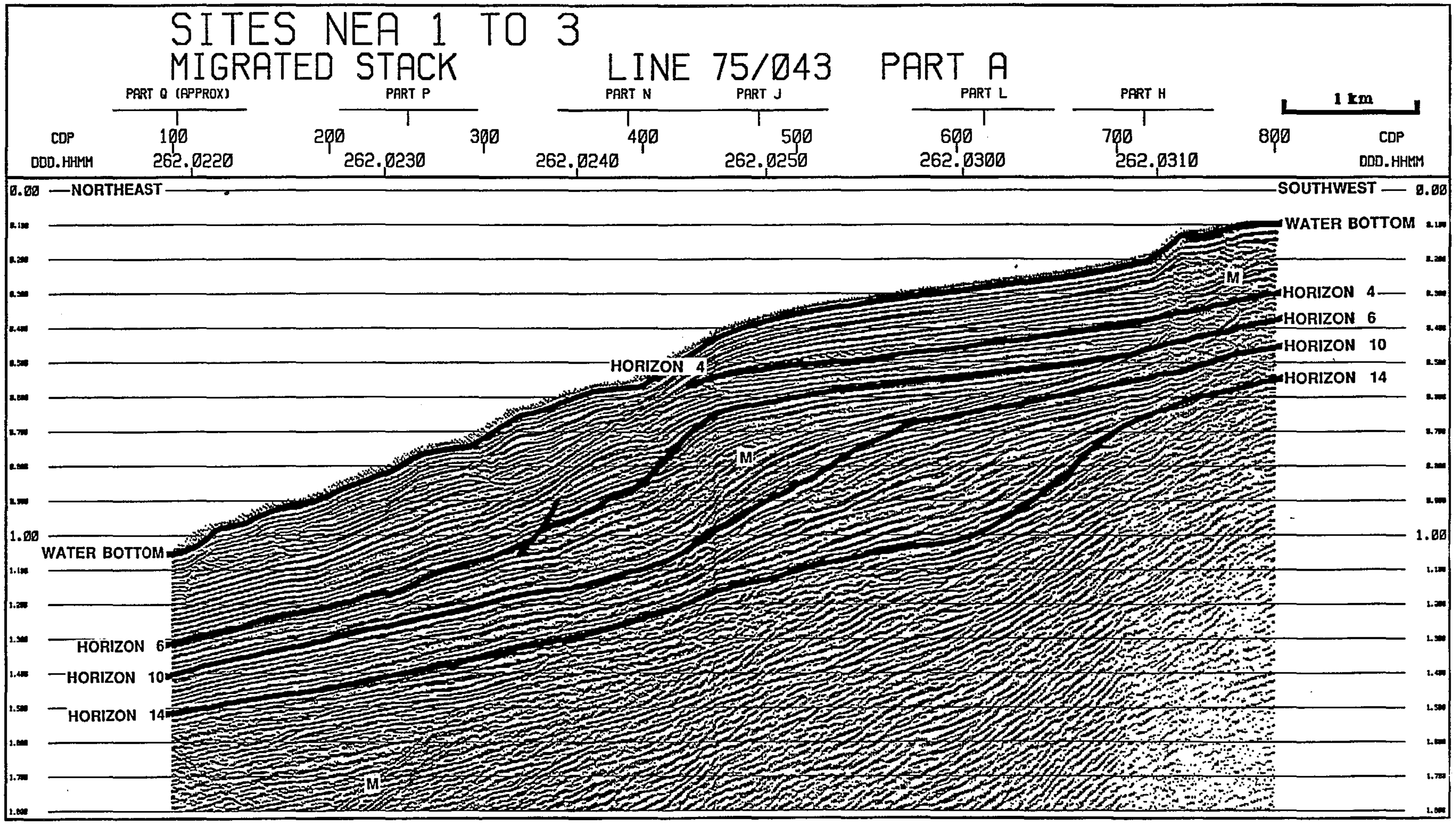
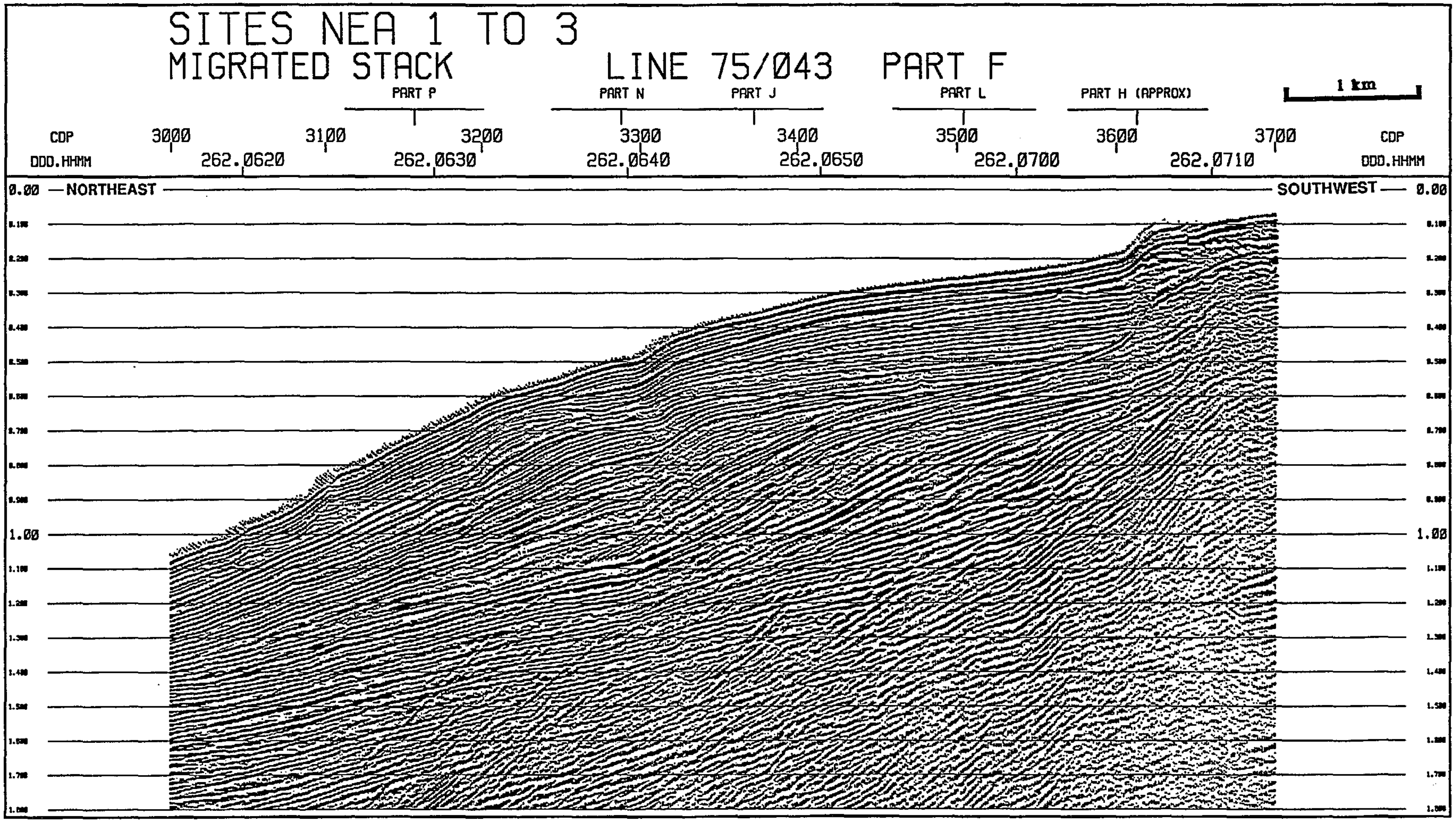
MIGRATED STACK
LINE 75/Ø43 PART A
PART Q (APPROX)
PART P
PART N
PART J
PART L
PART H
1 km
CDP
DDD.HHMM
1ØØ
2ØØ
3ØØ
4ØØ
5ØØ
6ØØ
7ØØ
8ØØ
262.Ø22Ø
262.Ø23Ø
262.Ø24Ø
262.Ø25Ø
262.Ø3ØØ
262.Ø31Ø
CDP
DDD.HHMM
Ø.ØØ
NORTHEAST
SOUTHWEST
Ø.ØØ
1.ØØ
1.ØØ



SITES NEA 1 TO 3
MIGRATED STACK
LINE 75/Ø43 PART A
PART Q (APPROX)
PART P
PART N
PART J
PART L
PART H
1 km
CDP
DDD.HHMM
100
200
300
400
500
600
700
800
262.0220
262.0230
262.0240
262.0250
262.0300
262.0310
0.00
1.00
NORTHEAST
SOUTHWEST
WATER BOTTOM
HORIZON 4
HORIZON 6
HORIZON 10
HORIZON 14
M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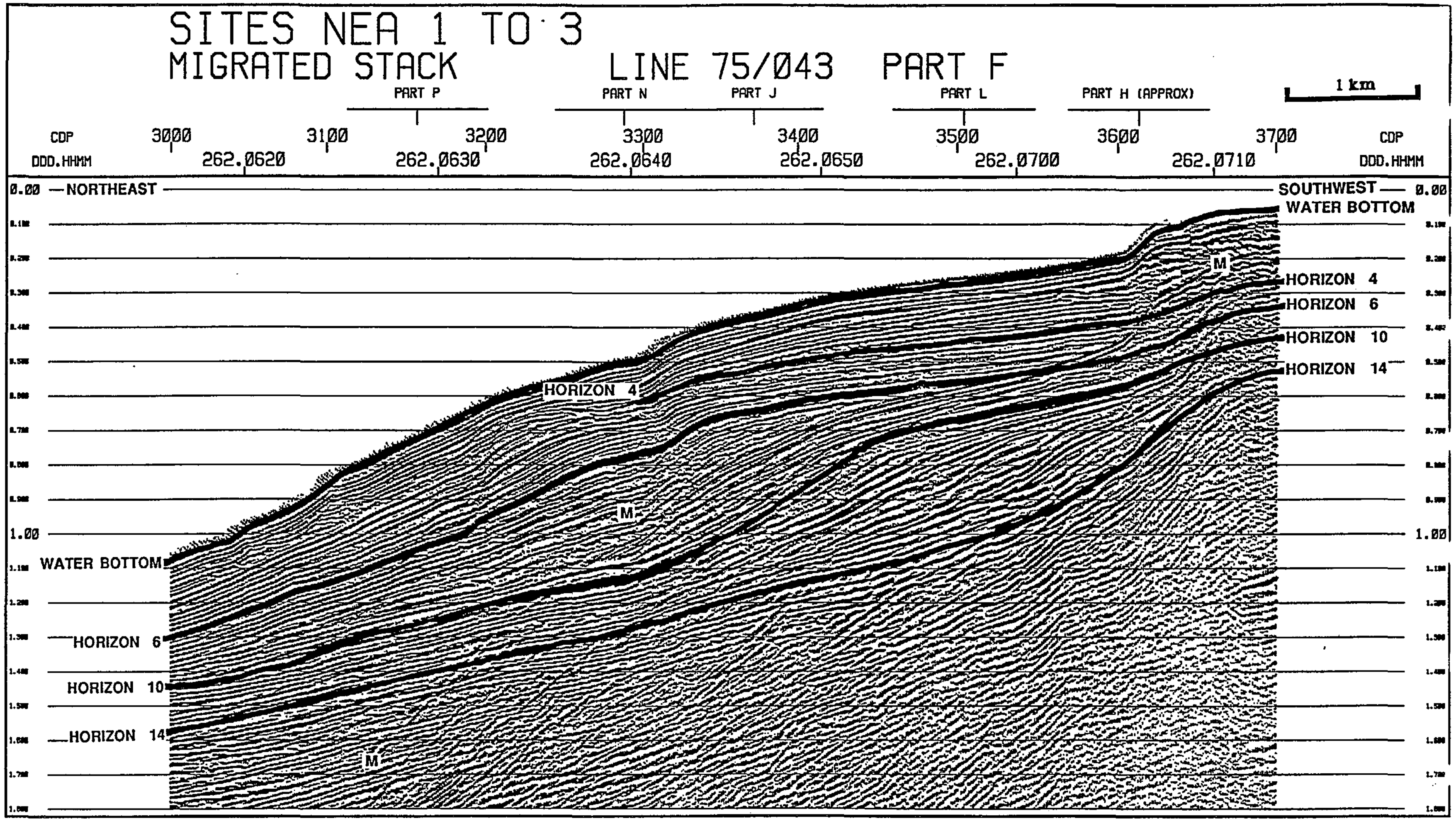
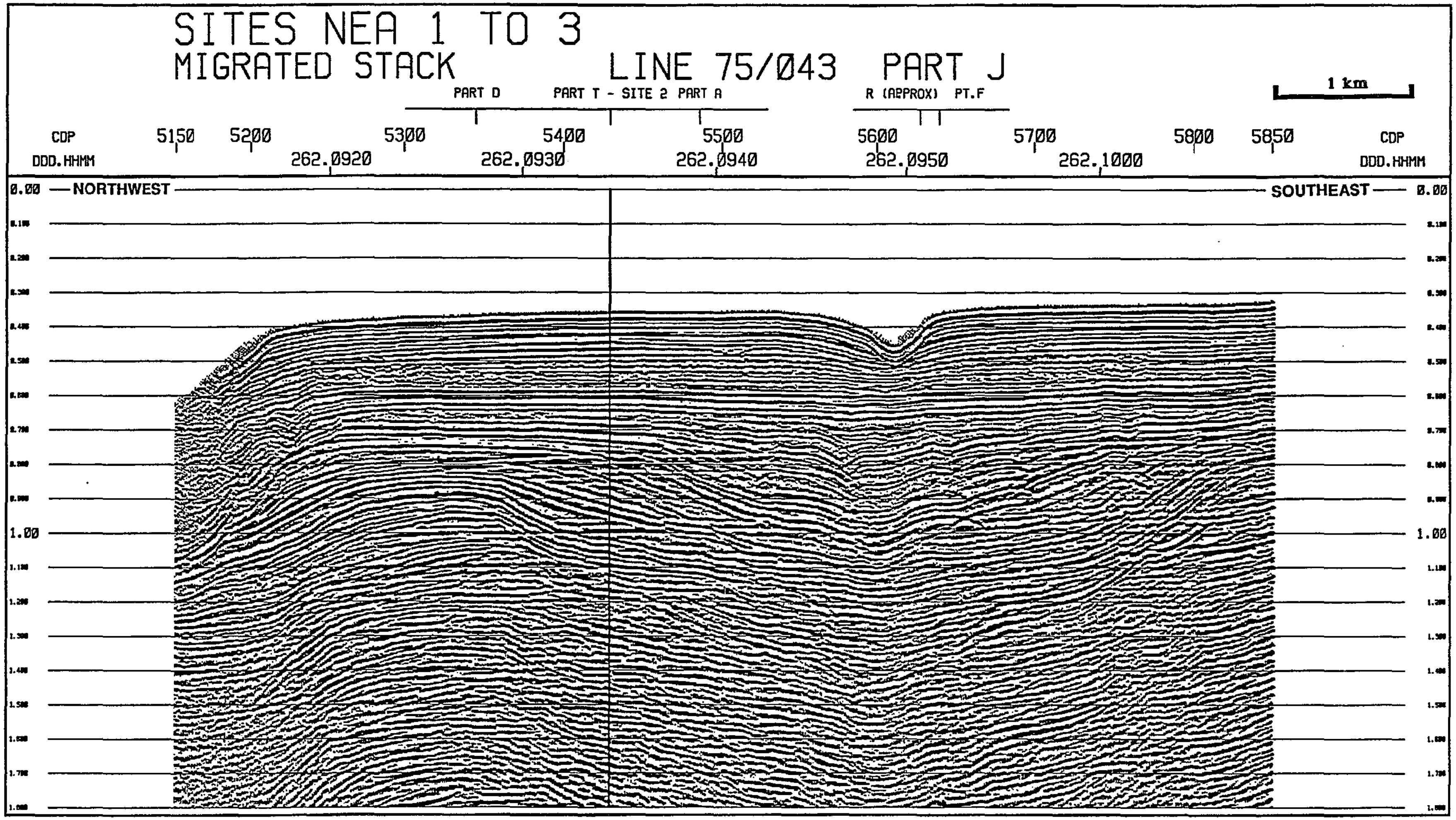
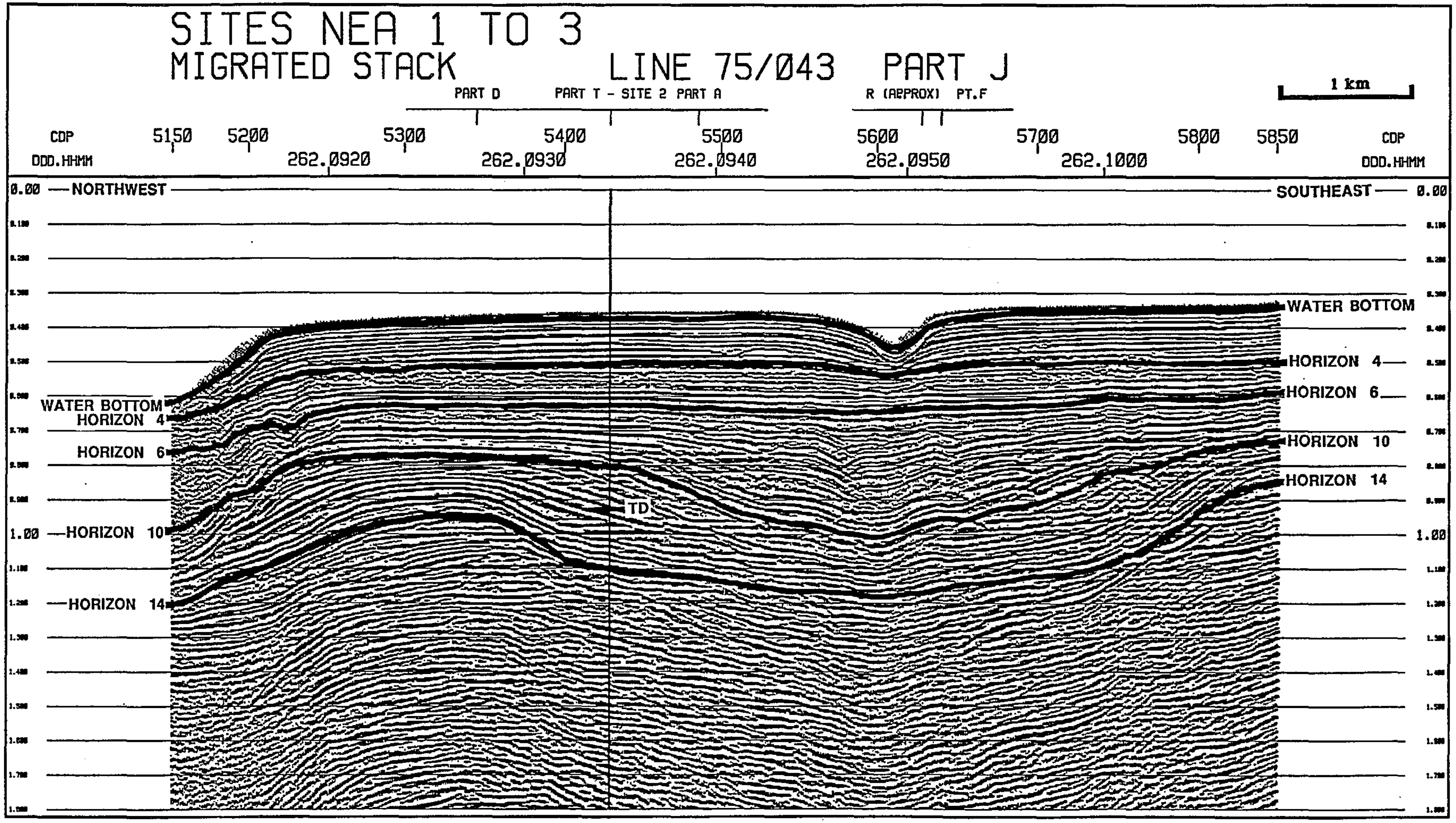
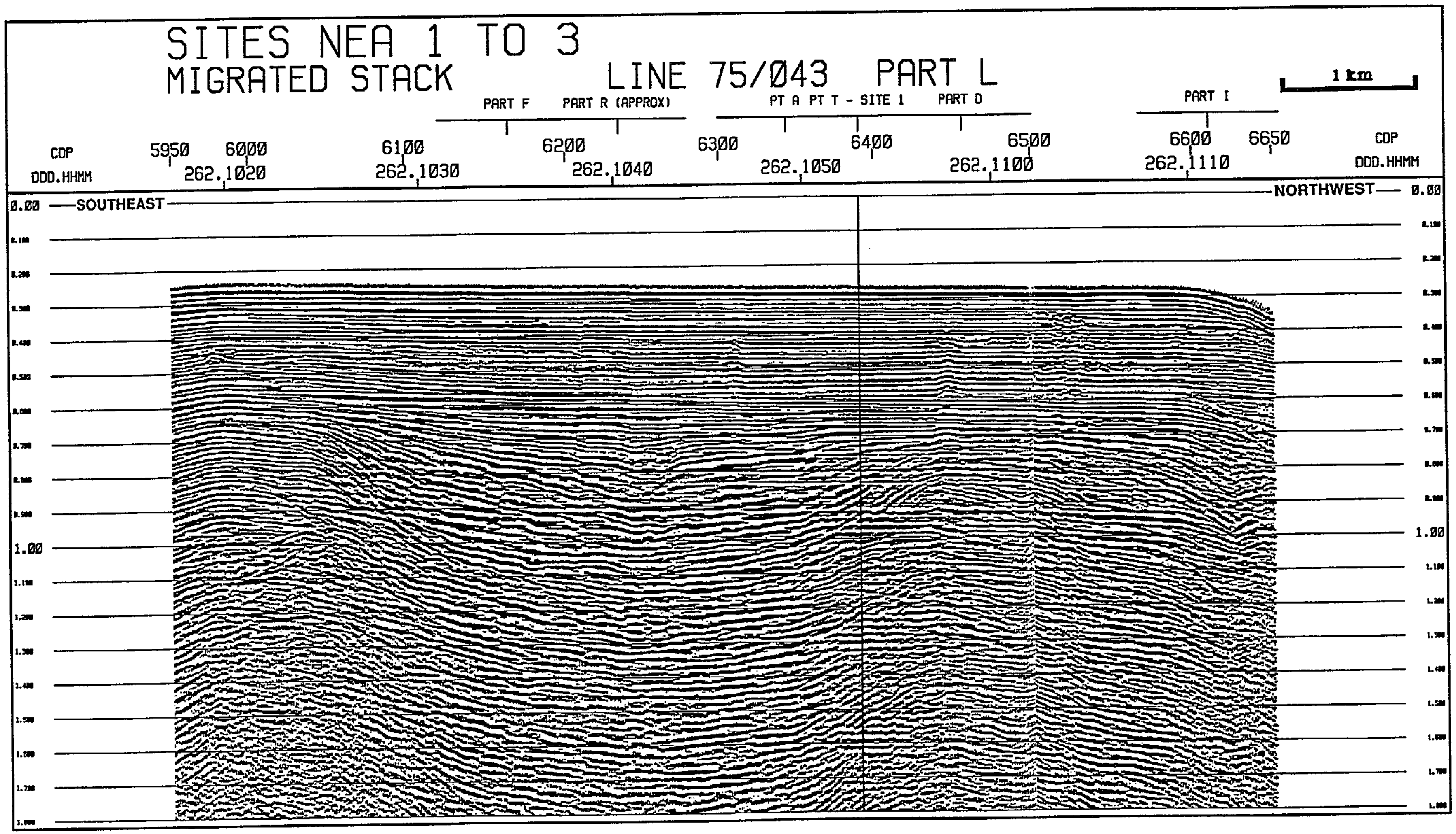
MIGRATED STACK
LINE 75/Ø43 PART F
PART P
PART N
PART J
PART L
PART H (APPROX)
1 km
CDP
DDD.HHMM
3ØØØ
31ØØ
32ØØ
33ØØ
34ØØ
35ØØ
36ØØ
37ØØ
262.Ø62Ø
262.Ø63Ø
262.Ø64Ø
262.Ø65Ø
262.Ø7ØØ
262.Ø71Ø
CDP
DDD.HHMM
Ø.ØØ
NORTHEAST
SOUTHWEST
Ø.ØØ
1.ØØ
1.ØØ

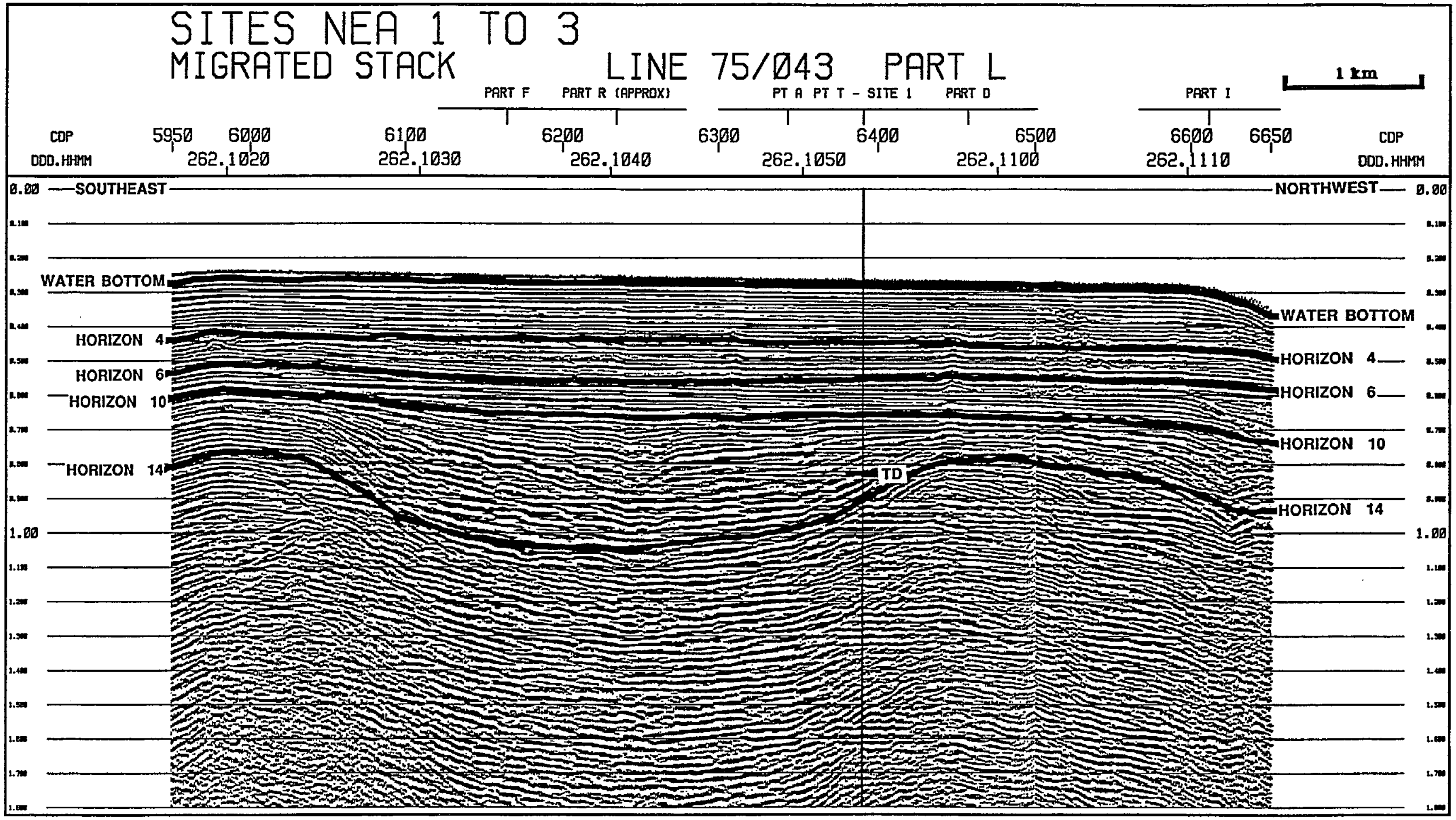

SITES NEA 1 TO 3
MIGRATED STACK
LINE 75/Ø43 PART F
PART P
PART N
PART J
PART L
PART H (APPROX)
1 km
CDP
DDD.HHMM
3ØØØ
31ØØ
32ØØ
33ØØ
34ØØ
35ØØ
36ØØ
37ØØ
262.Ø620
262.Ø630
262.Ø640
262.Ø650
262.Ø700
262.Ø710
Ø.ØØ
1.ØØ
NORTHEAST
SOUTHWEST
WATER BOTTOM
HORIZON 4
HORIZON 6
HORIZON 10
HORIZON 14
M

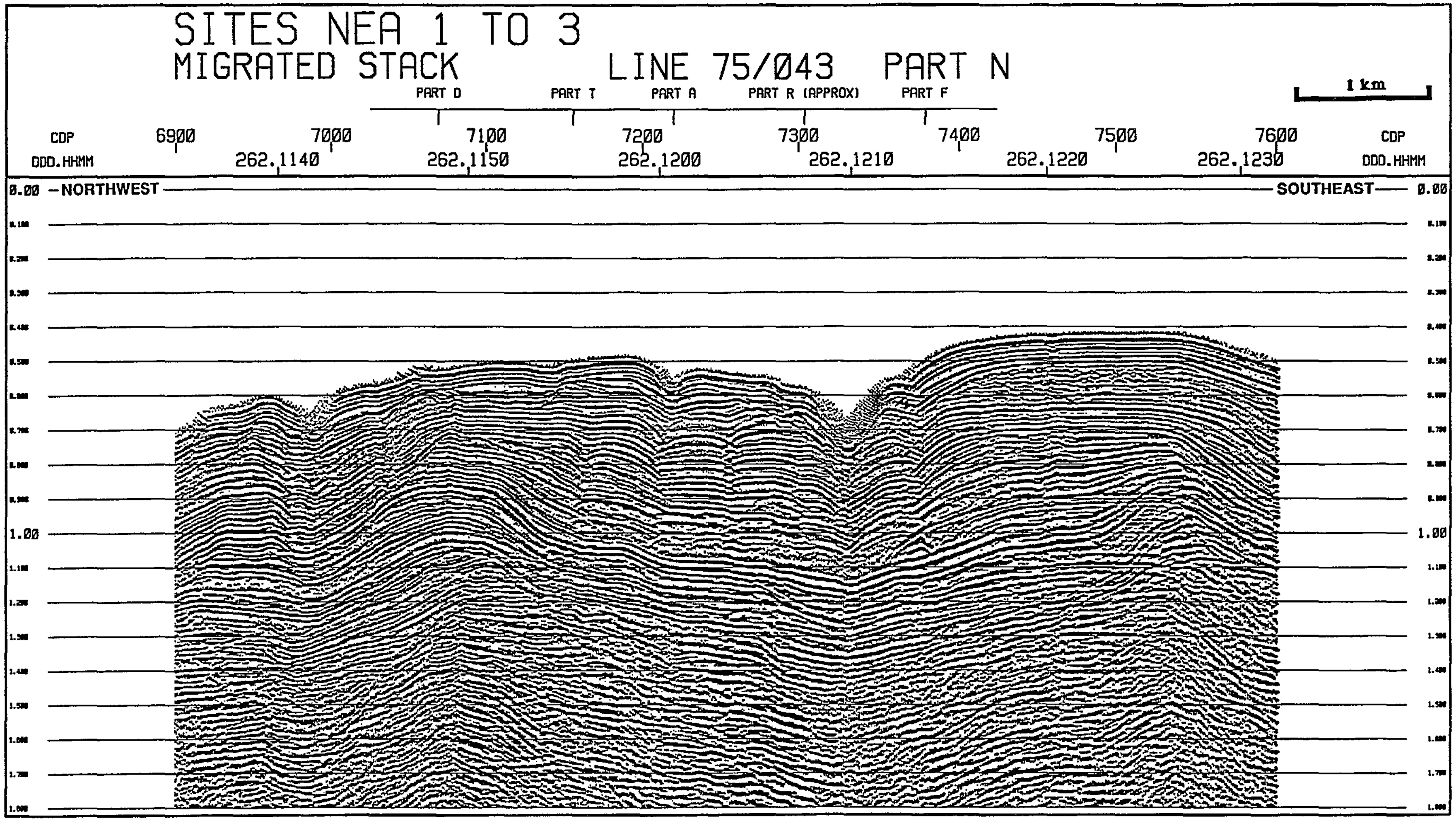

SITES NEA 1 TO 3
MIGRATED STACK
LINE 75/Ø43 PART J
PART D
PART T - SITE 2 PART A
R (APPROX) PT.F
1 km
CDP
DDD.HHMM
5150
5200
5300
5400
5500
5600
5700
5800
5850
262.Ø920
262.Ø930
262.Ø940
262.Ø950
262.1ØØØ
Ø.ØØ
1.ØØ
NORTHWEST
SOUTHEAST

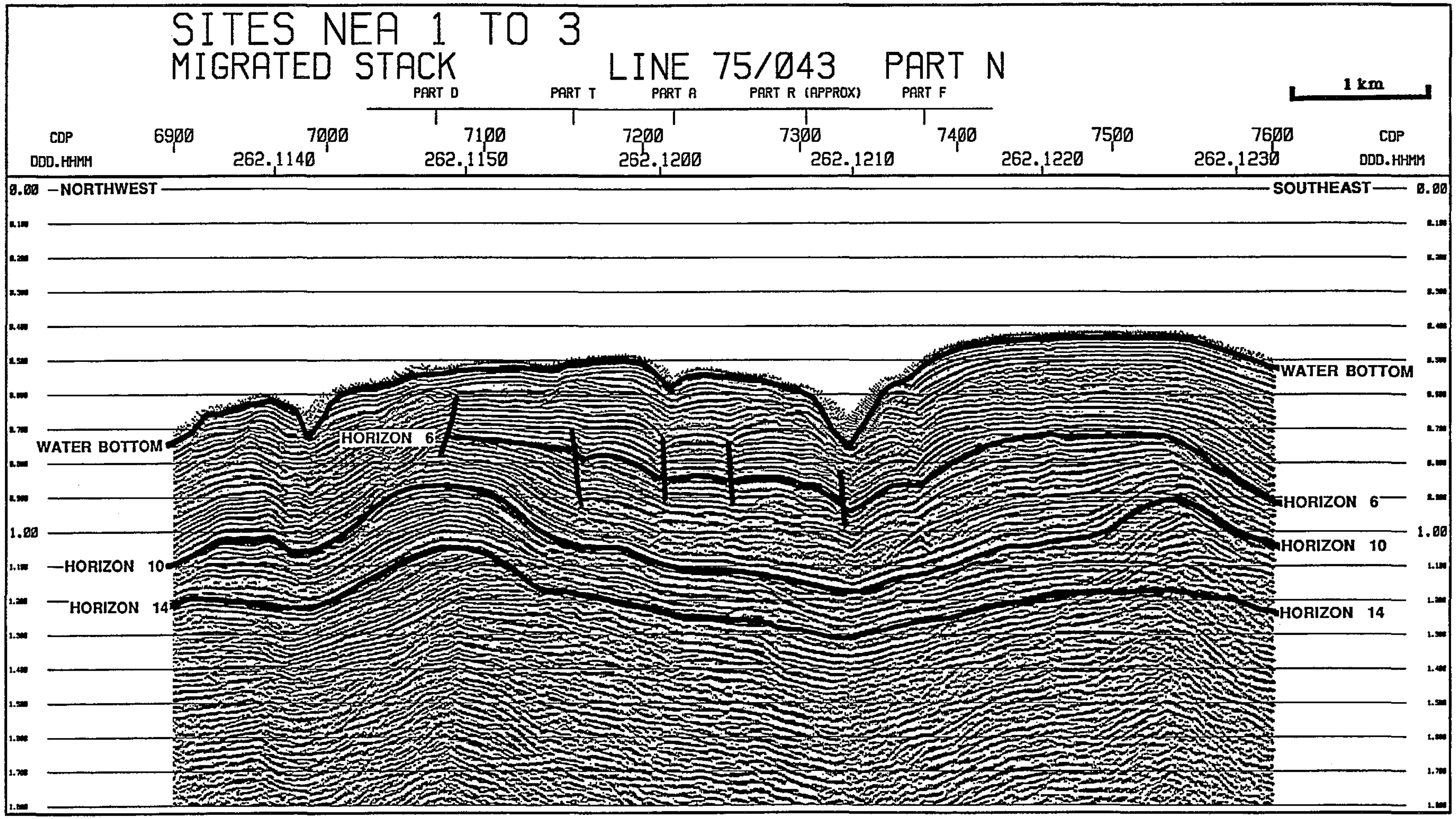


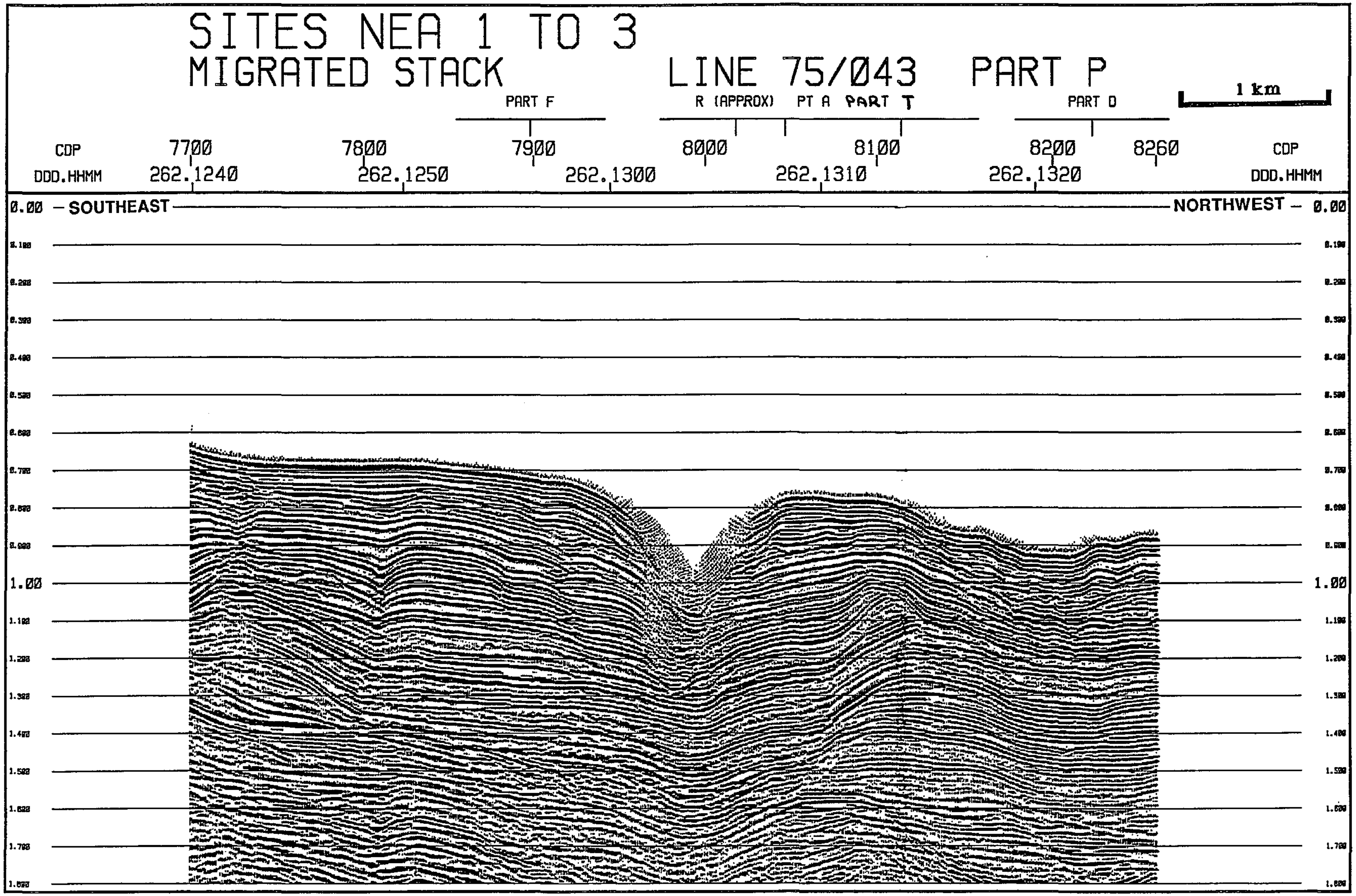
SITES NEA 1 TO 3
MIGRATED STACK
LINE 75/Ø43 PART J
PART D
PART T - SITE 2 PART A
R (APPROX) PT.F
1 km
CDP
DDD.HHMM
5150
5200
5300
5400
5500
5600
5700
5800
5850
262.Ø920
262.Ø930
262.Ø940
262.Ø950
262.1000
NORTHWEST
SOUTHEAST
Ø.ØØ
1.ØØ
WATER BOTTOM
HORIZON 4
HORIZON 6
HORIZON 10
HORIZON 14
TD

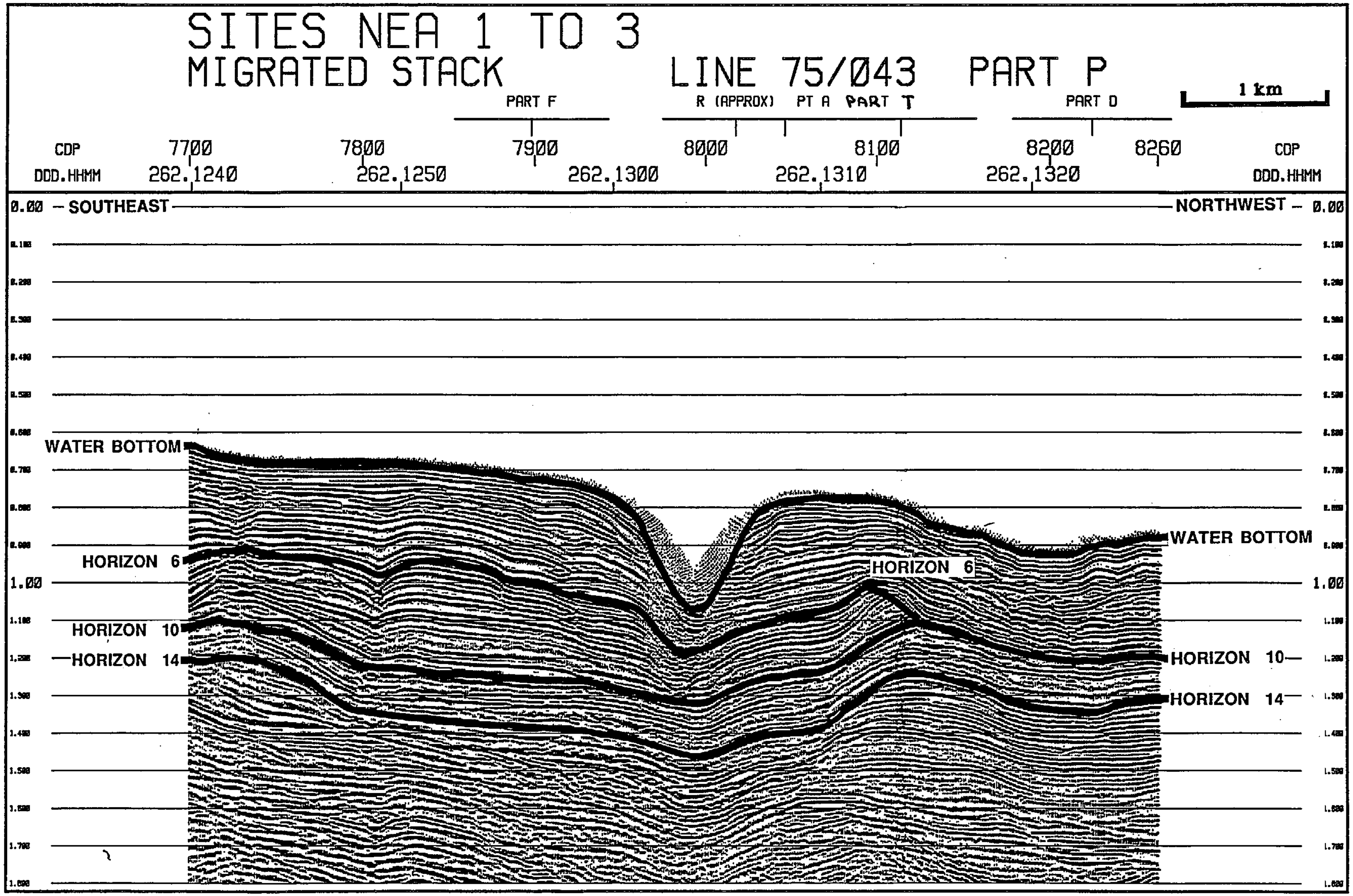

SITES NEA 1 TO 3
MIGRATED STACK
LINE 75/Ø43 PART L
1 km
PART F
PART R (APPROX)
PT A PT T - SITE 1
PART D
PART I
CDP
DDD.HHMM
5950
6ØØØ
61ØØ
62ØØ
63ØØ
64ØØ
65ØØ
66ØØ
665Ø
262.1Ø2Ø
262.1Ø3Ø
262.1Ø4Ø
262.1Ø5Ø
262.11ØØ
262.111Ø
CDP
DDD.HHMM
Ø.ØØ
SOUTHEAST
NORTHWEST
Ø.ØØ
1.ØØ
1.ØØ


SITES NEA 1 TO 3
MIGRATED STACK
LINE 75/Ø43 PART L
1 km
PART F
PART R (APPROX)
PT A PT T - SITE 1
PART D
PART I
CDP
DDD.HHMM
5950
6ØØØ
61ØØ
62ØØ
63ØØ
64ØØ
65ØØ
66ØØ
6650
262.1Ø2Ø
262.1Ø3Ø
262.1Ø4Ø
262.1Ø5Ø
262.11ØØ
262.111Ø
SOUTHEAST
NORTHWEST
Ø.ØØ
1.ØØ
WATER BOTTOM
HORIZON 4
HORIZON 6
HORIZON 10
HORIZON 14
TD

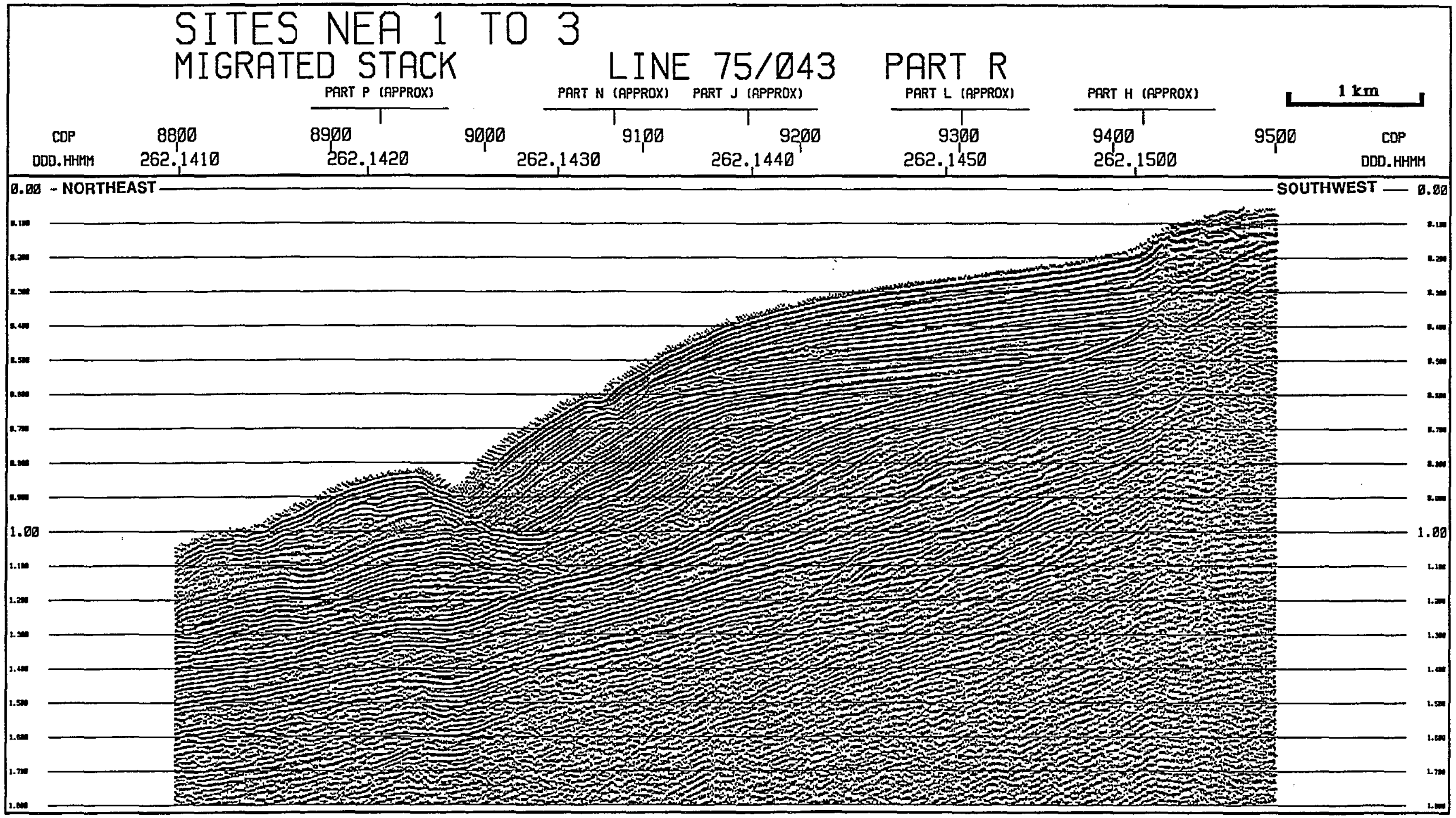

SITES NEA 1 TO 3
MIGRATED STACK
LINE 75/Ø43 PART N
PART D
PART T
PART A
PART R (APPROX)
PART F
1 km
CDP
DDD.HHMM
69ØØ
7ØØØ
71ØØ
72ØØ
73ØØ
74ØØ
75ØØ
76ØØ
262.114Ø
262.115Ø
262.12ØØ
262.121Ø
262.122Ø
262.123Ø
Ø.ØØ
NORTHWEST
SOUTHEAST
1.ØØ


SITES NEA 1 TO 3
MIGRATED STACK
LINE 75/Ø43 PART N
1 km
PART D
PART T
PART A
PART R (APPROX)
PART F
CDP
DDD.HHMM
6900
7000
7100
7200
7300
7400
7500
7600
262.1140
262.1150
262.1200
262.1210
262.1220
262.1230
0.00
NORTHWEST
SOUTHEAST
1.00
WATER BOTTOM
HORIZON 6
HORIZON 10
HORIZON 14


SITES NEA 1 TO 3
MIGRATED STACK
LINE 75/043 PART P
1 km
PART F
R (APPROX)
PT A
PART T
PART D
CDP
7700
7800
7900
8000
8100
8200
8260
CDP
DDD.HHMM
262.1240
262.1250
262.1300
262.1310
262.1320
DDD.HHMM
0.00
SOUTHEAST
NORTHWEST
0.00
1.00
1.00



SITES NEA 1 TO 3
MIGRATED STACK
LINE 75/Ø43 PART P
1 km
PART F
R (APPROX) PT A PART T
PART D
CDP
DDD.HHMM
7700 7800 7900 8000 8100 8200 8260
262.1240 262.1250 262.1300 262.1310 262.1320
SOUTHEAST
NORTHWEST
Ø.ØØ
1.ØØ
WATER BOTTOM
HORIZON 6
HORIZON 10
HORIZON 14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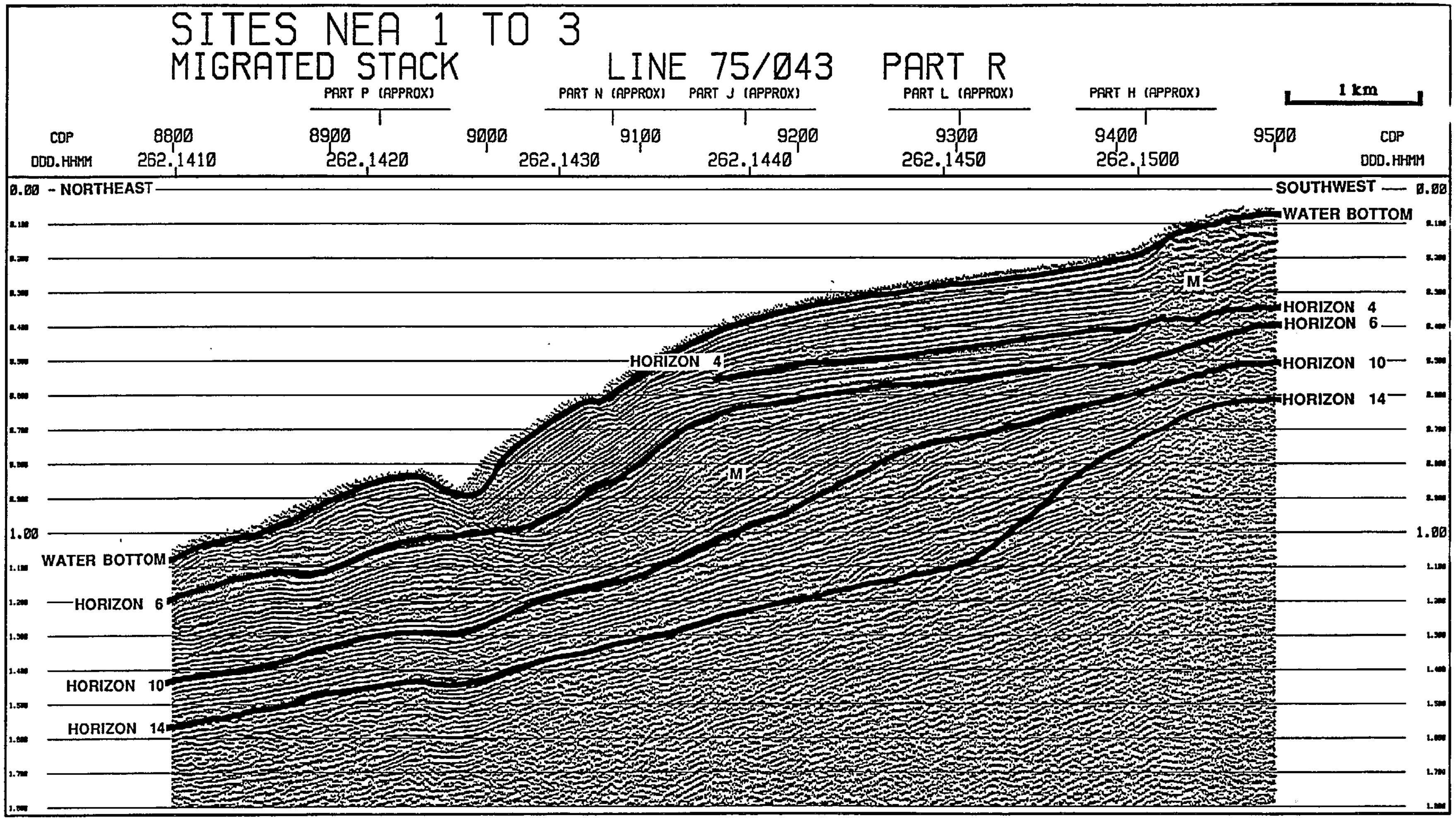
MIGRATED STACK
LINE 75/Ø43 PART R
PART P (APPROX)
PART N (APPROX)
PART J (APPROX)
PART L (APPROX)
PART H (APPROX)
1 km
CDP
DDD.HHMM
8800
8900
9000
9100
9200
9300
9400
9500
262.1410
262.1420
262.1430
262.1440
262.1450
262.1500
CDP
DDD.HHMM
0.00
- NORTHEAST
SOUTHWEST
0.00
1.00
1.00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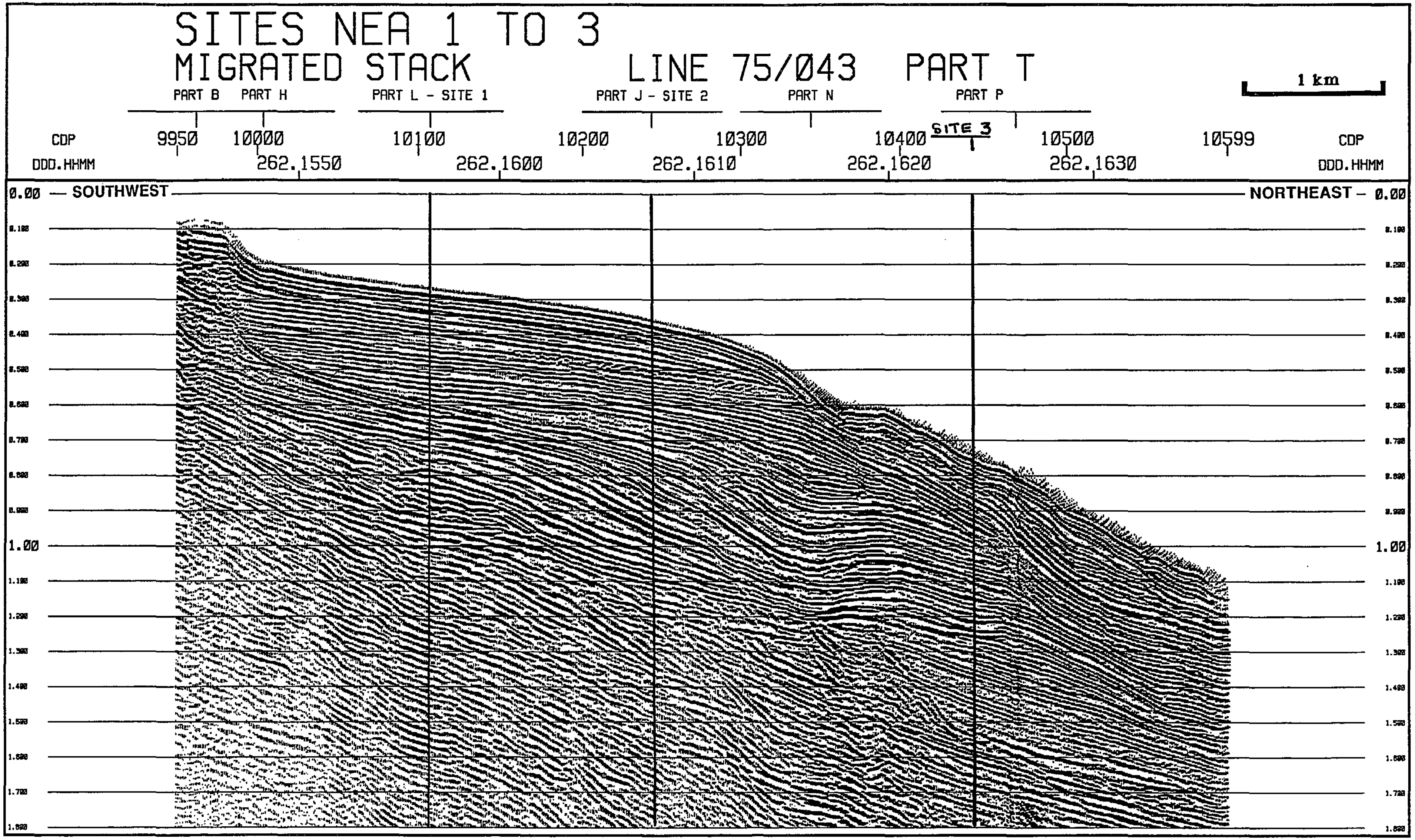
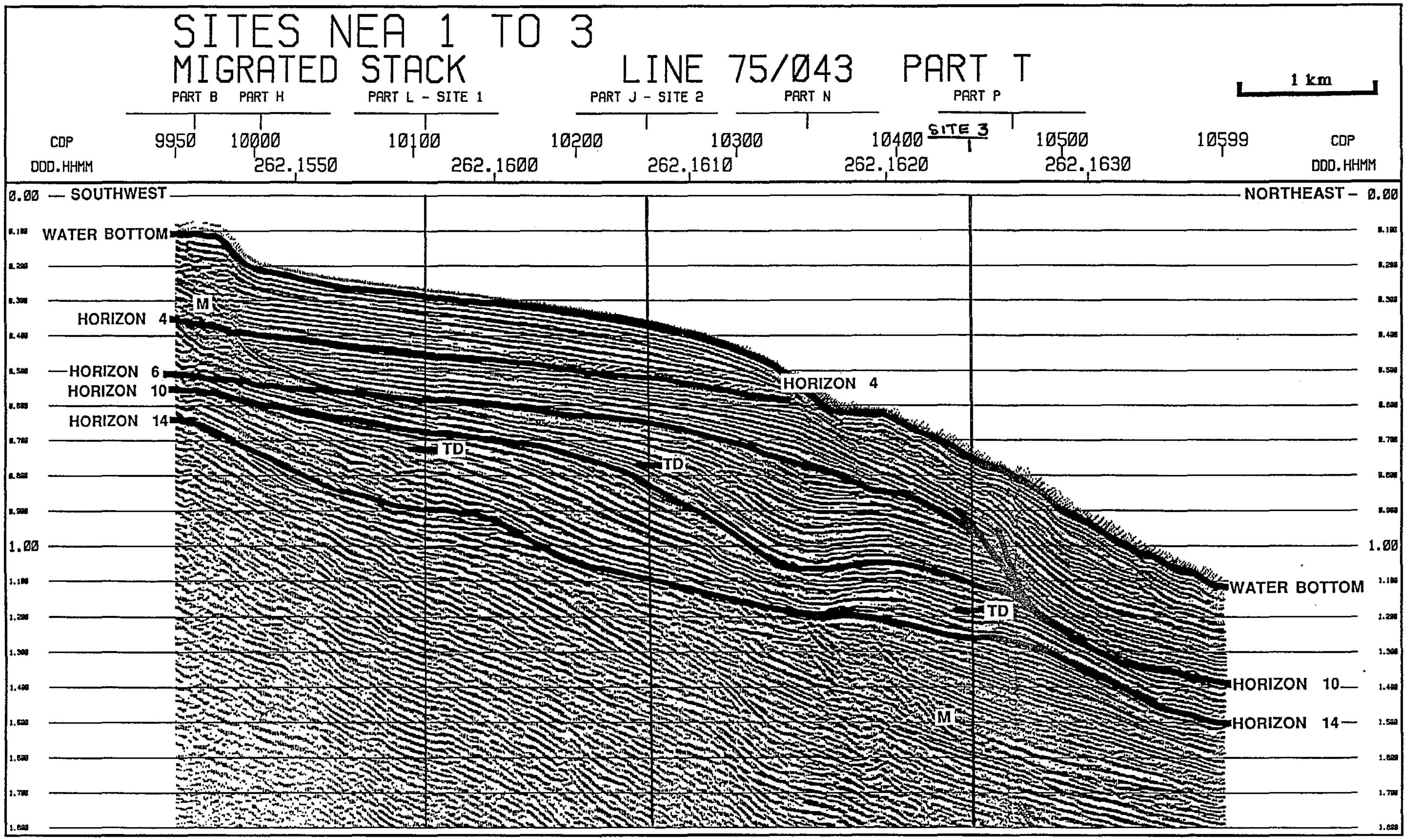
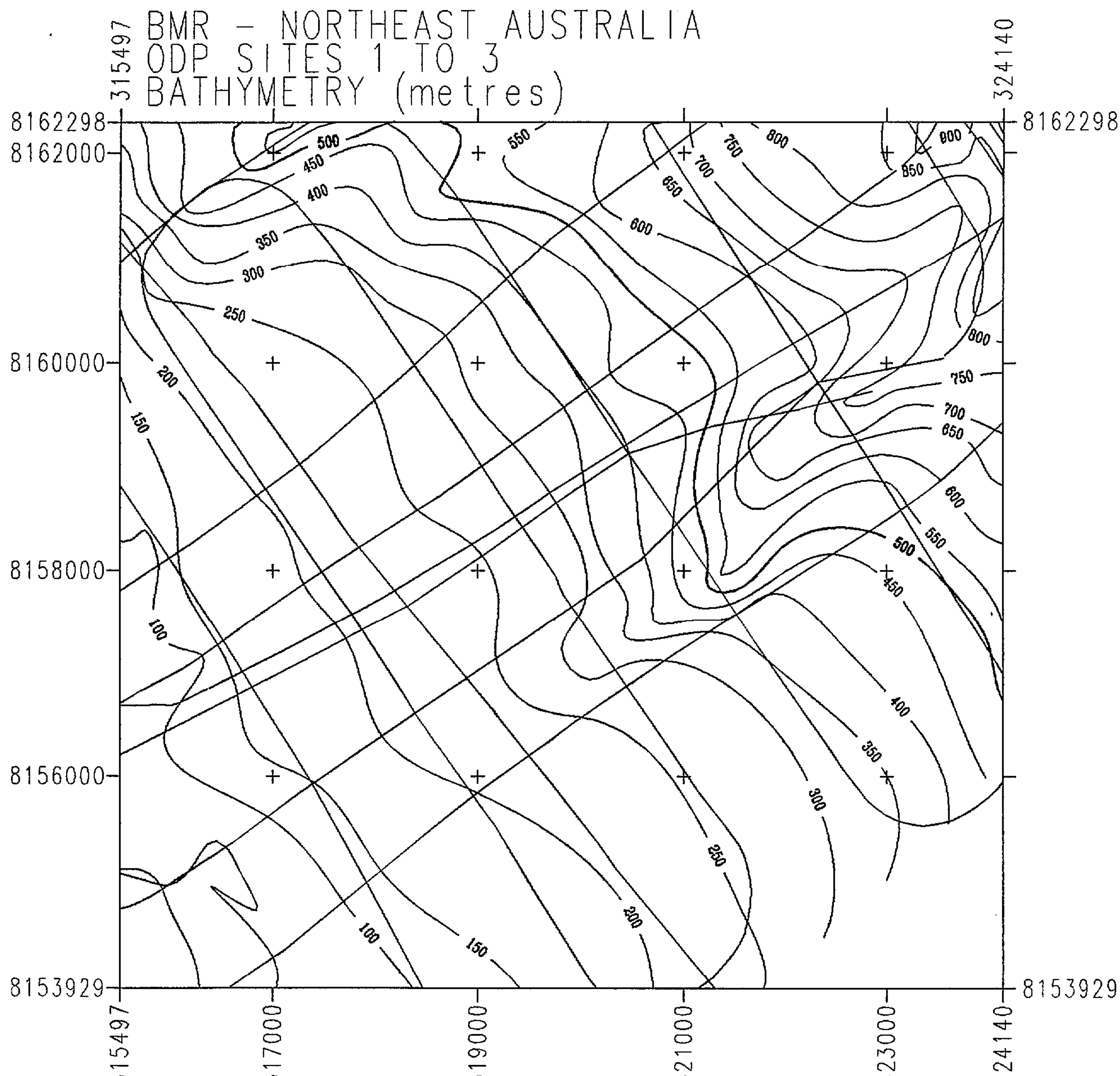
MIGRATED STACK
LINE 75/043 PART R
PART P (APPROX)
PART N (APPROX)
PART J (APPROX)
PART L (APPROX)
PART H (APPROX)
1 km
CDP
DDD.HHMM
8800
8900
9000
9100
9200
9300
9400
9500
262.1410
262.1420
262.1430
262.1440
262.1450
262.1500
0.00
NORTHEAST
SOUTHWEST
WATER BOTTOM
HORIZON 4
HORIZON 6
HORIZON 10
HORIZON 14
M
1.00


SITES NEA 1 TO 3
MIGRATED STACK
LINE 75/Ø43 PART T
1 km
PART B
PART H
PART L - SITE 1
PART J - SITE 2
PART N
PART P
SITE 3
CDP
DDD.HHMM
995Ø
1ØØØØ
1Ø1ØØ
1Ø2ØØ
1Ø3ØØ
1Ø4ØØ
1Ø5ØØ
1Ø599
262.155Ø
262.16ØØ
262.161Ø
262.162Ø
262.163Ø
Ø.ØØ
SOUTHWEST
NORTHEAST
1.ØØ


SITES NEA 1 TO 3
MIGRATED STACK
LINE 75/Ø43 PART T
1 km
PART B PART H
PART L - SITE 1
PART J - SITE 2
PART N
PART P
SITE 3
CDP
DDD.HHMM
9950
10000
10100
10200
10300
10400
10500
10599
262.1550
262.1600
262.1610
262.1620
262.1630
CDP
DDD.HHMM
0.00
SOUTHWEST
NORTHEAST
0.00
WATER BOTTOM
M
HORIZON 4
HORIZON 6
HORIZON 10
HORIZON 14
HORIZON 4
TD
TD
TD
1.00
1.00
WATER BOTTOM
HORIZON 10
HORIZON 14
M



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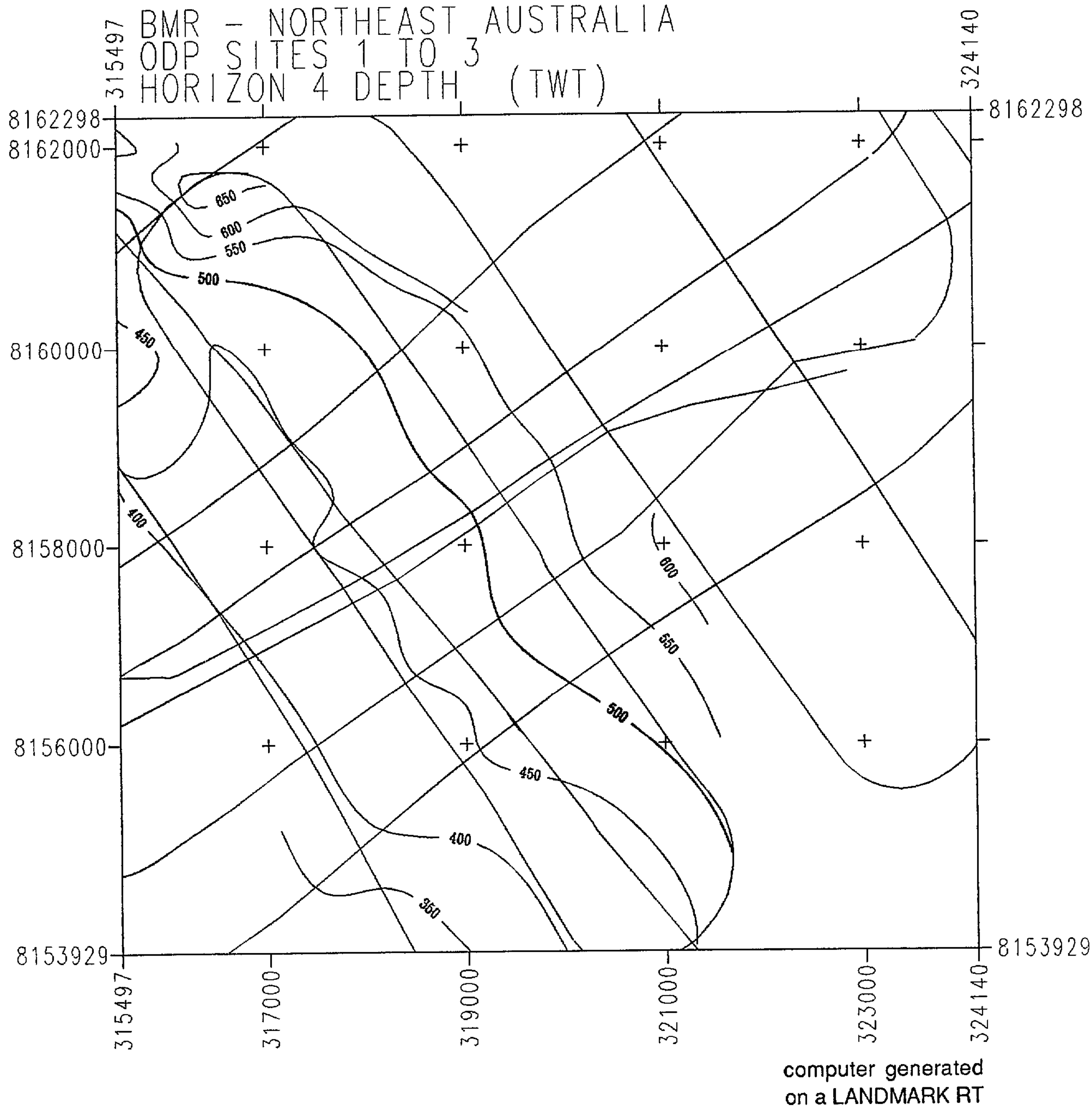
BMR - NORTHEAST AUSTRALIA
ODP SITES 1 TO 3
HORIZON 4 DEPTH (TWT)
8162298
8162000
8160000
8158000
8156000
8153929
315497
317000
319000
321000
323000
324140
650
600
550
500
450
400
350
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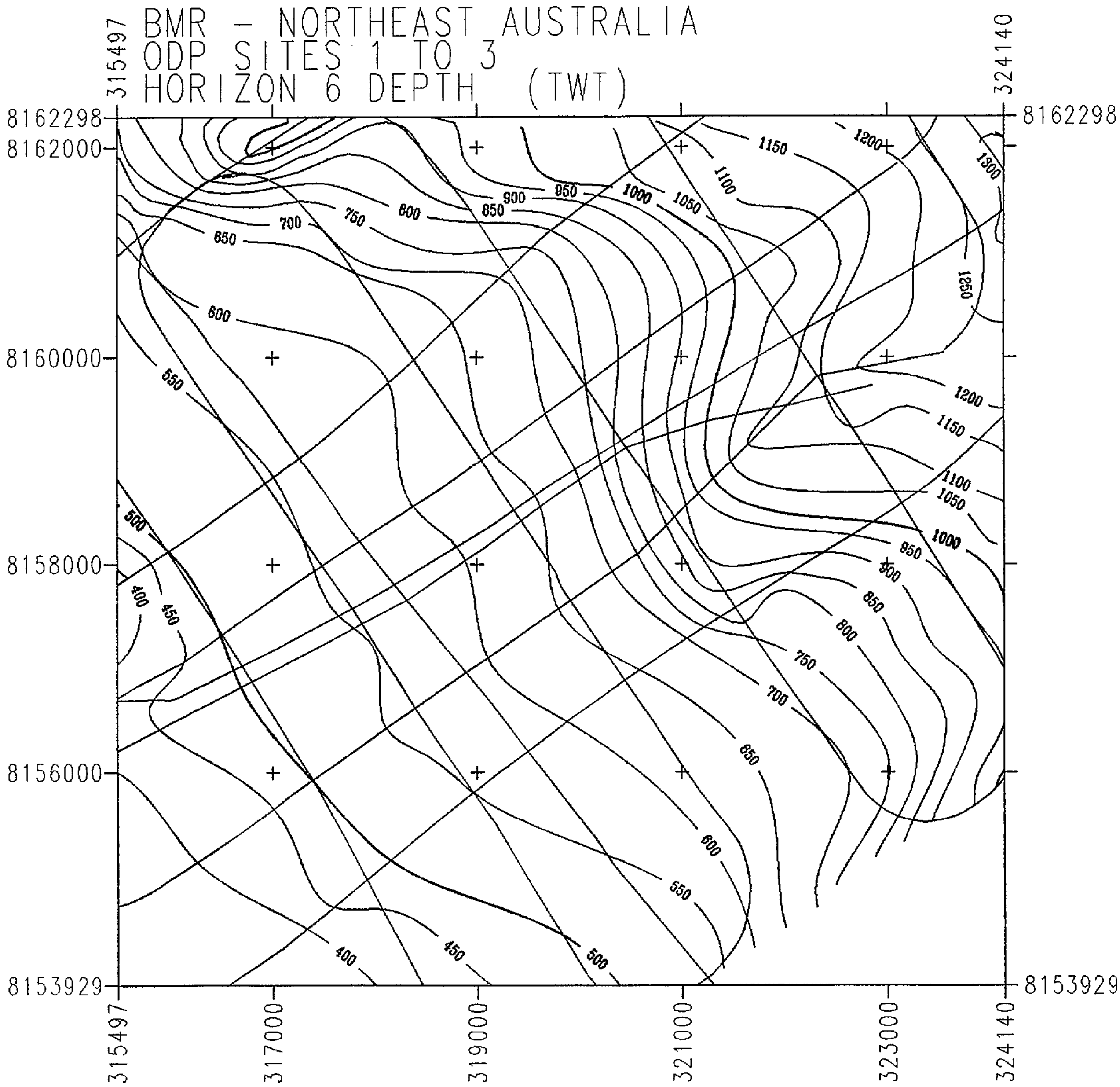

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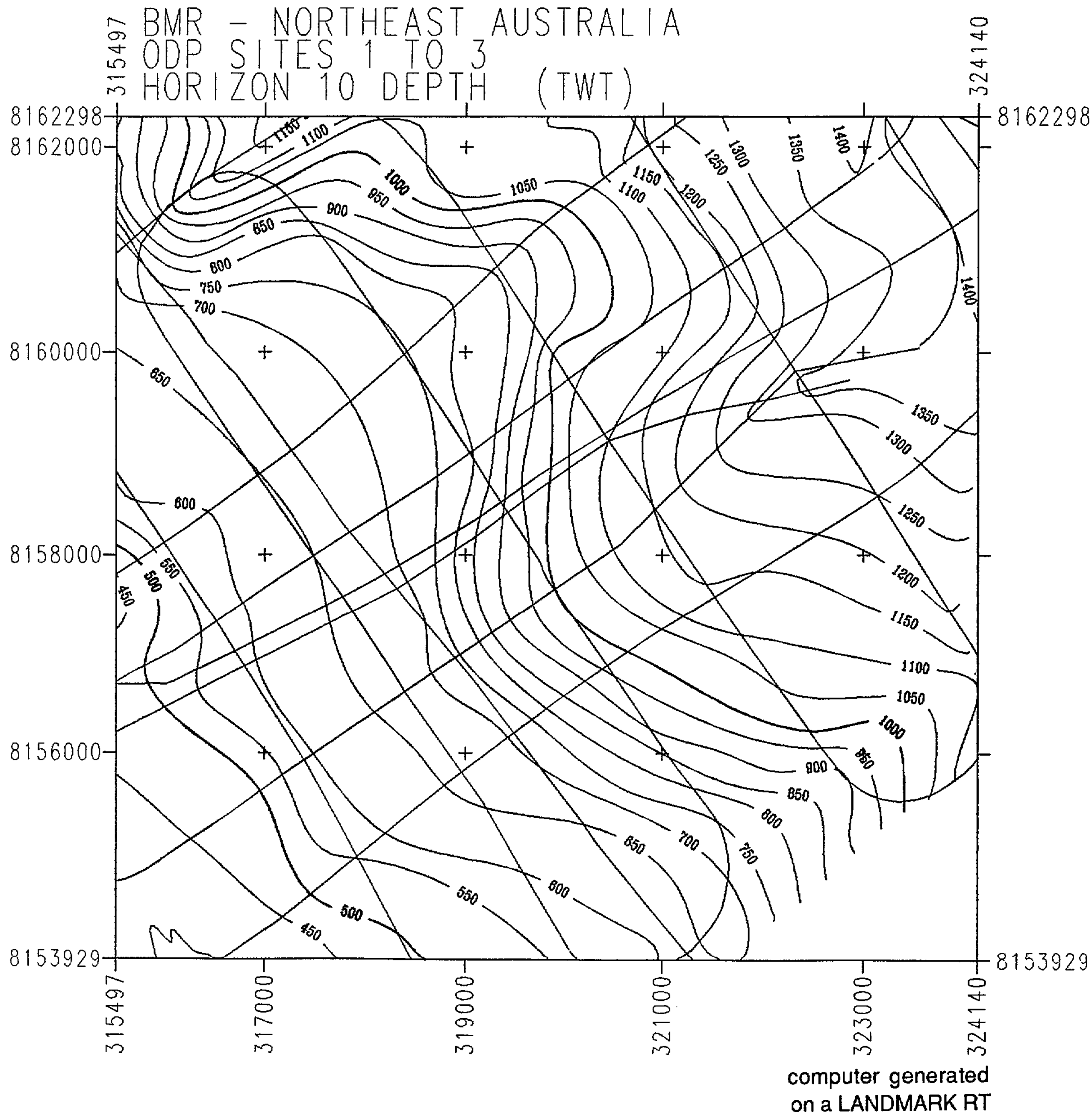
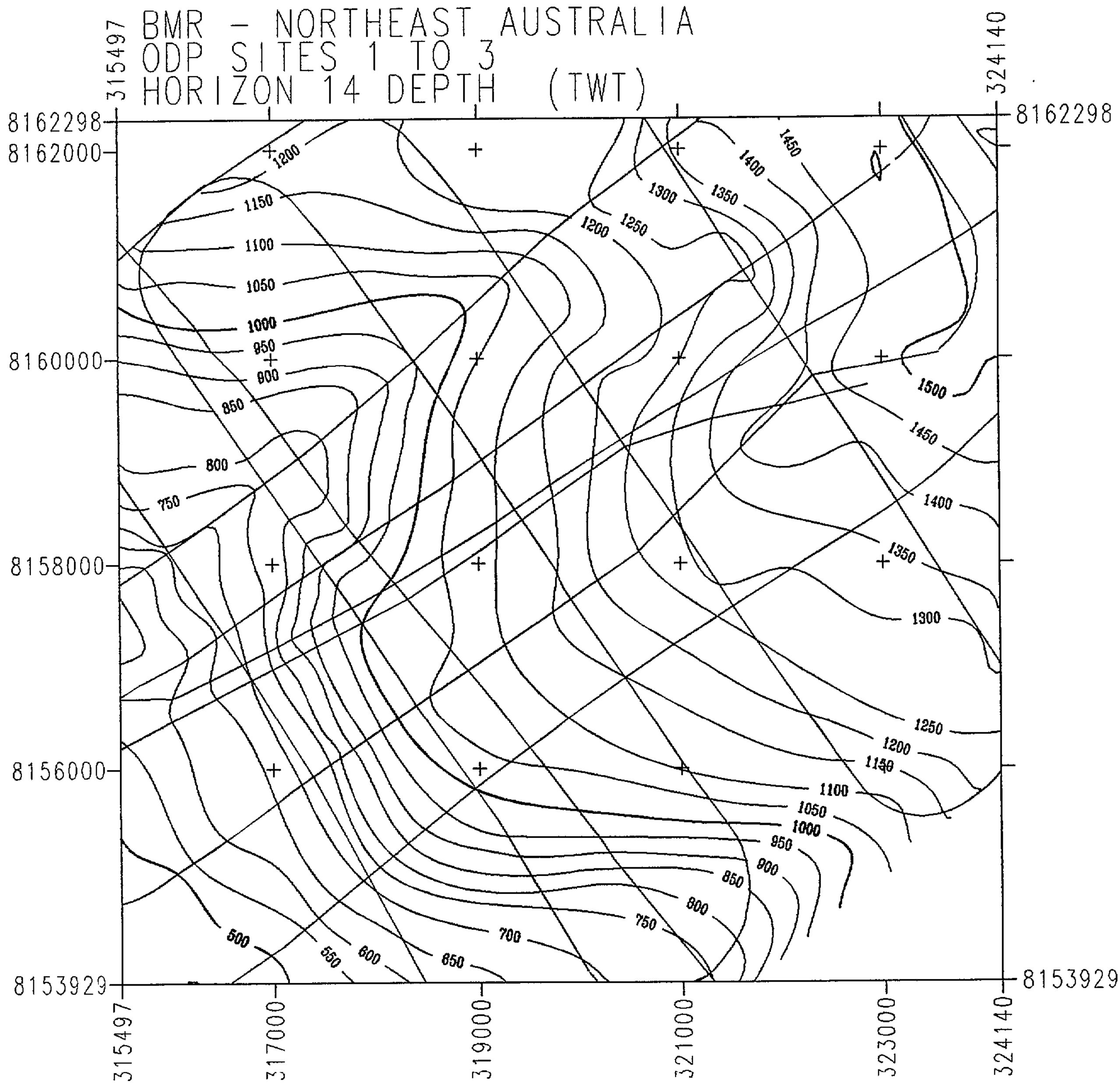

BMR - NORTHEAST AUSTRALIA
ODP SITES 1 TO 3
HORIZON 10 DEPTH (TWT)
315497
324140
8162298
8162000
8160000
8158000
8156000
8153929
317000
319000
321000
323000
computer generated
on a LANDMARK RT



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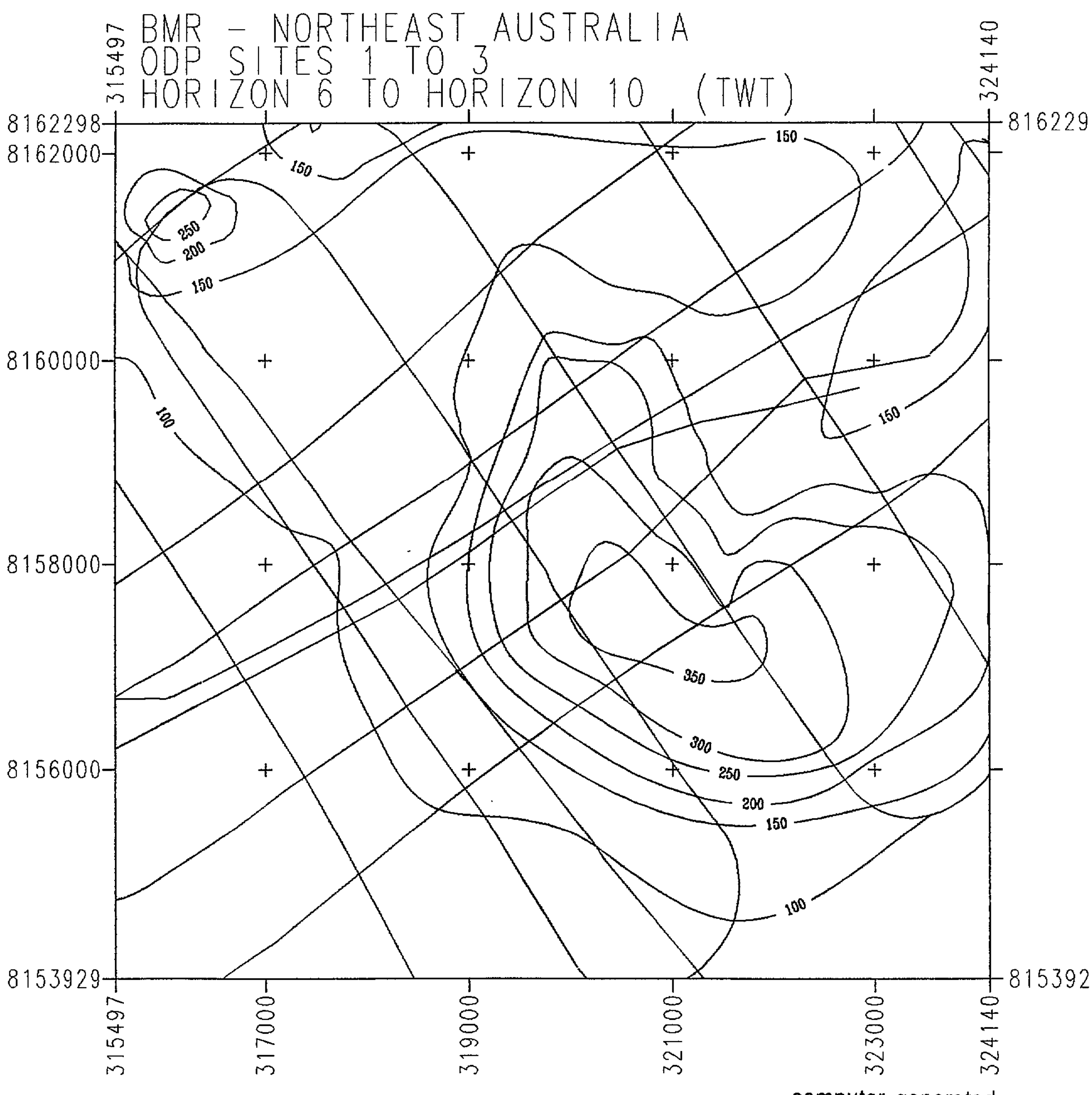

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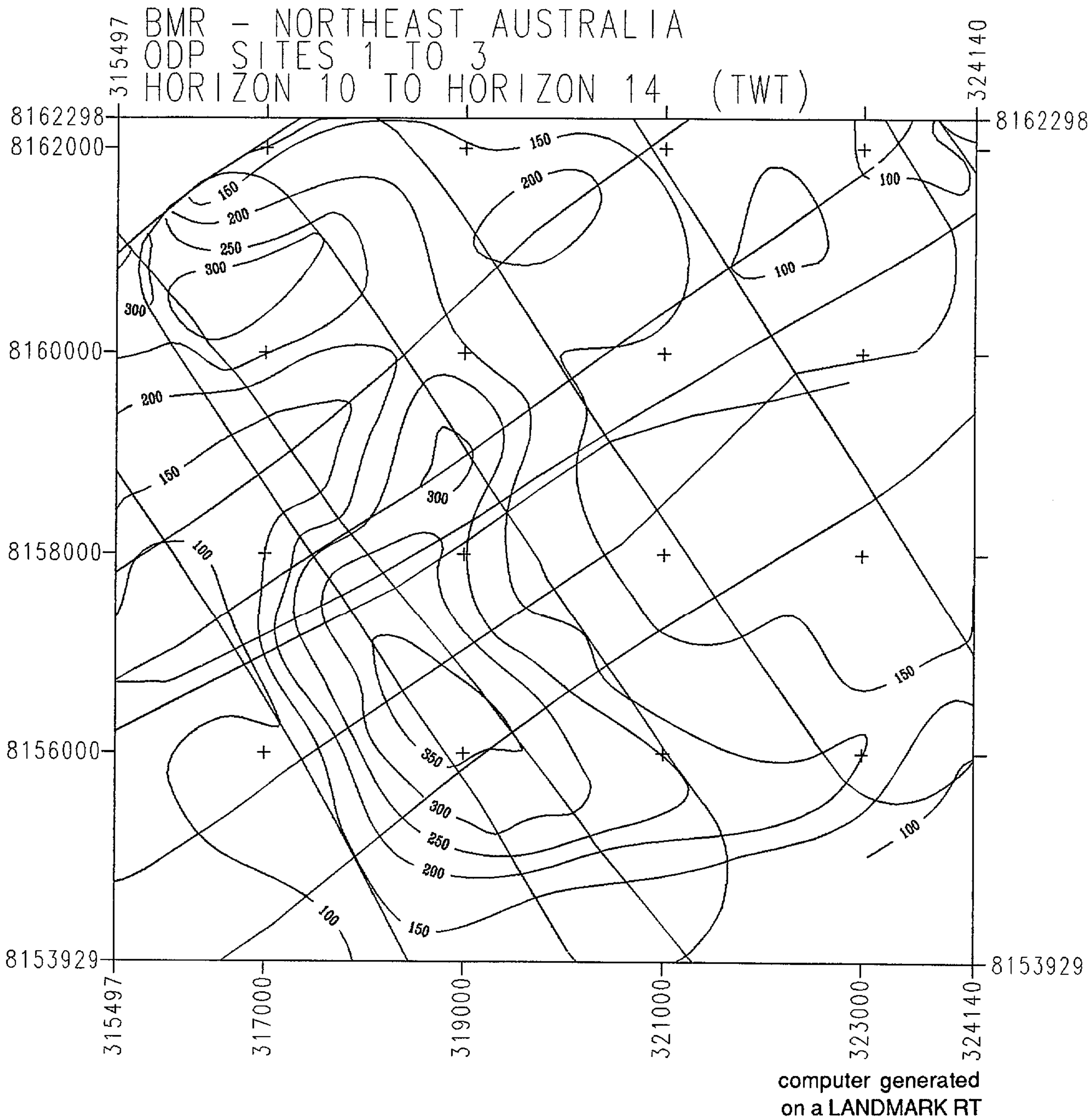
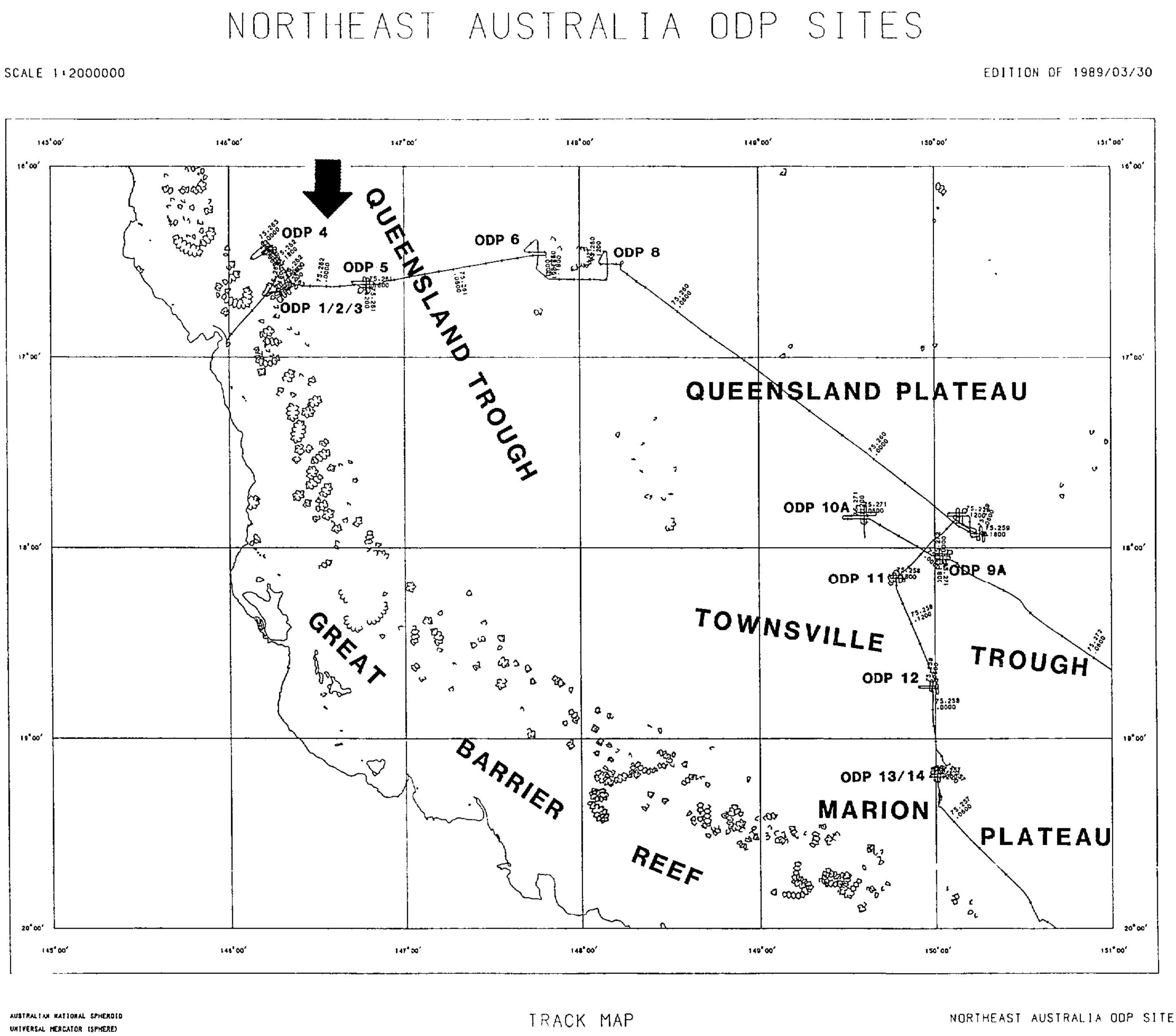


BMR - NORTHEAST AUSTRALIA
ODP SITES 1 TO 3
HORIZON 10 TO HORIZON 14 (TWT)
315497
324140
8162298
8162000
8160000
8158000
8156000
8153929
317000
319000
321000
323000
150
200
250
300
350
100
computer generated
on a LANDMARK RT

3.03 Site NEA 4



OVERVIEW - SITE NEA4

Site 4 lies on the western margin of the Queensland Trough, on the lower slope in front of the Great Barrier Reef. This hole will sample the upper part of a lower slope fan, and will provide data from a more distal position within the margin system controlled by sea level fluctuations, to complement the proximal sites NEA1 to NEA3. This site may contain sequences not represented, as a result of erosion or depositional hiatus, at sites NEA1 to NEA3, and will in addition sample deeper parts of the margin sequence.

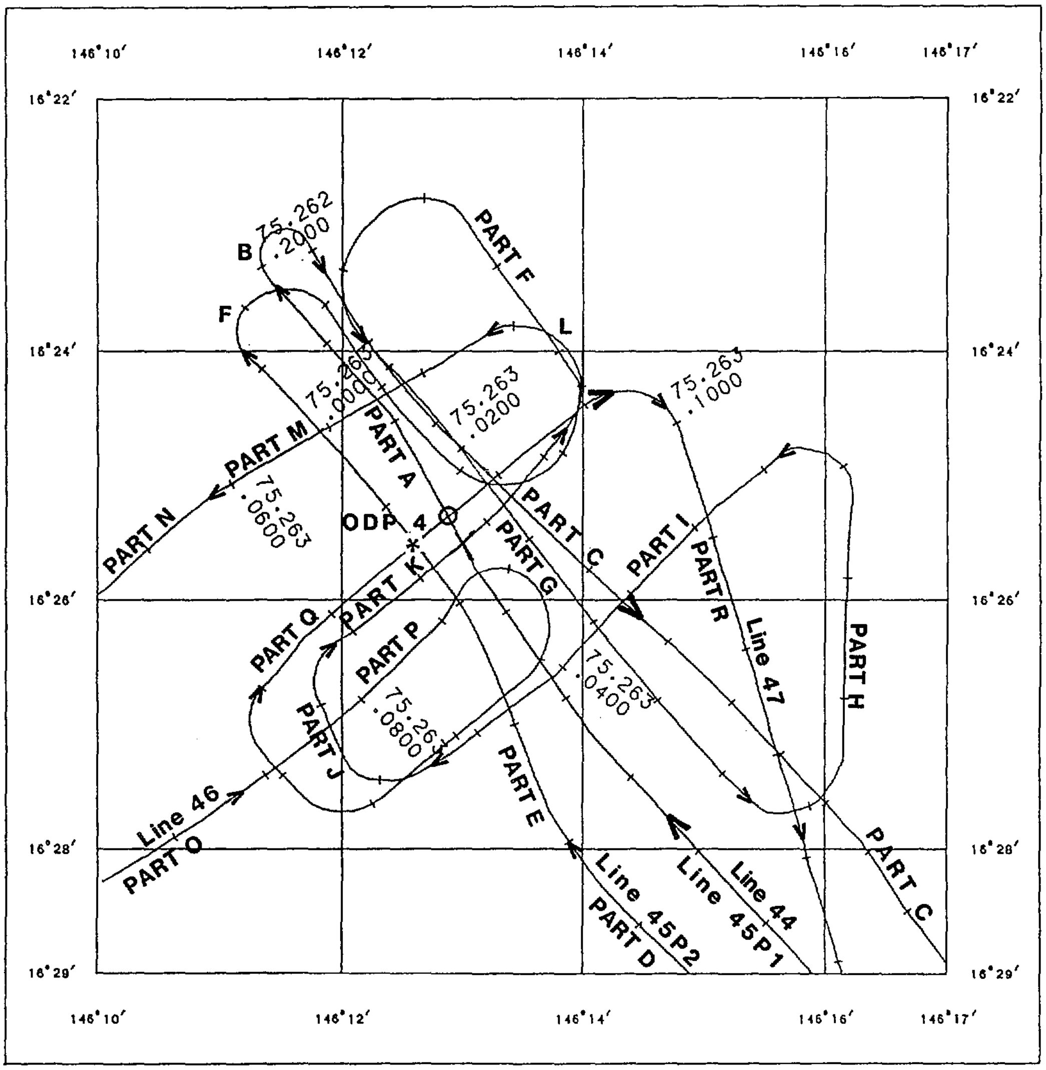
OBJECTIVES - SITE 4

1. To determine the age and facies of a lower slope fan in front of the present day Great Barrier Reef.
2. By comparison with sites NEA1 to NEA3, to determine the sea level signature preserved in lower slope facies.
3. To examine fan processes on the lower slope in a mixed siliciclastic/carbonate depositional system.

PROGNOSIS - SITE 4

1. 400 m of latest Miocene-Quaternary interbedded siliciclastic and carbonate sands and muds.

SCALE 1:100000 ODP SITE 4 EDITION OF 1989/03/23



* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 4

Site NEA 4

CHECK SHEET

JOIDES SAFETY REVIEW

Leg **133** *Site No.* **NEA 4** *Lat.* **16° 25.3'S** *Long.* **146° 12.7'E**

Water Depth:	*Dist. from Land:*	*Jurisdiction:*
960 m.	**38 n.mi.**	**AUSTRALIA**

General location or geomorphic province:
WESTERN QUEENSLAND TROUGH

Upon what geophysical and/or geological data was this site selection made:
Seismic lines: **BMR LINE 75/045P1 part A AND 75/046 part Q**
Piston cores: **75PC02 (gravity core 75GC05)**
DSDP holes: **NONE**
Other:

Proposed total penetration: **400 m.**
Probable sediment thickness: **2+ seconds TWT**

From previous DSDP drilling in this area, list all hydrocarbon occurrences of greater than background levels, give nature of show, age and depth of rock:
NO PREVIOUS DRILLING.

From available information, list all commercial drilling in this area that produced or yielded significant shows; give depths and ages of hydrocarbon bearing deposits:
NO COMMERCIAL DRILLING IN THIS AREA. NEAREST WELL IS APPROX. 455 n.mi. TO THE NORTH - NO HYDROCARBONS ENCOUNTERED. OIL SHALES OCCUR ONSHORE IN EARLY TERTIARY NONMARINE BASINS 240 n.mi. TO SOUTH.

Is there any indication of gas hydrates at this location:
NO INDICATION; NO BSR PRESENT.

Is there any reason to expect any hydrocarbon accumulation at this site? Please comment.
NO. ABSENCE OF STRUCTURE AND THERMALLY IMMATURE SECTION PRECLUDES POSSIBILITY OF HYDROCARBON OCCURRENCE.

What is your proposed drilling program?
APC/XCB TO 400 m.

What is your proposed logging program?
SCHLUMBERGER LOGGING SUITE; WATER SAMPLE EVERY 100 m.

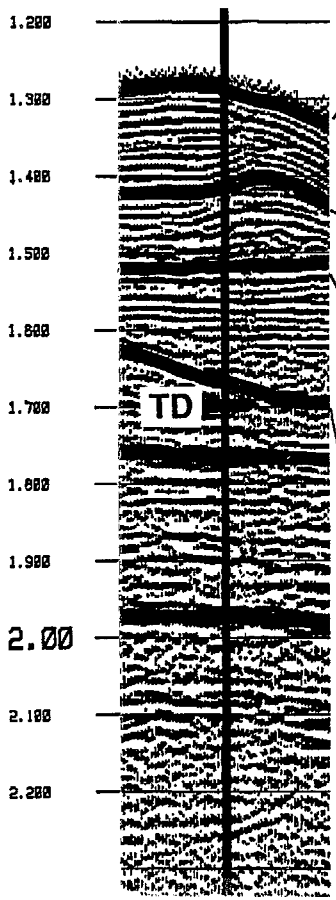
What "special" precautions will be taken during drilling?
STANDARD HYDROCARBON MONITORING.

What abandonment procedures do you plan to follow? (see Safety Manual, Sec. VIII, p. 22)
STANDARD PROCEDURES.

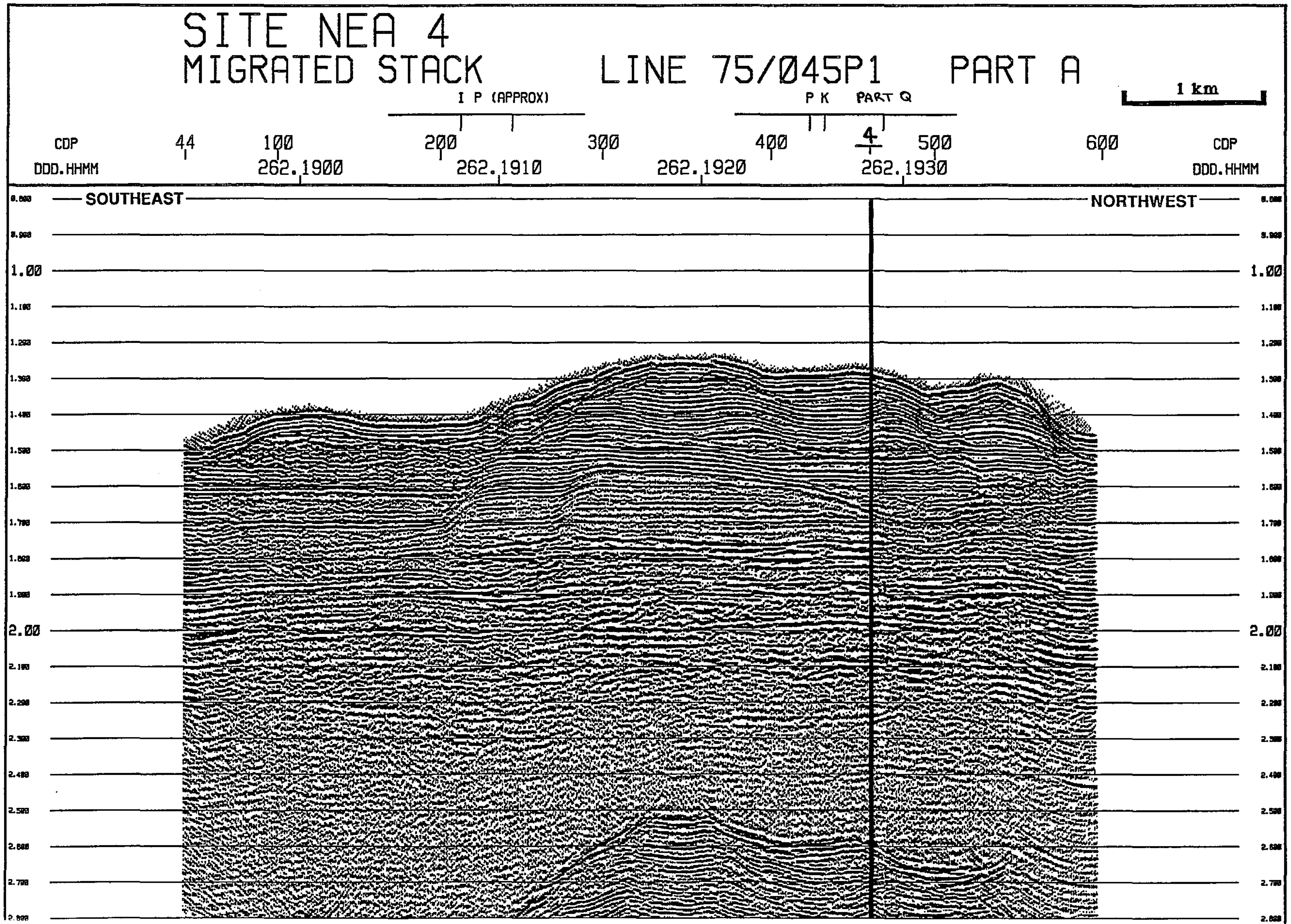
SUMMARY: What do you consider to be the major risks in drilling at this site?
NO MAJOR RISKS. SLIGHT CHANCE OF MINOR BIOGENIC GAS.

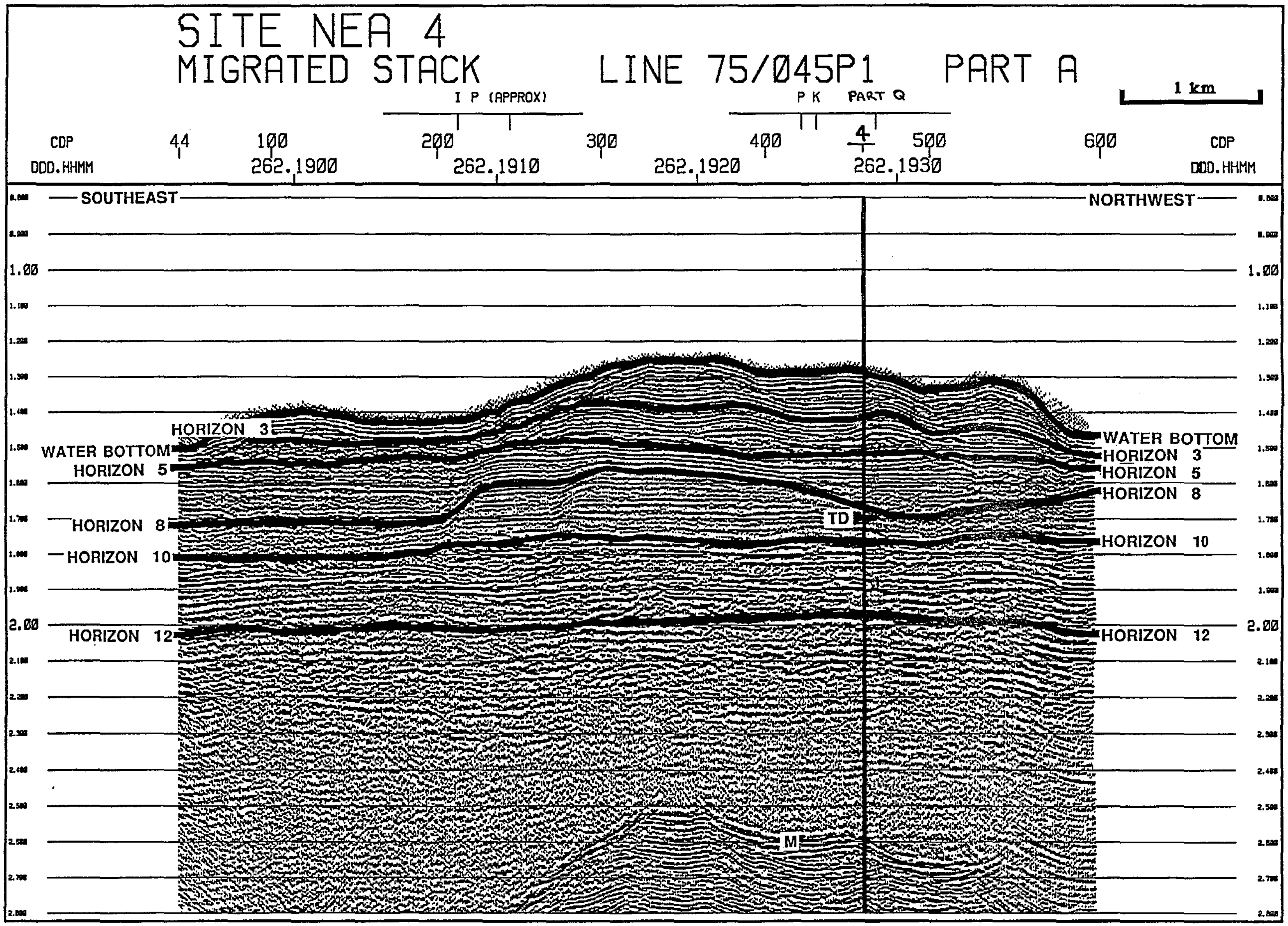
Please answer each question as carefully as possible, using extra pages if need be. The information you provide here will be an important factor in the Safety Review.

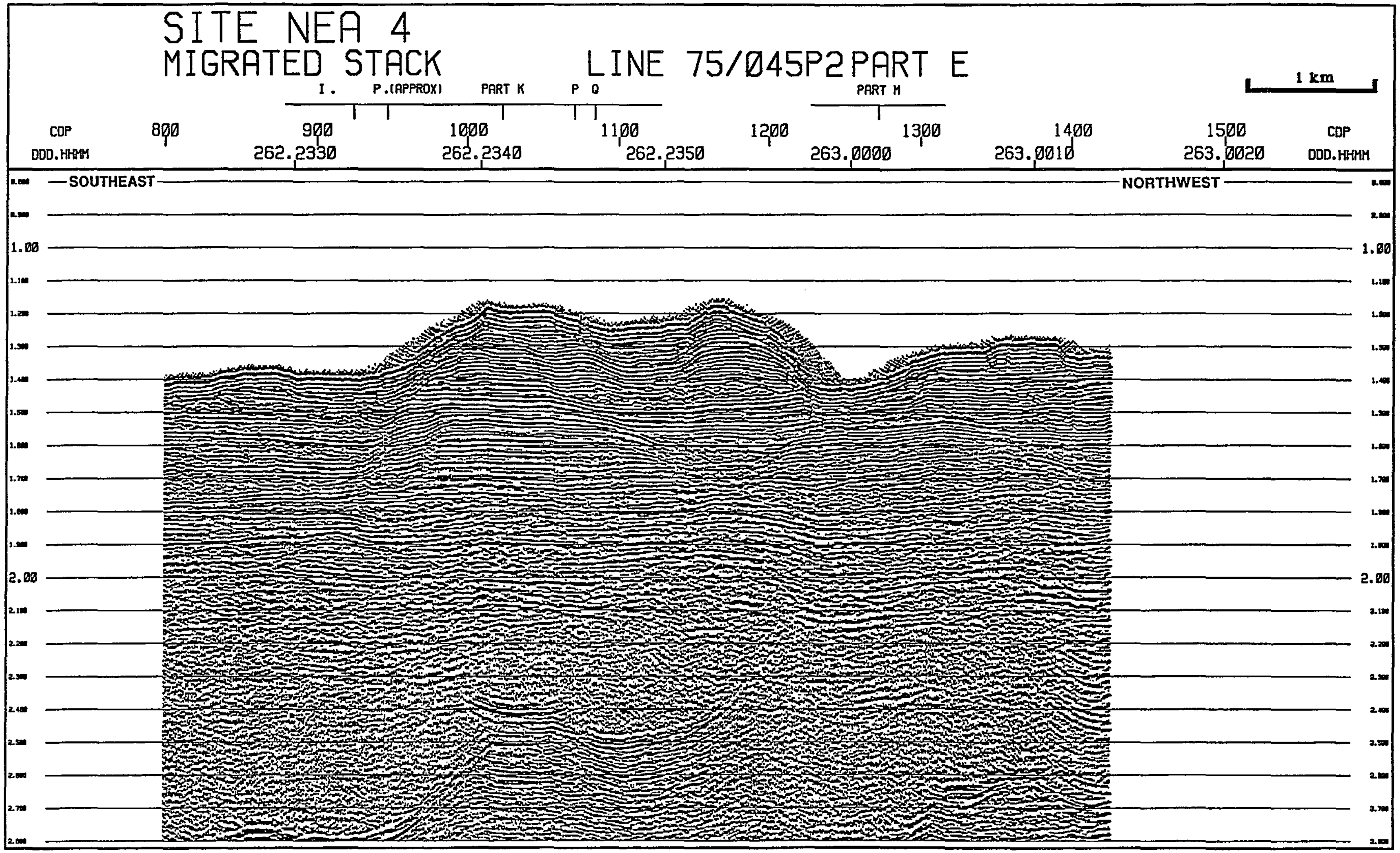
GRAPHIC SUMMARY: SITE NEA 4



Key Reflectors	Depth (m)	Age	Velocity (km/sec)	Lithology	Paleoenvironment	Sedim. Rate	Comments
	0–100	latest Pliocene to Quaternary	1.56	carbonate mud draped over siliciclastic & carbonate sand to mud	pelagic ooze over lower slope fan deposits	43 m/my	both coarser channel deposits and fine grained 'levee' deposits should be represented
H3		[113] Pliocene	1.56	siliciclastic & carbonate sand to mud	lower slope fan	35 m/my	
H5	200	[183] Pliocene	1.86	siliciclastic & carbonate sand to mud	lower slope fan	35 m/my	
H8	300	[318] latest Miocene to Pliocene	1.86 / 2.23	siliciclastic & carbonate sand to mud	lower slope fan	30 m/my	
TD	400						
H10	500	[445]					


SITE NEA 4
MIGRATED STACK
LINE 75/Ø45P1
PART A
1 km
I P (APPROX)
P K
PART Q
CDP
44
100
200
300
400
4
500
600
CDP
DDD.HHMM
262.1900
262.1910
262.1920
262.1930
DDD.HHMM
SOUTHEAST
NORTHWEST
1.00
2.00
1.00
2.00


SITE NEA 4
MIGRATED STACK LINE 75/Ø45P1 PART A
1 km
I P (APPROX)
P K
PART Q
CDP
DDD.HHMM
44
100
200
300
400
4
500
600
262.1900
262.1910
262.1920
262.1930
SOUTHEAST
NORTHWEST
1.00
2.00
HORIZON 3
WATER BOTTOM
HORIZON 5
HORIZON 8
HORIZON 10
HORIZON 12
TD
M


SITE NEA 4
MIGRATED STACK
LINE 75/045P2 PART E
1 km
I.
P.(APPROX)
PART K
P Q
PART M
CDP
DDD.HHMM
800
900
1000
1100
1200
1300
1400
1500
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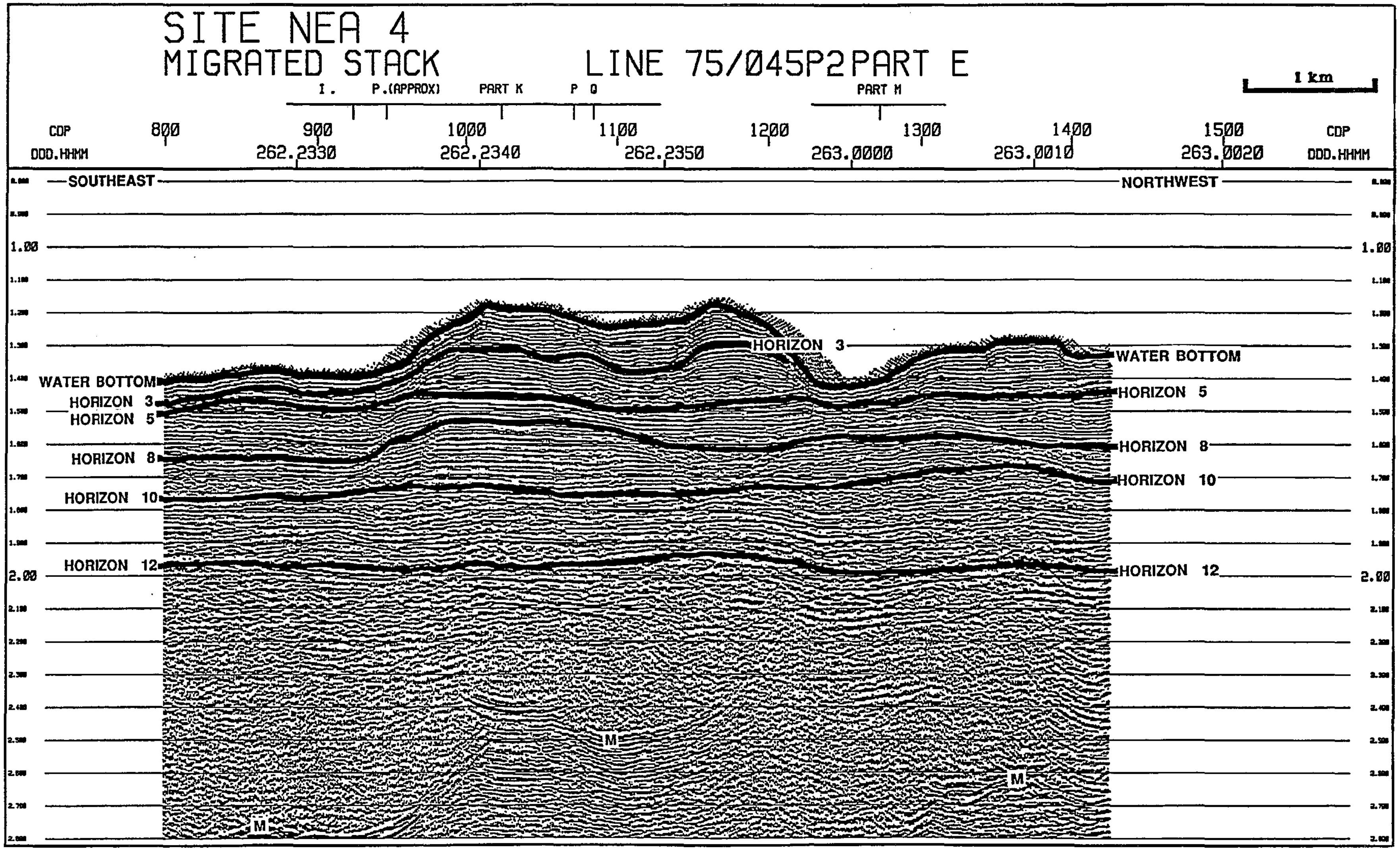
262.2340
262.2350
263.0000
263.0010
263.0020
SOUTHEAST
NORTHWEST
1.00
2.00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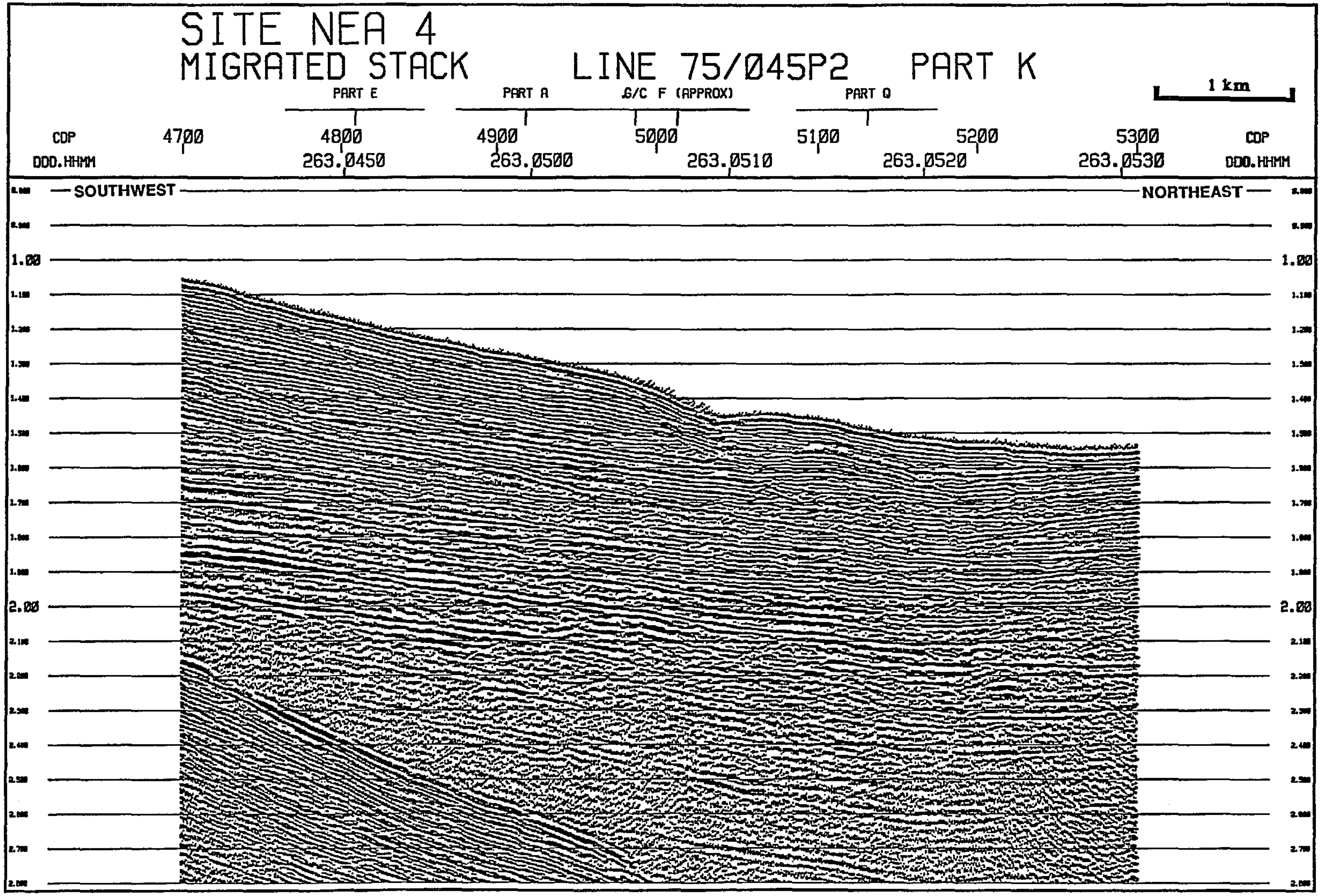
MIGRATED STACK
LINE 75/045P2 PART E
I.
P.(APPROX)
PART K
P
Q
PART M
1 km
CDP
DDD.HHMM
800
900
1000
1100
1200
1300
1400
1500
262.2330
262.2340
262.2350
263.0000
263.0010
263.0020
SOUTHEAST
NORTHWEST
1.00
2.00
WATER BOTTOM
HORIZON 3
HORIZON 5
HORIZON 8
HORIZON 10
HORIZON 12
M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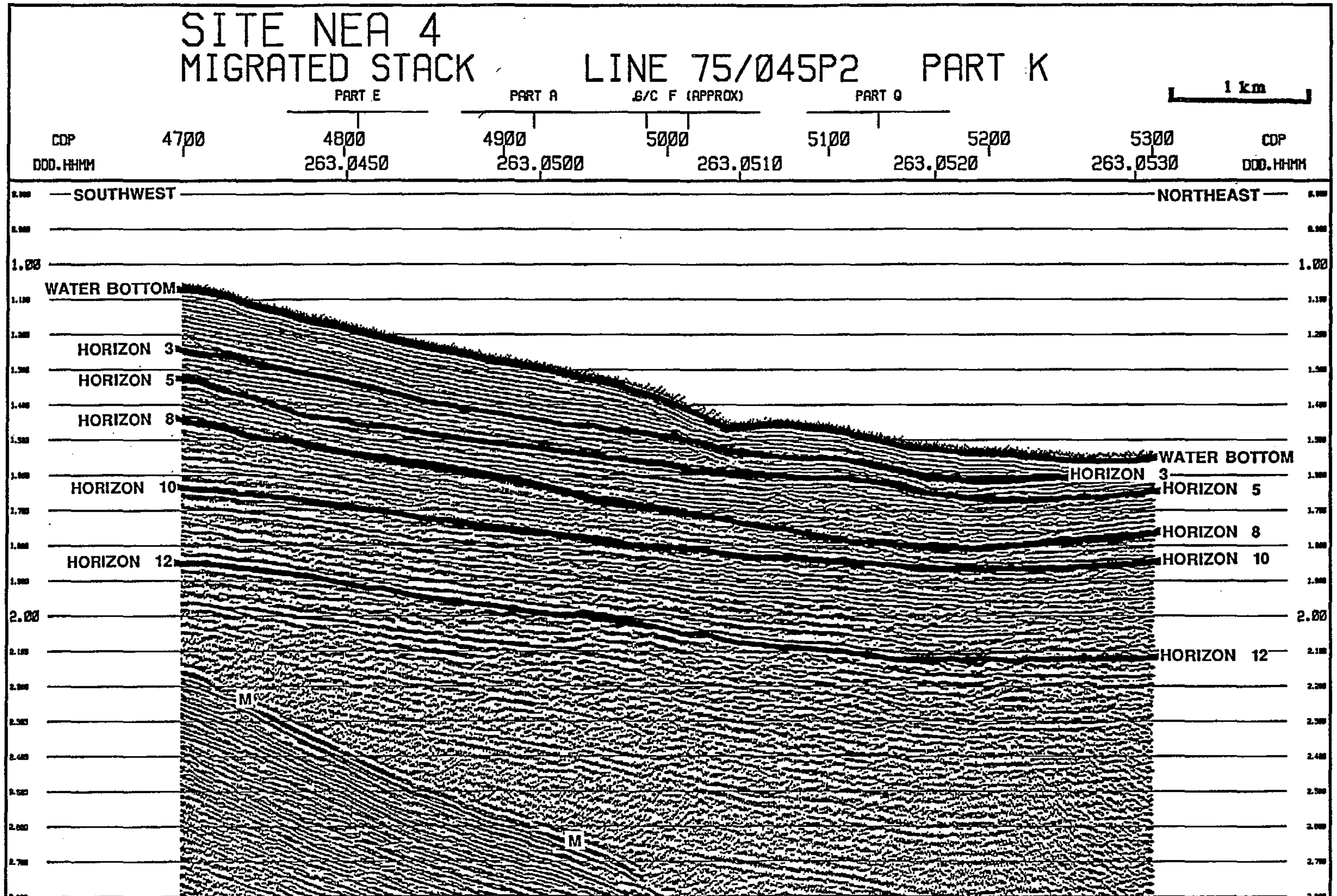
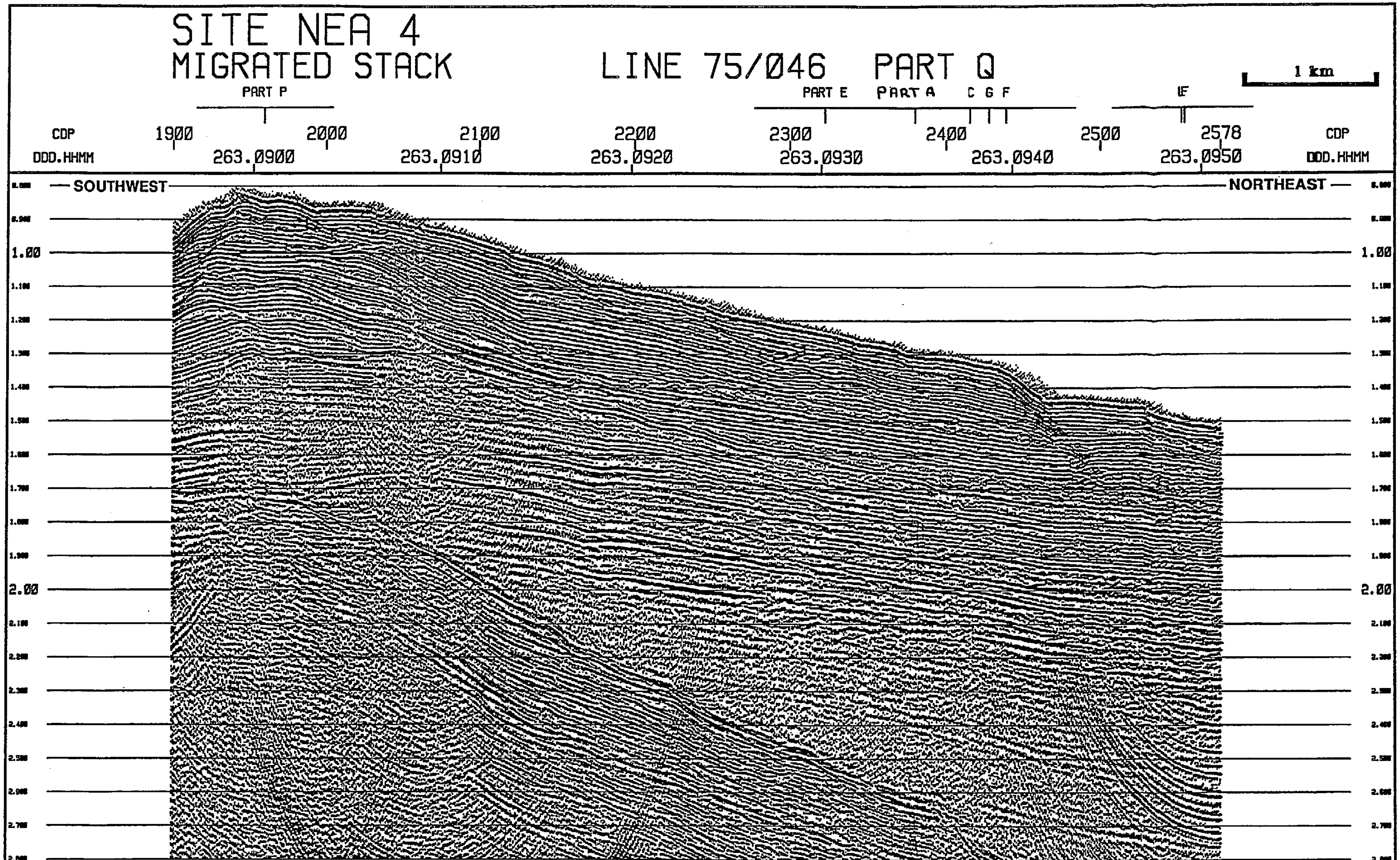
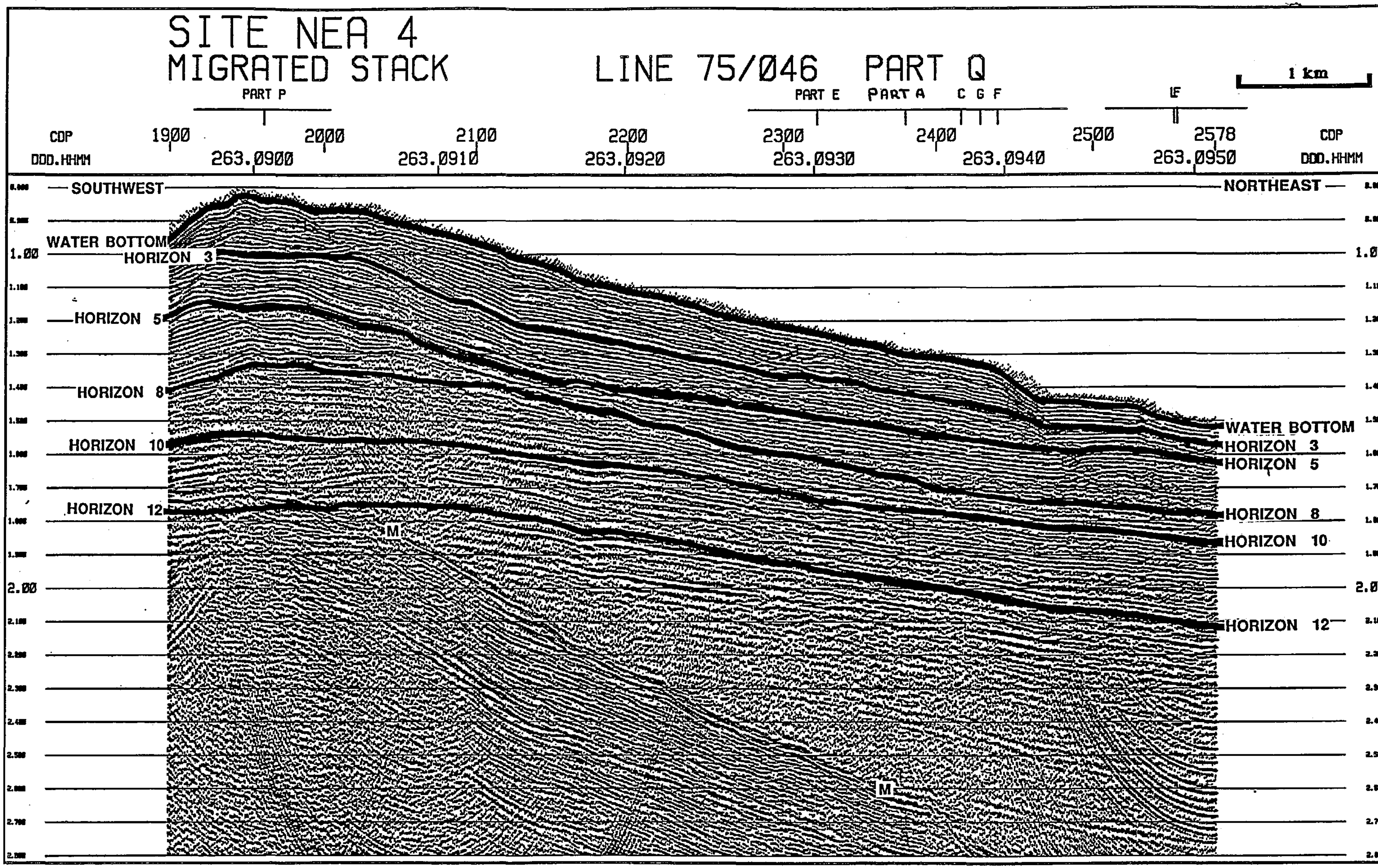
MIGRATED STACK LINE 75/Ø45P2 PART K
PART E
PART A
G/C F (APPROX)
PART Q
1 km
CDP
DDD.HHMM
47ØØ
48ØØ
49ØØ
5ØØØ
51ØØ
52ØØ
53ØØ
263.Ø45Ø
263.Ø5ØØ
263.Ø51Ø
263.Ø52Ø
263.Ø53Ø
CDP
DDD.HHMM
SOUTHWEST
NORTHEAST
1.ØØ
2.ØØ
1.ØØ
2.ØØ



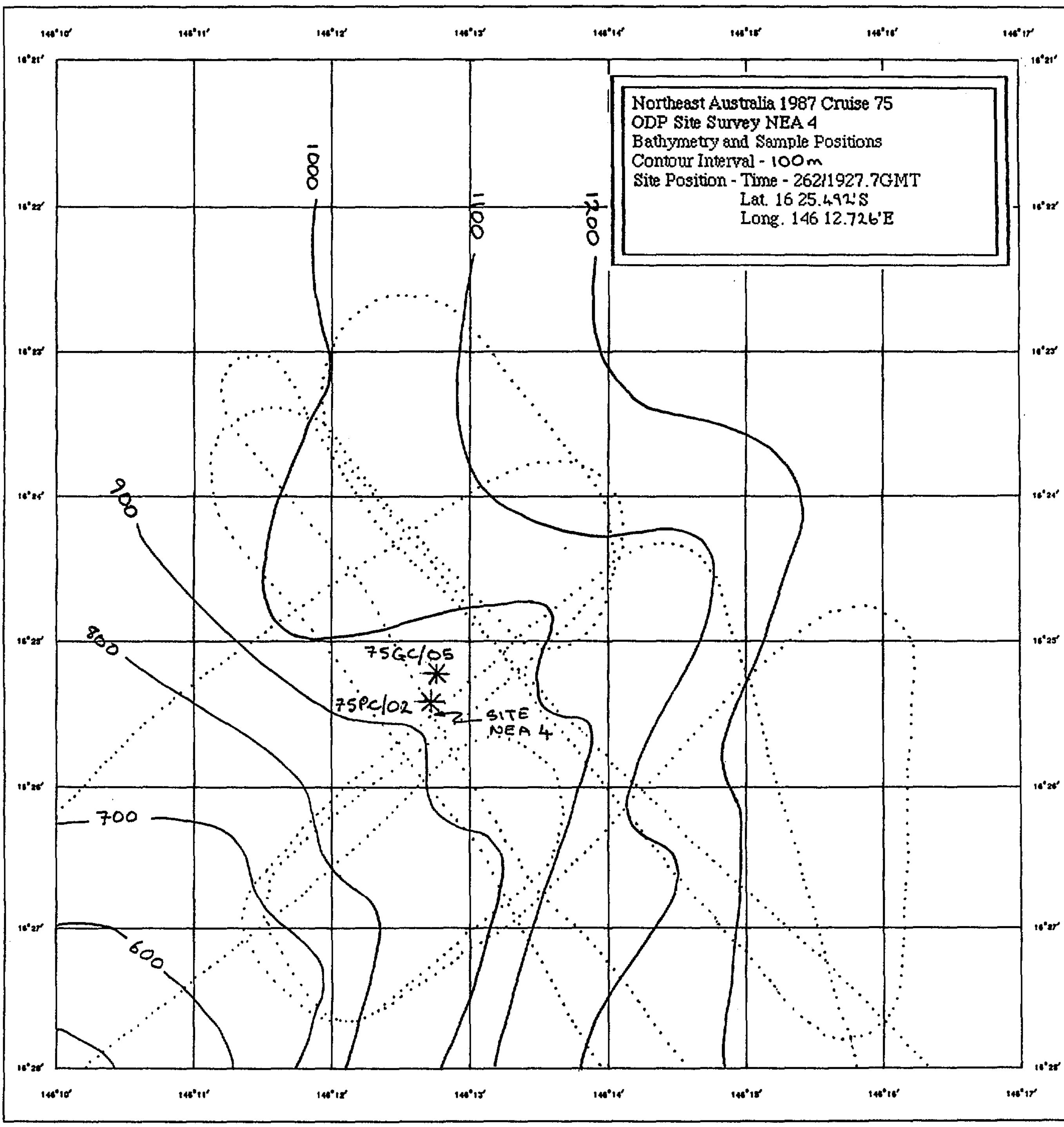
SITE NEA 4
MIGRATED STACK LINE 75/045P2 PART K
1 km
PART E
PART A
G/C F (APPROX)
PART Q
CDP
DDD.HHMM
4700
4800
4900
5000
5100
5200
5300
263.0450
263.0500
263.0510
263.0520
263.0530
SOUTHWEST
NORTHEAST
1.00
2.00
WATER BOTTOM
HORIZON 3
HORIZON 5
HORIZON 8
HORIZON 10
HORIZON 12
M
M


SITE NEA 4
MIGRATED STACK
LINE 75/Ø46 PART Q
1 km
PART P
PART E
PART A
C G F
F
CDP
DDD.HHMM
19ØØ
2ØØØ
21ØØ
22ØØ
23ØØ
24ØØ
25ØØ
2578
263.Ø9ØØ
263.Ø91Ø
263.Ø92Ø
263.Ø93Ø
263.Ø94Ø
263.Ø95Ø
CDP
DDD.HHMM
SOUTHWEST
NORTHEAST
1.ØØ
2.ØØ


SITE NEA 4
MIGRATED STACK
LINE 75/Ø46 PART Q
1 km
PART P
PART E
PART A
C G F
F
CDP
DDD.HHMM
19ØØ
2ØØØ
21ØØ
22ØØ
23ØØ
24ØØ
25ØØ
2578
263.Ø9ØØ
263.Ø91Ø
263.Ø92Ø
263.Ø93Ø
263.Ø94Ø
263.Ø95Ø
SOUTHWEST
NORTHEAST
WATER BOTTOM
HORIZON 3
HORIZON 5
HORIZON 8
HORIZON 10
HORIZON 12
M
1.ØØ
2.ØØ

O.D.P. SITE SURVEY

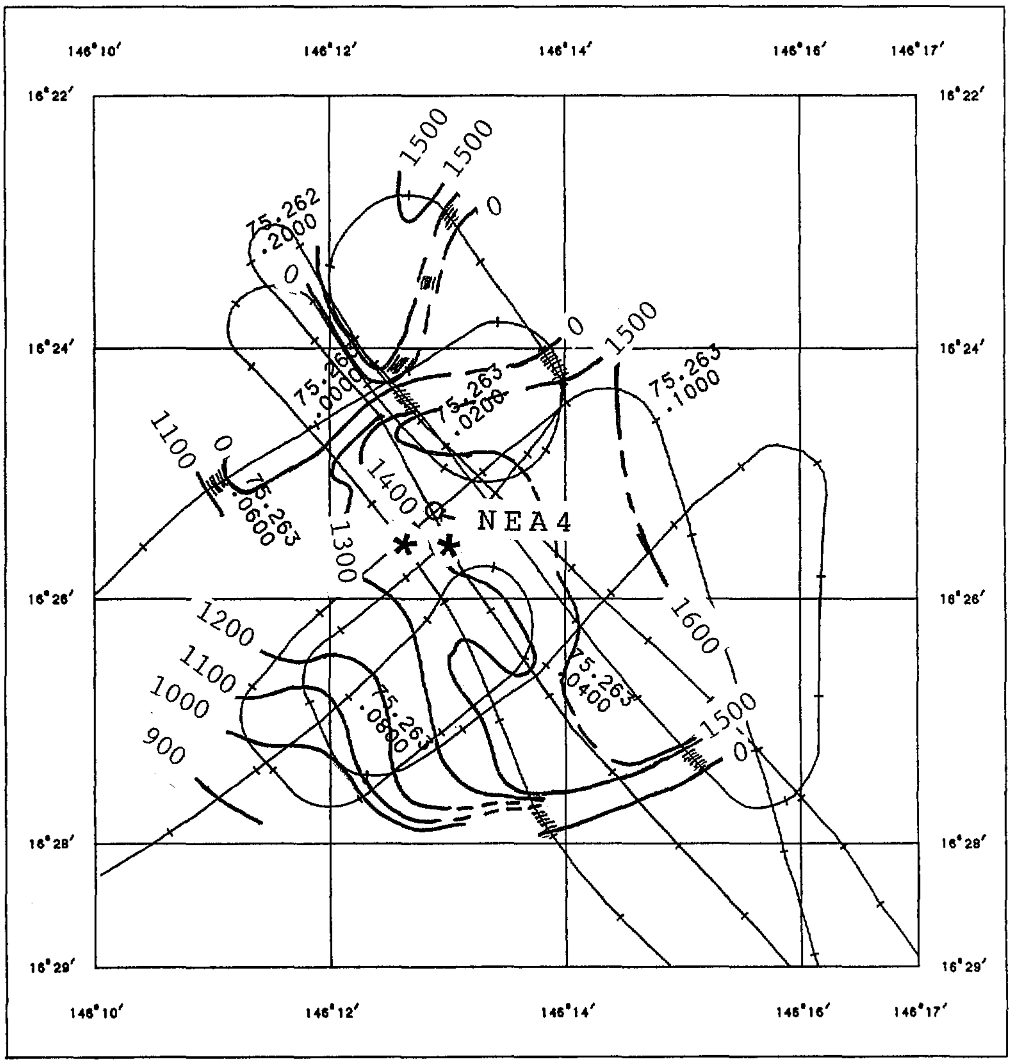
SCALE 1:50000 — NEA 4 — EDITION OF 1987/10/02



UNIVERSAL MERCATOR PROJECTION
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

SCALE 1:100000 ODP SITE 4 EDITION OF 1989/03/23

HORIZON 3 DEPTH (TWT)



* ALTERNATE SITE

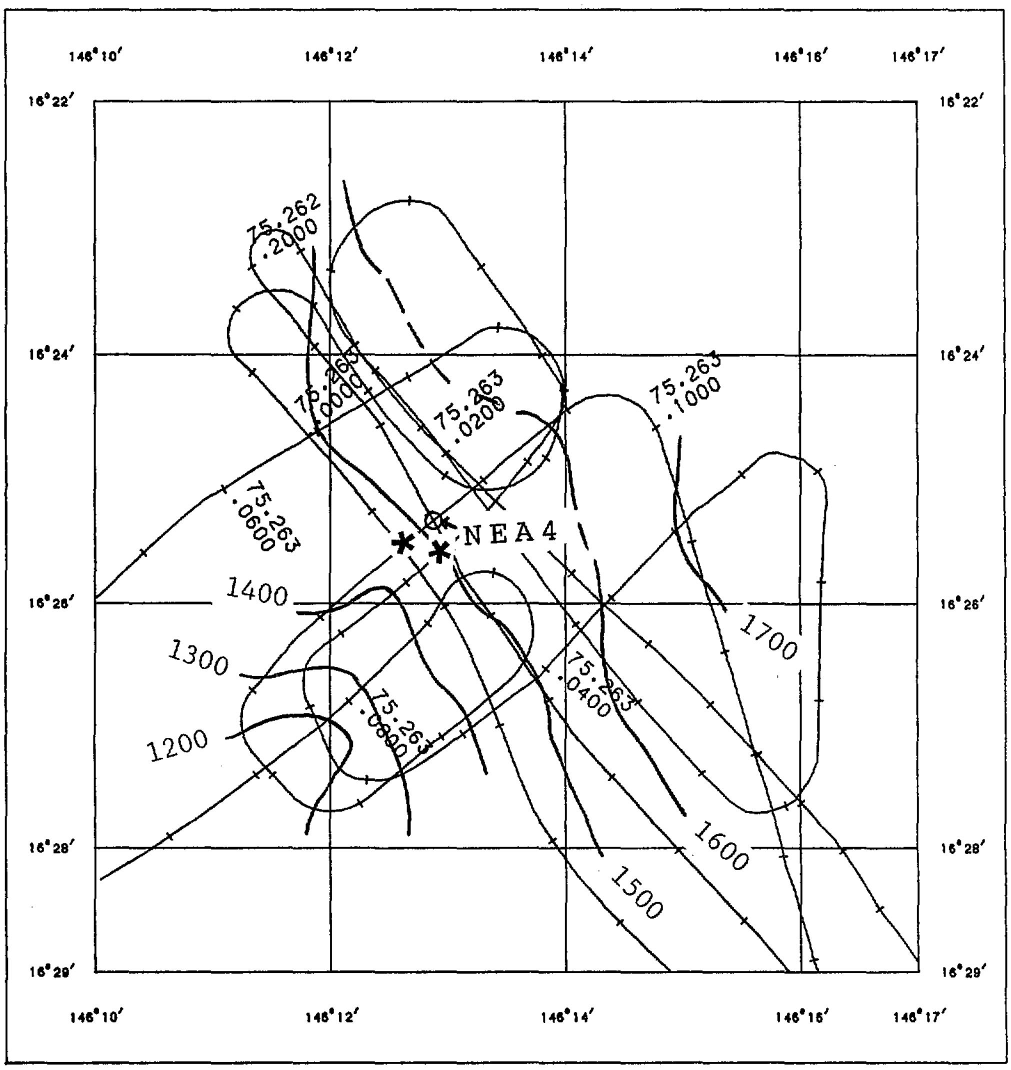
TRACK MAP

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

ODP SITE 4

SCALE 1:100000 ODP SITE 4 EDITION OF 1989/03/23

HORIZON 5 DEPTH (TWT)



* ALTERNATE SITE

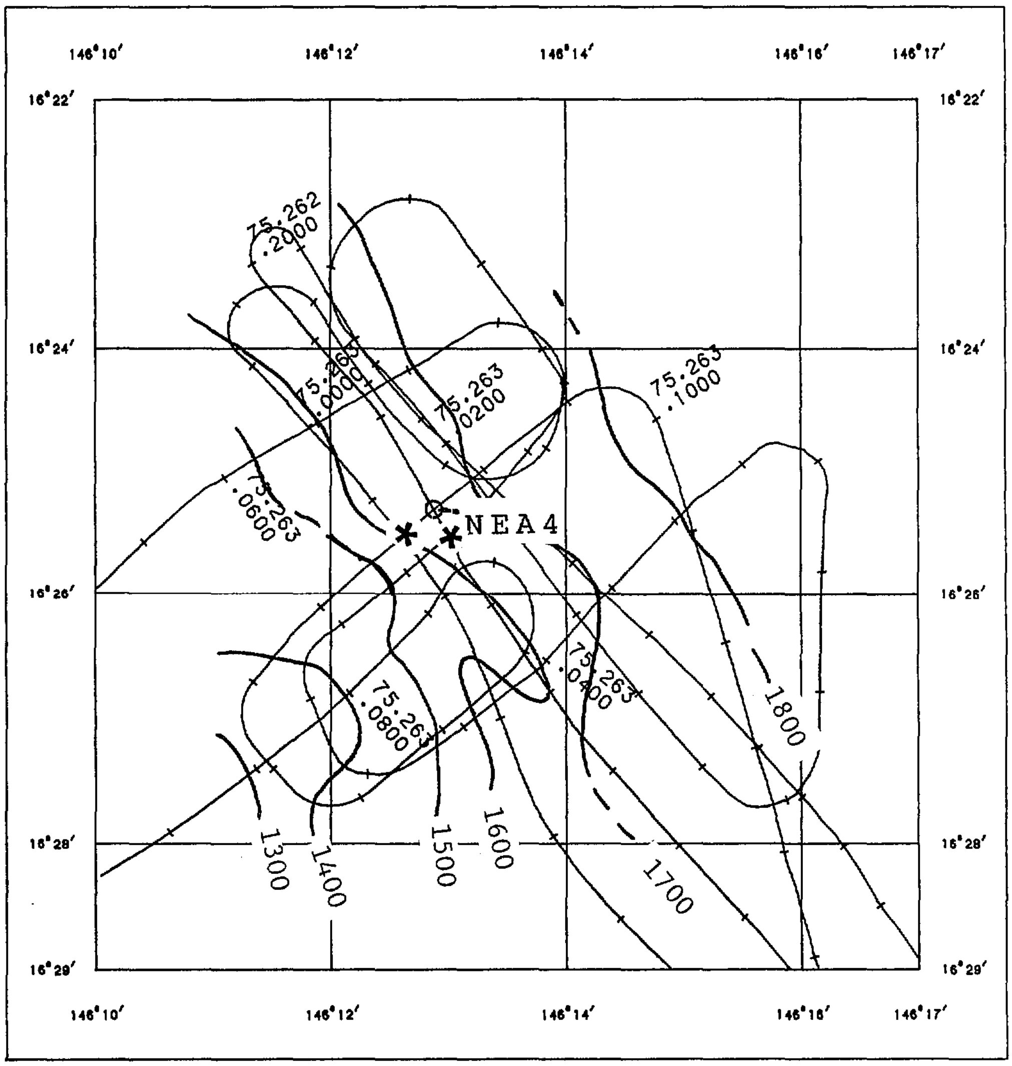
AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 4

SCALE 1:100000 ODP SITE 4 EDITION OF 1989/03/23

HORIZON 8 DEPTH (TWT)



* ALTERNATE SITE

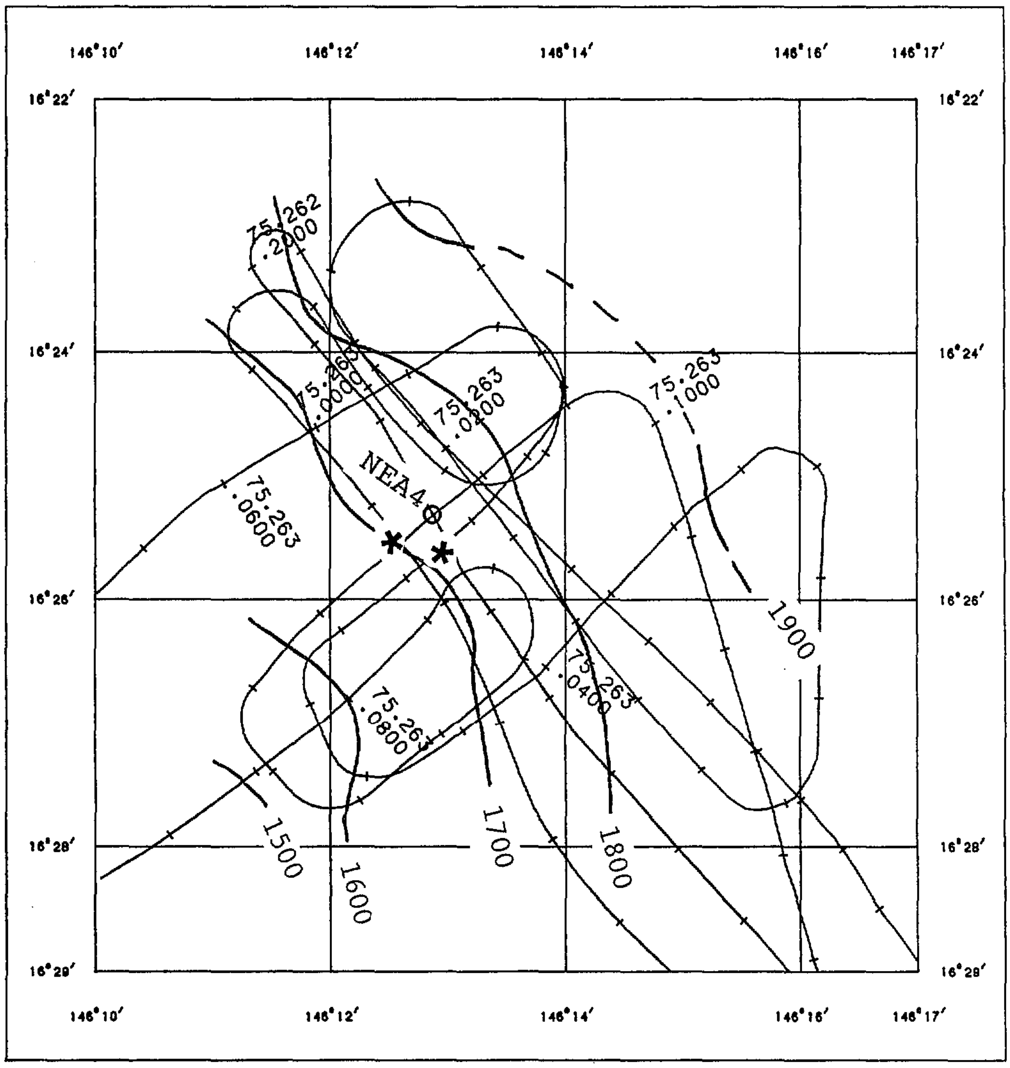
AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 4

SCALE 1:100000 ODP SITE 4 EDITION OF 1989/03/23

HORIZON 10 DEPTH (TWT)



* ALTERNATE SITE

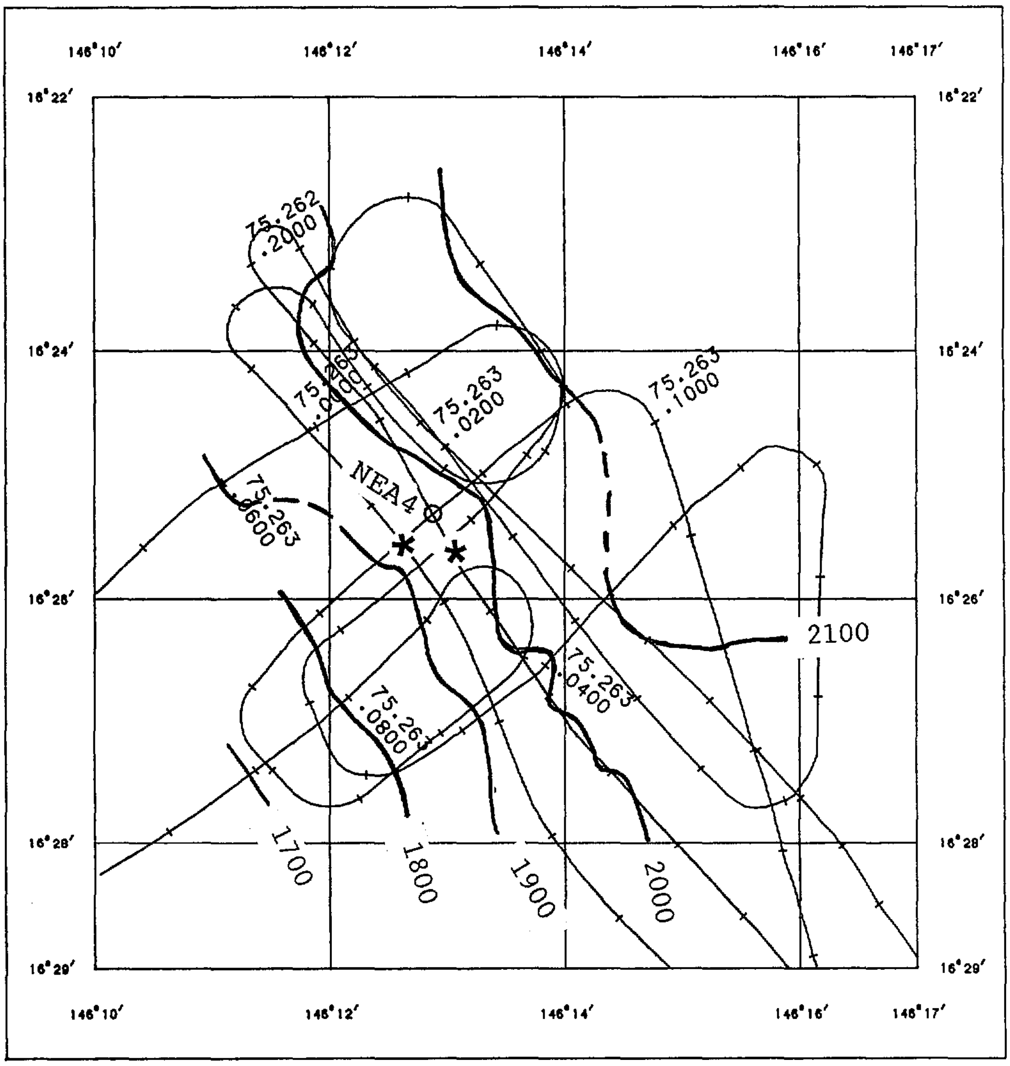
AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 4

SCALE 1:100000 ODP SITE 4 EDITION OF 1989/03/23

HORIZON 12 DEPTH (TWT)



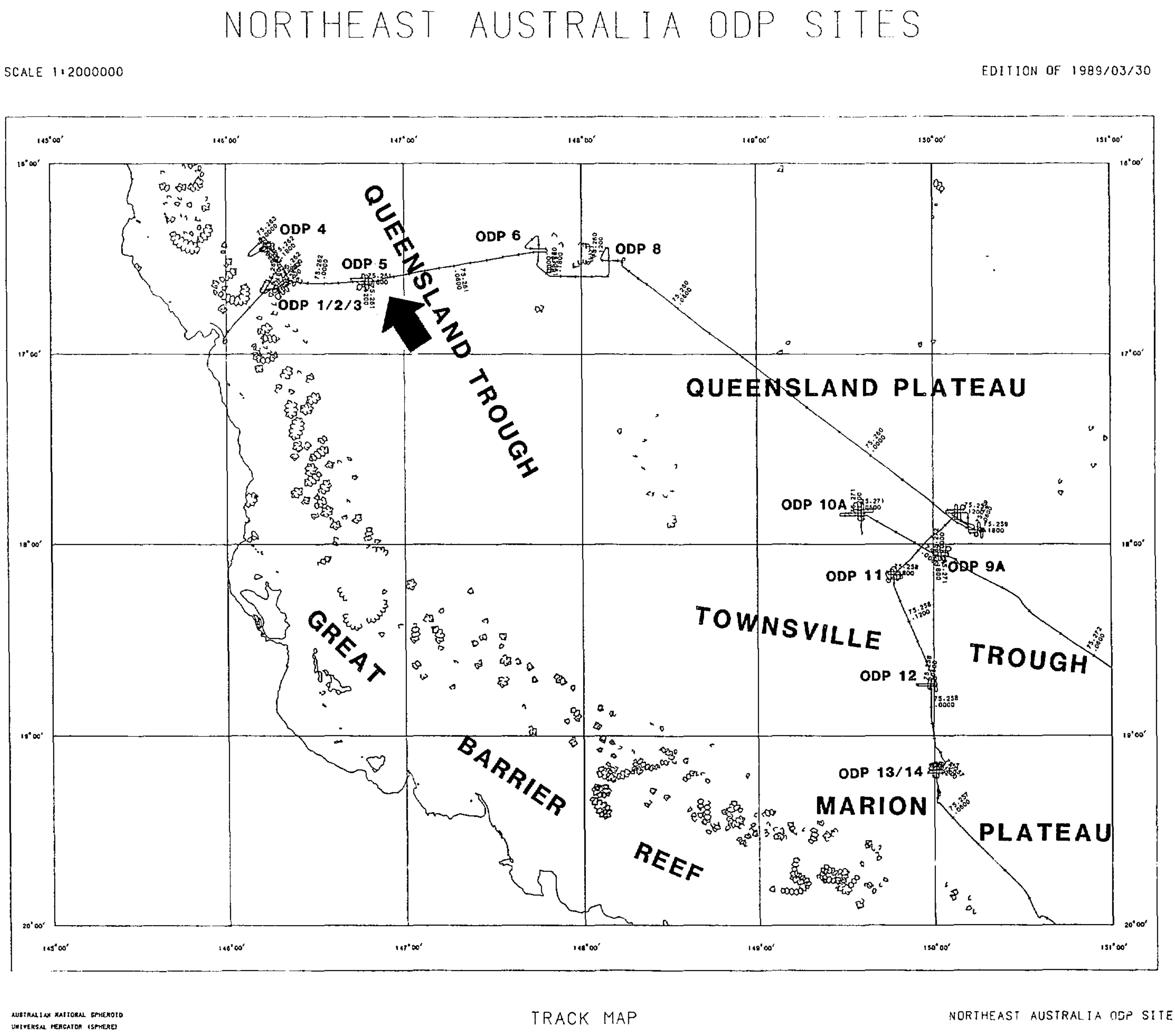
* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 4

3.04 Site NEA 5



OVERVIEW - SITE NEA5

Site 5 is located in the central-western Queensland Trough, towards the deepest part of the basin. This site will provide a relatively complete, high resolution depositional record in the upper part of the trough sequence. It will form a basis for comparison of sealevel signatures between shelf margin and trough settings, and provide a detailed paleoceanographic history throughout the late Cenozoic during the transitions from temperate to subtropical and from subtropical to tropical climatic regimes.

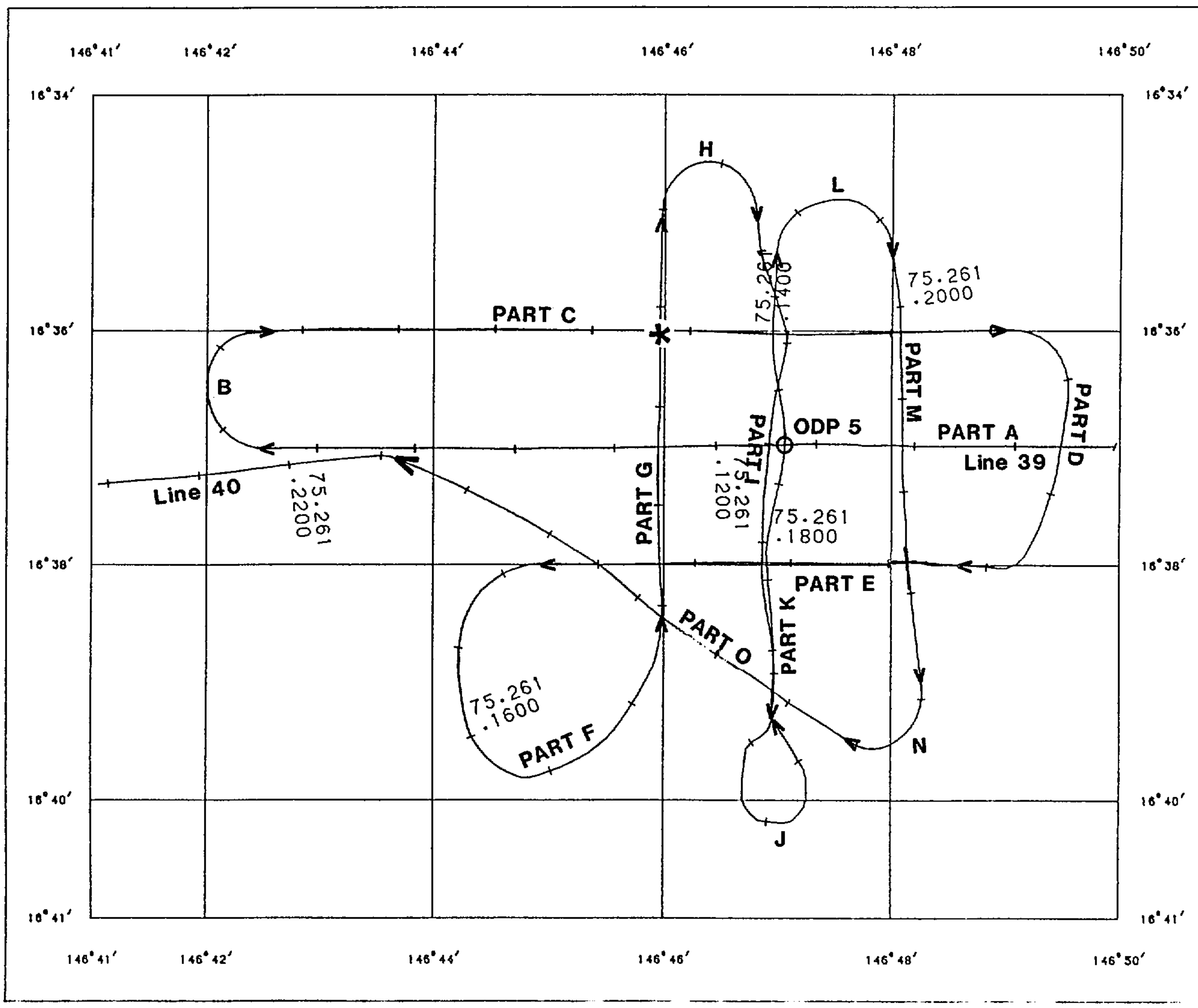
OBJECTIVES - SITE 5

1. To determine the age and facies of basinal sediments.
2. To derive a sealevel signature in a deep basin setting, and to relate this signature to that obtained from a shelf margin setting at sites NEA1 to NEA4.
3. To derive a high resolution paleoceanographic record reflecting late Cenozoic climatic variation.

PROGNOSIS - SITE 5

1. 785 m of Middle Miocene-Recent interbedded siliciclastic and carbonate pelagic sands and muds.
2. 84 m of Early Miocene shallow marine siliciclastic and carbonate sandstone and mudstone.
2. 142 m of Oligocene to Early Miocene shallow marine siliciclastic sandstone and mudstone.

SCALE 1:100000 ODP SITE 5 EDITION OF 1989/03/23



* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 5

CHECK SHEET

JOIDES SAFETY REVIEW

Leg **133** *Site No.* **NEA 5** *Lat.* **16° 36.96'S** *Long.* **146° 47.07'E**

Water Depth: **1638 m.** *Dist. from Land:* **50 n.mi.** *Jurisdiction:* **AUSTRALIA**

General location or geomorphic province:
Central western Queensland Trough

Upon what geophysical and/or geological data was this site selection made:
Seismic lines: **BMR LINE 75/041 (CROSSING 41A & 41K)**
Gravity cores: **75GC-13, 75GC-15, 75GC-17, 75GC-18**
DSDP holes: **NONE**
Other:

Proposed total penetration: **1011m.**
Probable sediment thickness: **4+ seconds TWT**

From previous DSDP drilling in this area, list all hydrocarbon occurrences of greater than background levels, give nature of show, age and depth of rock:
NO PREVIOUS DRILLING.

From available information, list all commercial drilling in this area that produced or yielded significant shows; give depths and ages of hydrocarbon bearing deposits:
NO COMMERCIAL DRILLING IN THIS AREA. NEAREST WELL IS APPROX. 465 n.mi. TO THE NORTH - NO HYDROCARBONS ENCOUNTERED. OIL SHALES OCCUR ONSHORE IN EARLY TERTIARY NONMARINE BASINS 200 n.mi. TO THE SOUTH.

Is there any indication of gas hydrates at this location:
NO INDICATION; NO BSR PRESENT.

Is there any reason to expect any hydrocarbon accumulation at this site? Please comment.
NO. ABSENCE OF STRUCTURE AND THERMALLY IMMATURE SECTION PRECLUDES POSSIBILITY OF HYDROCARBON OCCURRENCE.

What is your proposed drilling program?
APC/XCB TO 400 m (SECOND APC TO 200 m).
RCB FROM 400 m. TO TD AT 1011 m.

What is your proposed logging program?
SCHLUMBERGER LOGGING SUITE.

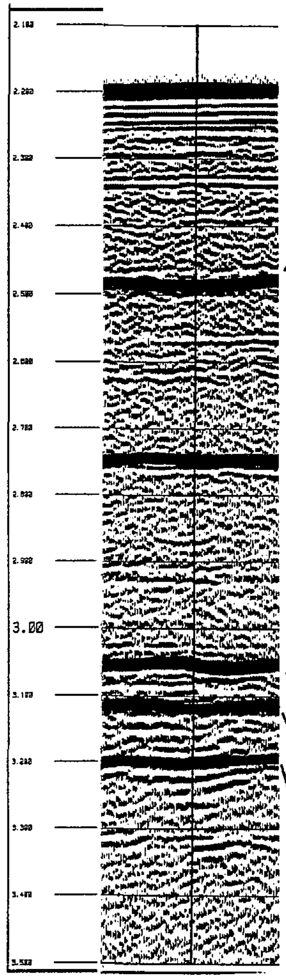
What "special" precautions will be taken during drilling?
STANDARD HYDROCARBON MONITORING.

What abandonment procedures do you plan to follow? (see Safety Manual, Sec. VIII, p. 22)
STANDARD PROCEDURES.

SUMMARY: What do you consider to be the major risks in drilling at this site?
NO MAJOR RISKS. SLIGHT CHANCE OF MINOR BIOGENIC GAS.

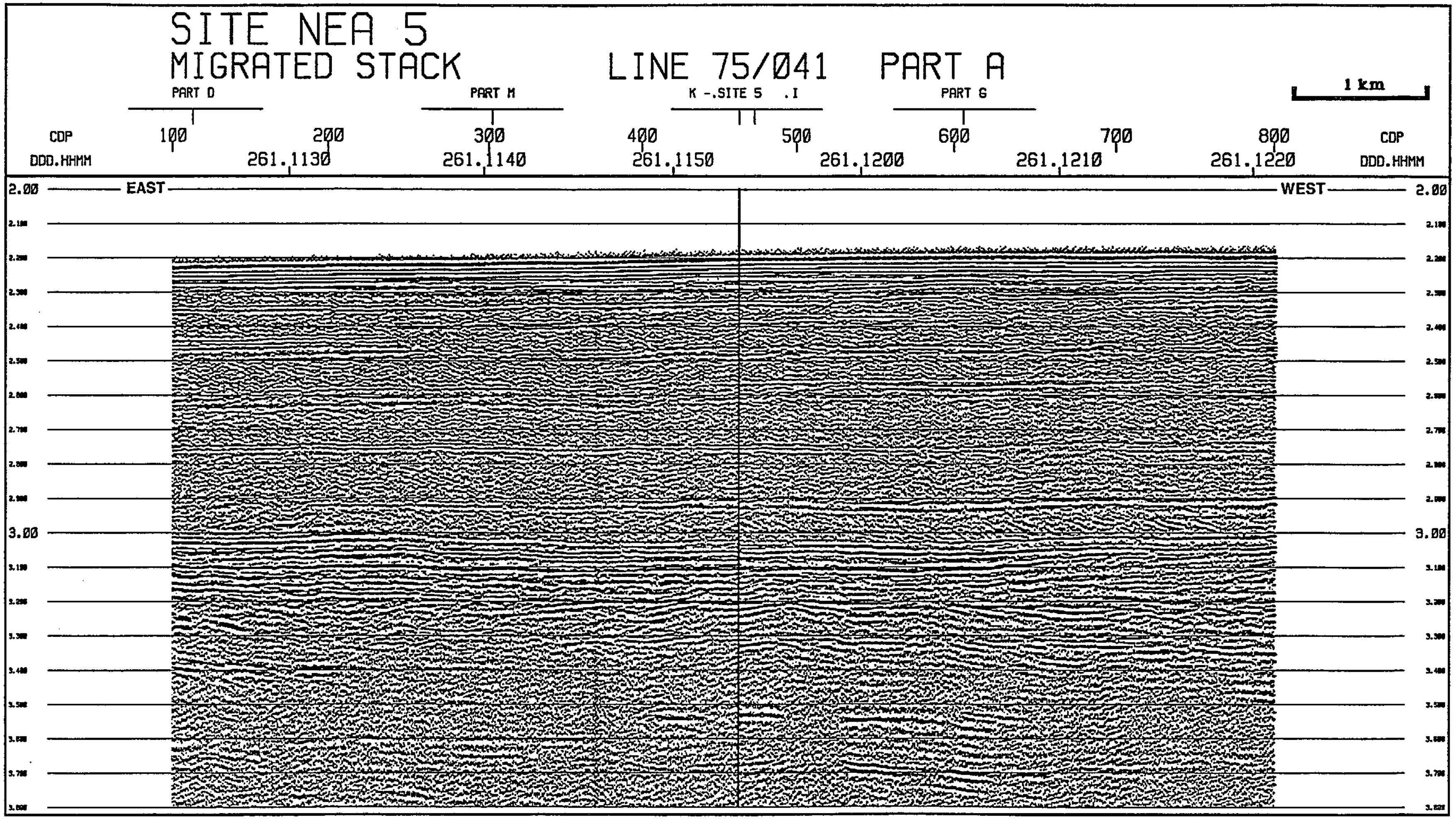
Please answer each question as carefully as possible, using extra pages if need be. The information you provide here will be an important factor in the Safety Review.

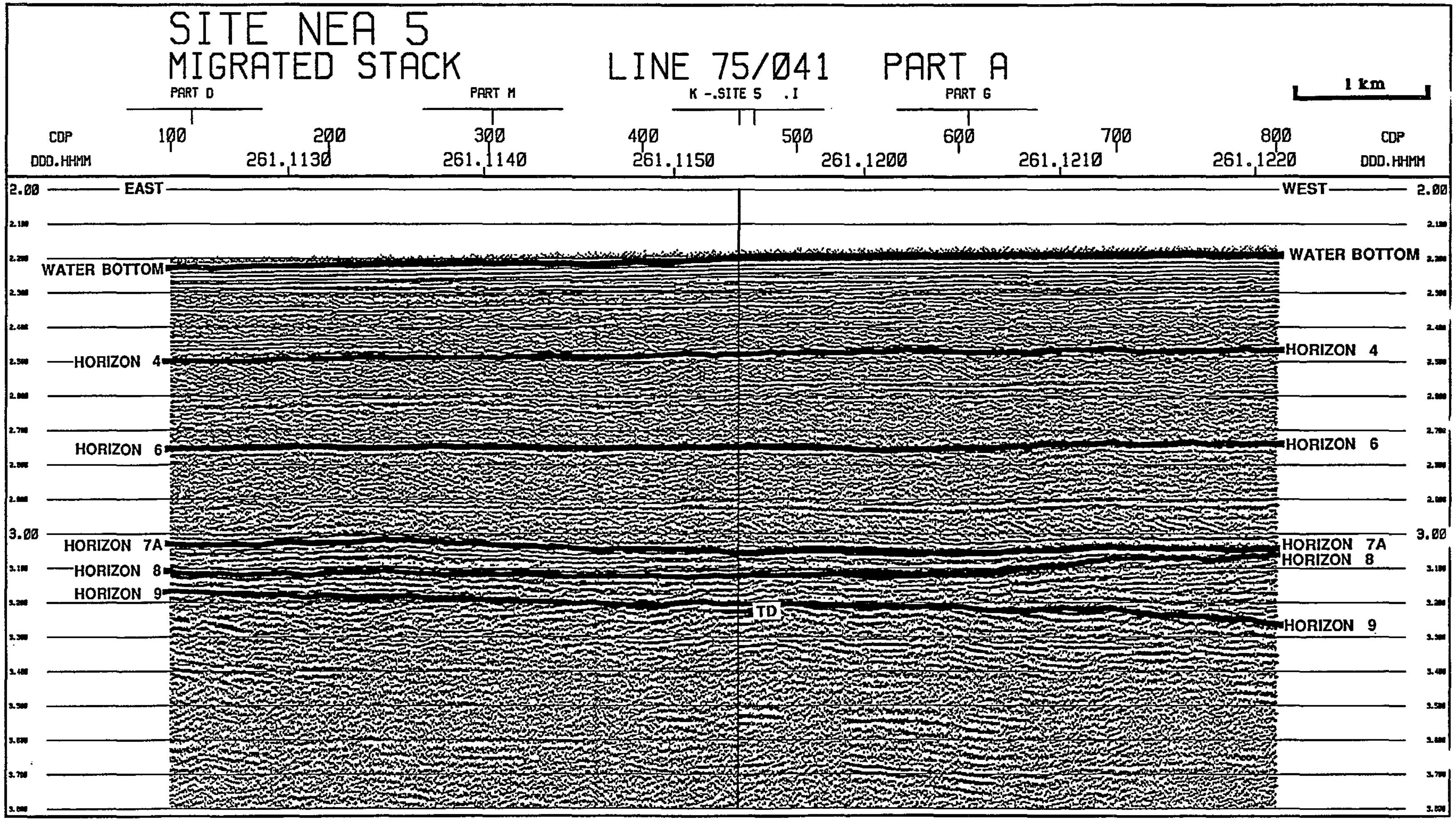
GRAPHIC SUMMARY: SITE NEA 5



Depth (m) / Key Reflectors	Age	Velocity (km/sec)	Lithology	Paleoenvironment	Sedim. Rate	Comments
0–100	Pliocene to Recent	1.6	mixed siliciclastic and carbonate sand and mud	pelagic	34 m/my	deep trough fill
H4	[112] Late Miocene	2.3	mixed siliciclastic and carbonate sand and mud	pelagic	52 m/my	trough fill will show interaction of lateral and longitude supply
H6	[422] Middle and Late Miocene	2.4	mixed siliciclastic and carbonate sand and mud	hemipelagic to pelagic	60 m/my	trough fill
H7A	[785] Early Miocene	2.8	siliciclastic & carbonate sandstone & mudstone	shallow marine	17 m/my	
H8	[869] Oligocene to Early Miocene	2.85	siliciclastic sandstone and mudstone	shallow marine	20 m/my	
H9 (TD)	[1011]					

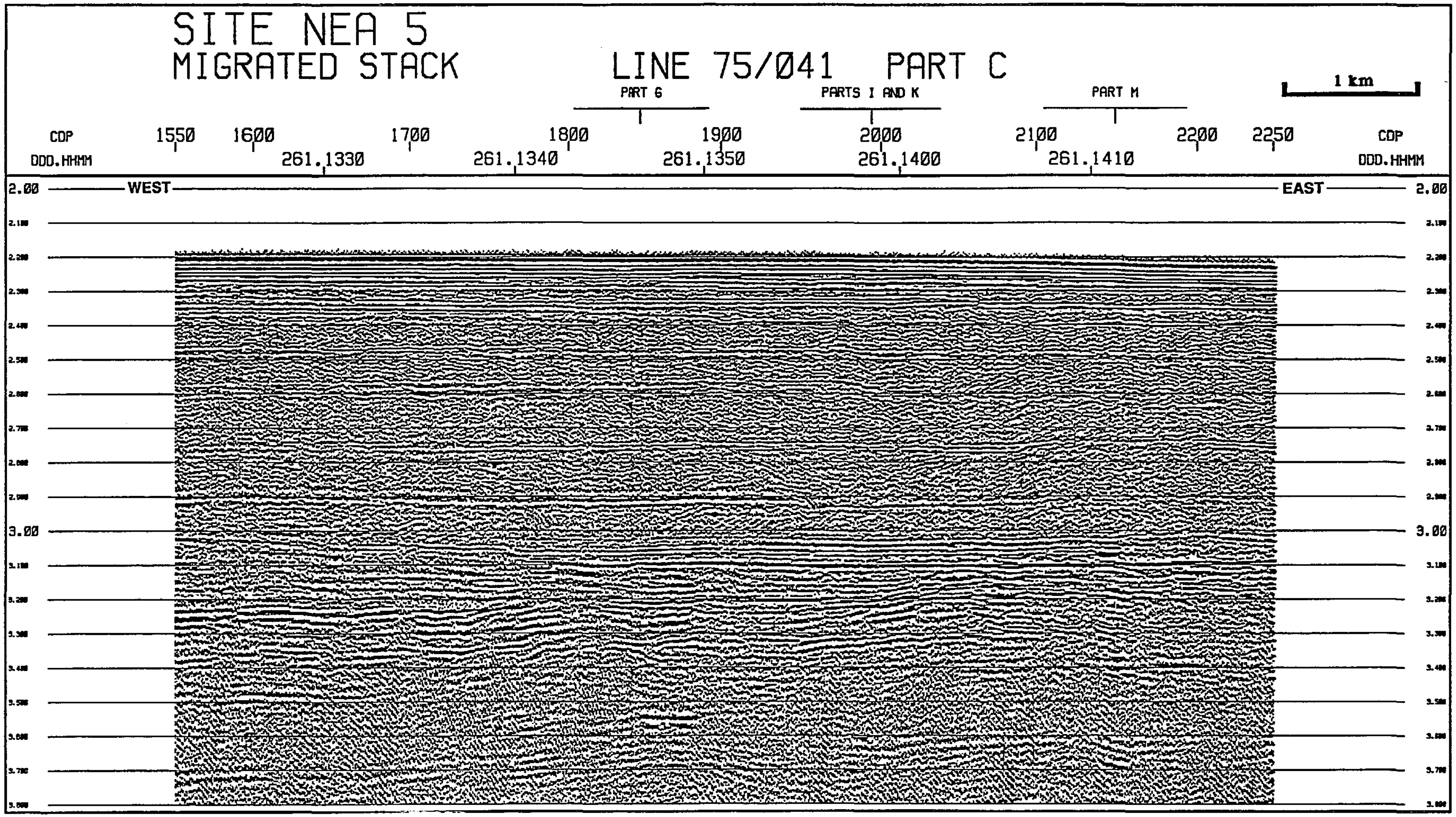
Depth scale (m): 0, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100


SITE NEA 5
MIGRATED STACK
LINE 75/Ø41
PART A
PART D
PART M
K -.SITE 5 .I
PART G
1 km
CDP
DDD.HHMM
1ØØ
2ØØ
3ØØ
4ØØ
5ØØ
6ØØ
7ØØ
8ØØ
261.113Ø
261.114Ø
261.115Ø
261.12ØØ
261.121Ø
261.122Ø
CDP
DDD.HHMM
EAST
WEST
2.ØØ
3.ØØ
2.ØØ
3.ØØ



SITE NEA 5
MIGRATED STACK
LINE 75/Ø41 PART A
PART D
PART M
K -.SITE 5 .I
PART G
1 km
CDP
DDD.HHMM
1ØØ
2ØØ
3ØØ
4ØØ
5ØØ
6ØØ
7ØØ
8ØØ
261.113Ø
261.114Ø
261.115Ø
261.12ØØ
261.121Ø
261.122Ø
2.ØØ
3.ØØ
EAST
WEST
WATER BOTTOM
HORIZON 4
HORIZON 6
HORIZON 7A
HORIZON 8
HORIZON 9
TD

R9000606


SITE NEA 5
MIGRATED STACK
LINE 75/Ø41 PART C
1 km
PART G
PARTS I AND K
PART M
CDP
DDD.HHMM
1550
1600
1700
1800
1900
2000
2100
2200
2250
261.1330
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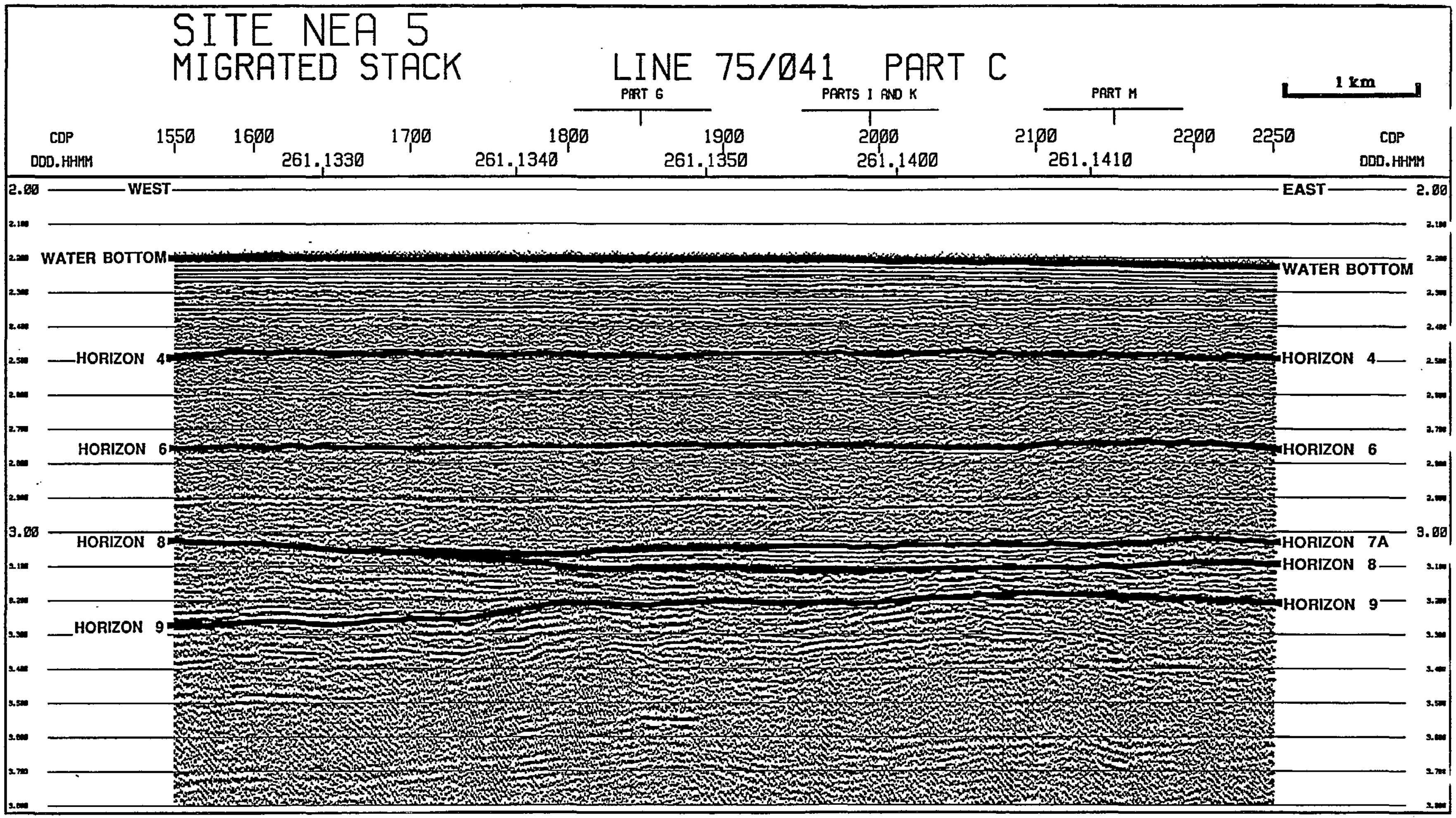
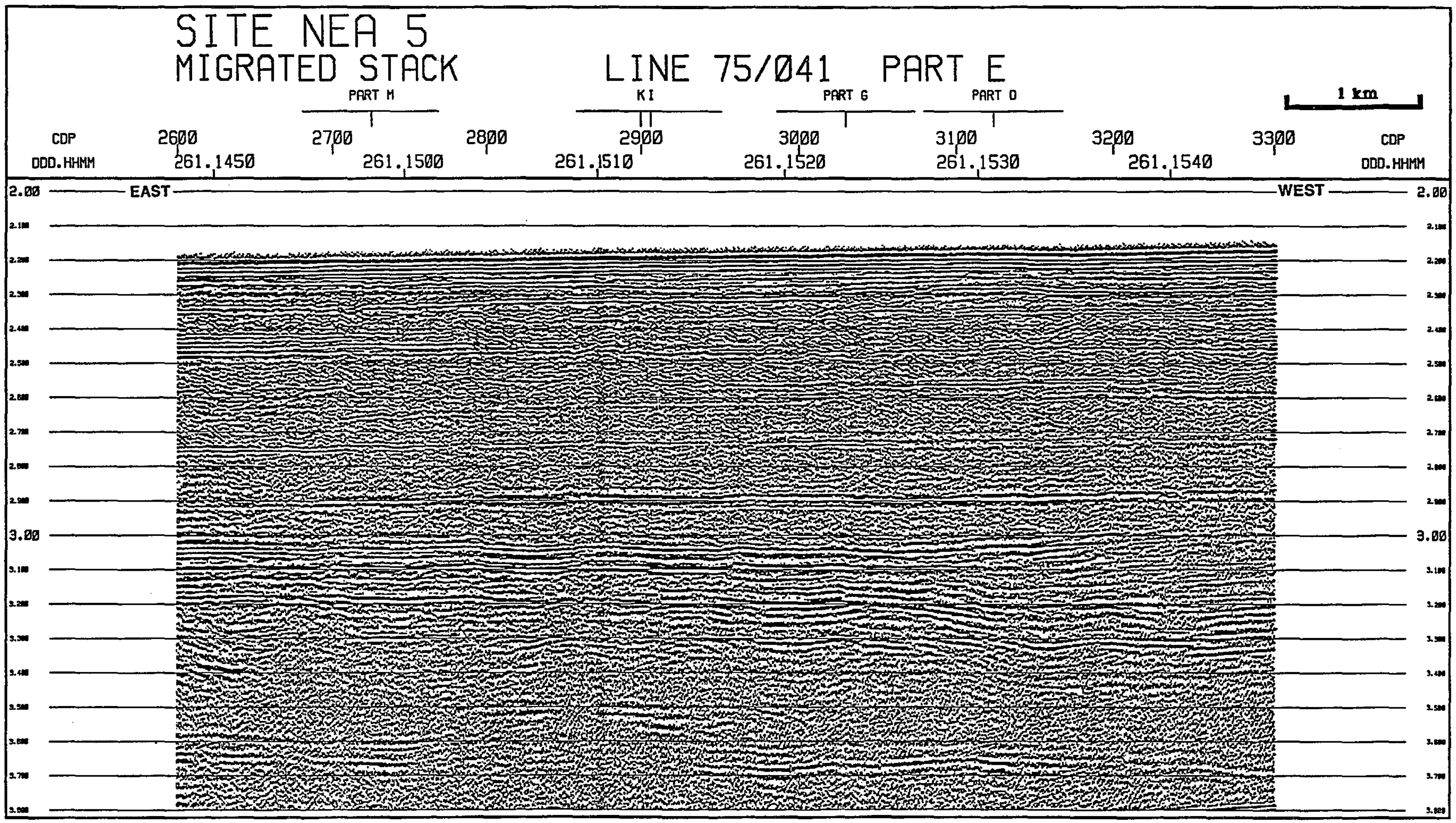
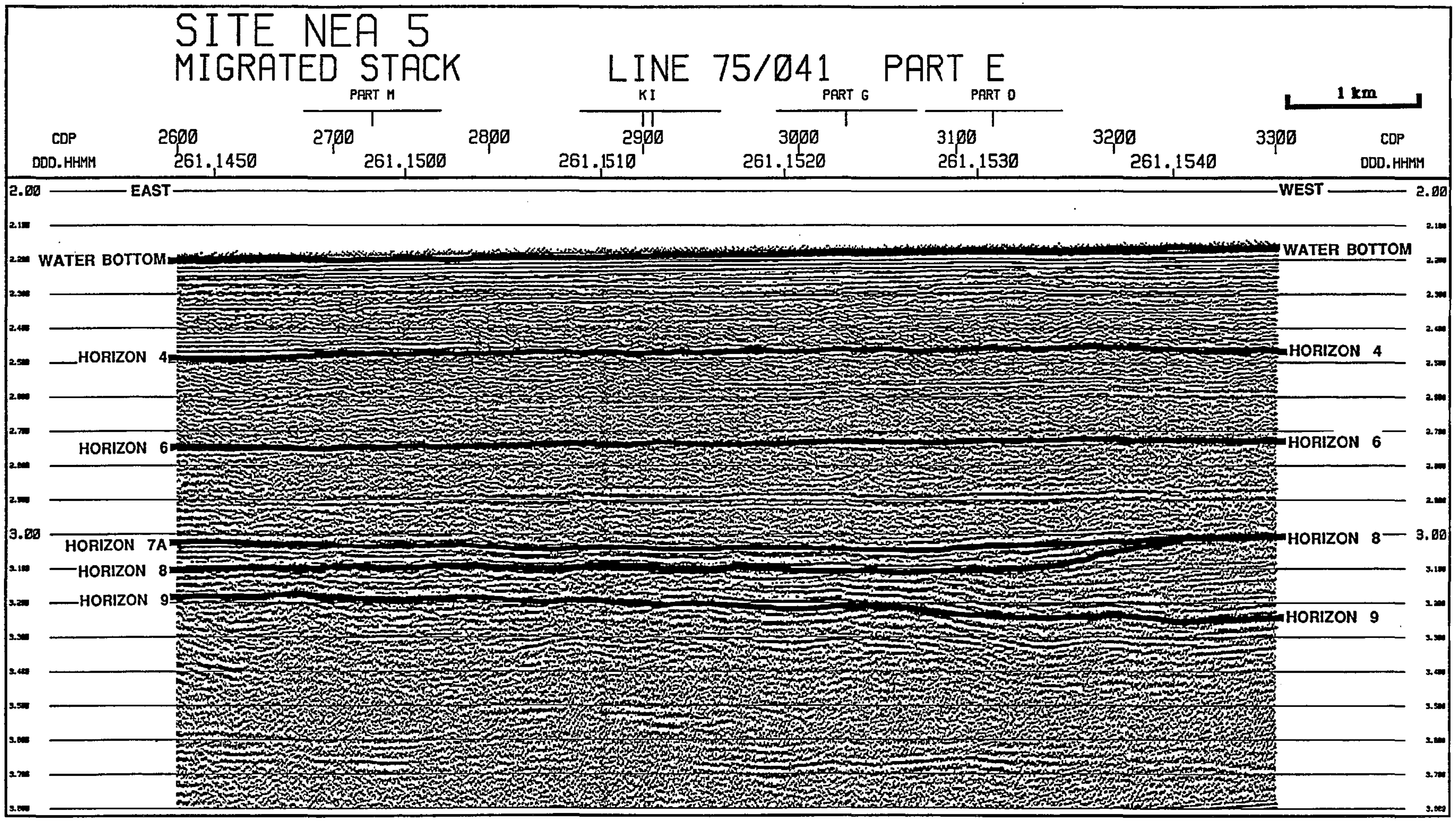
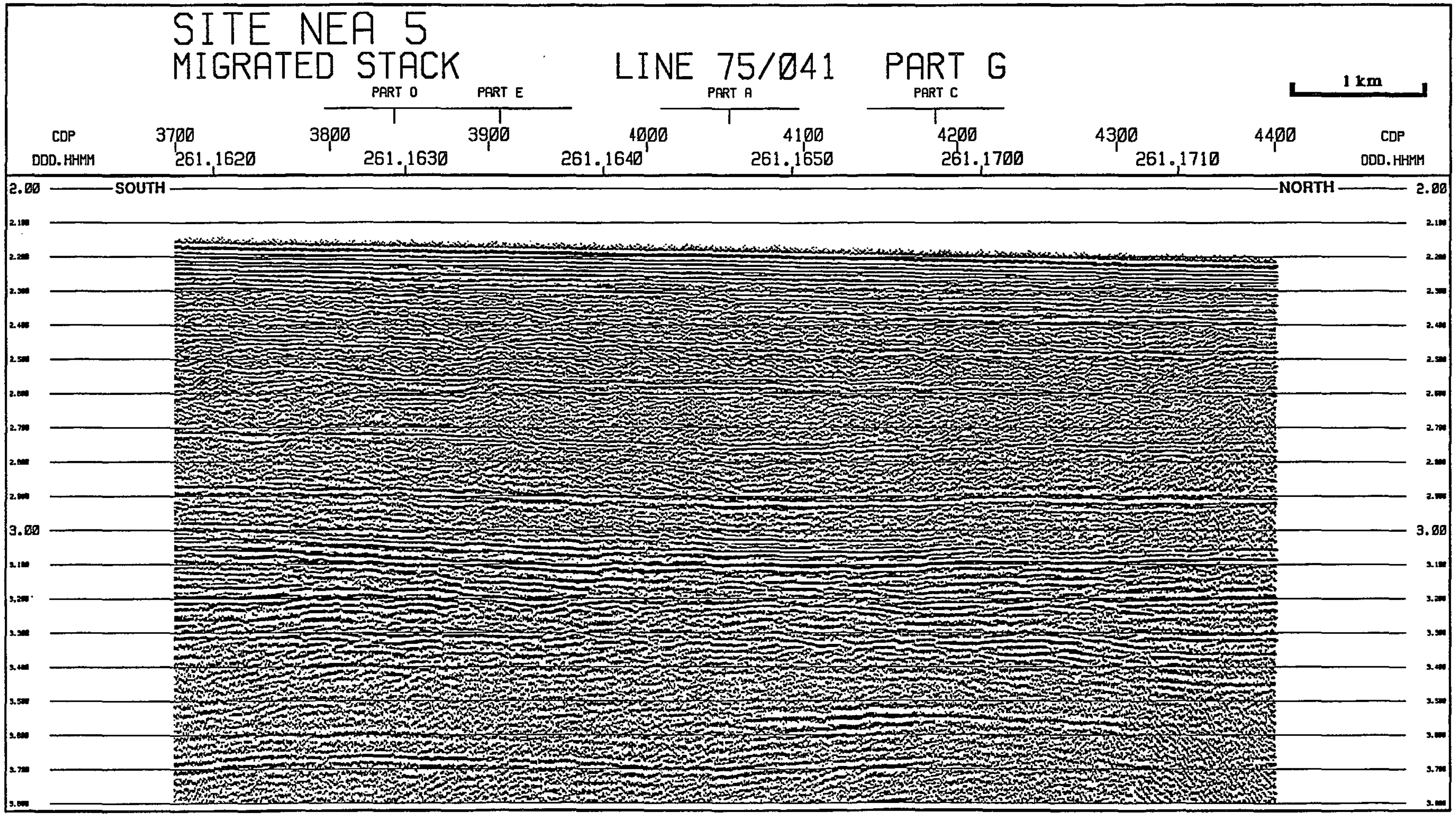
CDP
DDD.HHMM
2.00
WEST
EAST
2.00
3.00
3.00


SITE NEA 5
MIGRATED STACK
LINE 75/Ø41 PART C
PART G
PARTS I AND K
PART M
1 km
CDP
DDD.HHMM
1550 1600 1700 1800 1900 2000 2100 2200 2250
261.1330 261.1340 261.1350 261.1400 261.1410
CDP
DDD.HHMM
2.00
WEST
EAST
2.00
WATER BOTTOM
WATER BOTTOM
HORIZON 4
HORIZON 4
HORIZON 6
HORIZON 6
3.00
3.00
HORIZON 8
HORIZON 7A
HORIZON 8
HORIZON 9
HORIZON 9


SITE NEA 5
MIGRATED STACK
LINE 75/Ø41 PART E
PART M
KI
PART G
PART D
1 km
CDP
DDD.HHMM
2600
2700
2800
2900
3000
3100
3200
3300
261.1450
261.1500
261.1510
261.1520
261.1530
261.1540
EAST
WEST
2.ØØ
3.ØØ



SITE NEA 5
MIGRATED STACK
LINE 75/Ø41 PART E
PART M
KI
PART G
PART D
1 km
CDP
DDD.HHMM
2600
2700
2800
2900
3000
3100
3200
3300
261.1450
261.1500
261.1510
261.1520
261.1530
261.1540
2.ØØ
3.ØØ
EAST
WEST
WATER BOTTOM
HORIZON 4
HORIZON 6
HORIZON 7A
HORIZON 8
HORIZON 9


SITE NEA 5
MIGRATED STACK
LINE 75/Ø41 PART G
PART D
PART E
PART A
PART C
1 km
CDP
DDD.HHMM
3700
3800
3900
4000
4100
4200
4300
4400
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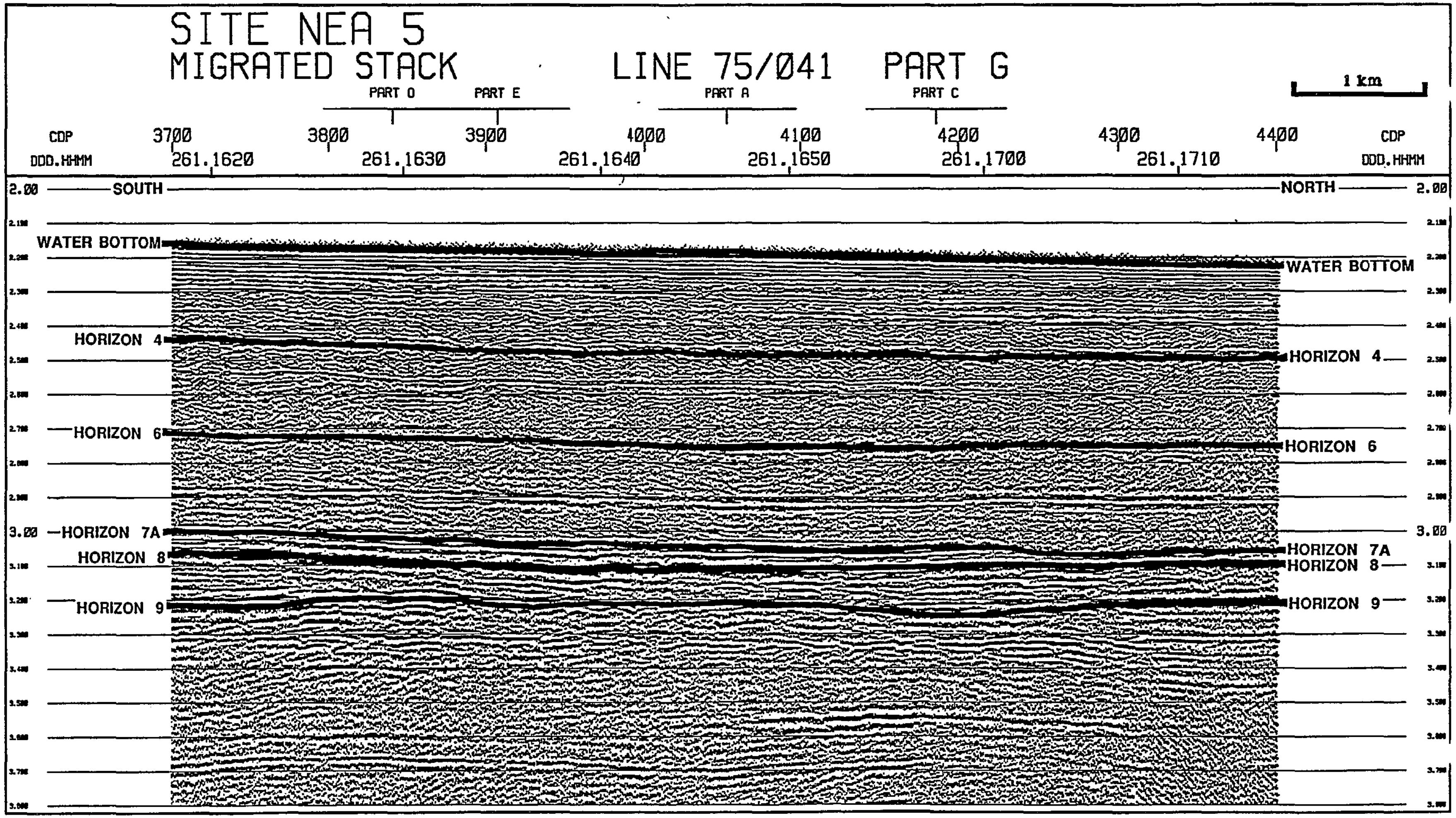
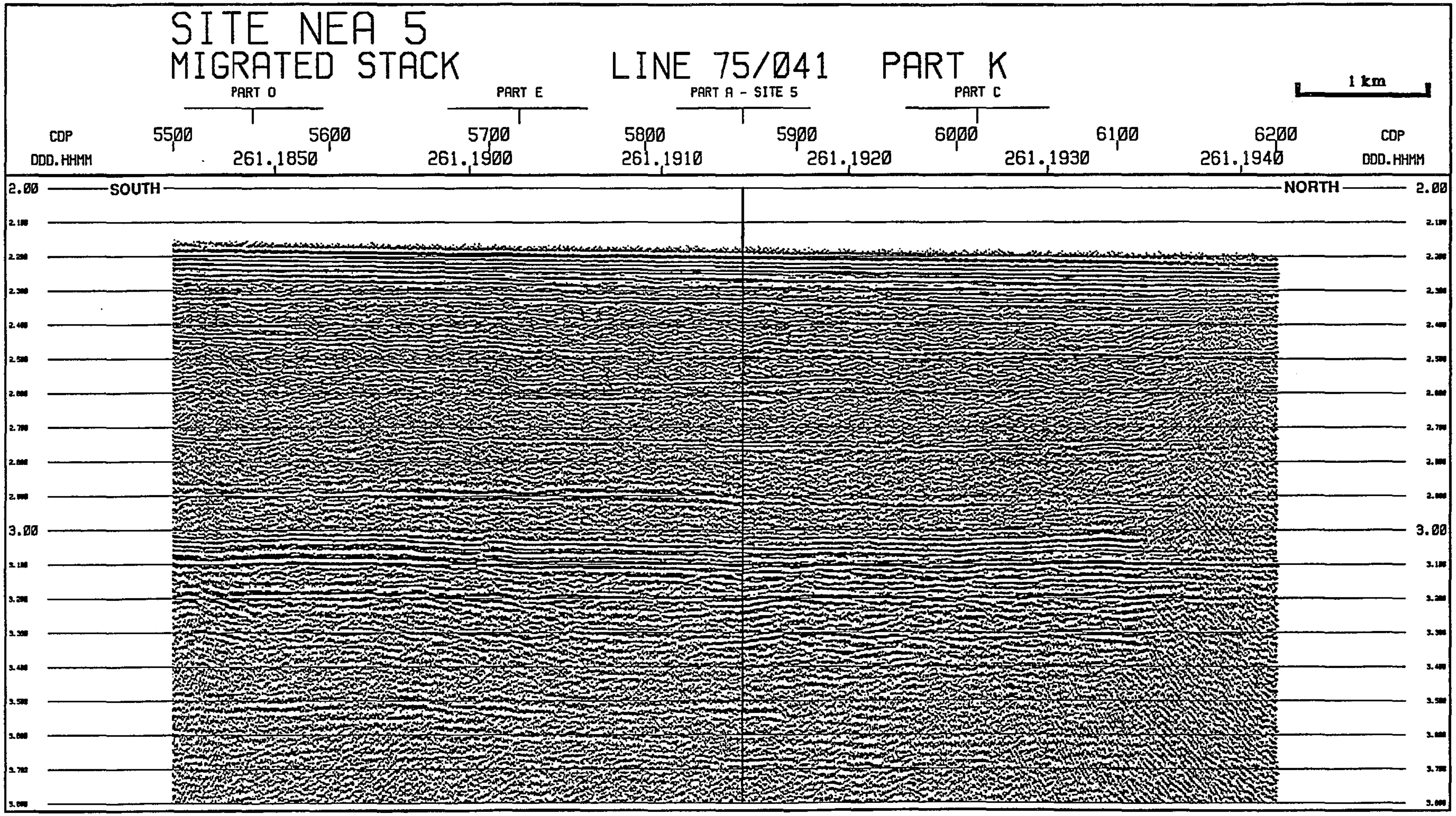
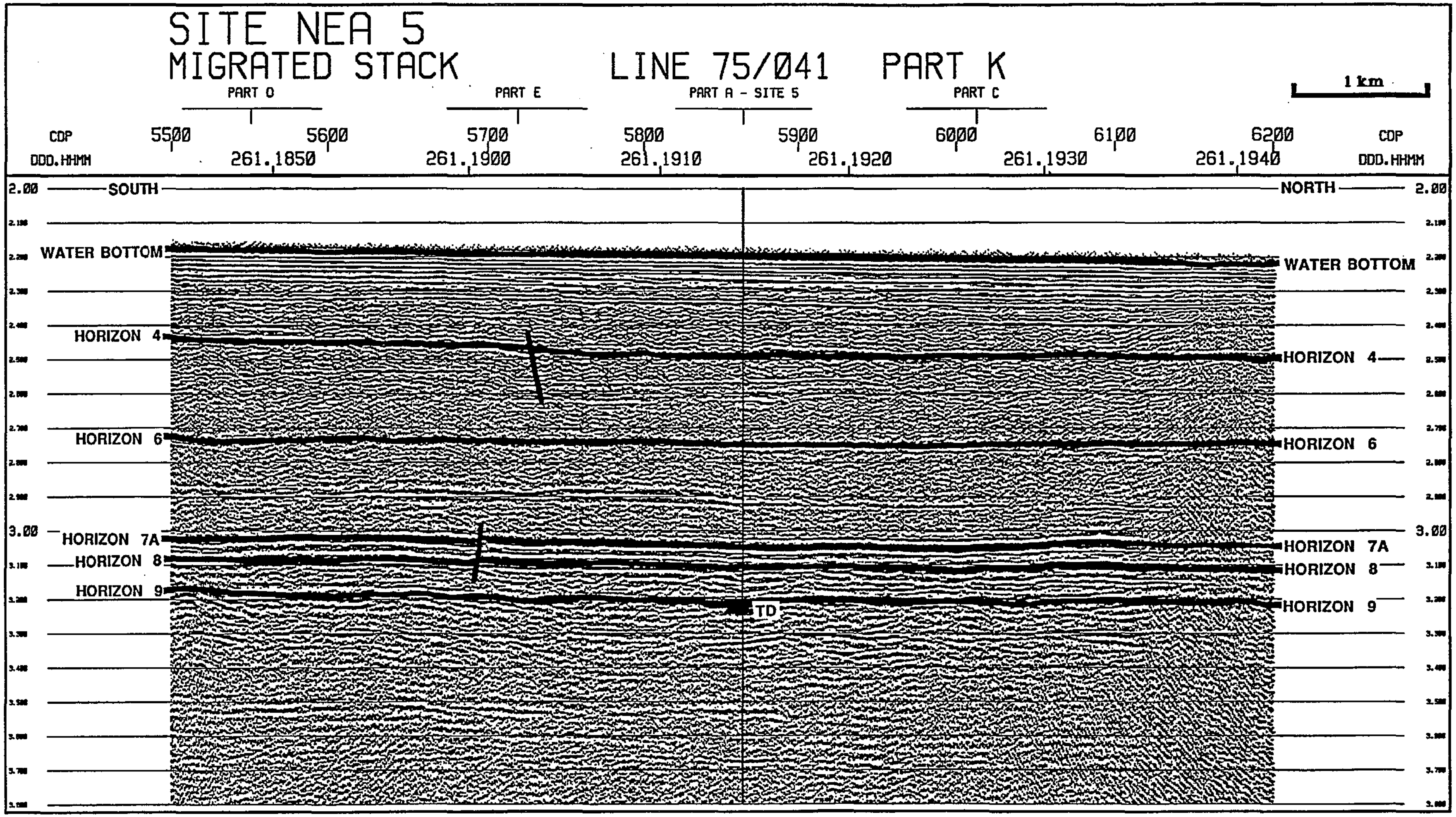
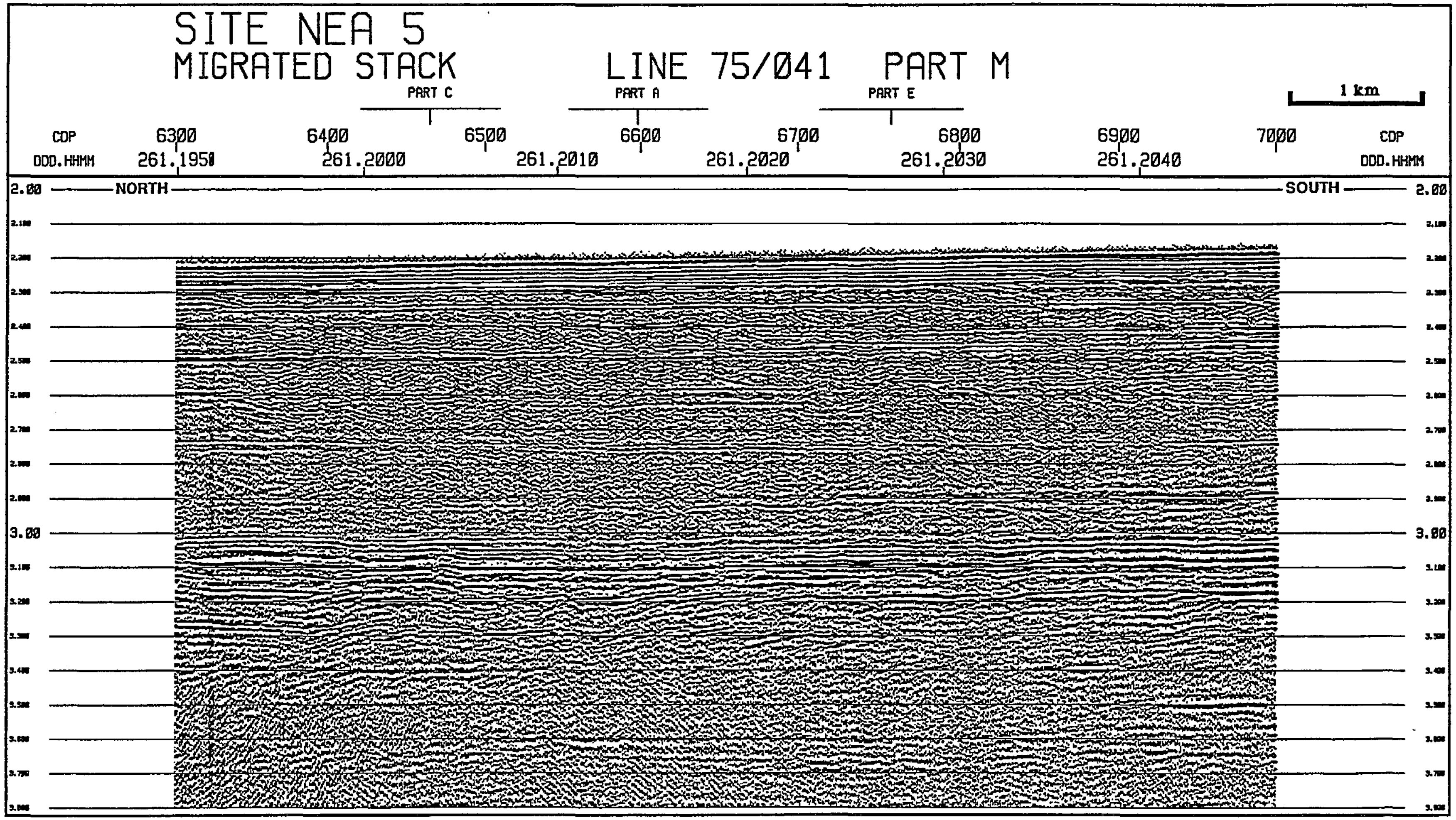
261.1640
261.1650
261.1700
261.1710
SOUTH
NORTH
2.ØØ
3.ØØ

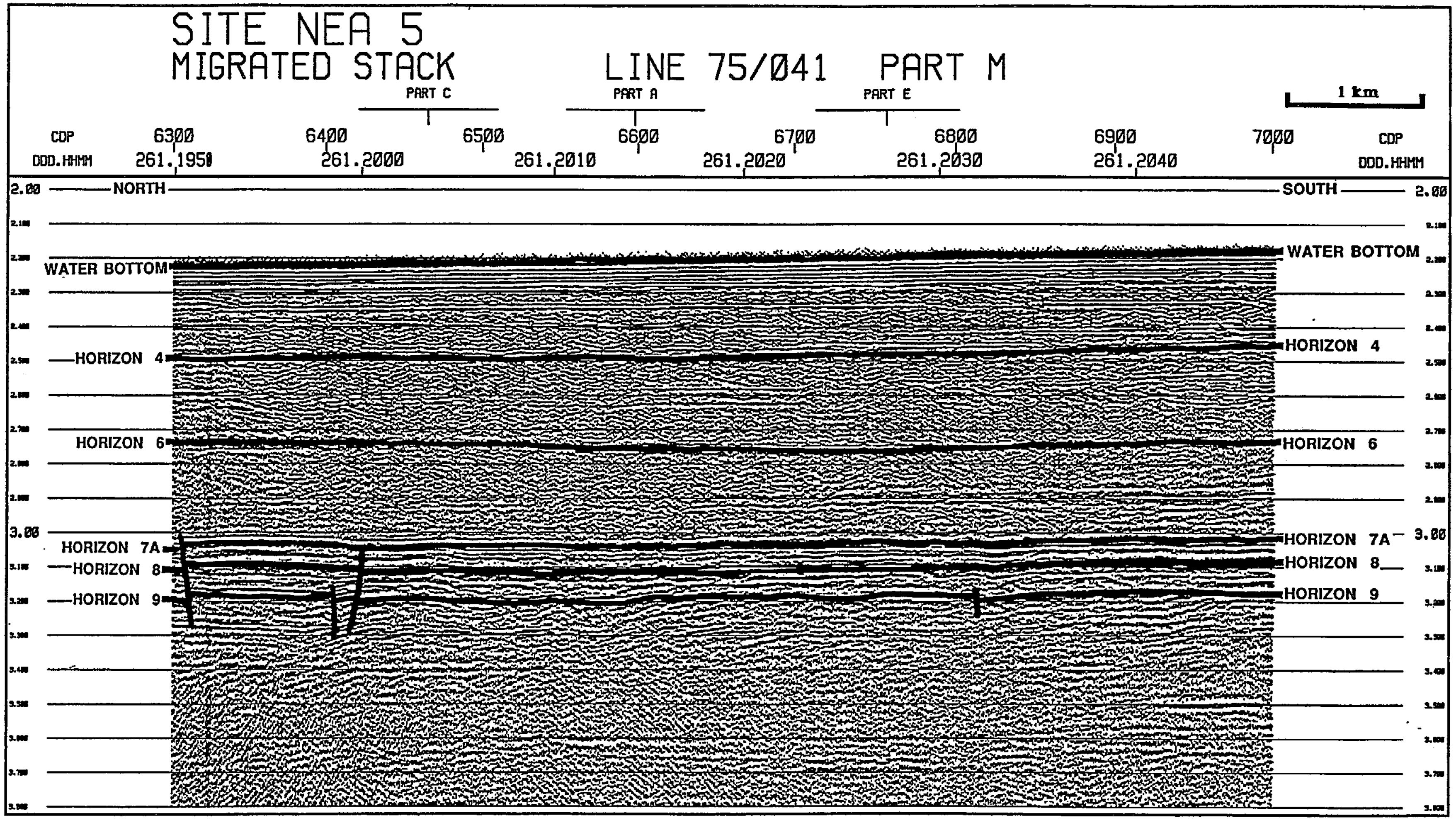

SITE NEA 5
MIGRATED STACK
LINE 75/Ø41 PART G
PART D
PART E
PART A
PART C
1 km
CDP
DDD.HHMM
3700
3800
3900
4000
4100
4200
4300
4400
261.1620
261.1630
261.1640
261.1650
261.1700
261.1710
SOUTH
NORTH
2.00
3.00
WATER BOTTOM
HORIZON 4
HORIZON 6
HORIZON 7A
HORIZON 8
HORIZON 9

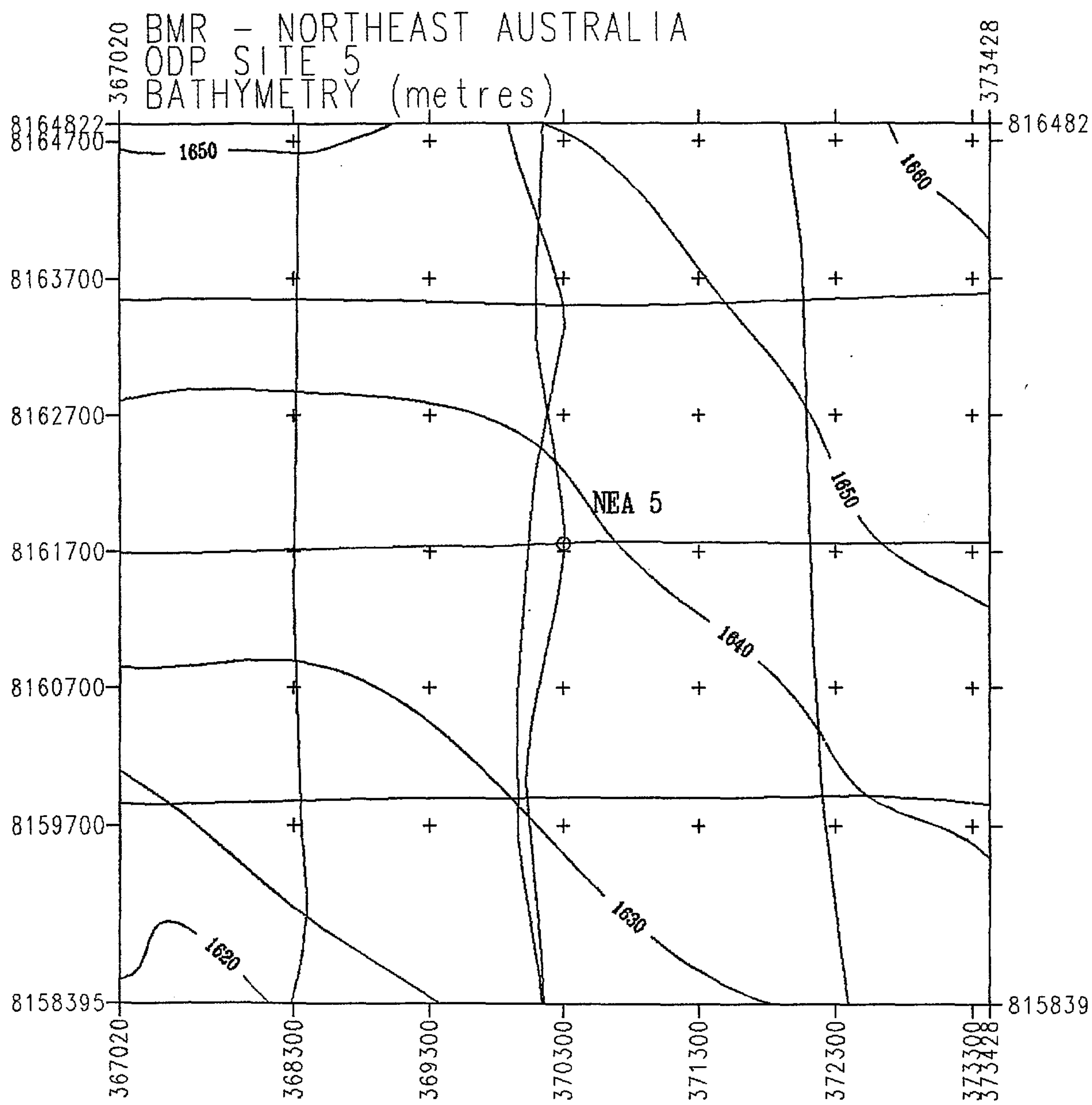

SITE NEA 5
MIGRATED STACK
LINE 75/Ø41 PART K
1 km
PART O
PART E
PART A - SITE 5
PART C
CDP
DDD.HHMM
5500 5600 5700 5800 5900 6000 6100 6200
261.1850 261.1900 261.1910 261.1920 261.1930 261.1940
SOUTH
NORTH
2.00
3.00


SITE NEA 5
MIGRATED STACK
LINE 75/Ø41 PART K
1 km
PART D
PART E
PART A - SITE 5
PART C
CDP
DDD.HHMM
55ØØ
56ØØ
57ØØ
58ØØ
59ØØ
6ØØØ
61ØØ
62ØØ
261.185Ø
261.19ØØ
261.191Ø
261.192Ø
261.193Ø
261.194Ø
CDP
DDD.HHMM
2.ØØ
SOUTH
NORTH
2.ØØ
WATER BOTTOM
WATER BOTTOM
HORIZON 4
HORIZON 4
HORIZON 6
HORIZON 6
3.ØØ
HORIZON 7A
HORIZON 8
HORIZON 9
3.ØØ
HORIZON 7A
HORIZON 8
HORIZON 9
TD

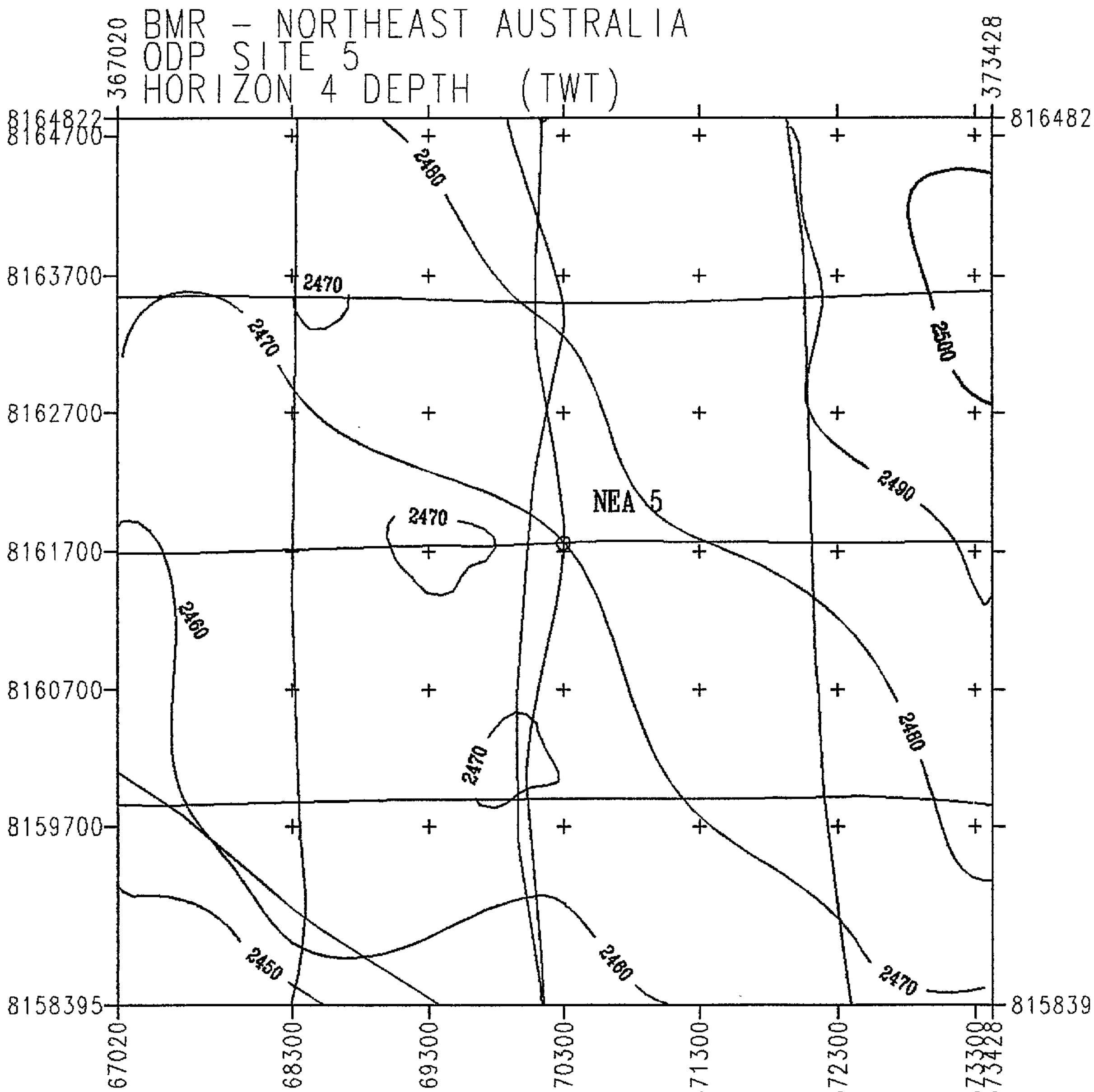


SITE NEA 5
MIGRATED STACK
LINE 75/Ø41 PART M
PART C
PART A
PART E
1 km
CDP
DDD.HHMM
63ØØ
64ØØ
65ØØ
66ØØ
67ØØ
68ØØ
69ØØ
7ØØØ
261.195Ø
261.2ØØØ
261.2Ø1Ø
261.2Ø2Ø
261.2Ø3Ø
261.2Ø4Ø
NORTH
SOUTH
2.ØØ
3.ØØ


SITE NEA 5
MIGRATED STACK
LINE 75/Ø41 PART M
PART C
PART A
PART E
1 km
CDP
DDD.HHMM
6300
6400
6500
6600
6700
6800
6900
7000
261.1950
261.2000
261.2010
261.2020
261.2030
261.2040
CDP
DDD.HHMM
2.00
NORTH
SOUTH
2.00
WATER BOTTOM
WATER BOTTOM
HORIZON 4
HORIZON 4
HORIZON 6
HORIZON 6
3.00
HORIZON 7A
HORIZON 8
HORIZON 9
HORIZON 7A
3.00
HORIZON 8
HORIZON 9



computer generated
on a LANDMARK RT



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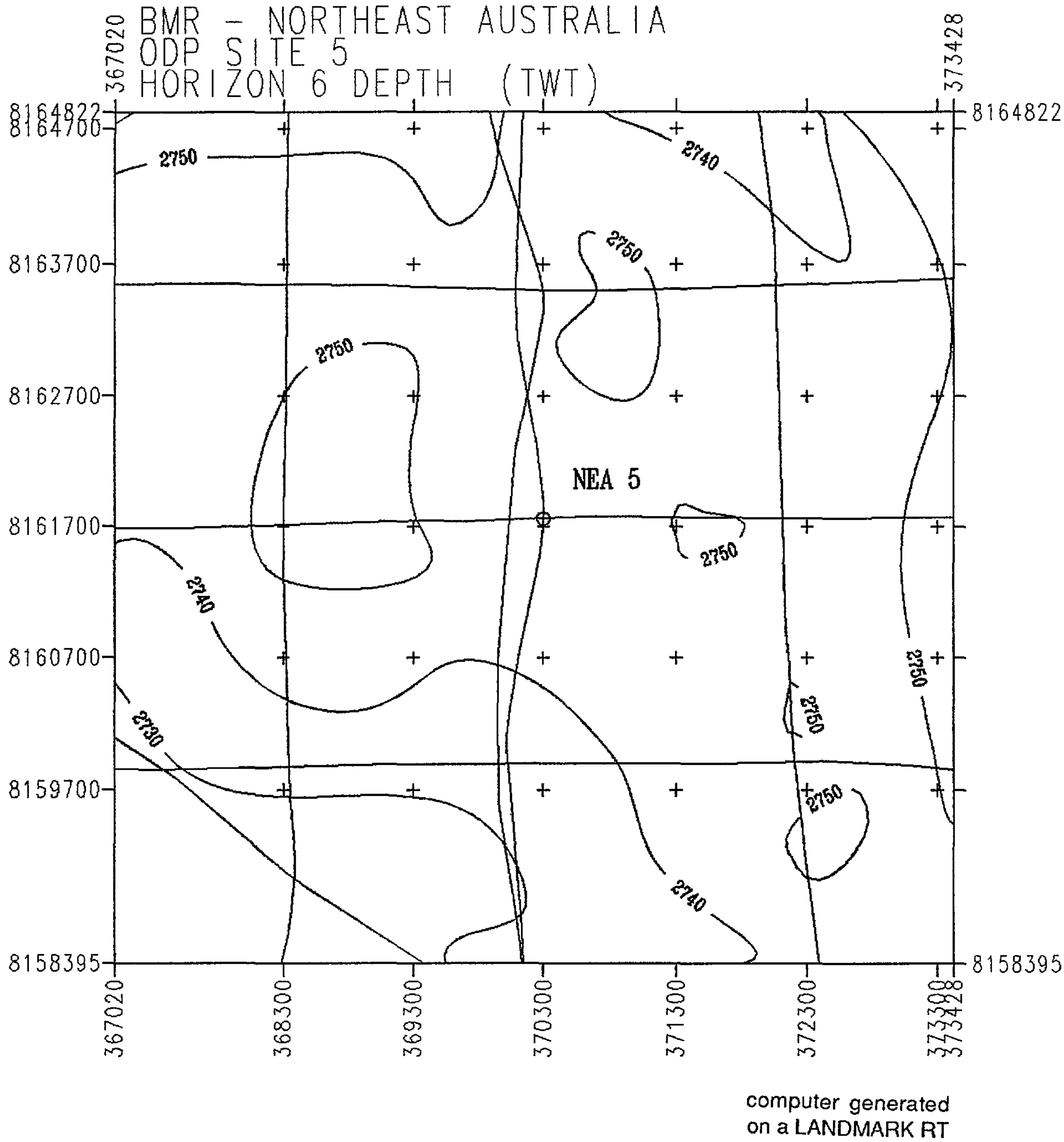
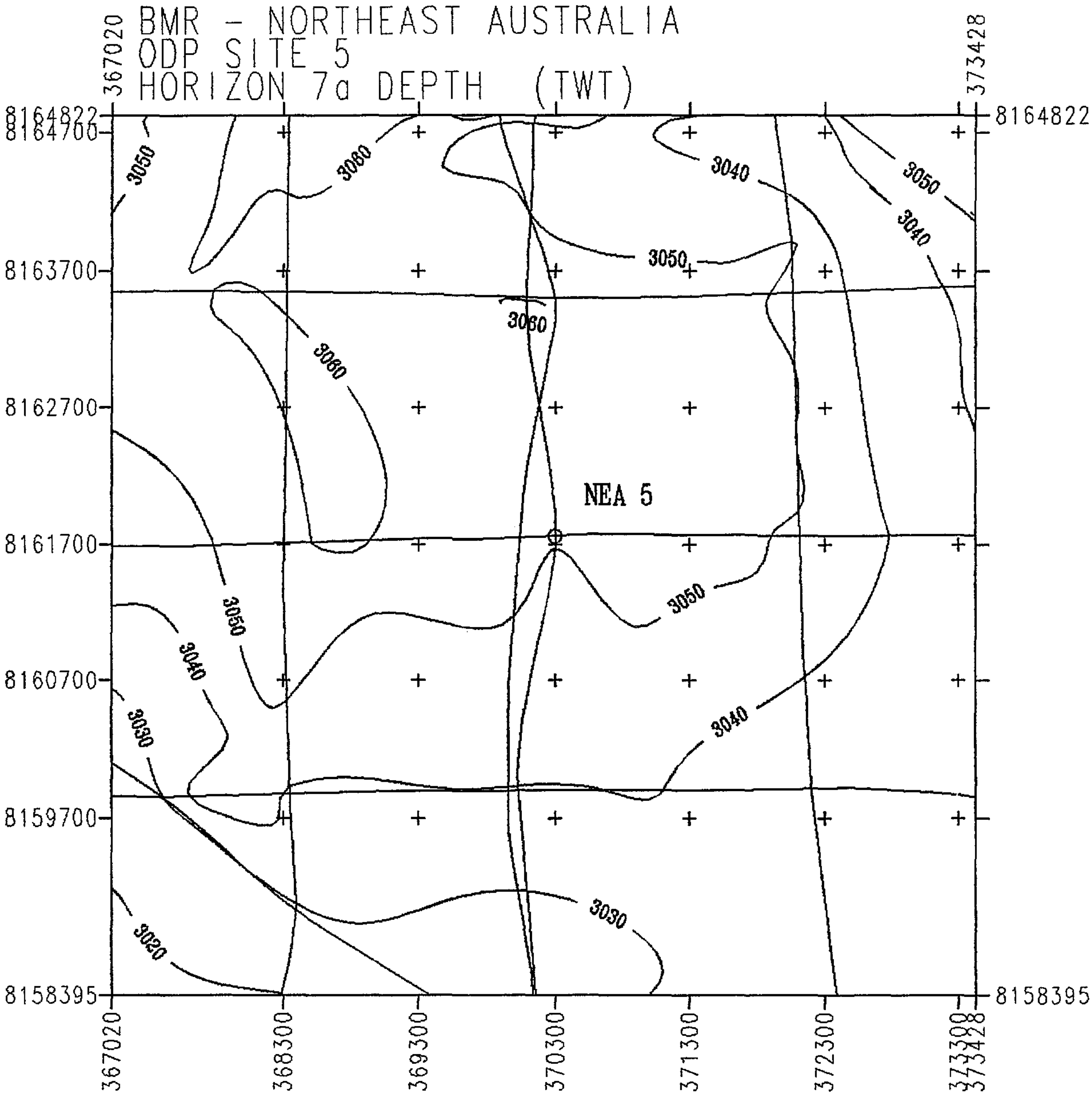
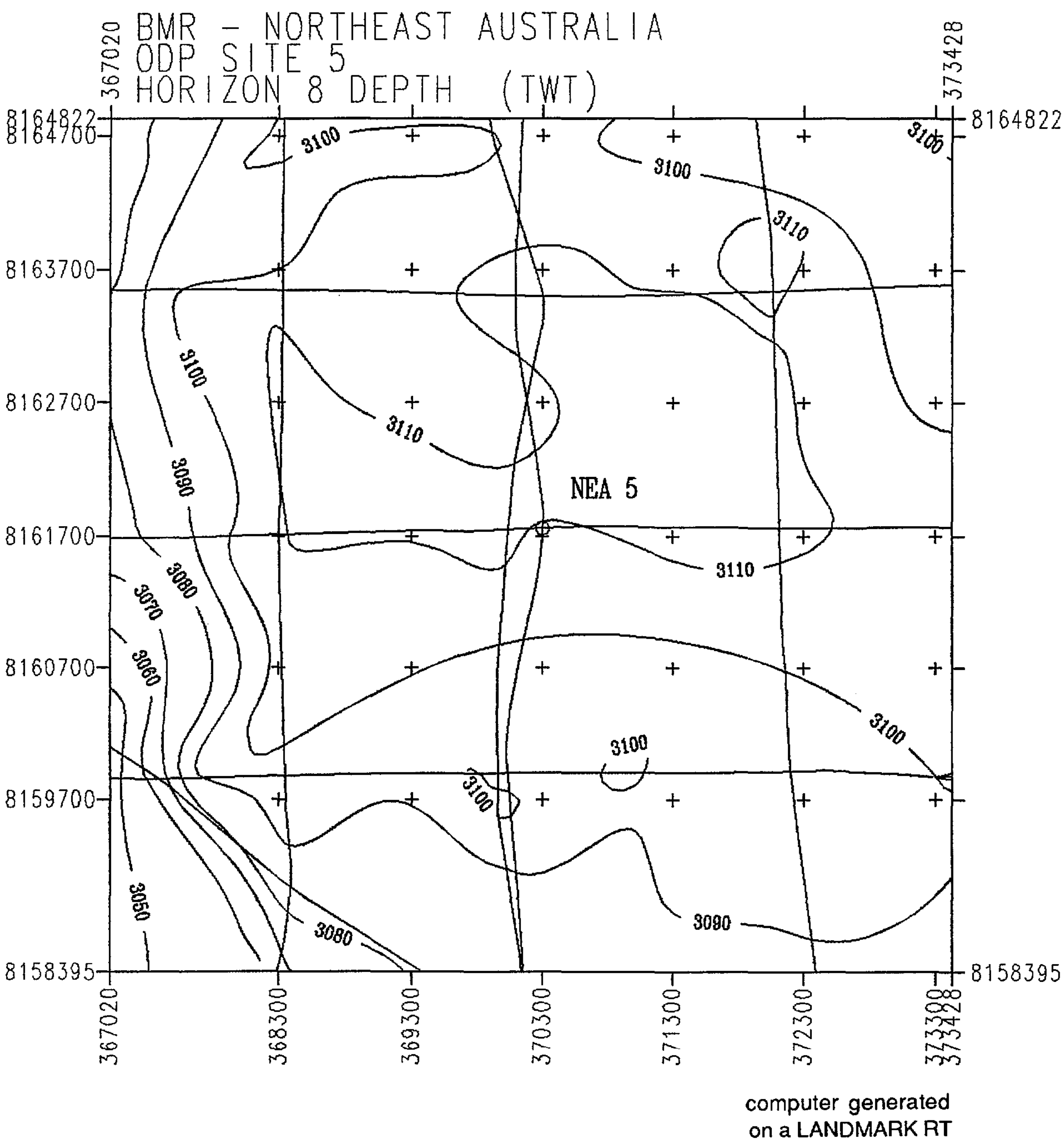


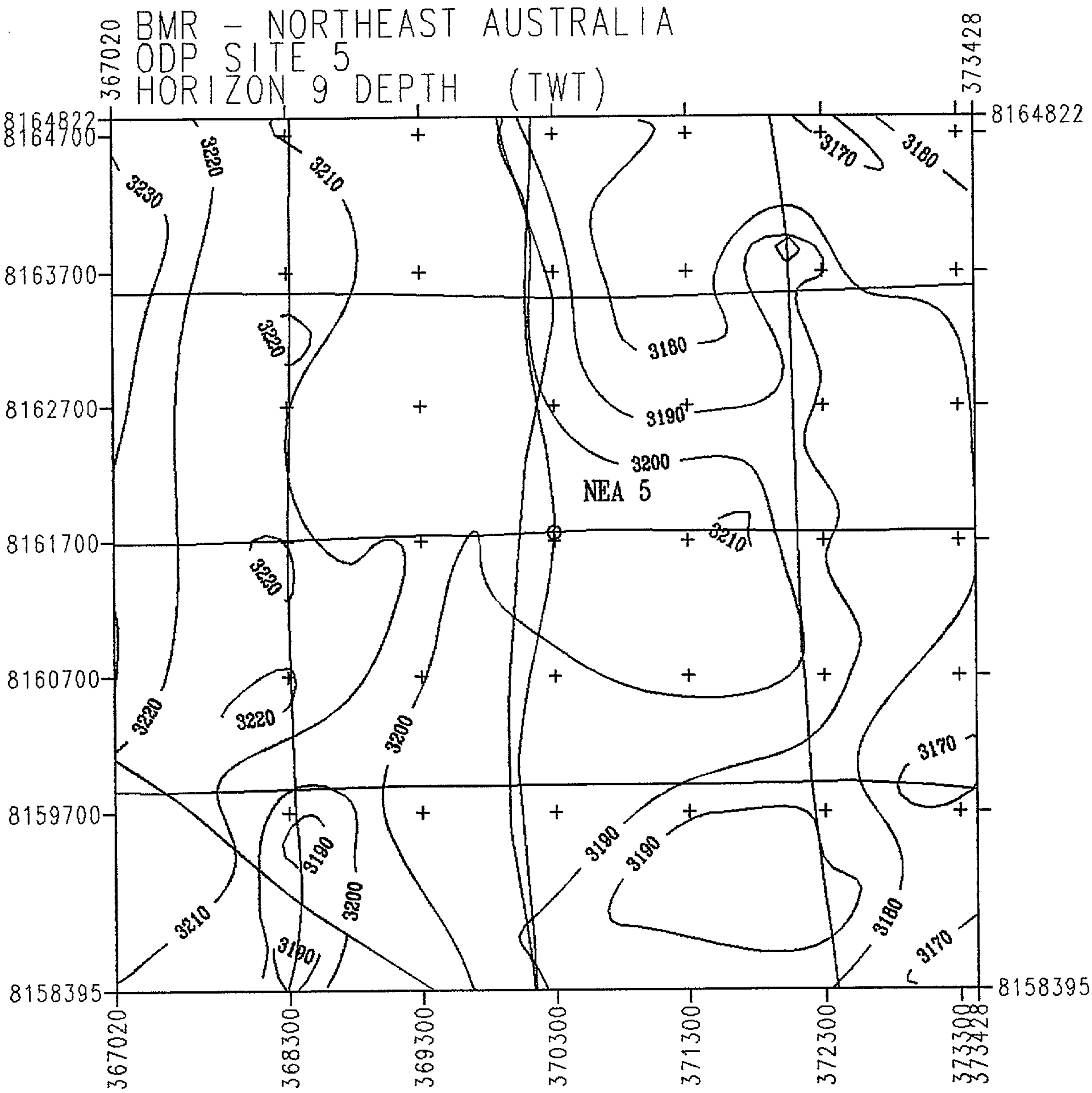
computer generated
on a LANDMARK RT



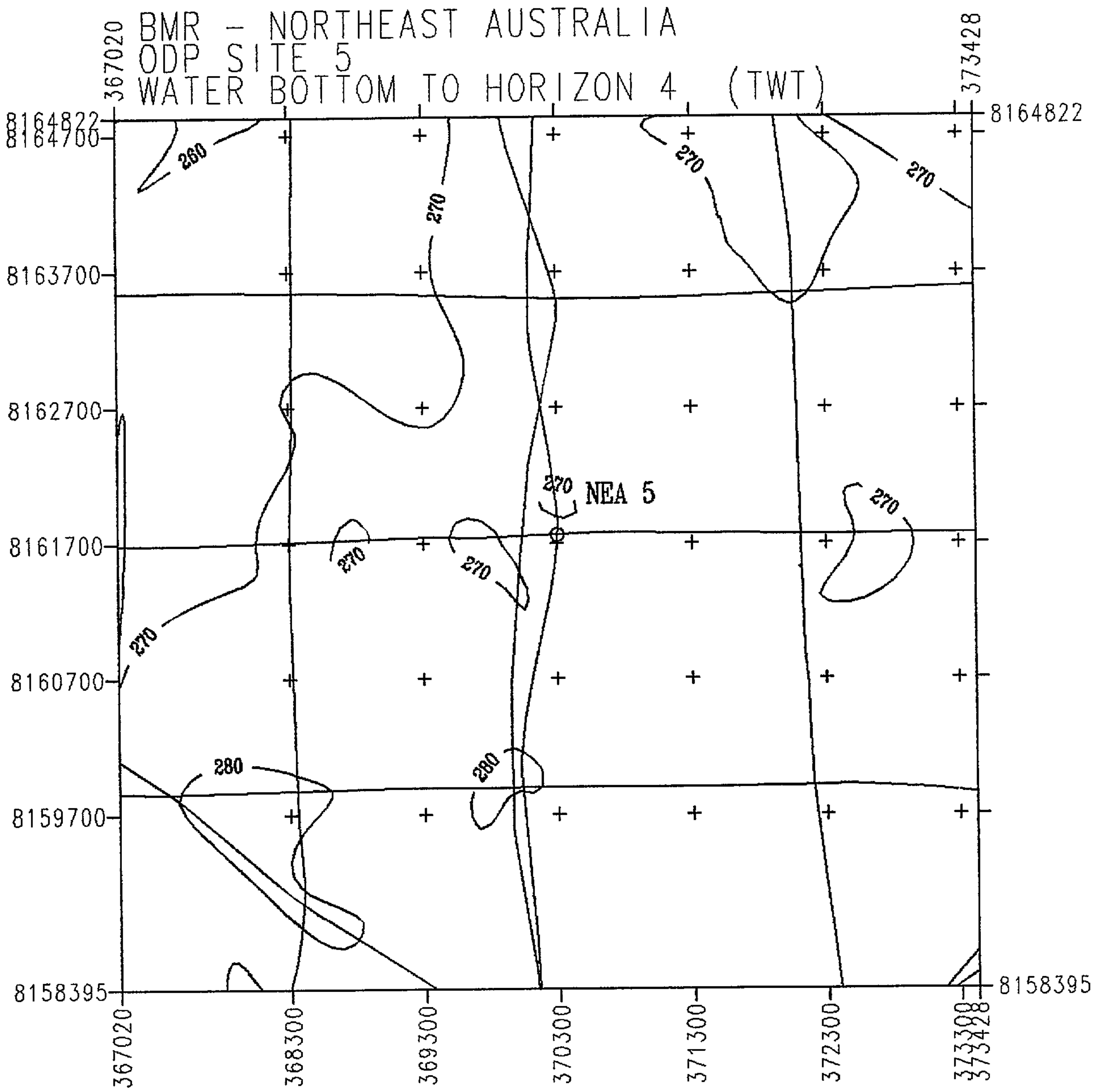
computer generated
on a LANDMARK RT



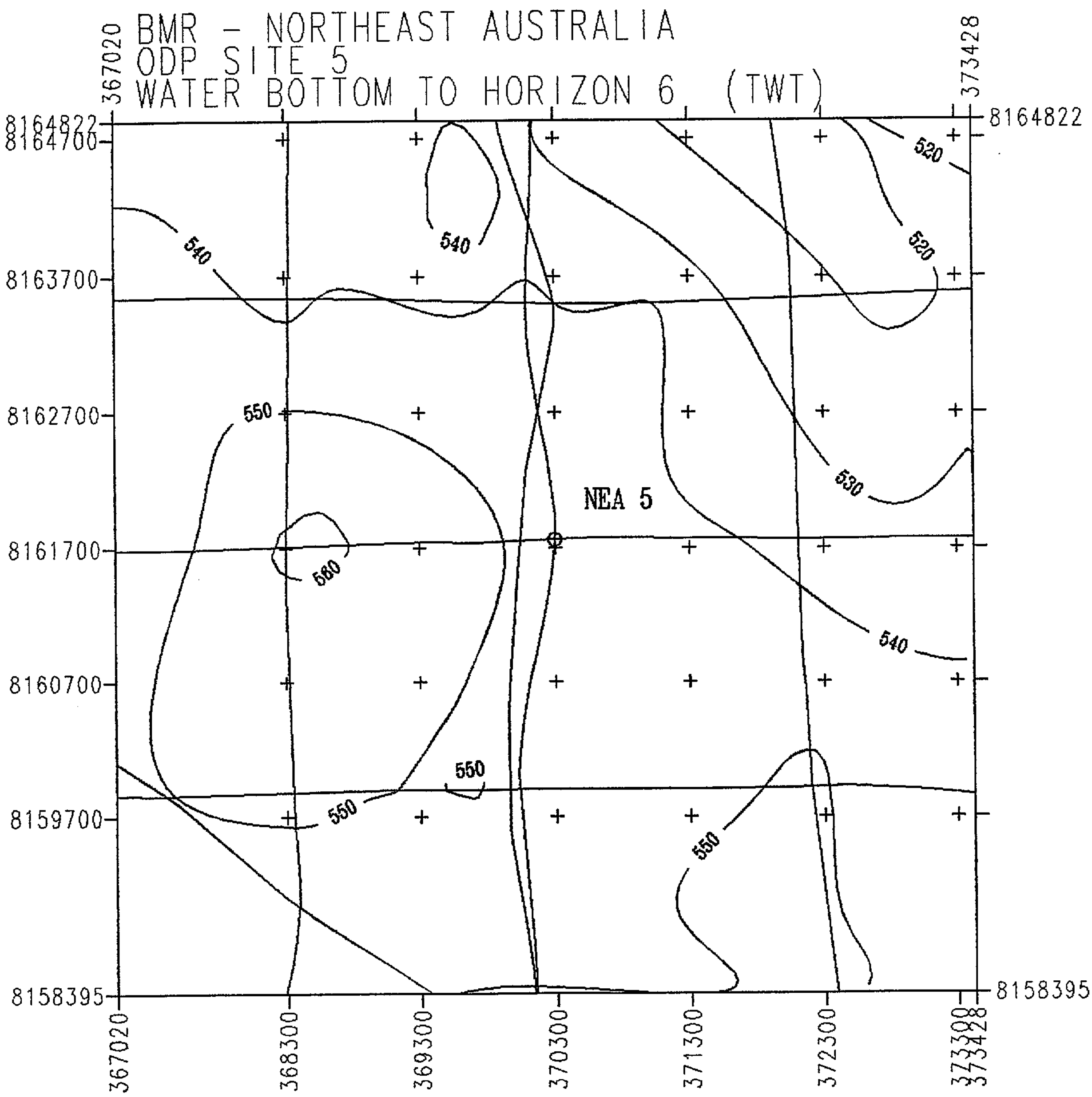
computer generated
on a LANDMARK RT



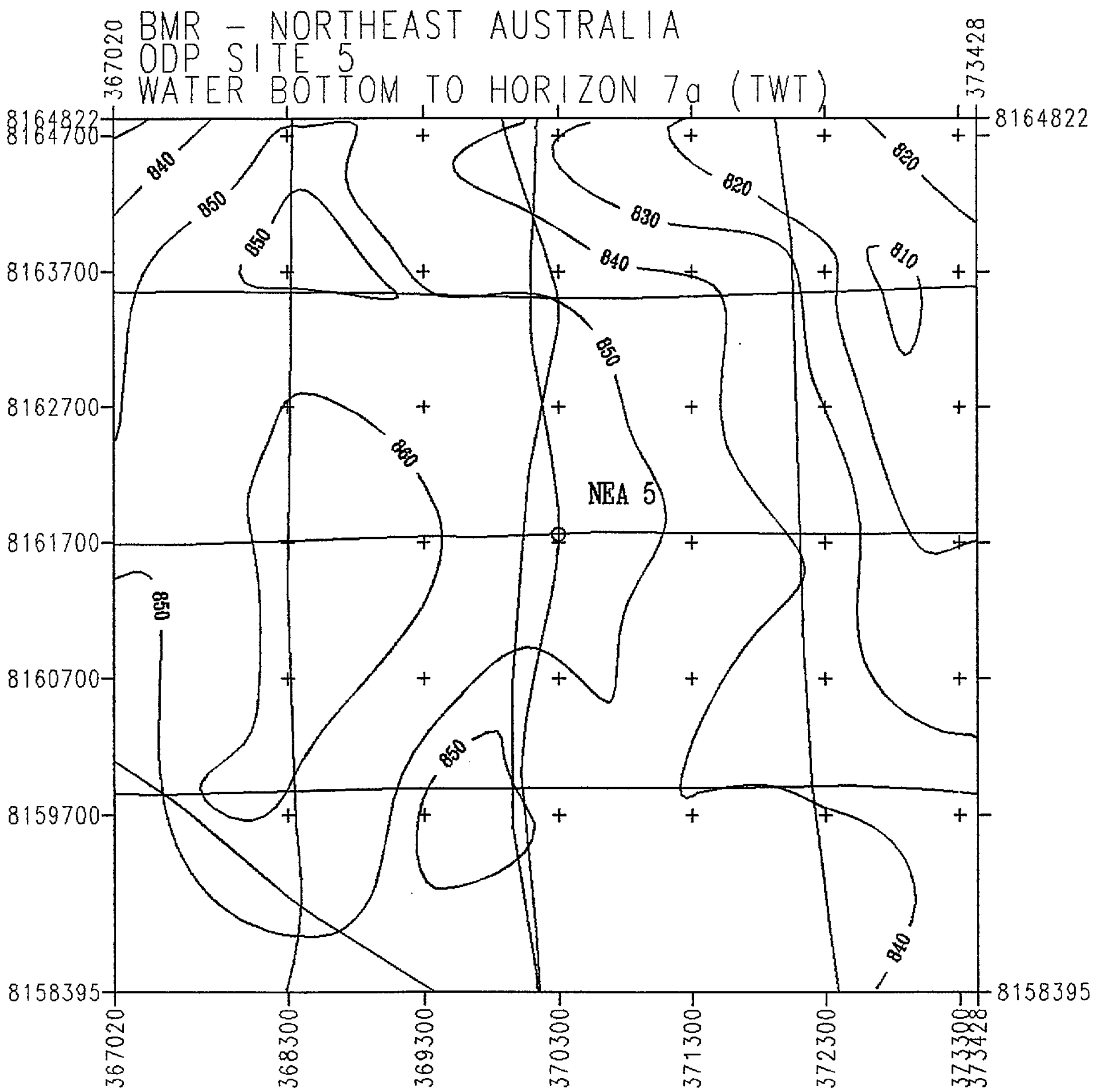
computer generated
on a LANDMARK RT



computer generated
on a LANDMARK RT



computer generated
on a LANDMARK RT



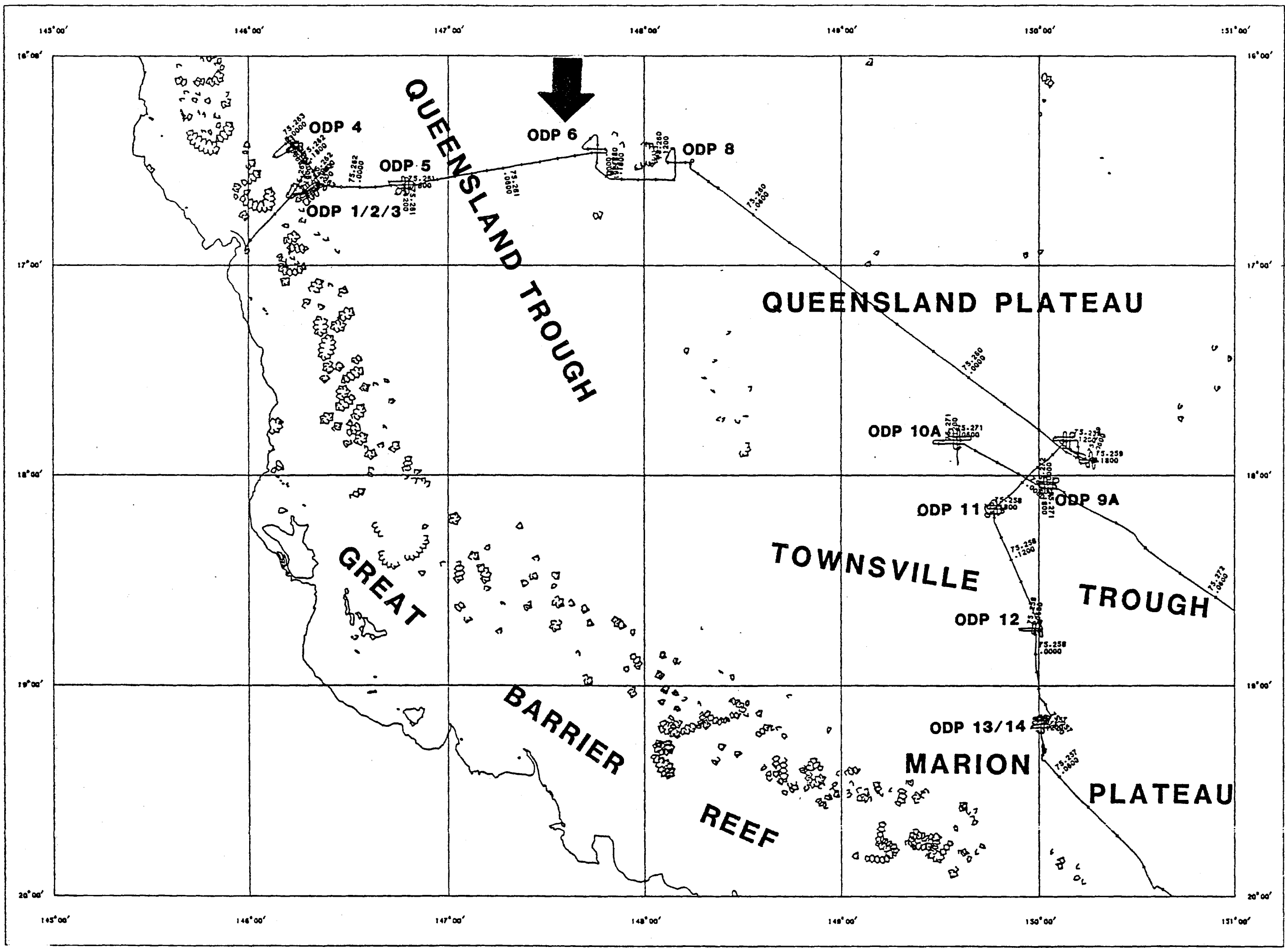
computer generated
on a LANDMARK RT

3.05 Site NEA 6

NORTHEAST AUSTRALIA ODP SITES

SCALE 1:2000000

EDITION OF 1989/03/30



AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT

TRACK MAP

NORTHEAST AUSTRALIA ODP SITES

OVERVIEW - SITE NEA6

Site 6 lies towards the eastern margin of the Queensland Trough, on the upper slope immediately west of Holmes Reef. It will provide a record of sealevel-controlled sedimentation analogous to sites NEA1 to NEA3, but in a purely carbonate regime. The sequence from this leeward, slope site will be compared with the windward, plateau-top sequence at NEA8. It will also provide information on slope processes in an exclusively carbonate system, and the factors controlling initiation and continued growth of carbonate platforms. The hole will bottom in Queensland Plateau basement.

OBJECTIVES - SITE 6

1. To determine the age and facies of upper slope deposits adjacent to a plateau margin reefal buildup.
2. To determine the paleoceanographic and paleoclimatic signal within a periplatform system.
3. To understand slope processes in an exclusively carbonate depositional system.
4. To determine the composition and age of basement.

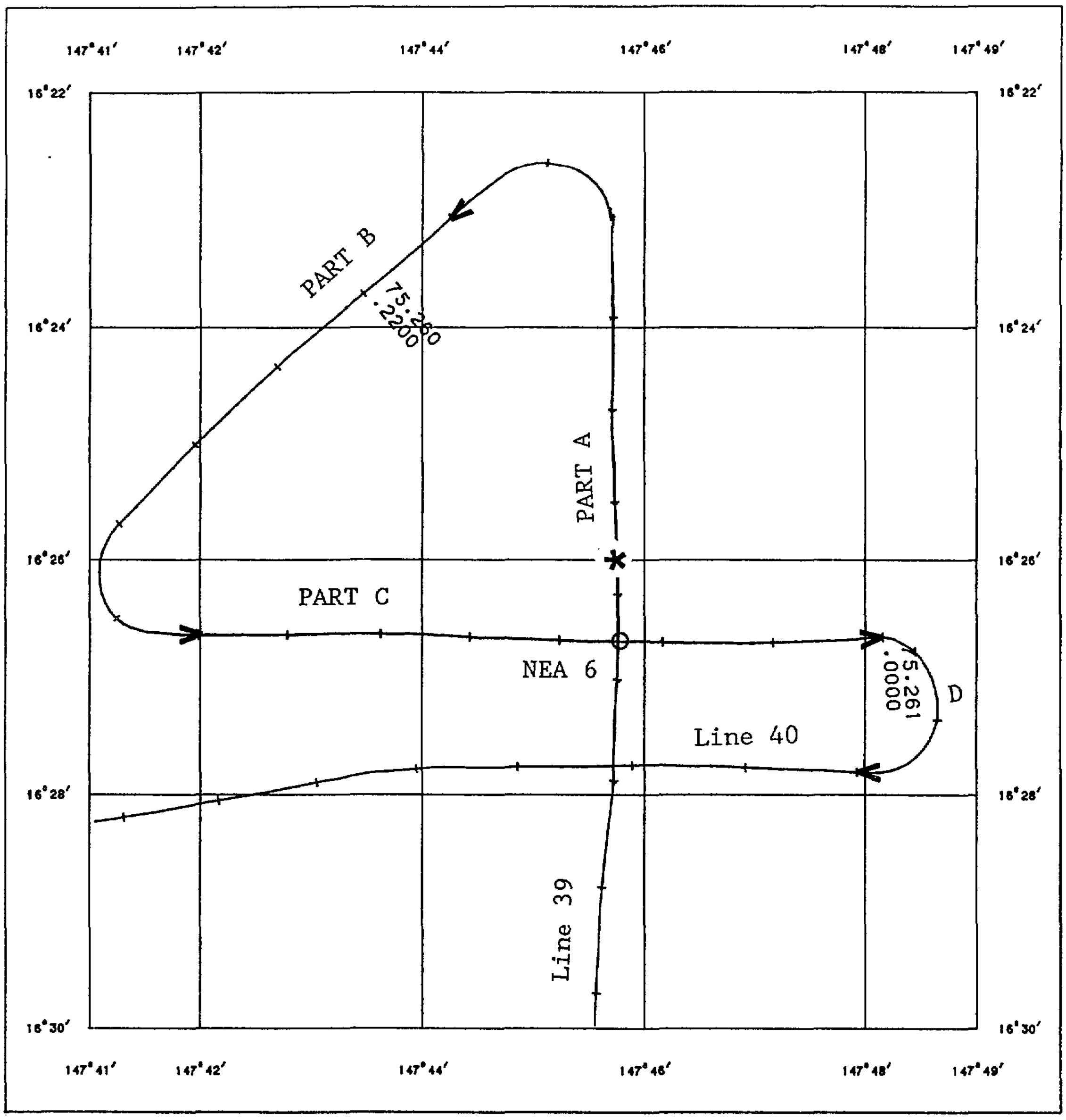
PROGNOSIS - SITE 6

1. 62 m of Quaternary current-winnowed carbonate sand and mud.
2. 204 m of Middle Miocene-Pliocene periplatform sands and muds, probably with a gravel component, and possibly containing significant gaps.
3. 99 m of latest Oligocene to Early Miocene carbonate sands and gravels in a debris apron.
4. 0.5 m of ?Paleozoic metasedimentary detritus.

SCALE 1:100000

ODP SITE 6

EDITION OF 1989/03/17



* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 6

CHECK SHEET

JOIDES SAFETY REVIEW

Leg **133** *Site No.* **NEA 6** *Lat.* **16° 26.7'S** *Long.* **147° 46.8'E**

Water Depth: **1000 m.** *Dist. from Land:* **110 n.mi.** *Jurisdiction:* **AUSTRALIA**

General location or geomorphic province:
Eastern Queensland Trough/Western Queensland Plateau adjacent to Holmes Reef.

Upon what geophysical and/or geological data was this site selection made:
Seismic lines: **BMR LINE 75/039 (CROSSING 39A & 39C)**
Gravity cores: **75GC19**
DSDP holes: **NONE**
Other:

Proposed total penetration: **390 m.**
Probable sediment thickness: **365 m.**

From previous DSDP drilling in this area, list all hydrocarbon occurrences of greater than background levels, give nature of show, age and depth of rock:
NO PREVIOUS DRILLING.

From available information, list all commercial drilling in this area that produced or yielded significant shows; give depths and ages of hydrocarbon bearing deposits:
NO COMMERCIAL DRILLING IN THIS AREA. NEAREST WELL IS APPROX. 475 n.mi. TO THE NORTH - NO HYDROCARBONS ENCOUNTERED. OIL SHALES OCCUR ONSHORE IN EARLY TERTIARY NONMARINE BASINS 200 n.mi. TO SOUTH.

Is there any indication of gas hydrates at this location:
NO INDICATION; NO BSR PRESENT.

Is there any reason to expect any hydrocarbon accumulation at this site? Please comment.
NO. SHALLOW BASEMENT, ABSENCE OF STRUCTURE AND THERMALLY IMMATURE SECTION PRECLUDES POSSIBILITY OF HYDROCARBON OCCURRENCE.

What is your proposed drilling program?
APC/XCB TO 365 m.
RCB from 365 m to TD at 390 m.

What is your proposed logging program?
SCHLUMBERGER LOGGING SUITE.

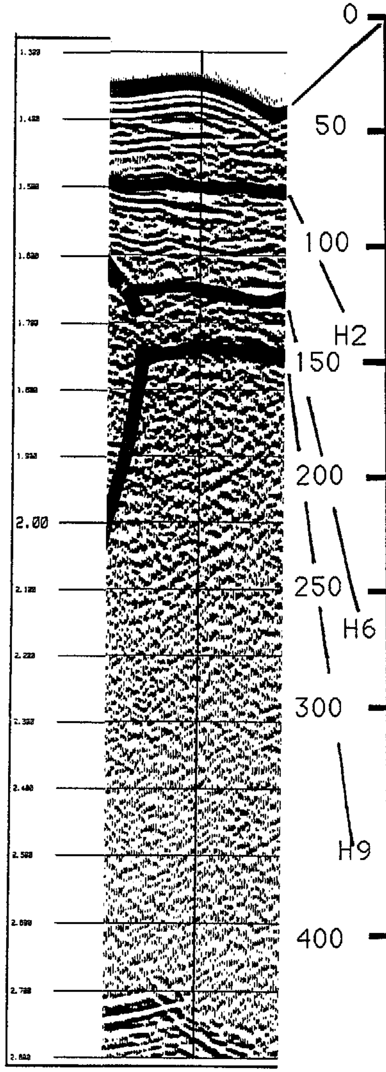
What "special" precautions will be taken during drilling?
STANDARD HYDROCARBON MONITORING.

What abandonment procedures do you plan to follow? (see Safety Manual, Sec. VIII, p. 22)
STANDARD PROCEDURES.

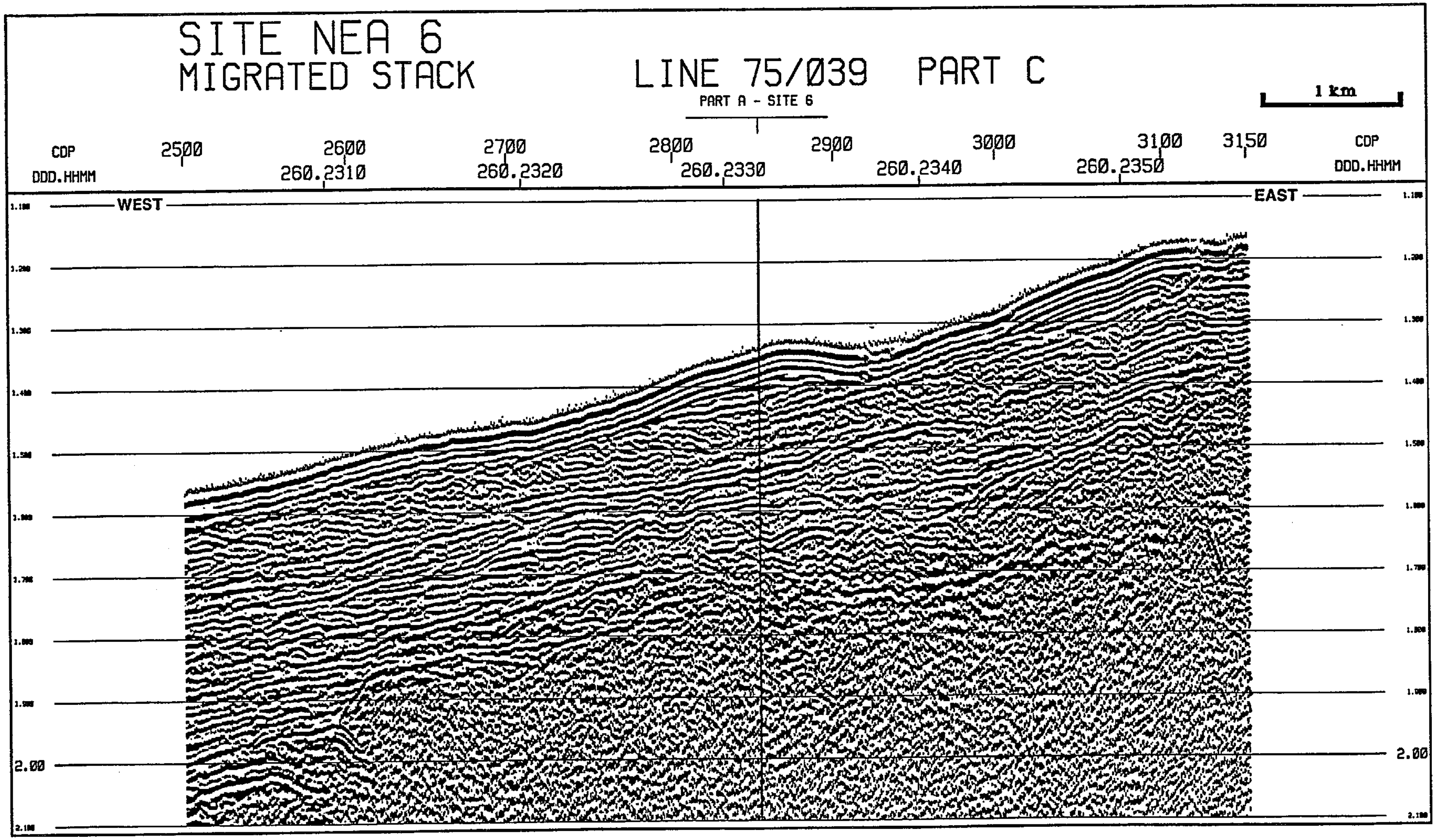
SUMMARY: What do you consider to be the major risks in drilling at this site?
NO MAJOR RISKS. SLIGHT CHANCE OF MINOR BIOGENIC GAS.

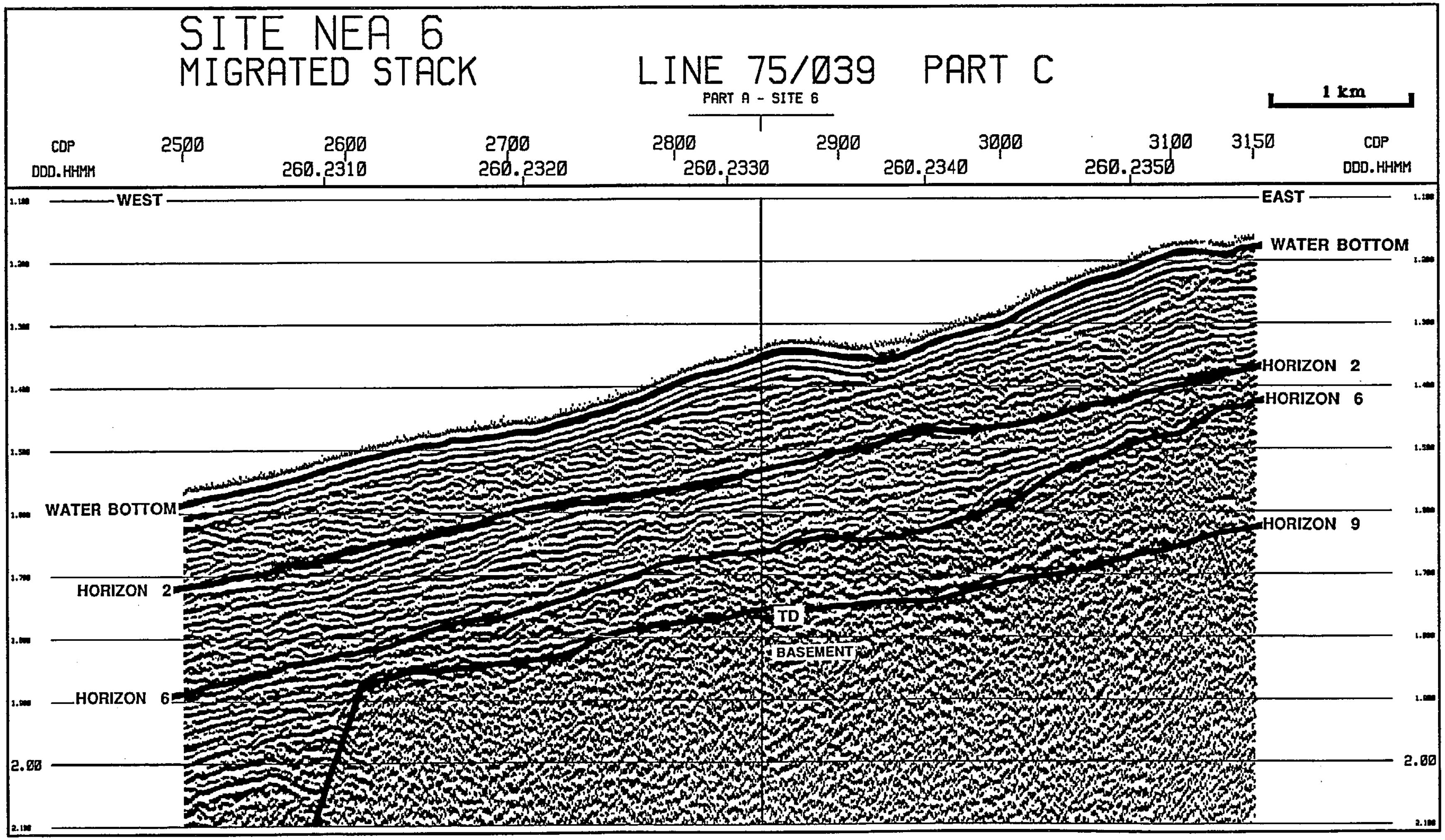
Please answer each question as carefully as possible, using extra pages if need be. The information you provide here will be an important factor in the Safety Review.

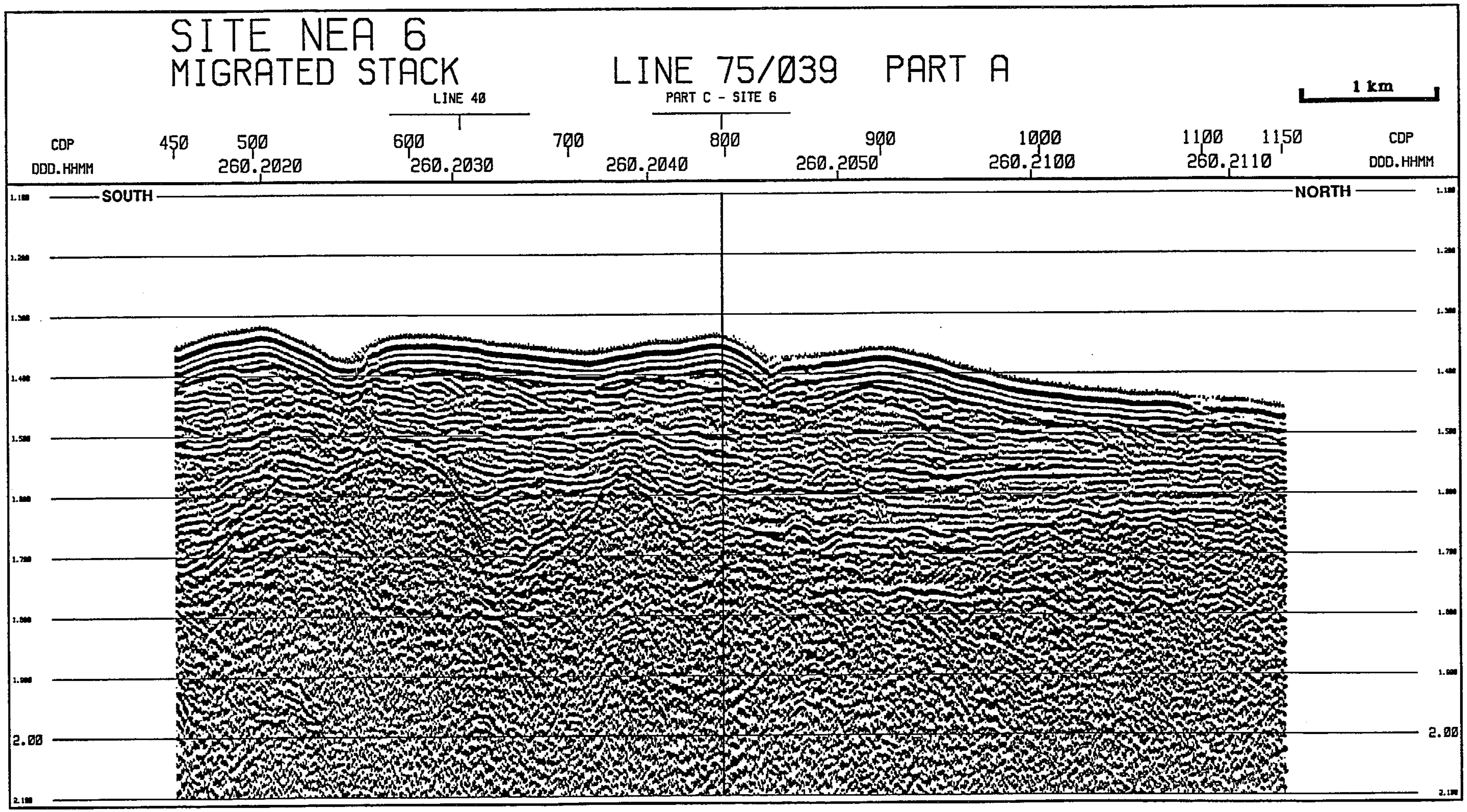
GRAPHIC SUMMARY: SITE NEA 6

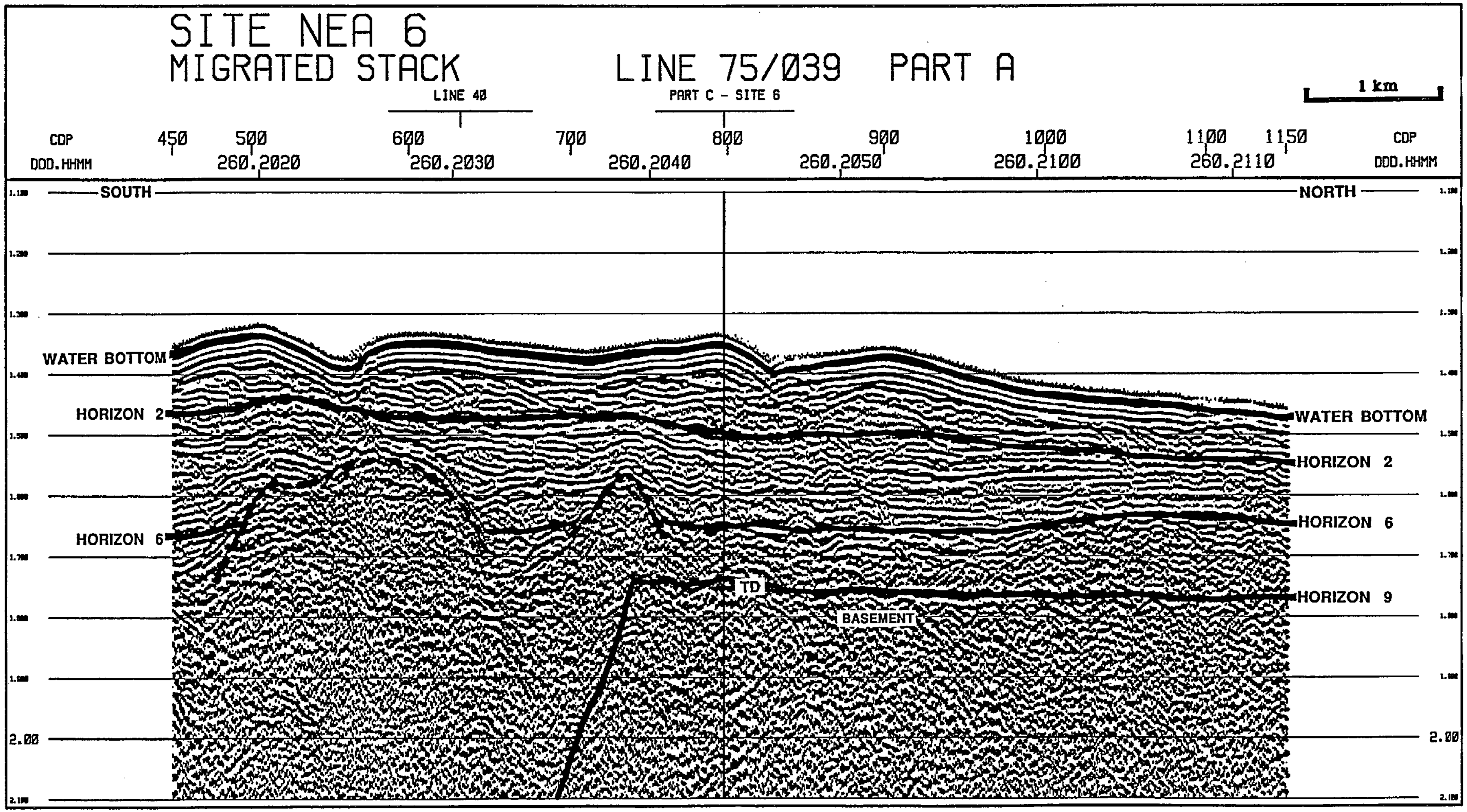


Age	Velocity (km/sec)	Lithology	Paleoenvironment	Sedim. Rate	Comments
Quaternary	1.55	current winnowed carbonate sand and mud	pelagic plateau slope	21.0 m/my	?contourite
[62] latest Miocene and Pliocene	1.75	interbedded carbonate sand and mud possibly with some gravel beds	pelagic toe of slope	17.5 m/my	periplatform deposits
[149] ?Late Miocene	1.8	as above but with more gravel	pelagic	9 m/my	periplatform deposits
[203] late Early to Middle Miocene	2.1	carbonate gravel, sand	hemipelagic midslope	10.5 m/my	periplatform deposits
[266] latest Oligocene to Early Miocene	2.2	rudstone, wackestone and packstone	carbonate platform slope	12.5 m/my	debris apron
[365] ?Palaeozoic		low grade metasediments			basement
TD [390]					


SITE NEA 6
MIGRATED STACK
LINE 75/Ø39 PART C
PART A - SITE 6
1 km
CDP
DDD.HHMM
25ØØ
26ØØ
27ØØ
28ØØ
29ØØ
3ØØØ
31ØØ
315Ø
26Ø.231Ø
26Ø.232Ø
26Ø.233Ø
26Ø.234Ø
26Ø.235Ø
WEST
EAST
2.ØØ


SITE NEA 6
MIGRATED STACK
LINE 75/039 PART C
PART A - SITE 6
1 km
CDP
DDD.HHMM
2500
2600
2700
2800
2900
3000
3100
3150
260.2310
260.2320
260.2330
260.2340
260.2350
WEST
EAST
WATER BOTTOM
HORIZON 2
HORIZON 6
HORIZON 9
TD
BASEMENT
2.00


SITE NEA 6
MIGRATED STACK
LINE 75/Ø39 PART A
1 km
LINE 4Ø
PART C - SITE 6
CDP
DDD.HHMM
45Ø
5ØØ
6ØØ
7ØØ
8ØØ
9ØØ
1ØØØ
11ØØ
115Ø
260.2020
260.2030
260.2040
260.2050
260.2100
260.2110
SOUTH
NORTH
2.ØØ



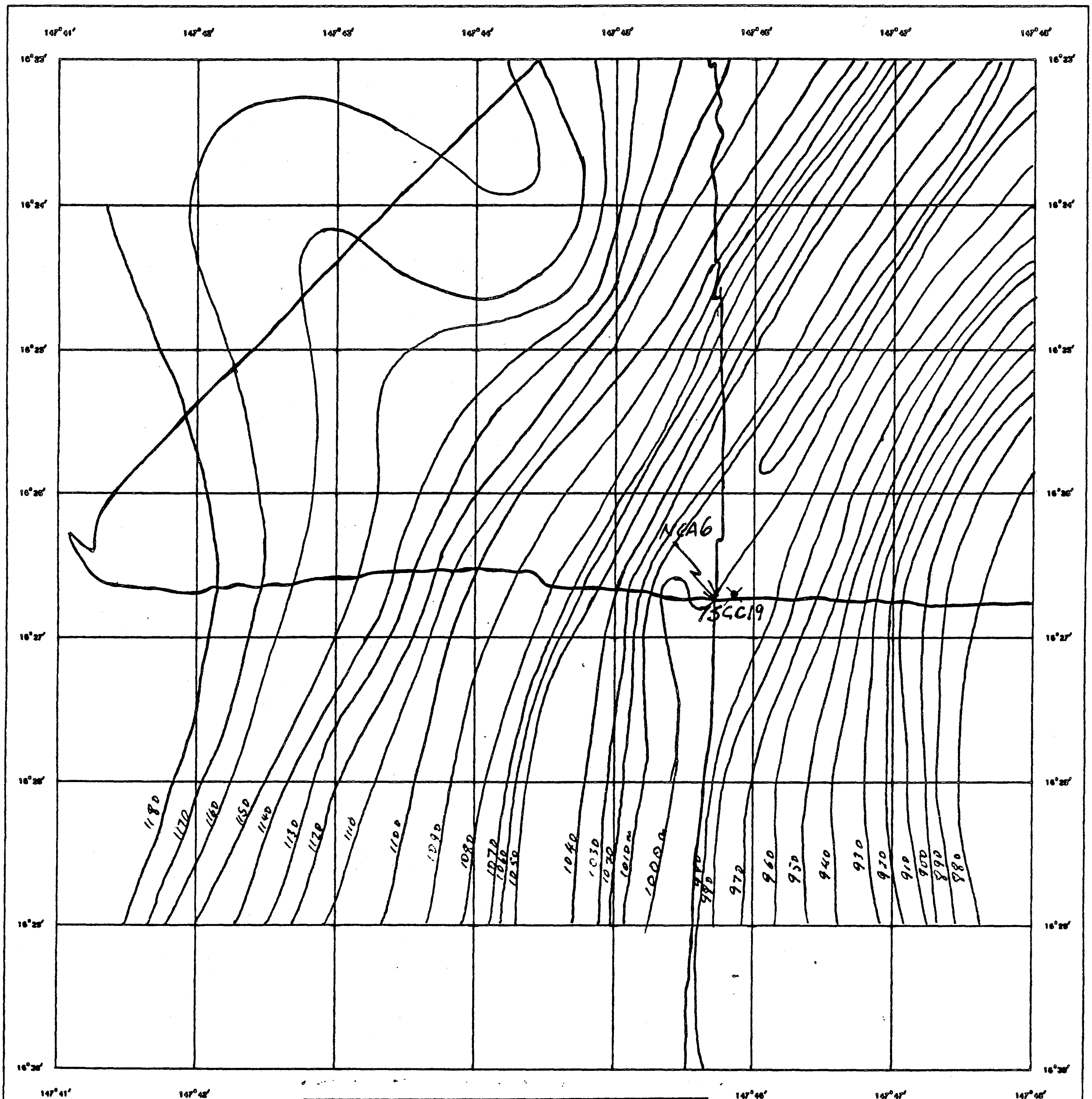
SITE NEA 6
MIGRATED STACK
LINE 75/039 PART A
1 km
LINE 40
PART C - SITE 6
CDP
DDD.HHMM
450
500
600
700
800
900
1000
1100
1150
260.2020
260.2030
260.2040
260.2050
260.2100
260.2110
SOUTH
NORTH
WATER BOTTOM
HORIZON 2
HORIZON 6
HORIZON 9
TD
BASEMENT
2.00

O.D.P. SITE SURVEY

SCALE 1:50000

NEA 6

EDITION OF 1987/10/02



Northeast Australia 1987 Cruise 75-Rig Seismic
ODP Site Survey 6
Bathymetry and Sample Positions
Contour Interval - 10m
Site Position - Time - 260/2042GMT
Lat. 16 26.734S
Long. 147 45.727E

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR PROJECTION
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

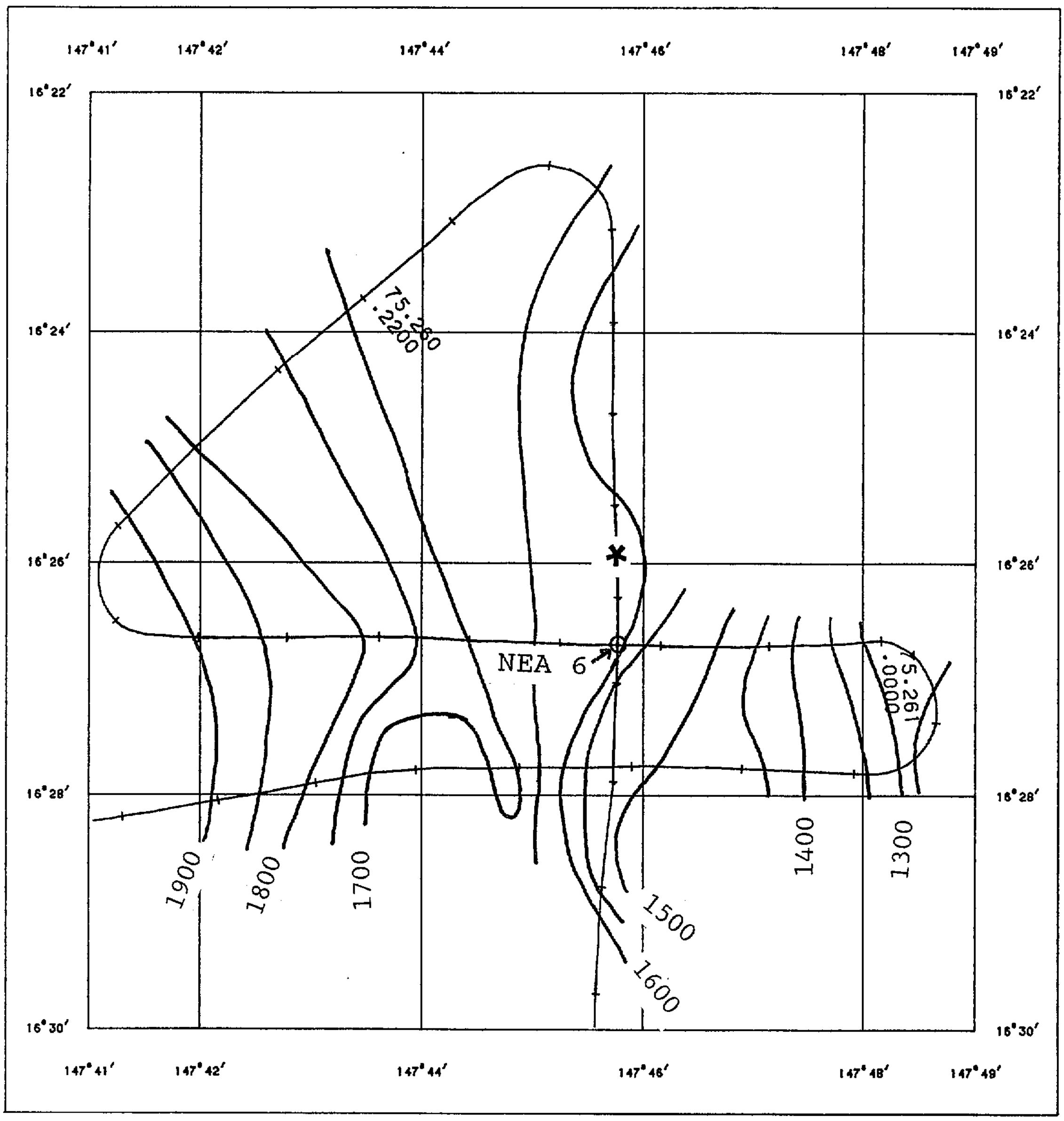
O.D.P.SITE SURVEY
NEA 6

SCALE 1:100000

ODP SITE 6

EDITION OF 1989/03/17

HORIZON 6 DEPTH (TWT)



* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

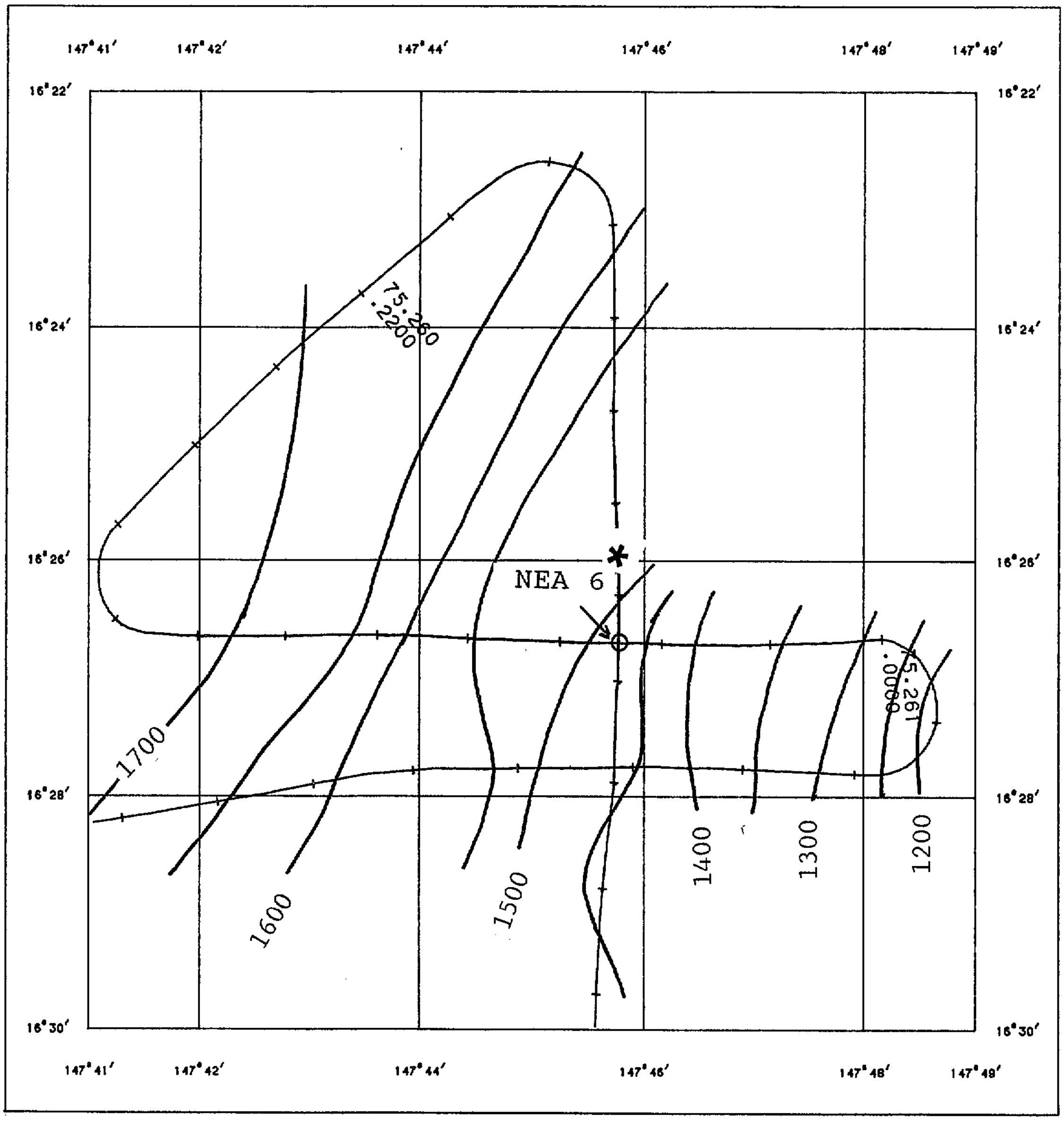
ODP SITE 6

SCALE 1:100000

ODP SITE 6

EDITION OF 1989/03/17

HORIZON 2 DEPTH (TWT)



* ALTERNATE SITE

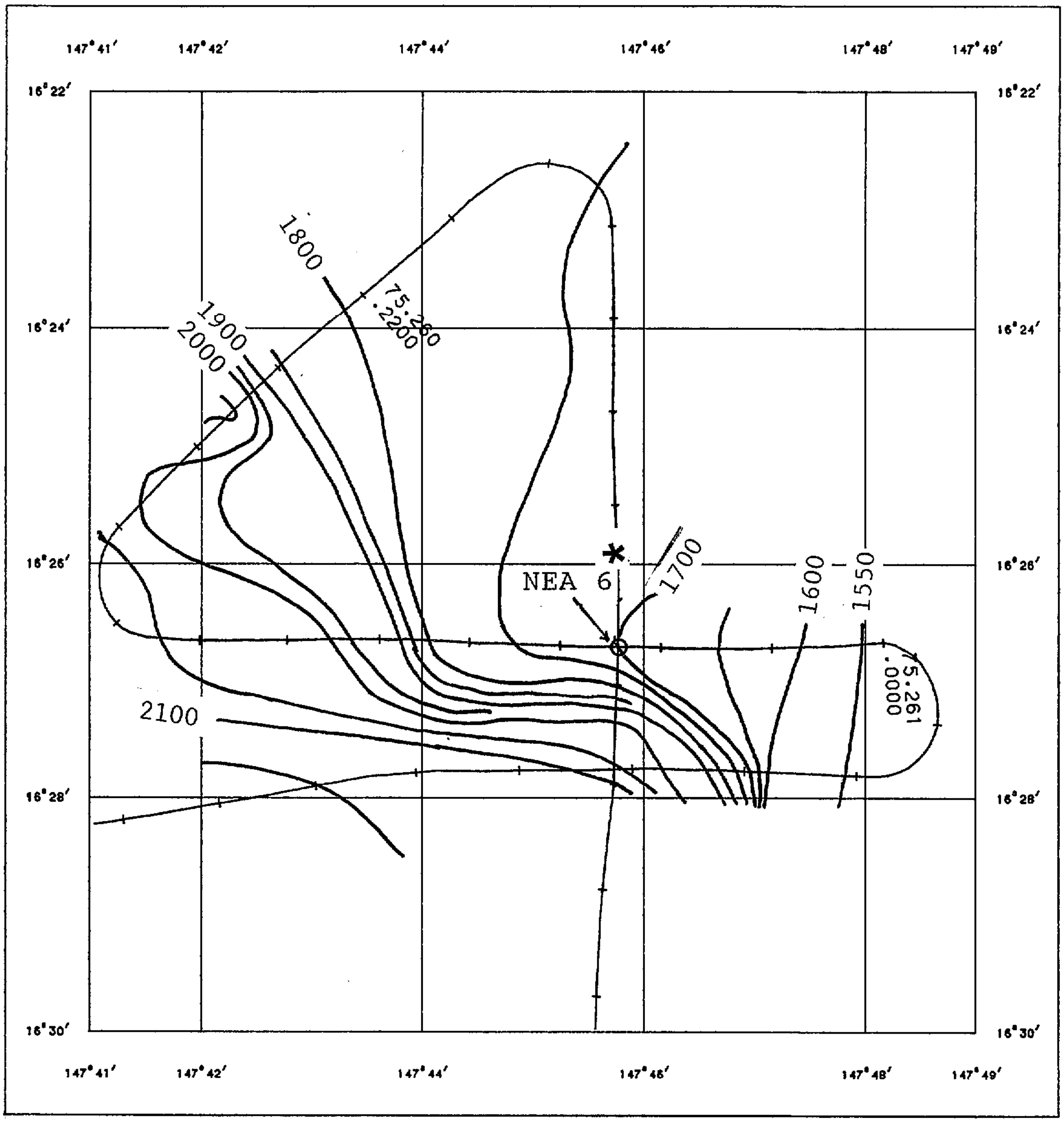
AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 6

SCALE 1:100000 ODP SITE 6 EDITION OF 1989/03/17

HORIZON 9 DEPTH (TWT)



* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

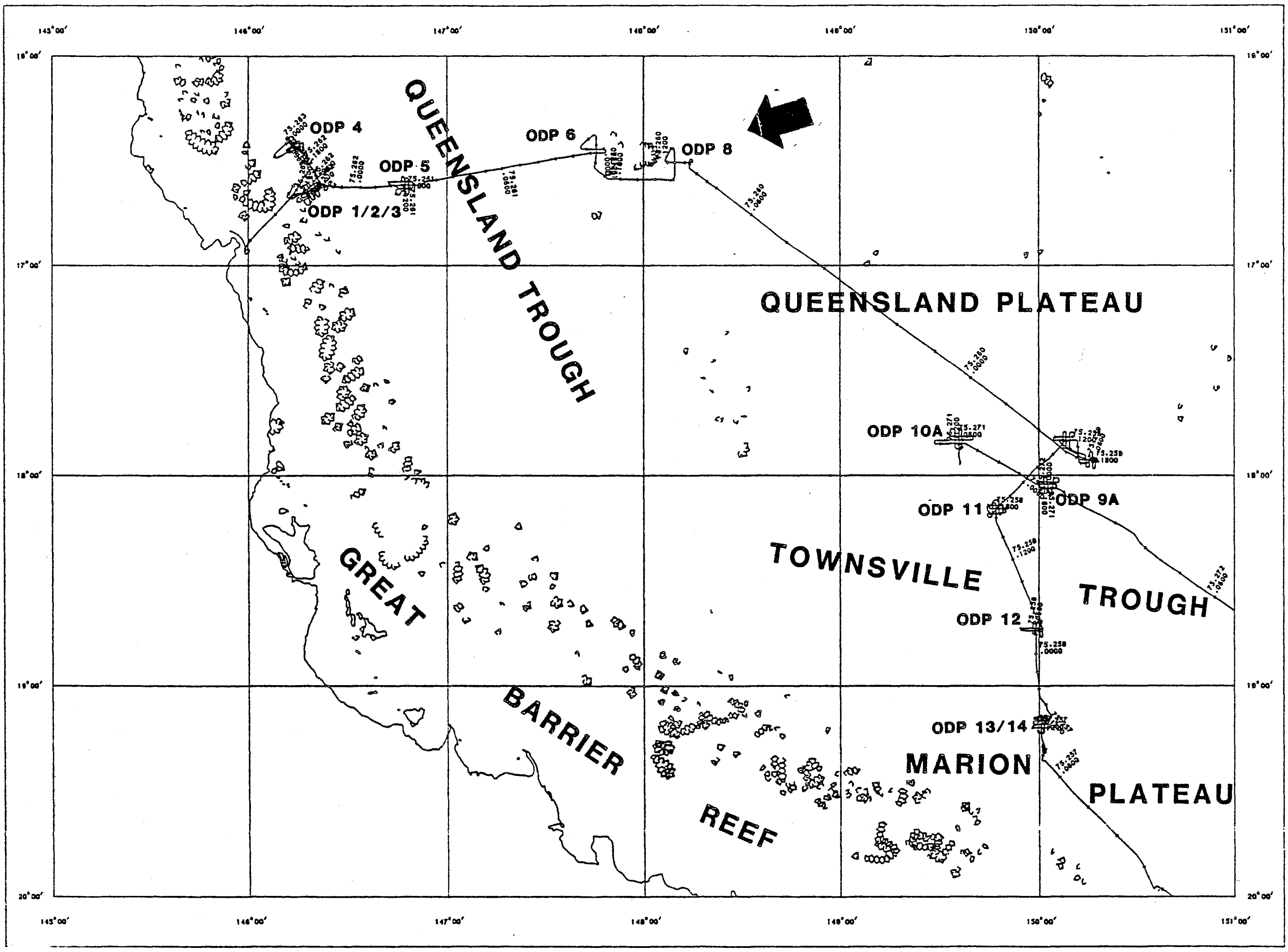
ODP SITE 6

3.06 Site NEA 8

NORTHEAST AUSTRALIA ODP SITES

SCALE 1:2000000

EDITION OF 1989/03/30



AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT

TRACK MAP

NORTHEAST AUSTRALIA ODP SITES

OVERVIEW - SITE NEA8

Site 8 lies on the western margin of the Queensland Plateau, immediately east of Holmes Reef. The sequence here should provide a complete record of plateau deposition during the late Neogene, and a record of plateau-top deposition during high sealevel periods during the early Neogene/late Paleogene. The sequence from this windward, plateau-top sequence will be compared with the leeward, slope site at NEA6. It will also provide information on the factors controlling initiation and continued growth of carbonate platforms. The hole will bottom in Queensland Plateau basement.

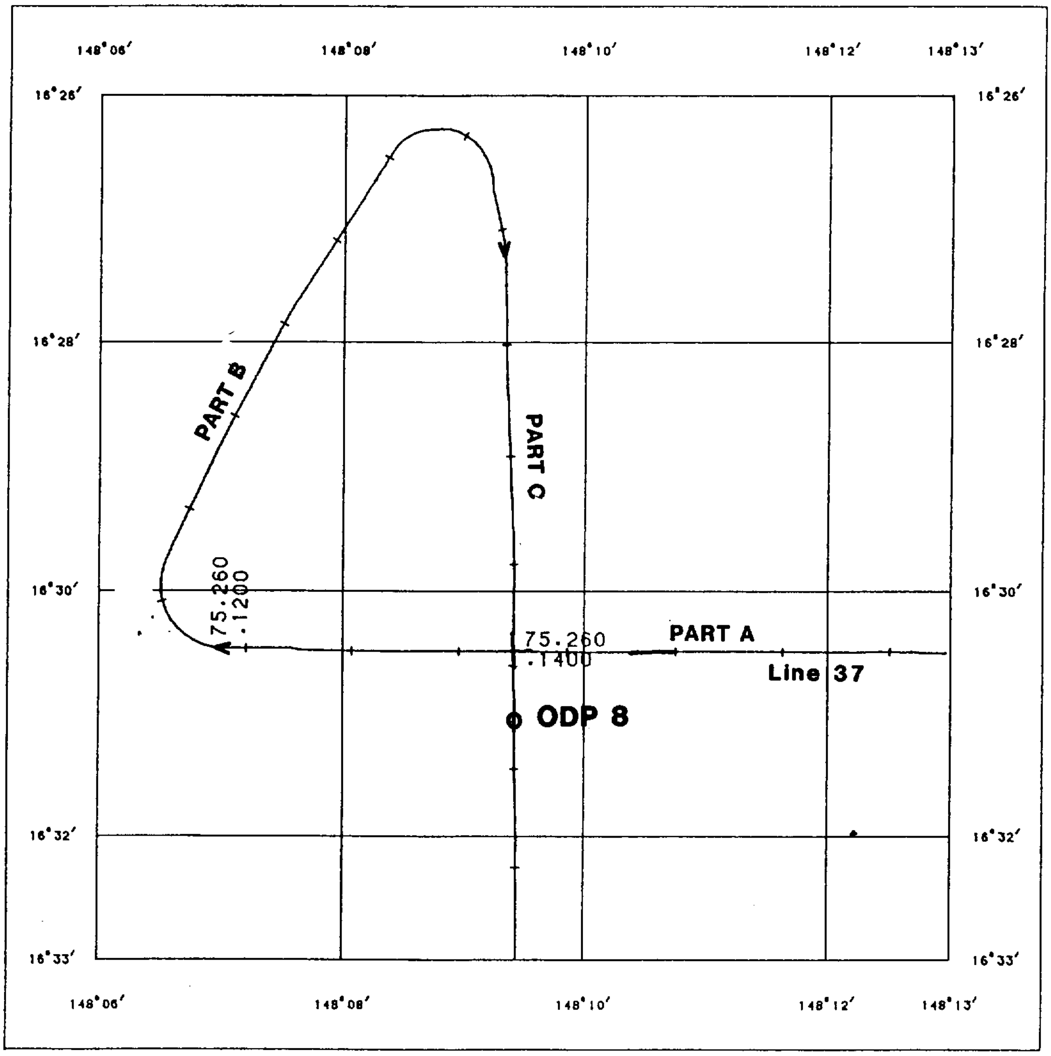
OBJECTIVES - SITE 8

1. To determine the age and facies of periplatform deposits adjacent to a plateau margin reefal buildup.
2. To determine the sealevel, paleoceanographic, and paleoclimatic signal within a periplatform system.
3. To understand plateau processes in an exclusively carbonate depositional system.
4. To determine the composition and age of basement.

PROGNOSIS - SITE 8

1. 400 m of latest Oligocene to Quaternary periplatform sands and muds, possibly with some minor gravel beds.
2. 0.5 m of ?Paleozoic metasedimentary detritus.

SCALE 1:100000 ODP SITE 8 EDITION OF 1989/03/17



* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 8

CHECK SHEET

JOIDES SAFETY REVIEW

Leg **133** *Site No.* **NEA 8** *Lat.* **16° 31.1'S** *Long.* **148° 9.4'E**

Water Depth:	*Dist. from Land:*	*Jurisdiction:*
934 m.	**128 n.mi.**	**AUSTRALIA**

General location or geomorphic province:
Western Queensland Plateau, adjacent to Holmes Reef.

Upon what geophysical and/or geological data was this site selection made:
Seismic lines: **BMR LINE 75/037 (37C)**
Gravity cores: **75GC/22, 75GC/23**
DSDP holes: **NONE**
Other:

Proposed total penetration: **400 m.**
Probable sediment thickness: **343 m.**

From previous DSDP drilling in this area, list all hydrocarbon occurrences of greater than background levels, give nature of show, age and depth of rock:
NO PREVIOUS DRILLING.

From available information, list all commercial drilling in this area that produced or yielded significant shows; give depths and ages of hydrocarbon bearing deposits:
NO COMMERCIAL DRILLING IN THIS AREA. NEAREST WELL IS APPROX. 470 n.mi. TO THE SOUTH - NO HYDROCARBONS ENCOUNTERED. OIL SHALES OCCUR ONSHORE IN EARLY TERTIARY NONMARINE BASINS 220 n.mi. TO SOUTH.

Is there any indication of gas hydrates at this location:
NO INDICATION; NO BSR PRESENT.

Is there any reason to expect any hydrocarbon accumulation at this site? Please comment.
NO. SHALLOW BASEMENT, ABSENCE OF STRUCTURE AND THERMALLY IMMATURE SECTION PRECLUDES POSSIBILITY OF HYDROCARBON OCCURRENCE.

What is your proposed drilling program?
APC/XCB to 343 m.
RCB from 343 m to TD AT 400 m.

What is your proposed logging program?
NO LOGGING.

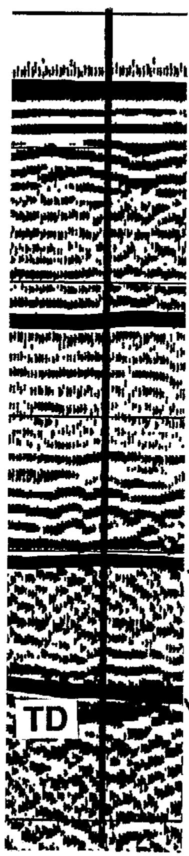
What "special" precautions will be taken during drilling?
STANDARD HYDROCARBON MONITORING.

What abandonment procedures do you plan to follow? (see Safety Manual, Sec. VIII, p. 22)
STANDARD PROCEDURES.

SUMMARY: What do you consider to be the major risks in drilling at this site?
NO MAJOR RISKS. SLIGHT CHANCE OF MINOR BIOGENIC GAS.

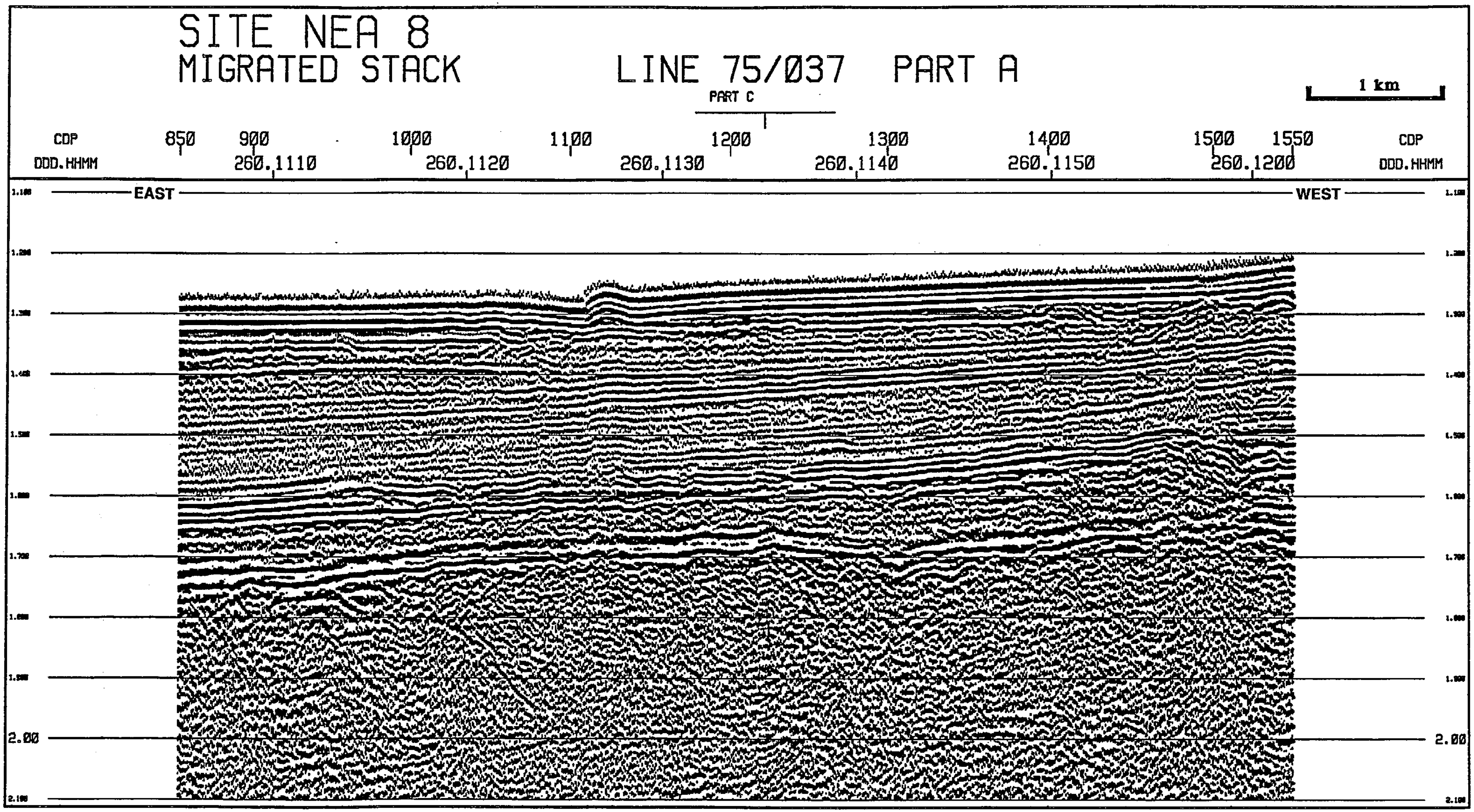
Please answer each question as carefully as possible, using extra pages if need be. The information you provide here will be an important factor in the Safety Review.

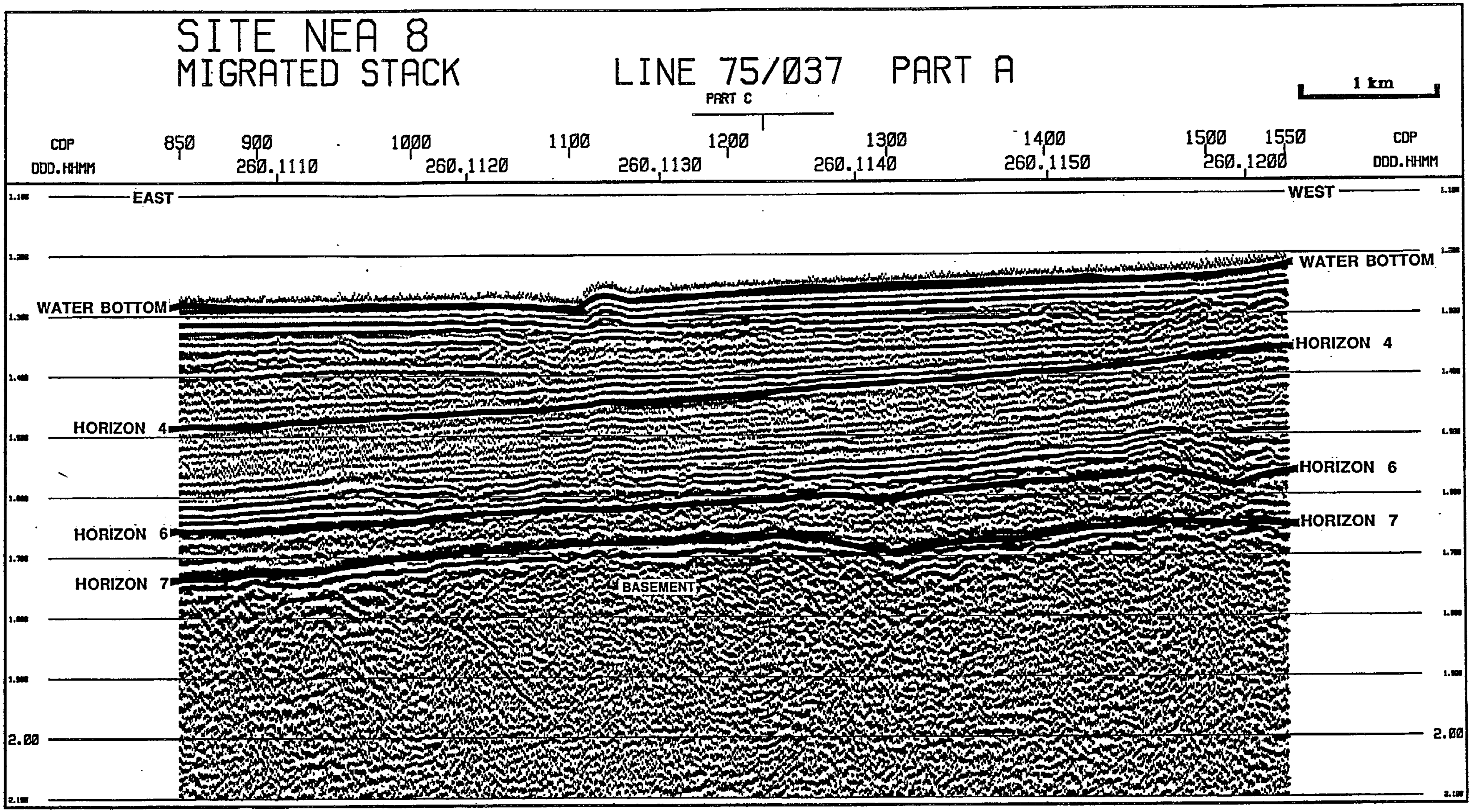
GRAPHIC SUMMARY: SITE NEA 8



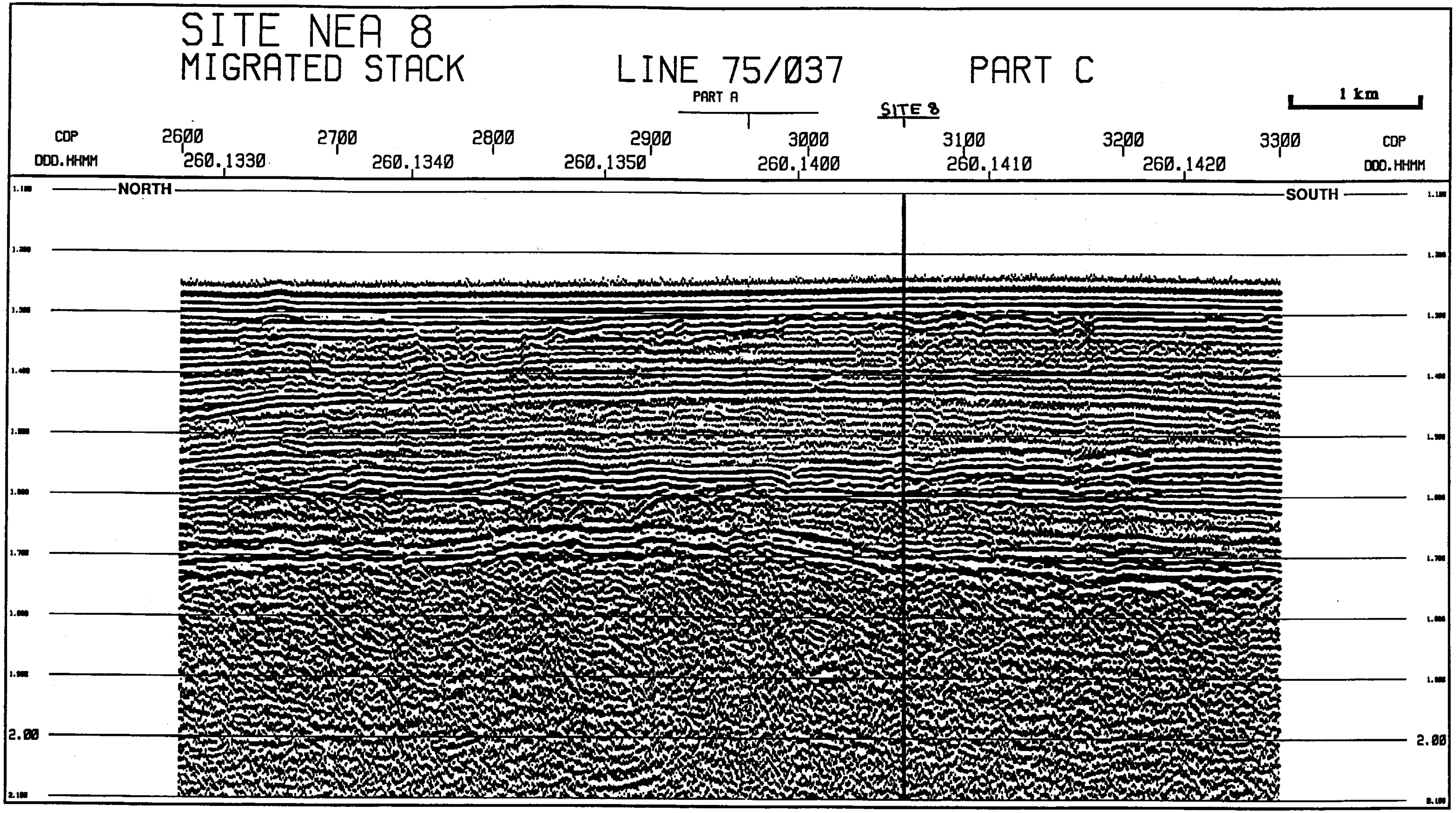
Key Reflectors	Depth (m)	Age	Velocity (km/sec)	Lithology	Paleoenvironment	Sedim. Rate	Comments
	0–62	Pliocene to Recent	1.55	sand and mud	pelagic plateau outer margin	21.0 m/my	periplatform sediments
	[62]	latest Miocene to Pliocene	1.6	sand and mud	as above	8 m/my	periplatform sediments
H4	[138]	Late Miocene	1.7	sand and mud		20 m/my	periplatform sediments
H6	[240]	Middle Miocene	1.8	sand and mud with gravel beds and possible hardgrounds		7 m/my	
H7	[292]	latest Oligocene to Early Miocene	2.0	gravel, sand and mud		5 m/my	
TD	[400]	?Palaeozoic		low grade metasediment			basement

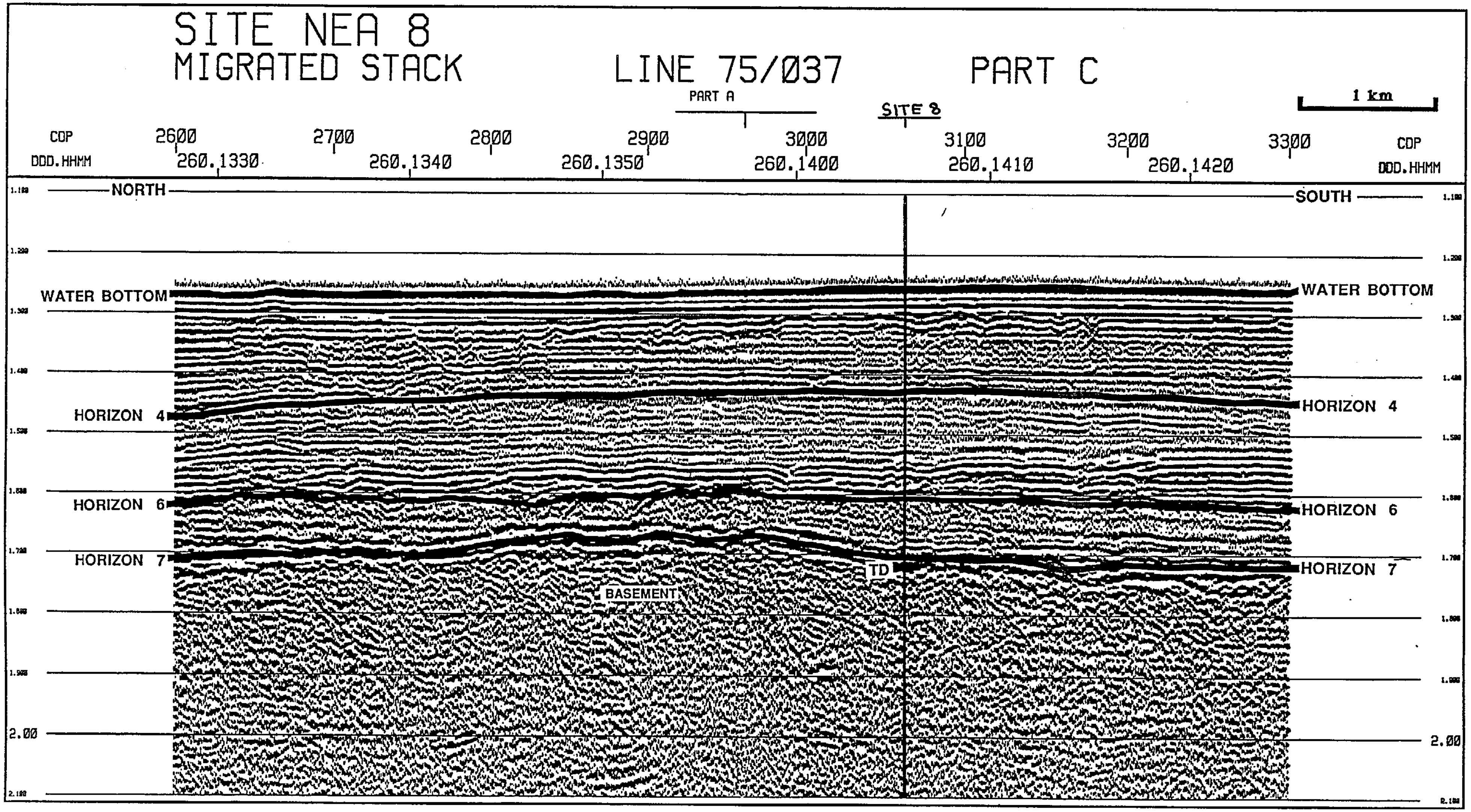
Depth scale: 0, 50, 100, 150, 200, 250, 300, 350, 400, 500


SITE NEA 8
MIGRATED STACK
LINE 75/Ø37 PART A
PART C
1 km
CDP
DDD.HHMM
850
900
1000
1100
1200
1300
1400
1500
1550
260.1110
260.1120
260.1130
260.1140
260.1150
260.1200
EAST
WEST
2.00



SITE NEA 8
MIGRATED STACK
LINE 75/Ø37 PART A
PART C
1 km
CDP
DDD.HHMM
85Ø
9ØØ
1ØØØ
11ØØ
12ØØ
13ØØ
14ØØ
15ØØ
155Ø
26Ø.111Ø
26Ø.112Ø
26Ø.113Ø
26Ø.114Ø
26Ø.115Ø
26Ø.12ØØ
CDP
DDD.HHMM
EAST
WEST
WATER BOTTOM
HORIZON 4
HORIZON 6
HORIZON 7
BASEMENT
WATER BOTTOM
HORIZON 4
HORIZON 6
HORIZON 7
2.ØØ
2.ØØ

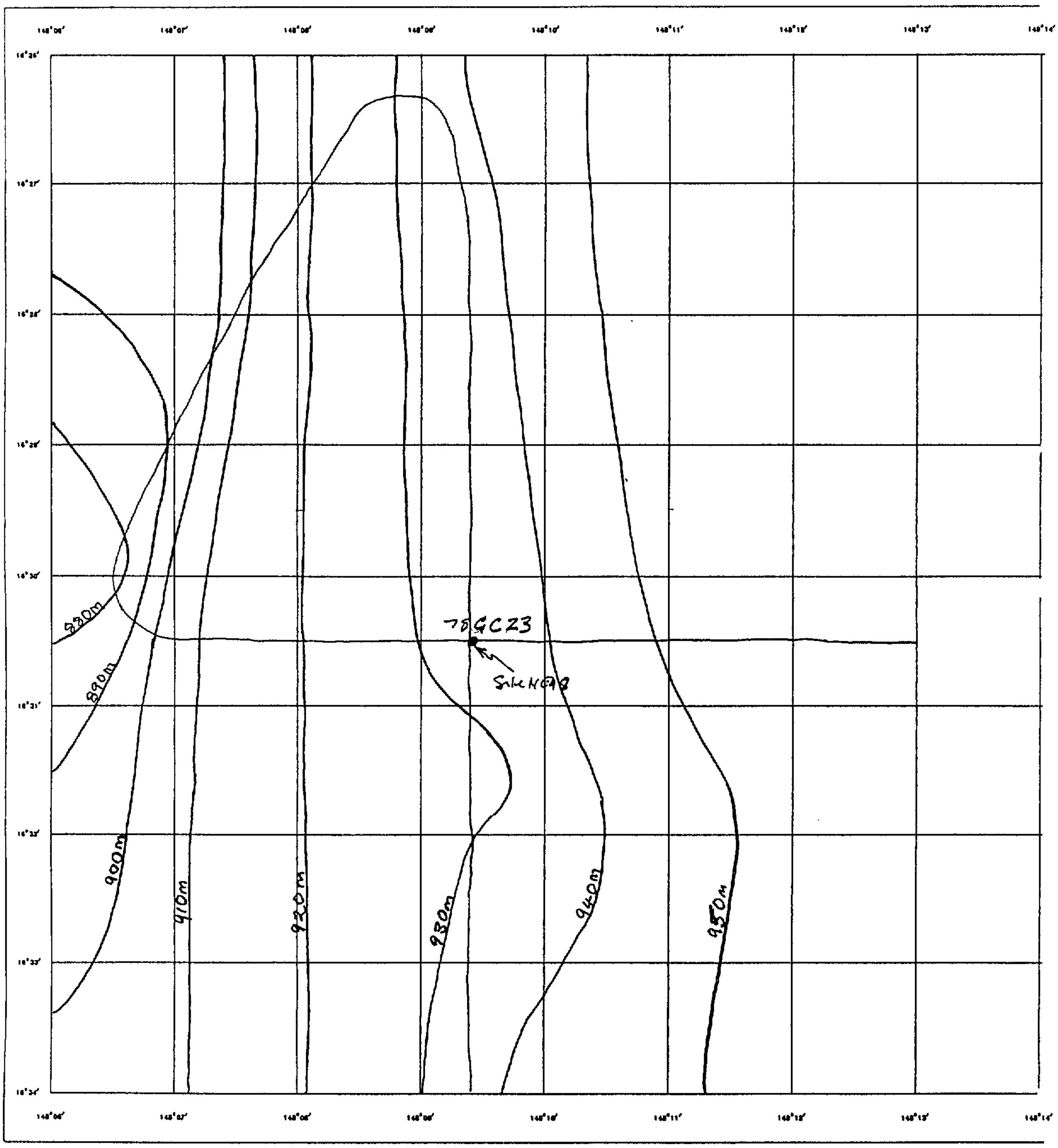

SITE NEA 8
MIGRATED STACK
LINE 75/Ø37
PART C
PART A
SITE 8
1 km
CDP
DDD.HHMM
26ØØ
27ØØ
28ØØ
29ØØ
3ØØØ
31ØØ
32ØØ
33ØØ
260.1330
260.1340
260.1350
260.1400
260.1410
260.1420
NORTH
SOUTH
2.ØØ


SITE NEA 8
MIGRATED STACK
LINE 75/037
PART C
PART A
SITE 8
1 km
CDP
DDD.HHMM
2600
2700
2800
2900
3000
3100
3200
3300
260.1330
260.1340
260.1350
260.1400
260.1410
260.1420
NORTH
SOUTH
WATER BOTTOM
HORIZON 4
HORIZON 6
HORIZON 7
TD
BASEMENT
2.00

O.D.P. SITE SURVEY

NEA 8

SCALE 1:50000

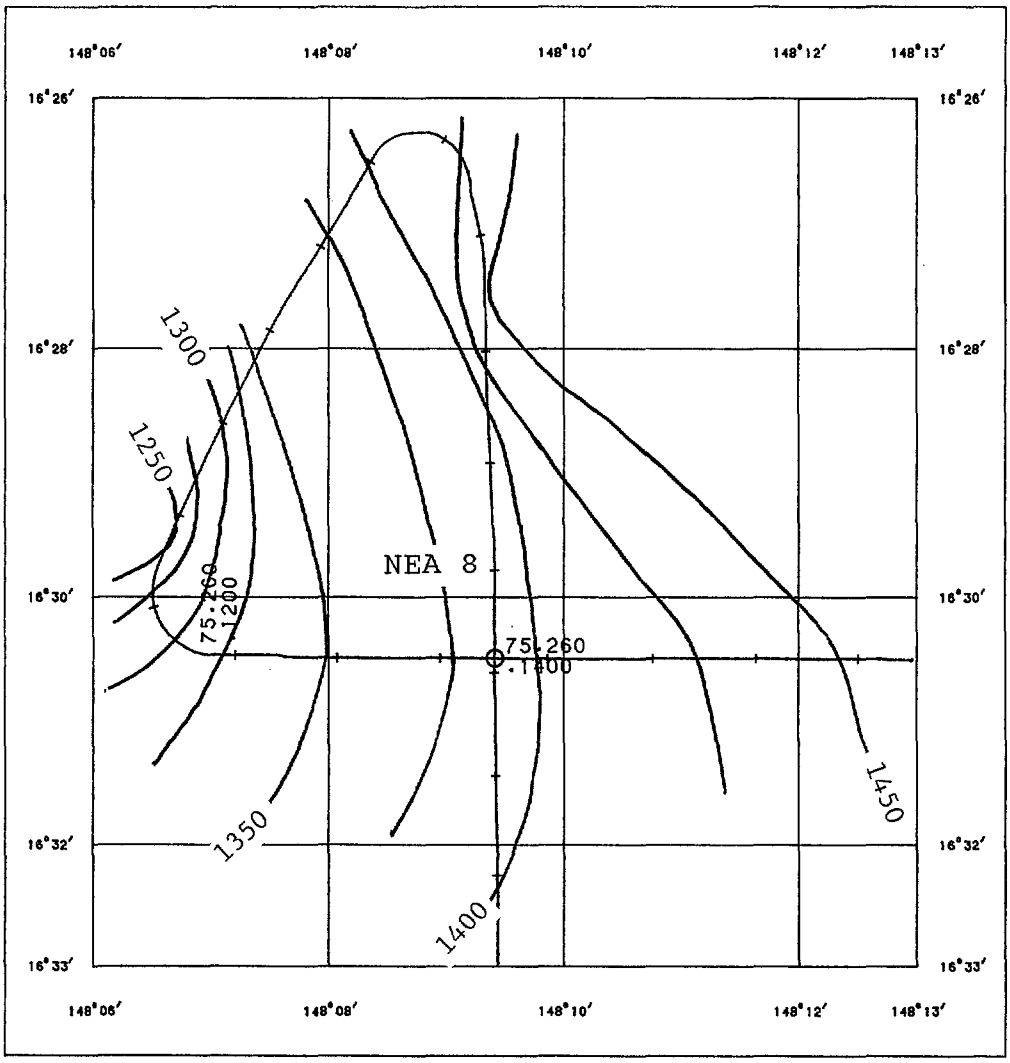


AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR PROJECTION
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

Northeast Australia 1987 Cruise 75
ODP Site Survey NEA 8
Bathymetry and Sample Positions
Contour interval is 10m
Site Position:Lat 16 30.557, Long 148 09.388E

SCALE 1:100000 ODP SITE 8 EDITION OF 1989/03/17

HORIZON 4 DEPTH (TWT)



* ALTERNATE SITE

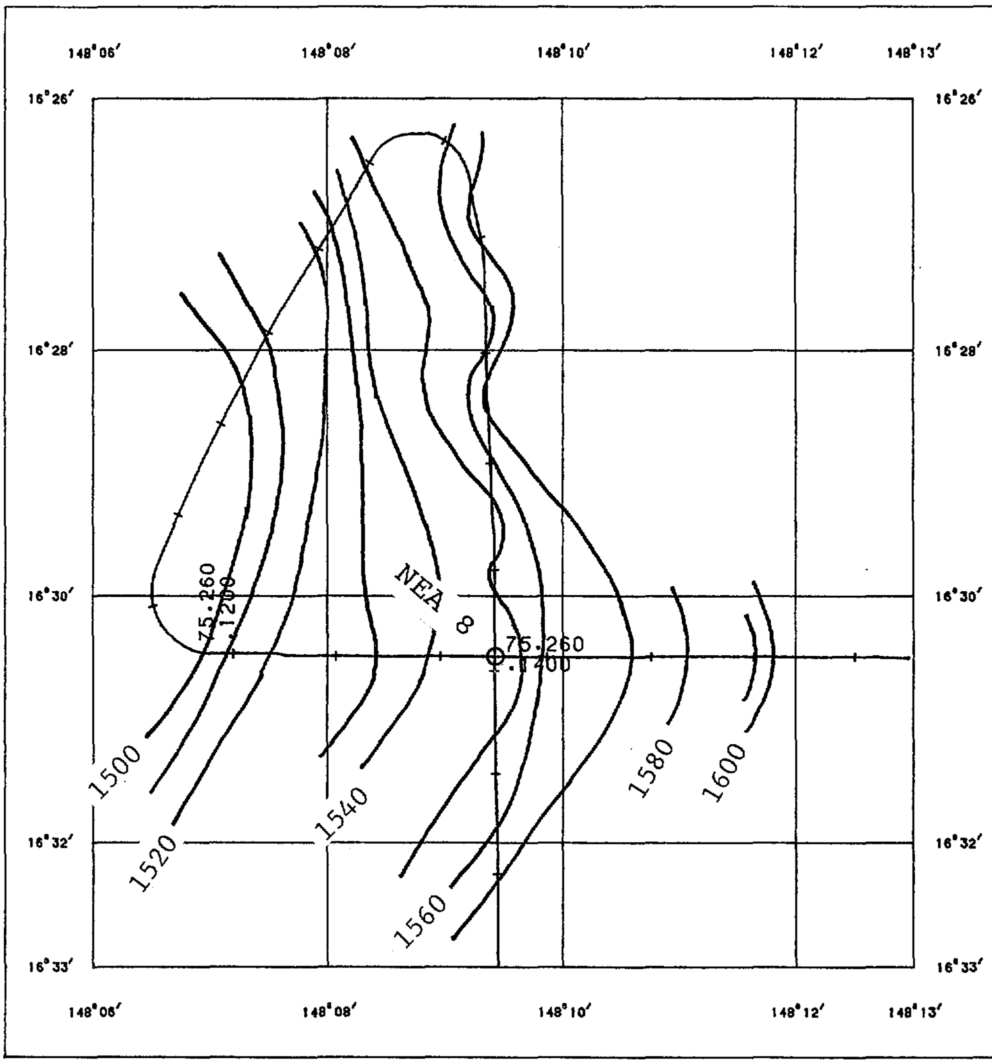
AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 8

SCALE 1:100000 ODP SITE 8 EDITION OF 1989/03/17

HORIZON 6 DEPTH (TWT)



* ALTERNATE SITE

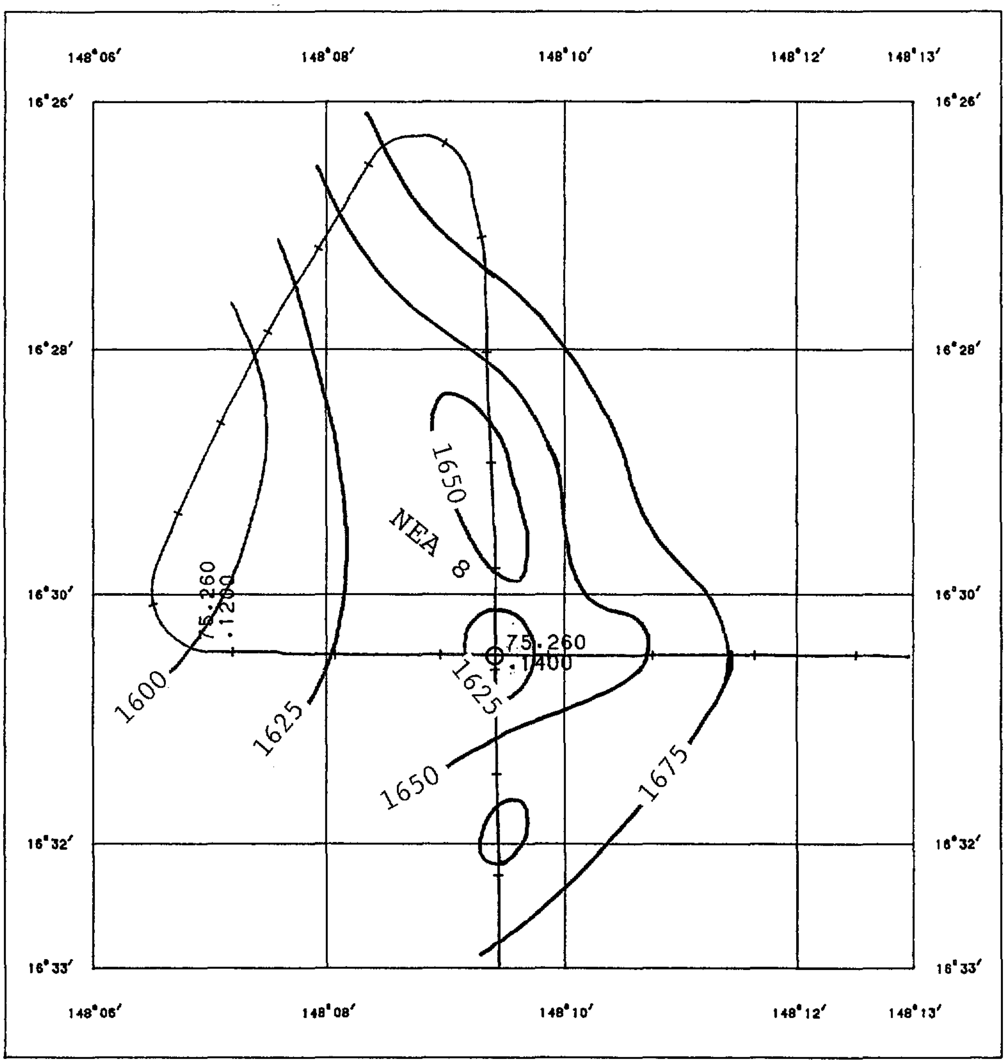
AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 8

SCALE 1:100000 ODP SITE 8 EDITION OF 1989/03/17

HORIZON 7 DEPTH (TWT)



* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

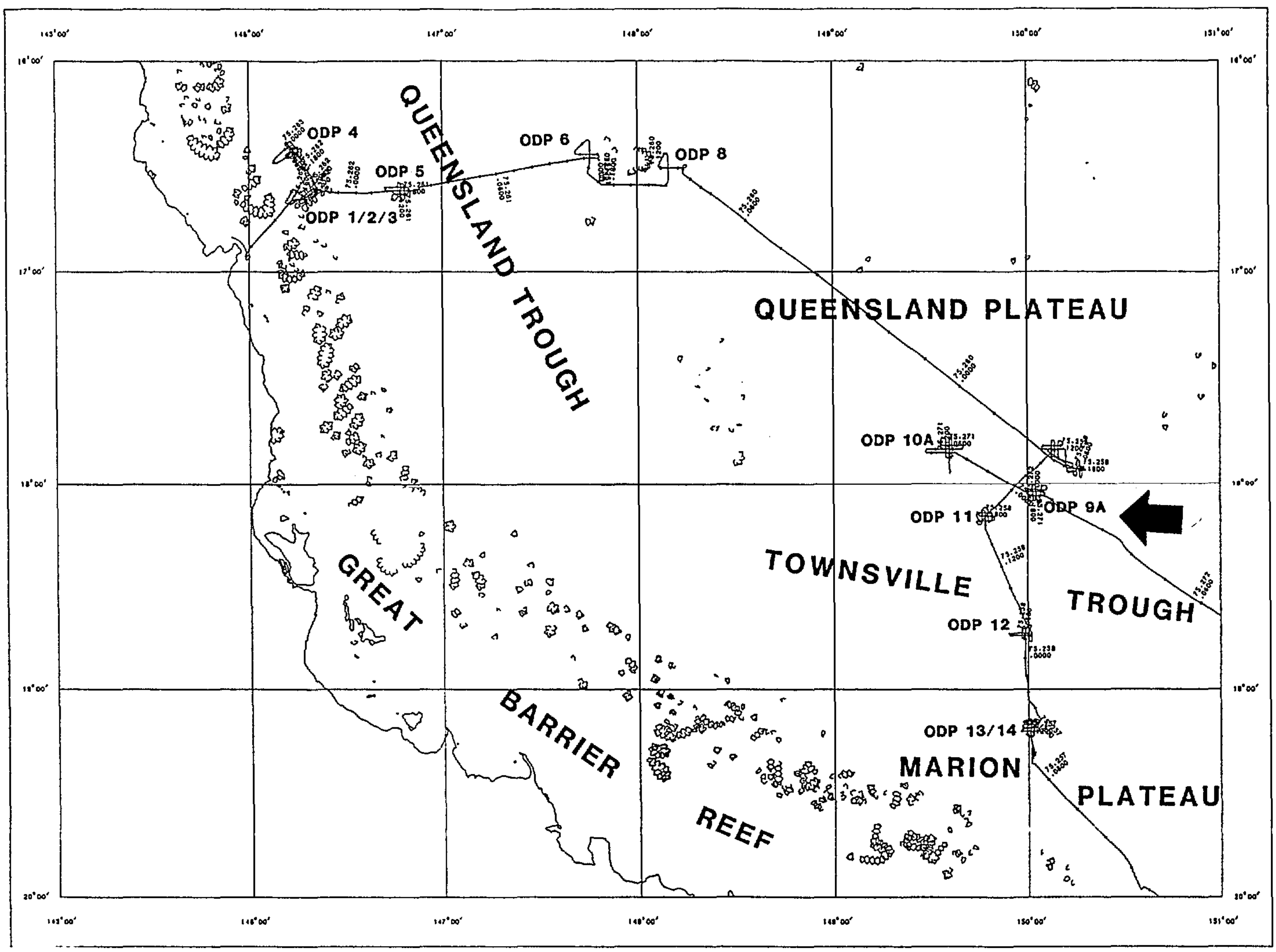
ODP SITE 8

3.07 Site NEA 9A

NORTHEAST AUSTRALIA ODP SITES

SCALE 1:2000000

EDITION OF 1989/03/30



TRACK MAP

NORTHEAST AUSTRALIA ODP SITES

OVERVIEW - SITE NEA9A

Site 9A lies on the southern margin of the Queensland Plateau, southwest of Tregrosse Reef. This sequence will provide information detailing the factors controlling carbonate bank development on the Queensland Plateau. This site, together with the complementary site NEA 10A in shallower water, will be compared with sites NEA 13 and NEA 14 on the northern margin of the Marion Plateau to enable more general conclusions regarding carbonate platform development.

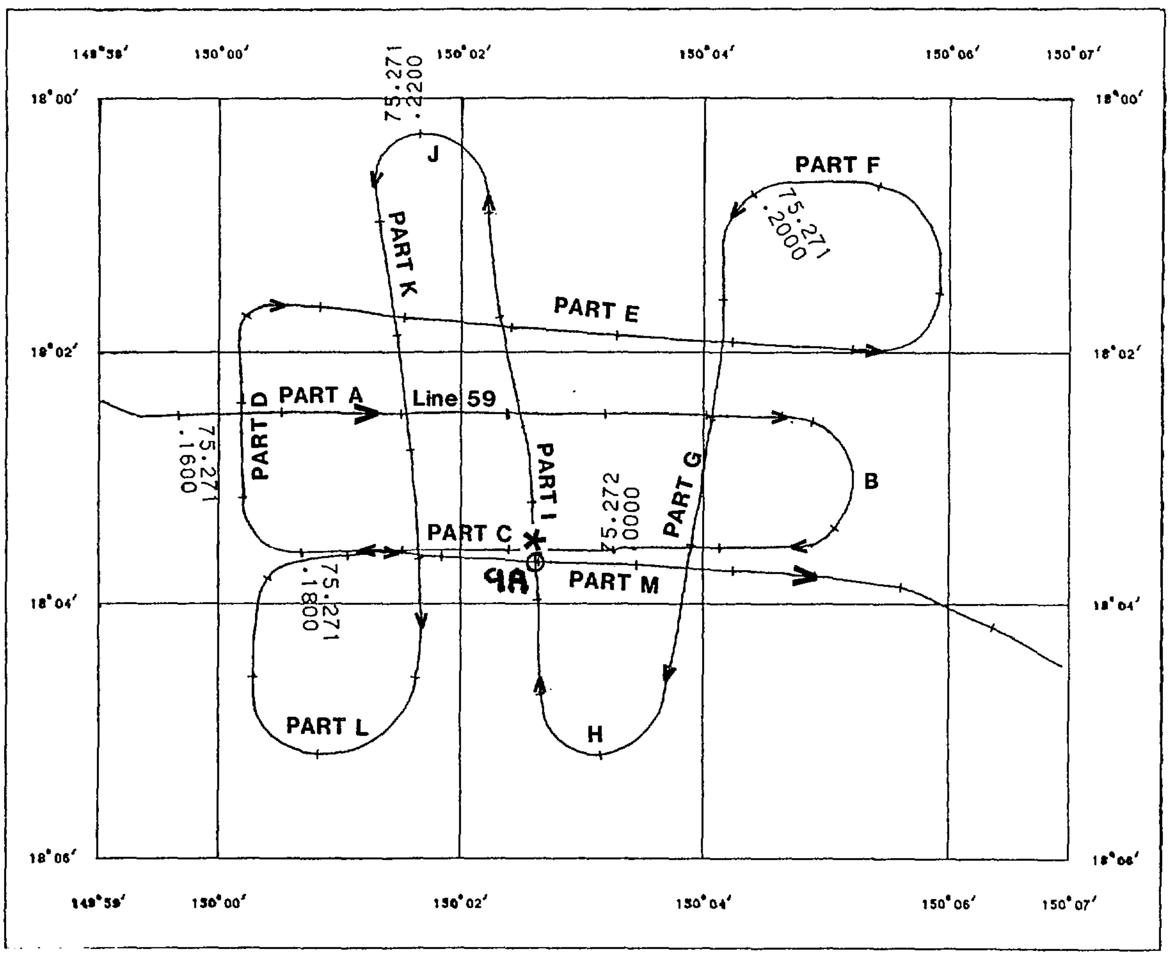
OBJECTIVES - SITE 9A

1. To determine the age and facies of periplatform and fore-reef sequences on the margin of a carbonate platform complex.
2. To determine the Late Miocene to Recent paleoceanographic signal in the periplatform ooze.
3. To establish the relationship between sea level fluctuations and bank-derived carbonate facies.
4. To determine the late Cenozoic carbonate saturation history within the region.
5. To analyse the 'backstepping' history of the shallow carbonate banks of the Queensland Plateau.
6. To determine the diagenetic signal contained within periplatform sediments; in particular to establish the stability regimes of high magnesium calcite and aragonite within the platform margin environment.

PROGNOSIS - SITE 9A

1. 265 m of Pliocene to Recent periplatform ooze.
2. 235 m of Miocene rudstone, wackestone, and packstone, fining upwards.

SCALE 1:100000 ODP SITE 9A EDITION OF 1989/03/17



AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 9A

CHECK SHEET
JOIDES SAFETY REVIEW

Leg **133** *Site No.* **NEA 9A** *Lat.* **18° 03.7'S** *Long.* **150° 02.6'E**

Water Depth: **739 m.** *Dist. from Land:* **156 n.mi.** *Jurisdiction:* **AUSTRALIA**

General location or geomorphic province:
SOUTHERN QUEENSLAND PLATEAU

Upon what geophysical and/or geological data was this site selection made:
Seismic lines: **BMR LINE 75/059 (CROSSING 59I & 59M)**
Piston cores: **75PC06 (75GC29)**
DSDP holes: **NONE**
Other:

Proposed total penetration: **500 m.**
Probable sediment thickness: **1100 m.**

From previous DSDP drilling in this area, list all hydrocarbon occurrences of greater than background levels, give nature of show, age and depth of rock:
NO PREVIOUS DRILLING.

From available information, list all commercial drilling in this area that produced or yielded significant shows; give depths and ages of hydrocarbon bearing deposits:
NO COMMERCIAL DRILLING IN THIS AREA. NEAREST WELL IS APPROX. 395 n.mi. TO THE SOUTH - NO HYDROCARBONS ENCOUNTERED. OIL SHALES OCCUR ONSHORE IN EARLY TERTIARY NONMARINE BASINS 220 n mi. TO SOUTH.

Is there any indication of gas hydrates at this location:
NO INDICATION; NO BSR PRESENT.

Is there any reason to expect any hydrocarbon accumulation at this site? Please comment.
NO. SHALLOW BASEMENT, ABSENCE OF STRUCTURE AND THERMALLY IMMATURE SECTION PRECLUDES POSSIBILITY OF HYDROCARBON OCCURRENCE.

What is your proposed drilling program?
APC/XCB TO 265 m.
RCB FROM 265 m. TO TD AT 500 m.

What is your proposed logging program?
NO LOGGING.

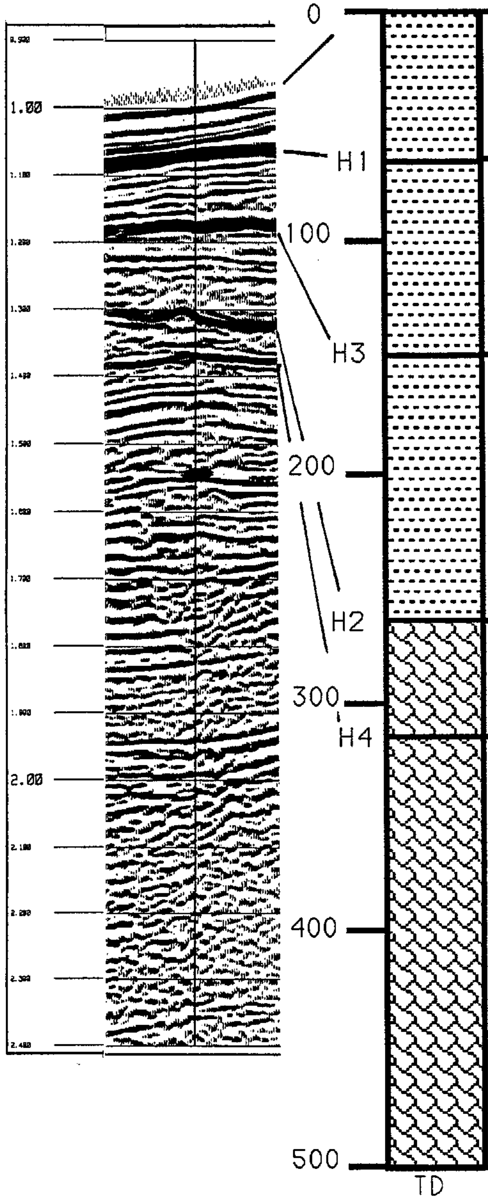
What "special" precautions will be taken during drilling?
STANDARD HYDROCARBON MONITORING.

What abandonment procedures do you plan to follow? (see Safety Manual, Sec. VIII, p. 22)
STANDARD PROCEDURES.

SUMMARY: What do you consider to be the major risks in drilling at this site?
NO MAJOR RISKS. SLIGHT CHANCE OF MINOR BIOGENIC GAS.

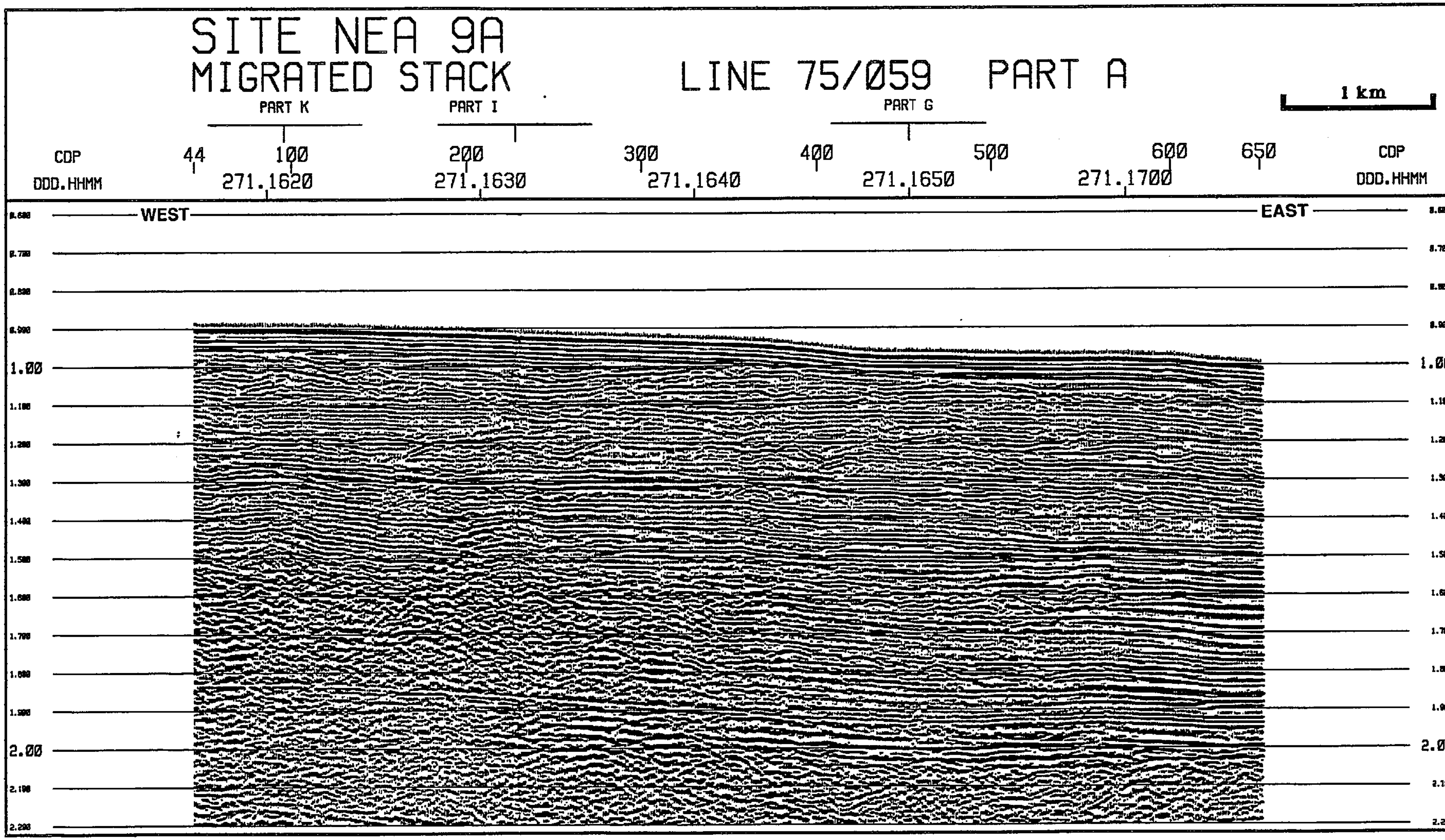
Please answer each question as carefully as possible, using extra pages if need be. The information you provide here will be an important factor in the Safety Review.

GRAPHIC SUMMARY: SITE NEA 9A

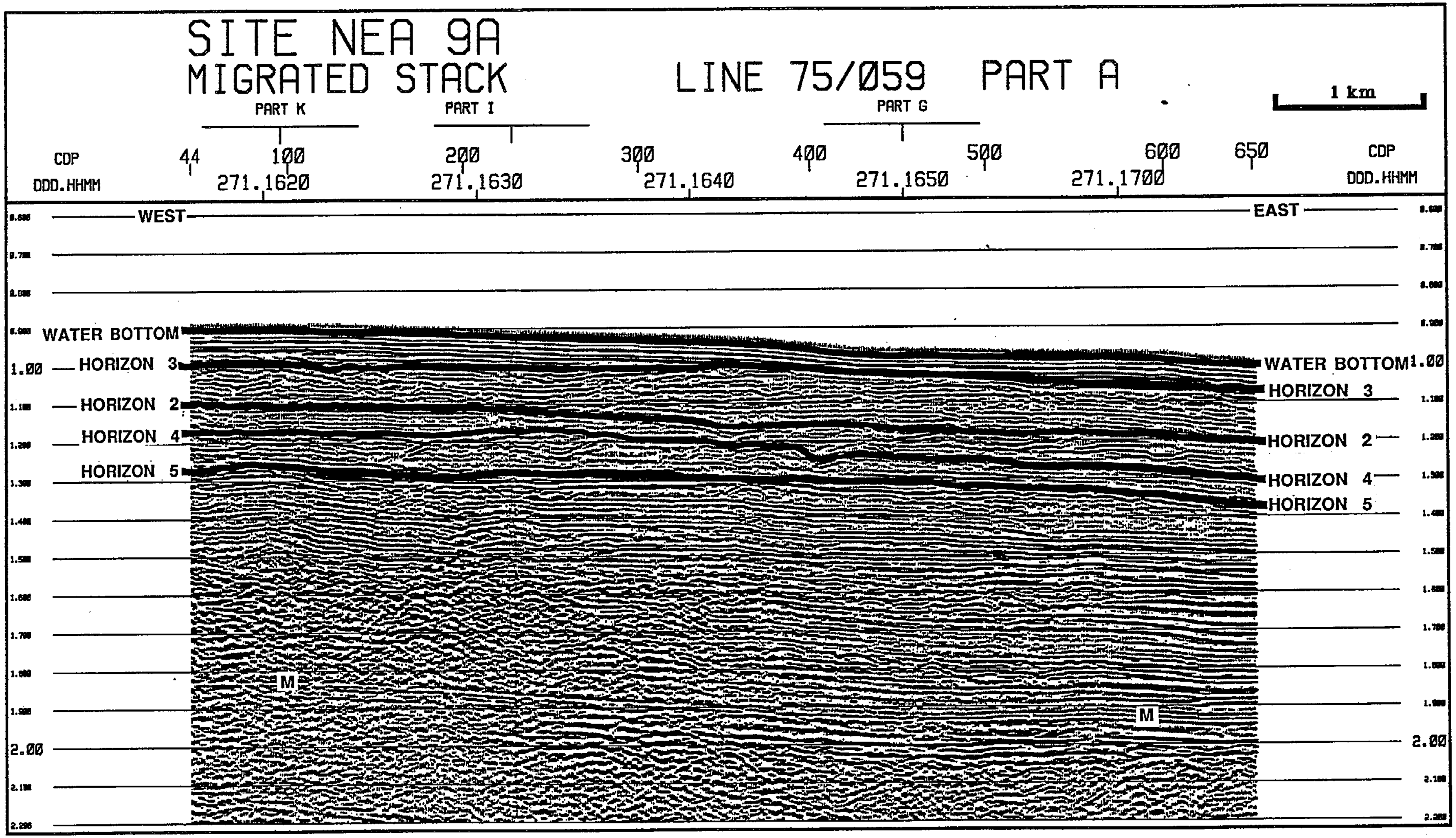


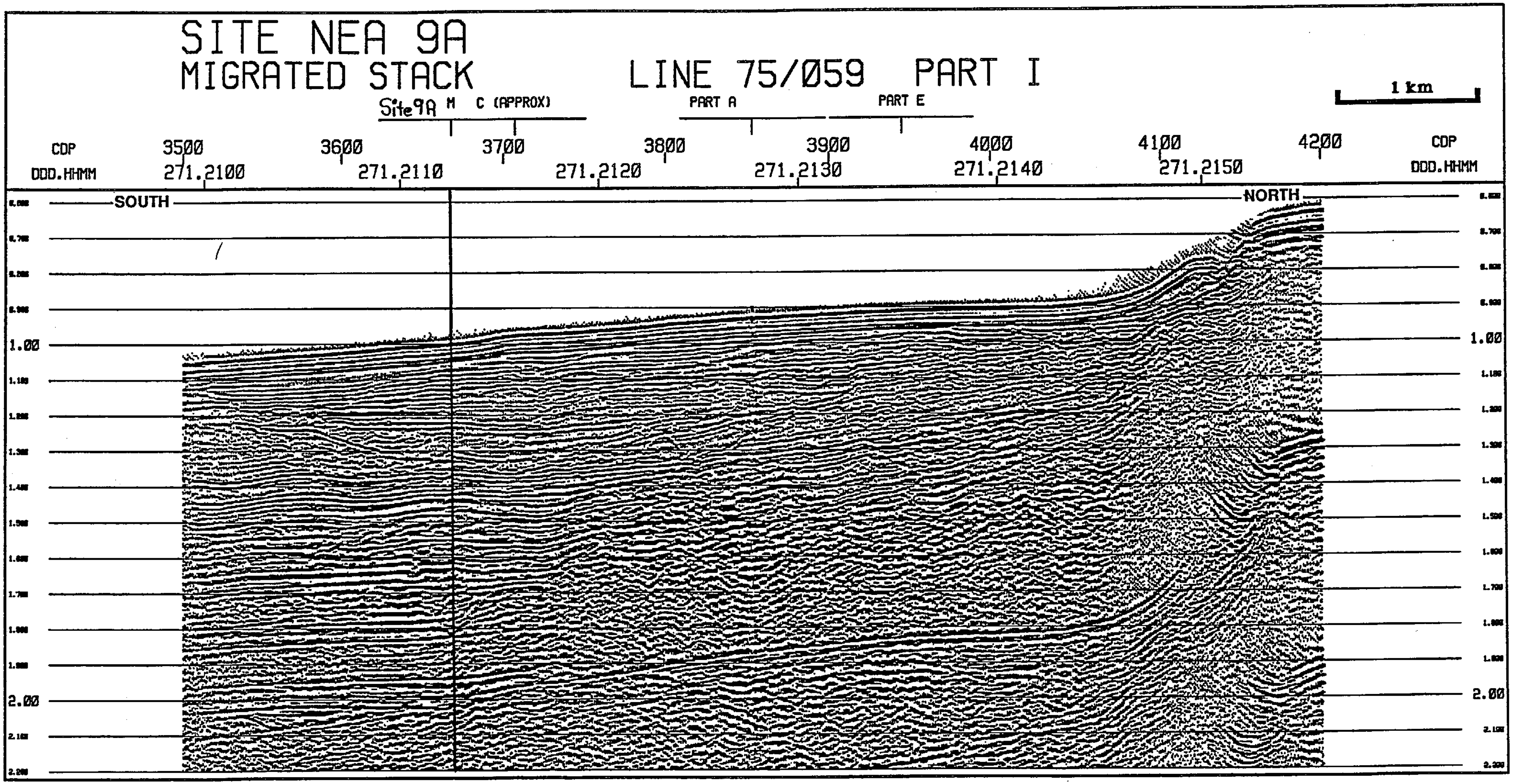
Age	Velocity (km/sec)	Lithology	Paleoenvironment	Sedim. Rate	Comments
Quaternary	1.65	carbonate sand & mud	periplatform ooze	30 m/my	
[66] Pliocene to Pliestocene	1.65	carbonate sand & mud	periplatform ooze	30 m/my	
[149] Pliocene	1.65	carbonate sand & mud	periplatform ooze	35 m/my	
[265] latest Miocene	1.65	wackestone/ packstone	reef slope	20 m/my	
[315] Early Miocene	2.4	rudstone, packstone & wackestone	reef slope	25 m/my	section subjected to cementation

JOIDES Safety Review Check Sheet - Site NEA 9A

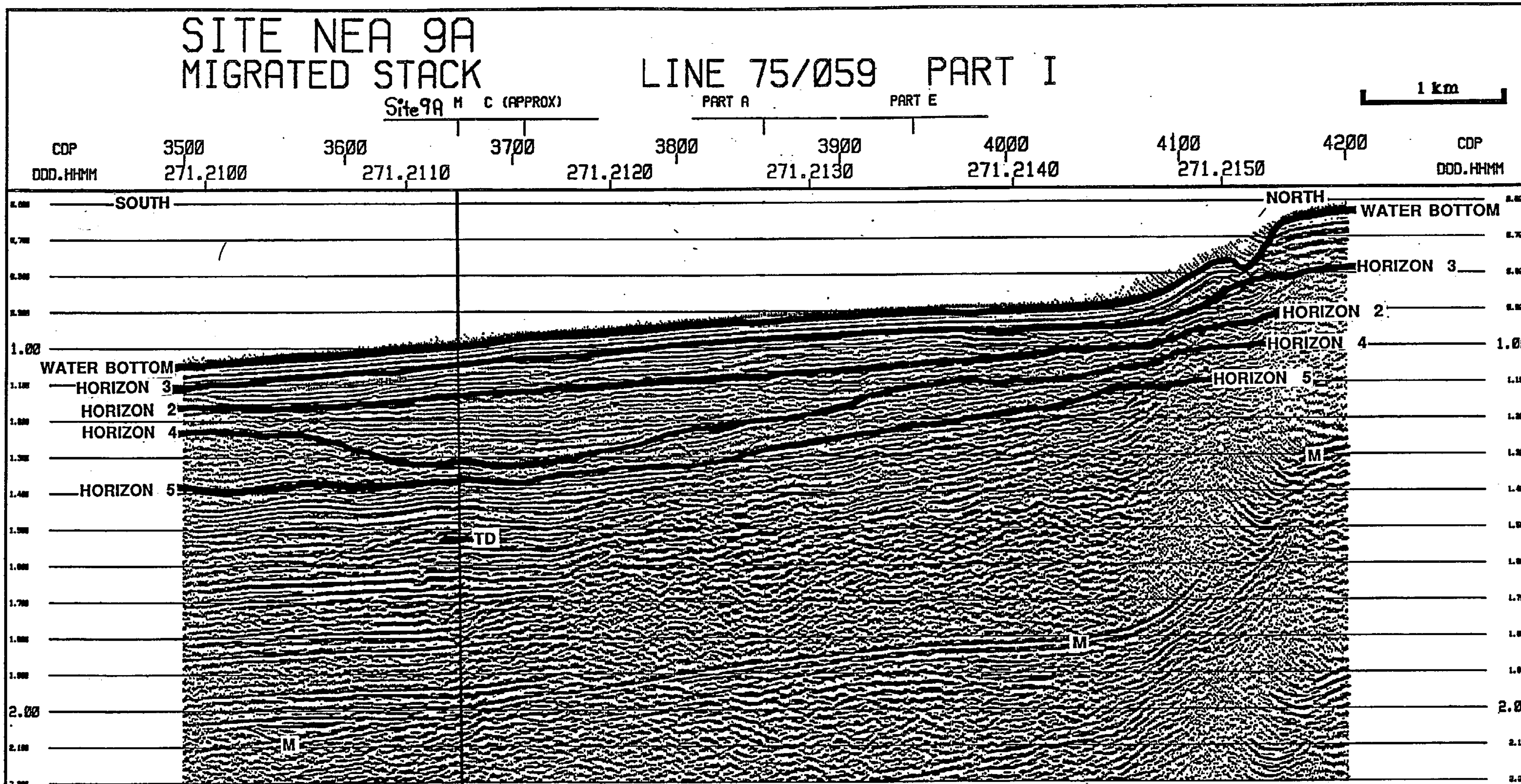


SITE NEA 9A
MIGRATED STACK
LINE 75/Ø59 PART A
1 km
PART K
PART I
PART G
CDP
DDD.HHMM
44
1ØØ
2ØØ
3ØØ
4ØØ
5ØØ
6ØØ
65Ø
271.162Ø
271.163Ø
271.164Ø
271.165Ø
271.17ØØ
WEST
EAST
1.ØØ
2.ØØ


SITE NEA 9A
MIGRATED STACK
LINE 75/Ø59 PART A
1 km
PART K
PART I
PART G
CDP
DDD.HHMM
44
1ØØ
2ØØ
3ØØ
4ØØ
5ØØ
6ØØ
65Ø
271.162Ø
271.163Ø
271.164Ø
271.165Ø
271.17ØØ
WEST
EAST
WATER BOTTOM
HORIZON 3
HORIZON 2
HORIZON 4
HORIZON 5
1.ØØ
2.ØØ
M
M



SITE NEA 9A
MIGRATED STACK
LINE 75/059 PART I
1 km
Site 9A
M C (APPROX)
PART A
PART E
CDP
DDD.HHMM
3500
3600
3700
3800
3900
4000
4100
4200
271.2100
271.2110
271.2120
271.2130
271.2140
271.2150
SOUTH
NORTH
1.00
2.00


SITE NEA 9A
MIGRATED STACK
LINE 75/059 PART I
Site 9A M C (APPROX)
PART A
PART E
1 km
CDP
DDD.HHMM
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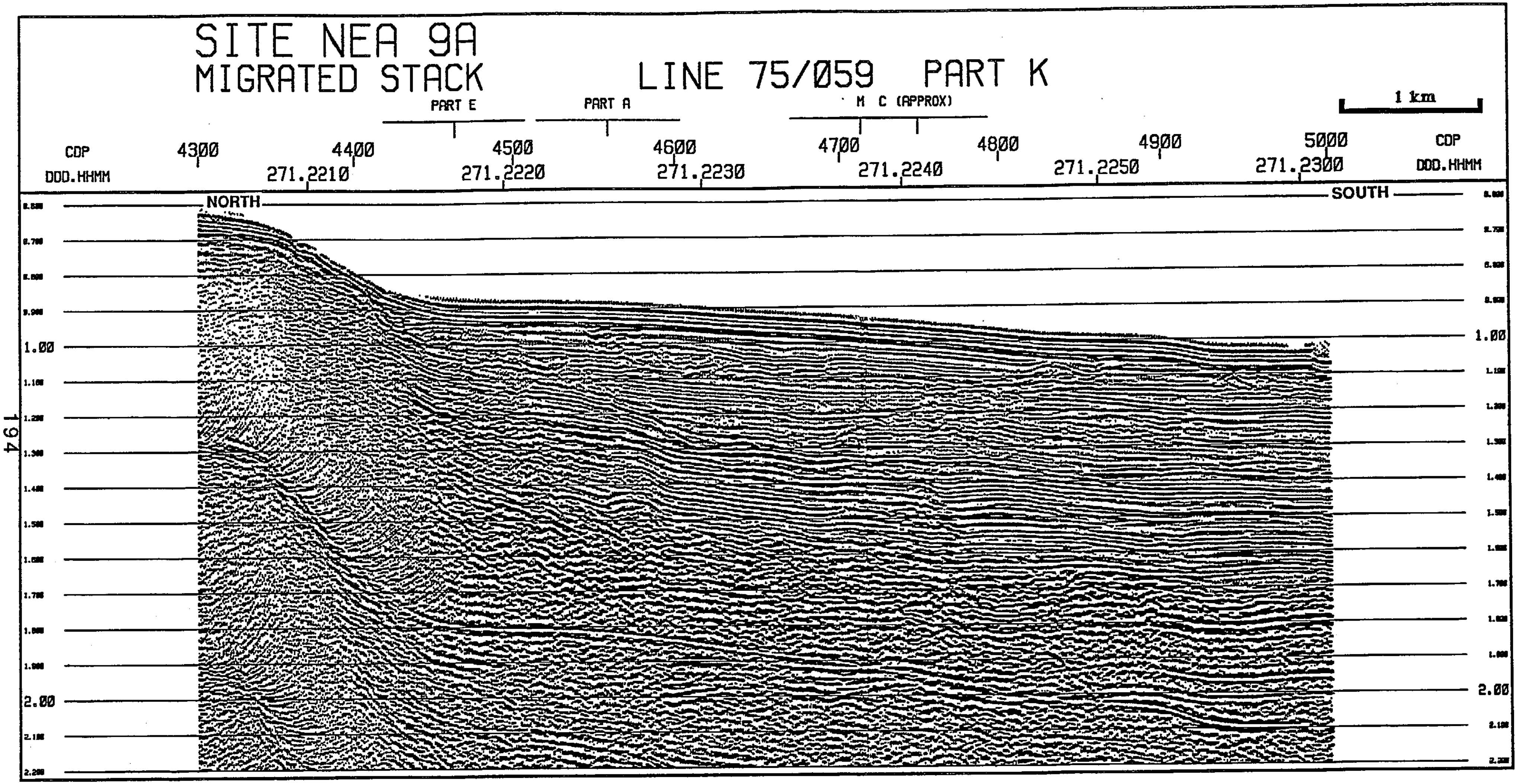
3600
3700
3800
3900
4000
4100
4200
271.2100
271.2110
271.2120
271.2130
271.2140
271.2150
SOUTH
NORTH
WATER BOTTOM
HORIZON 3
HORIZON 2
HORIZON 4
HORIZON 5
TD
M
1.00
2.00



SITE NEA 9A
MIGRATED STACK
LINE 75/059 PART K
1 km
PART E
PART A
M C (APPROX)
CDP
DDD.HHMM
4300
4400
4500
4600
4700
4800
4900
5000
271.2210
271.2220
271.2230
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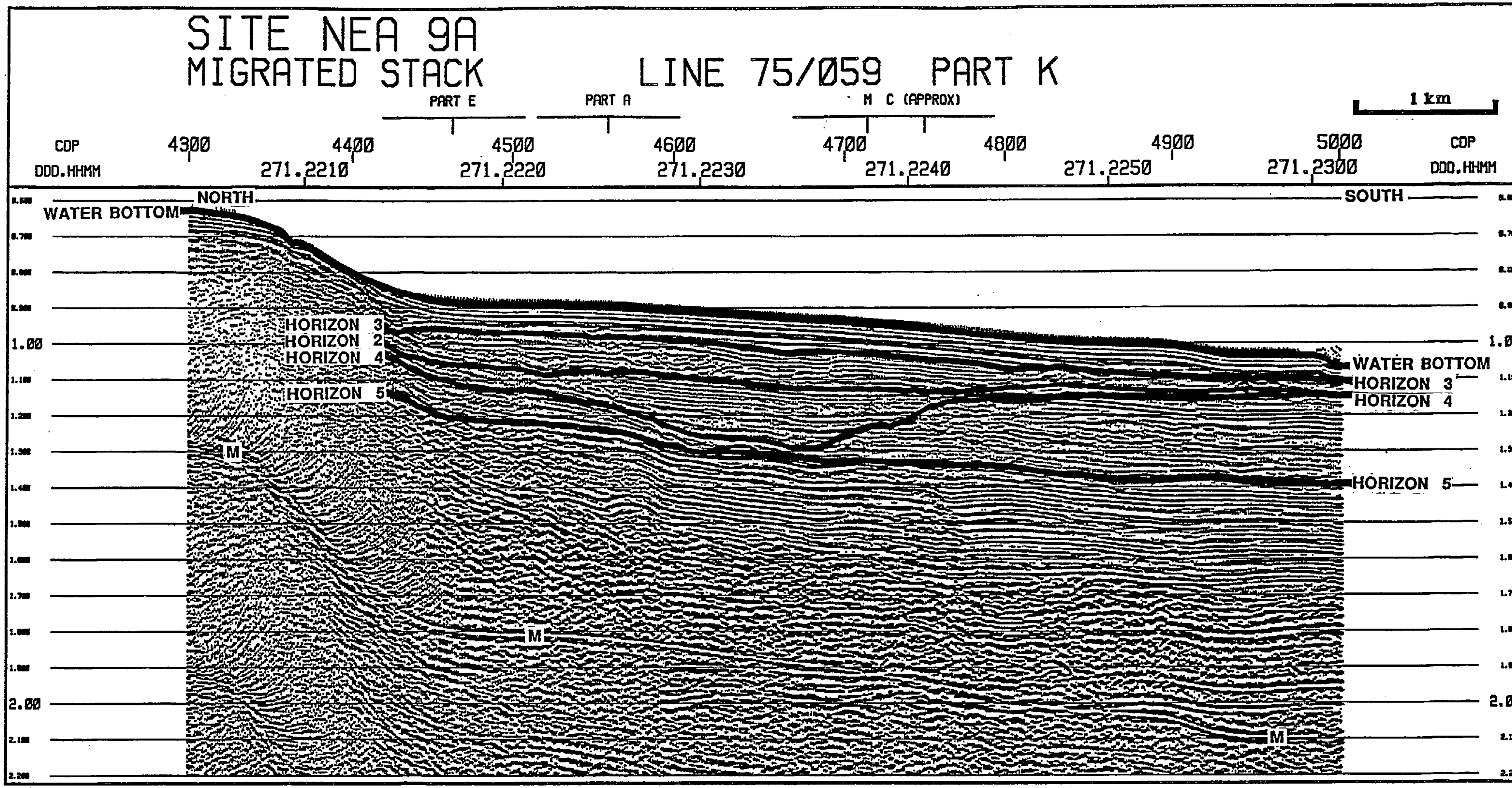
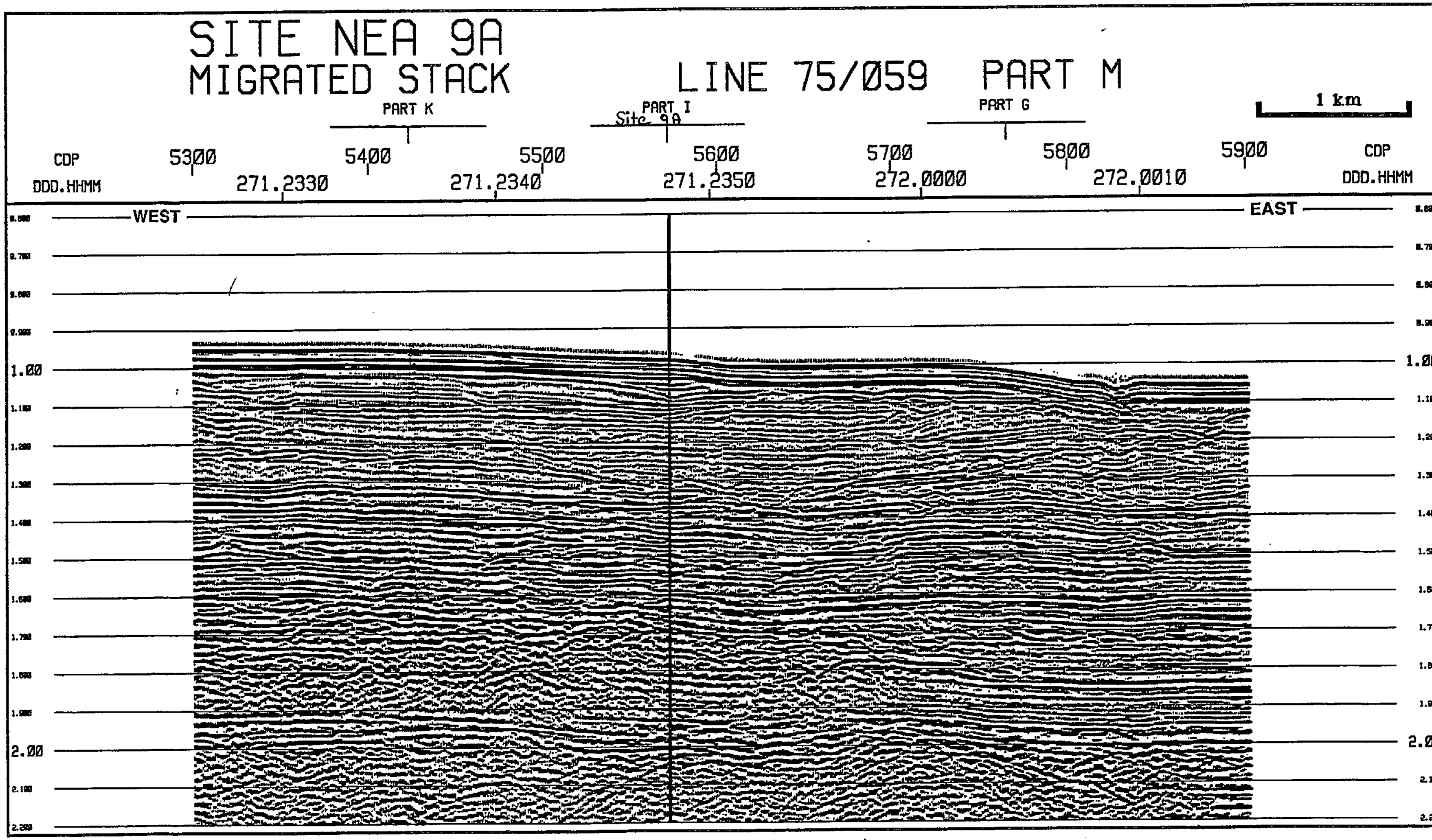
271.2250
271.2300
CDP
DDD.HHMM
NORTH
SOUTH
1.00
2.00
1.00
2.00


SITE NEA 9A
MIGRATED STACK
LINE 75/Ø59 PART K
PART E
PART A
M C (APPROX)
1 km
CDP
DDD.HHMM
43ØØ
44ØØ
45ØØ
46ØØ
47ØØ
48ØØ
49ØØ
5ØØØ
271.221Ø
271.222Ø
271.223Ø
271.224Ø
271.225Ø
271.23ØØ
NORTH
SOUTH
WATER BOTTOM
HORIZON 3
HORIZON 2
HORIZON 4
HORIZON 5
M
1.ØØ
2.ØØ
WATER BOTTOM
HORIZON 3
HORIZON 4
HORIZON 5


SITE NEA 9A
MIGRATED STACK
LINE 75/059 PART M
1 km
PART K
PART I
Site 9A
PART G
CDP
DDD.HHMM
5300
5400
5500
5600
5700
5800
5900
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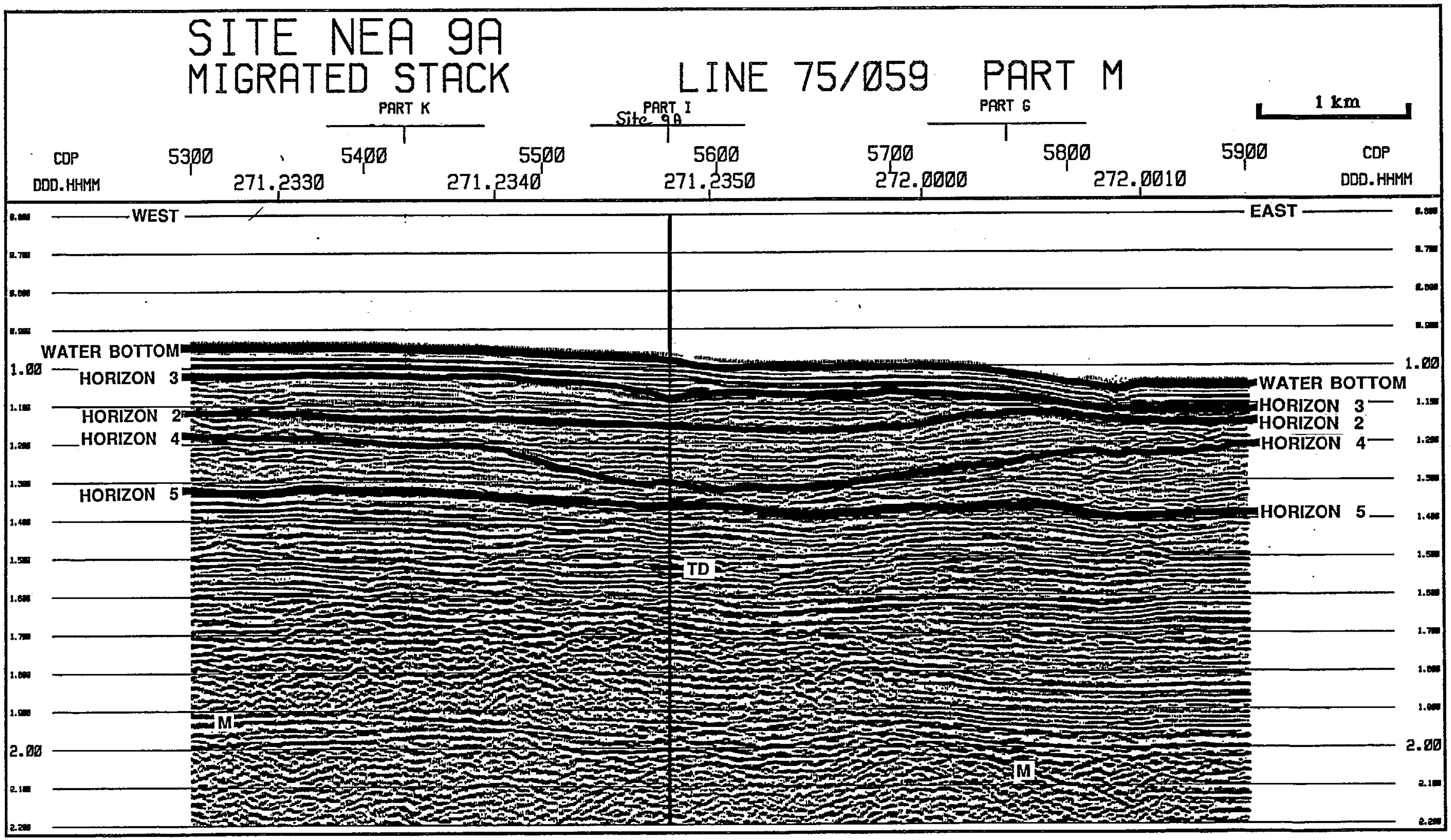
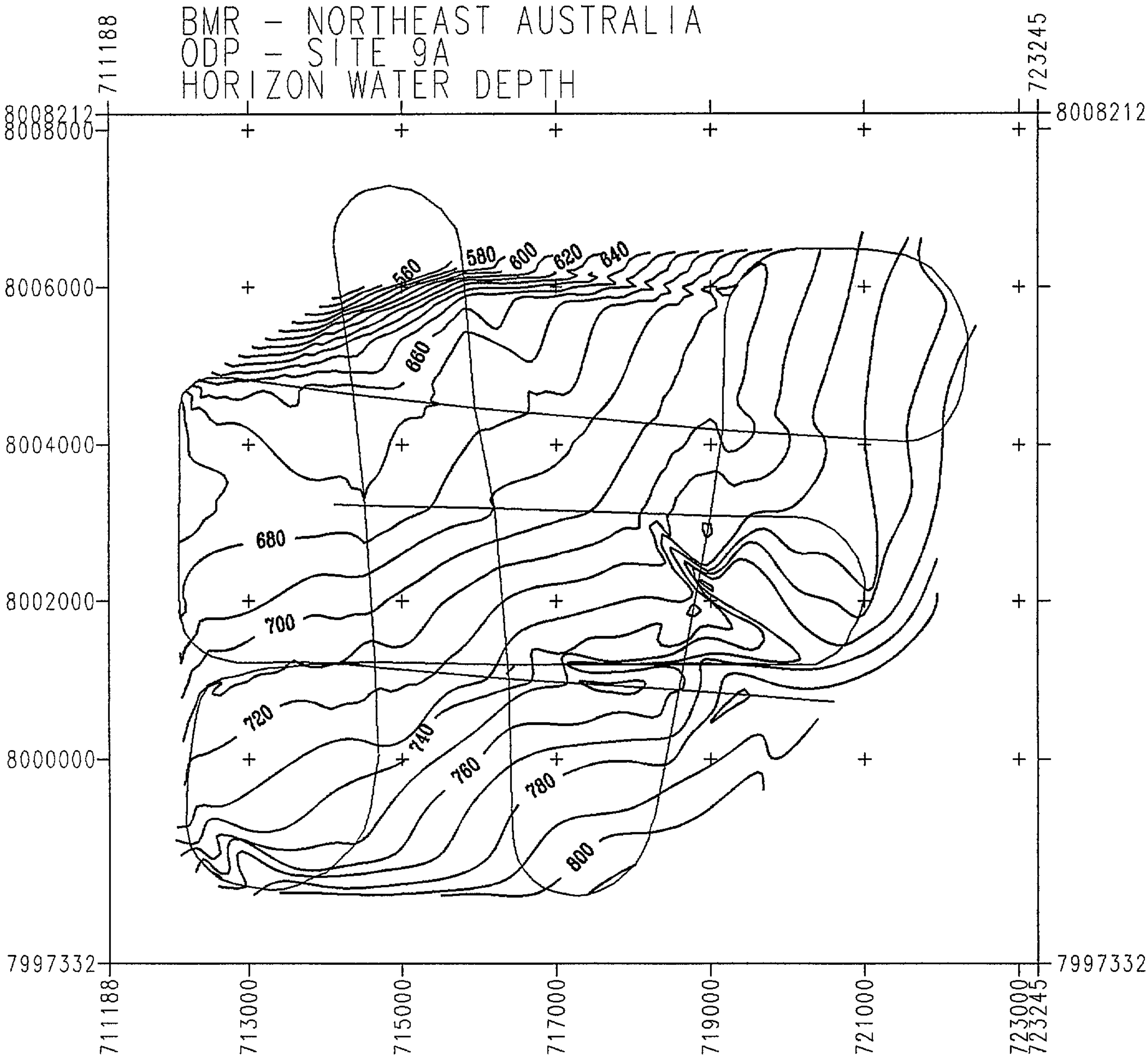
271.2340
271.2350
272.0000
272.0010
WEST
EAST
1.00
2.00


SITE NEA 9A
MIGRATED STACK
LINE 75/059 PART M
PART K
PART I
Site 9A
PART G
1 km
CDP
DDD.HHMM
5300
5400
5500
5600
5700
5800
5900
271.2330
271.2340
271.2350
272.0000
272.0010
WEST
EAST
WATER BOTTOM
HORIZON 3
HORIZON 2
HORIZON 4
HORIZON 5
1.00
2.00
TD
M



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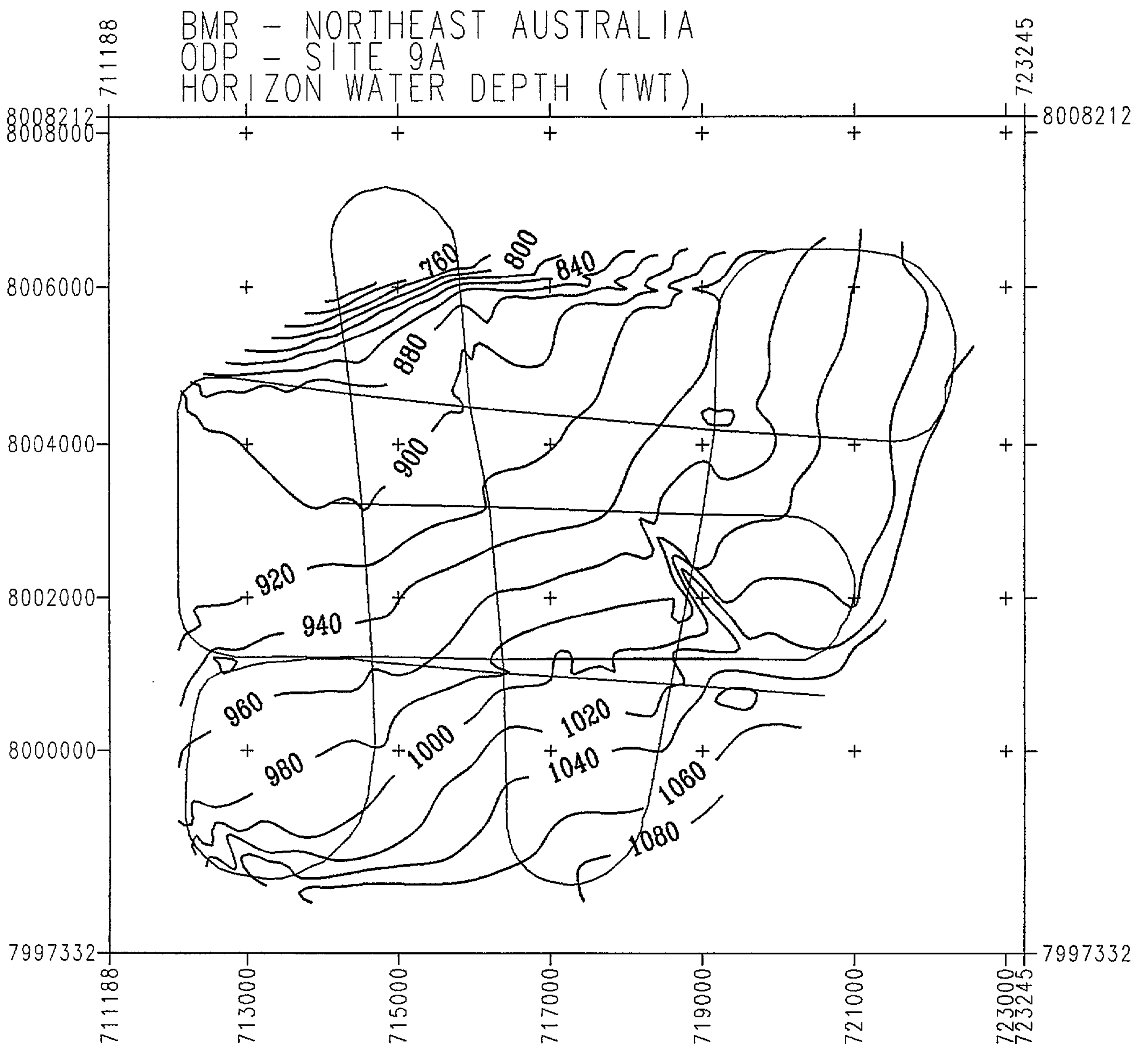
on a LANDMARK RT



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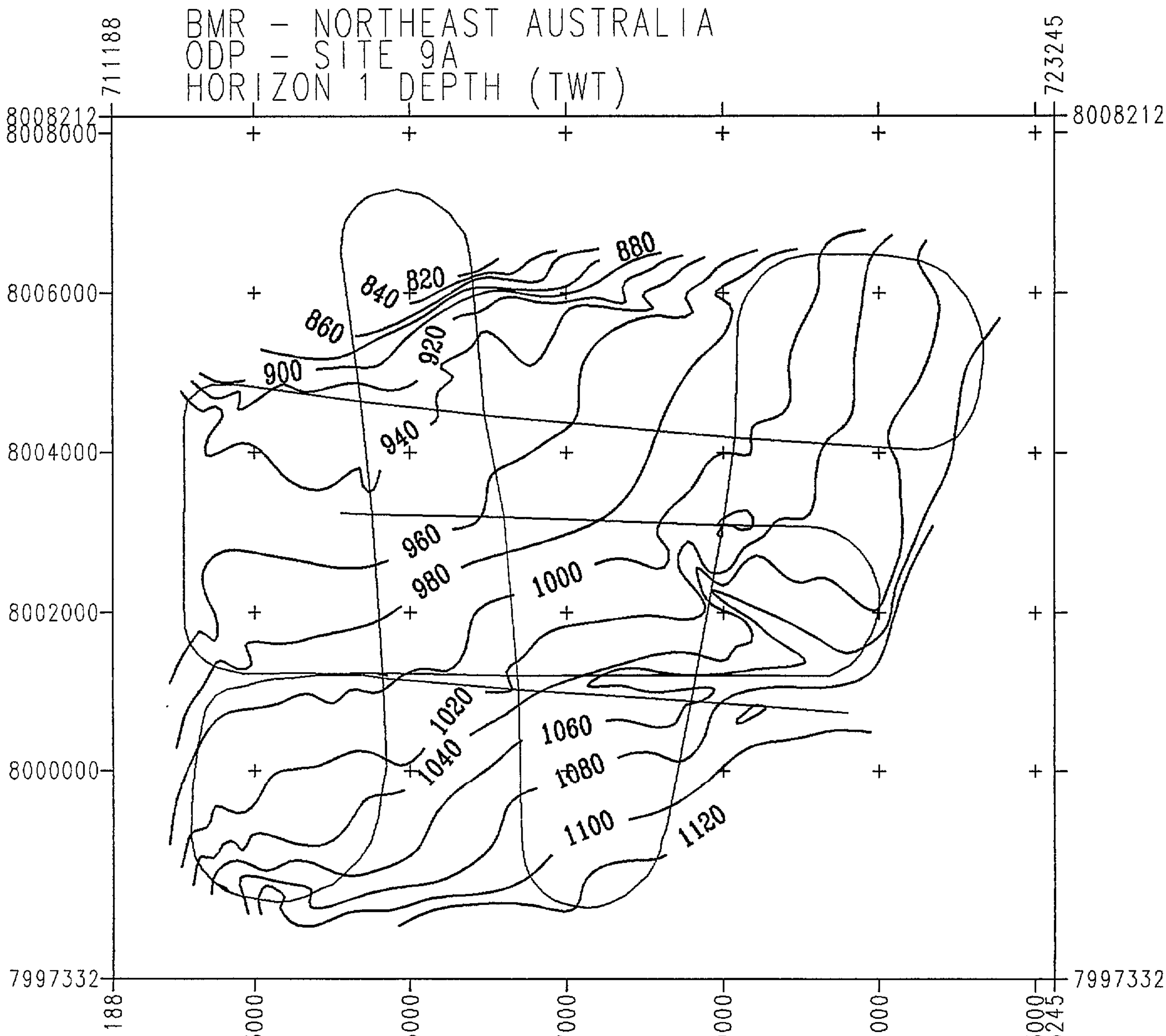

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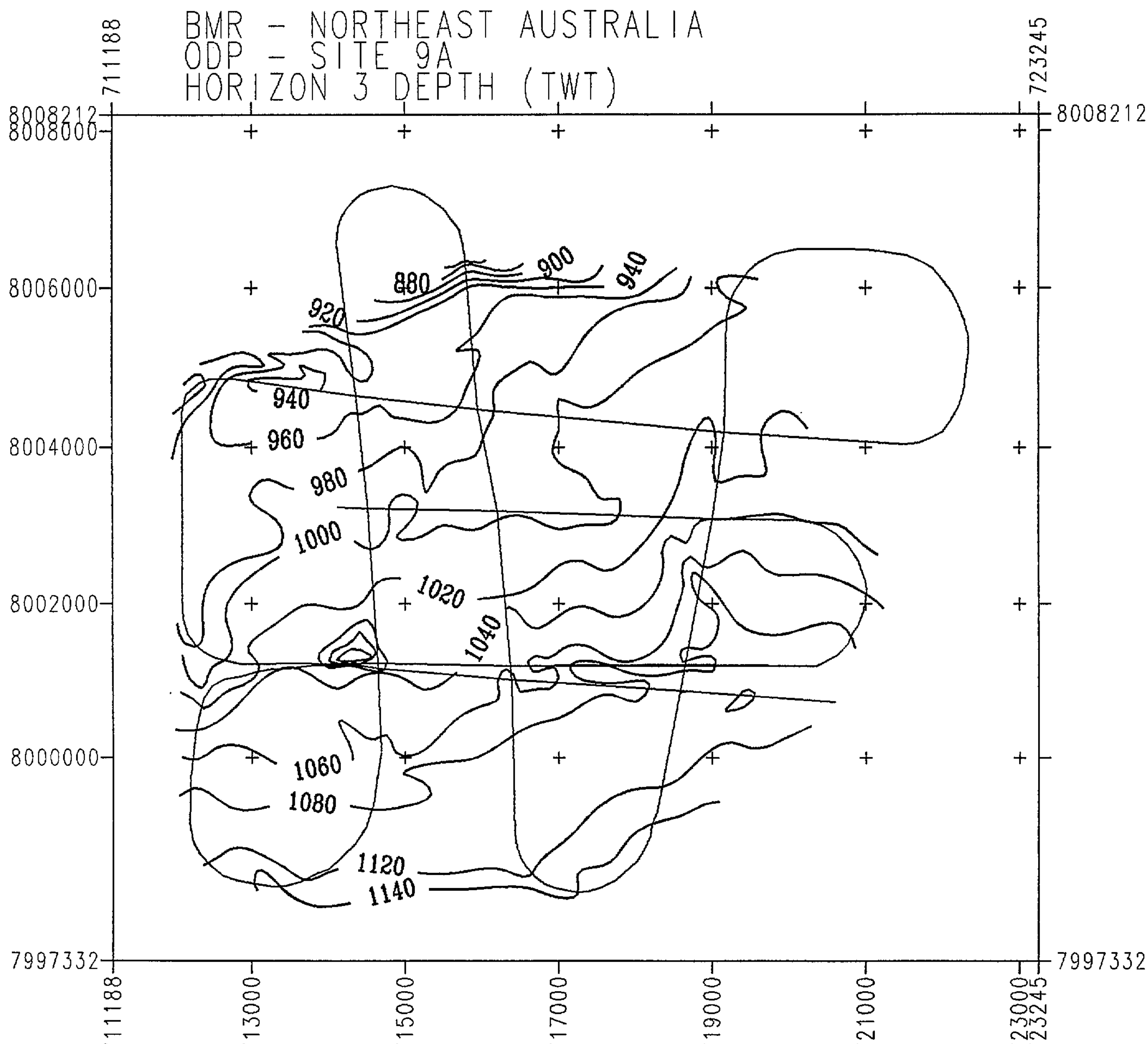

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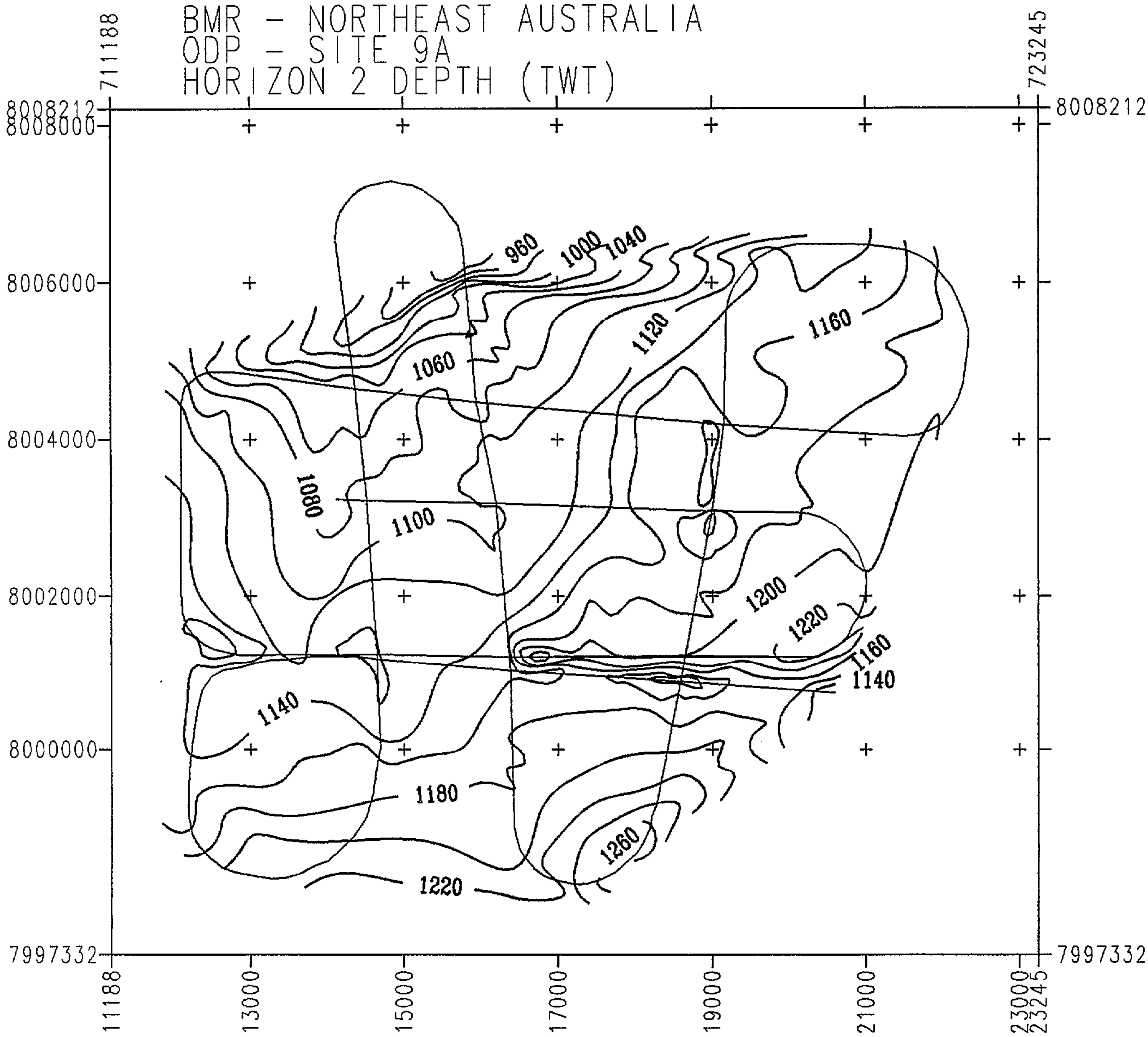

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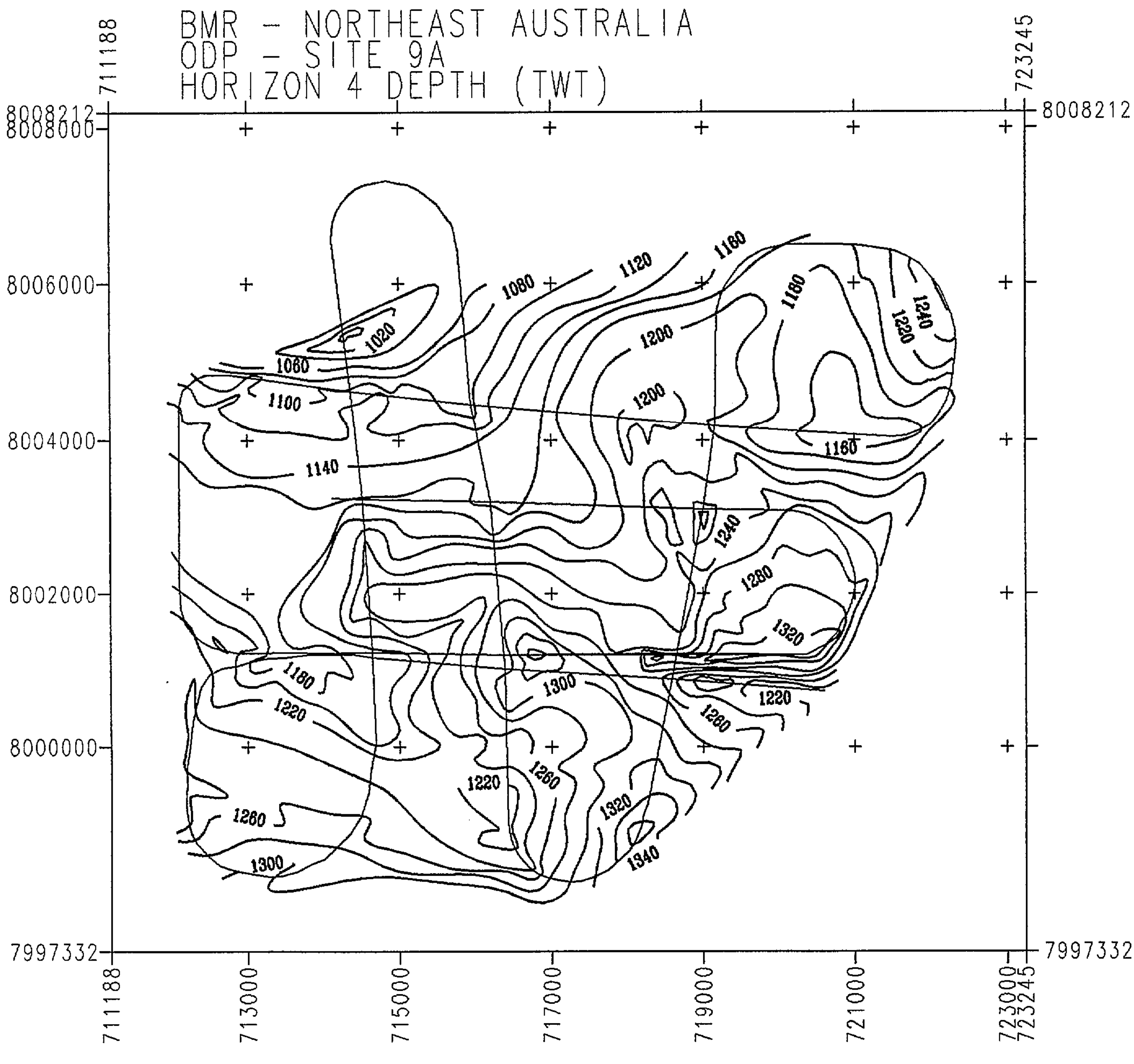

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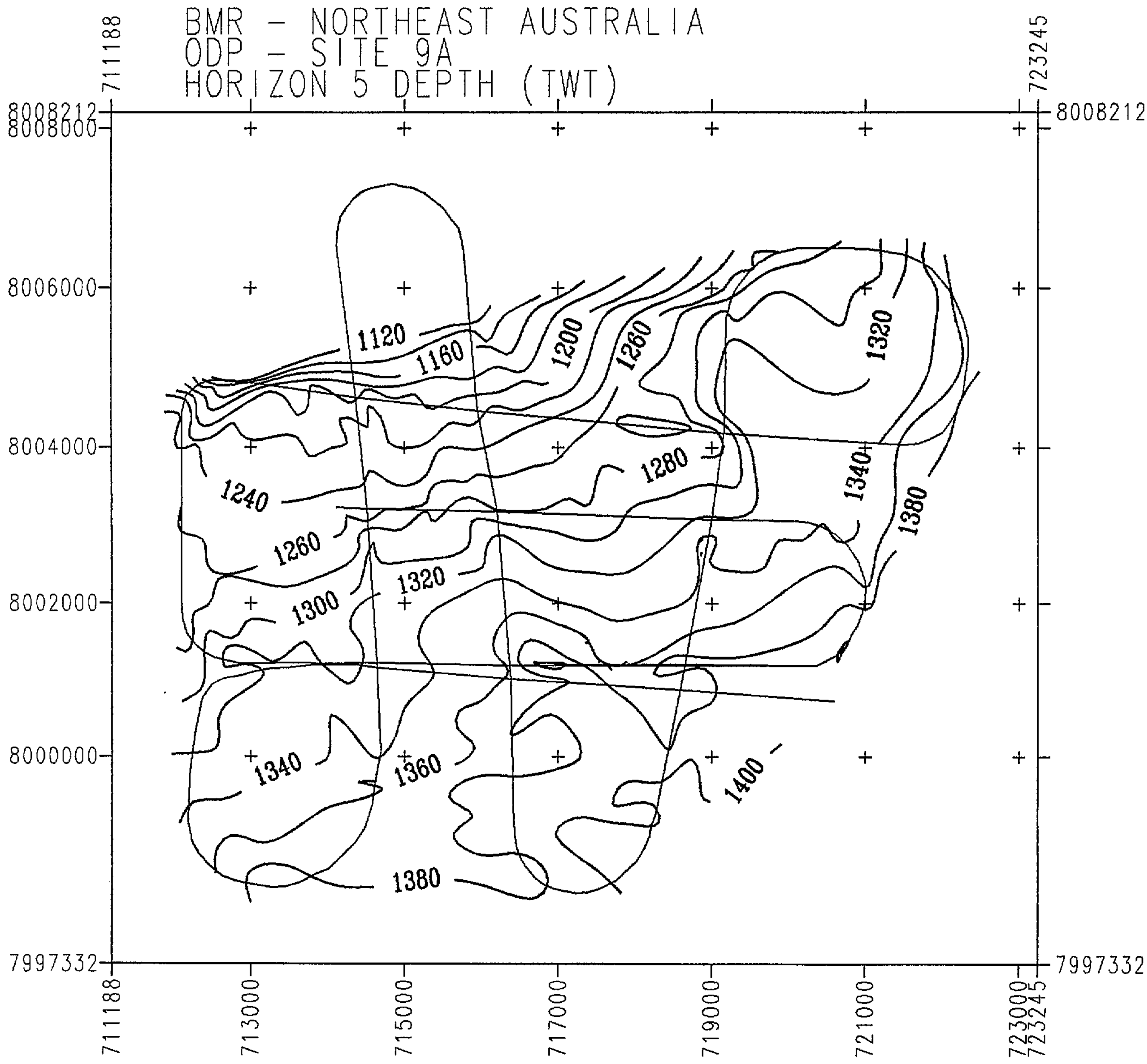

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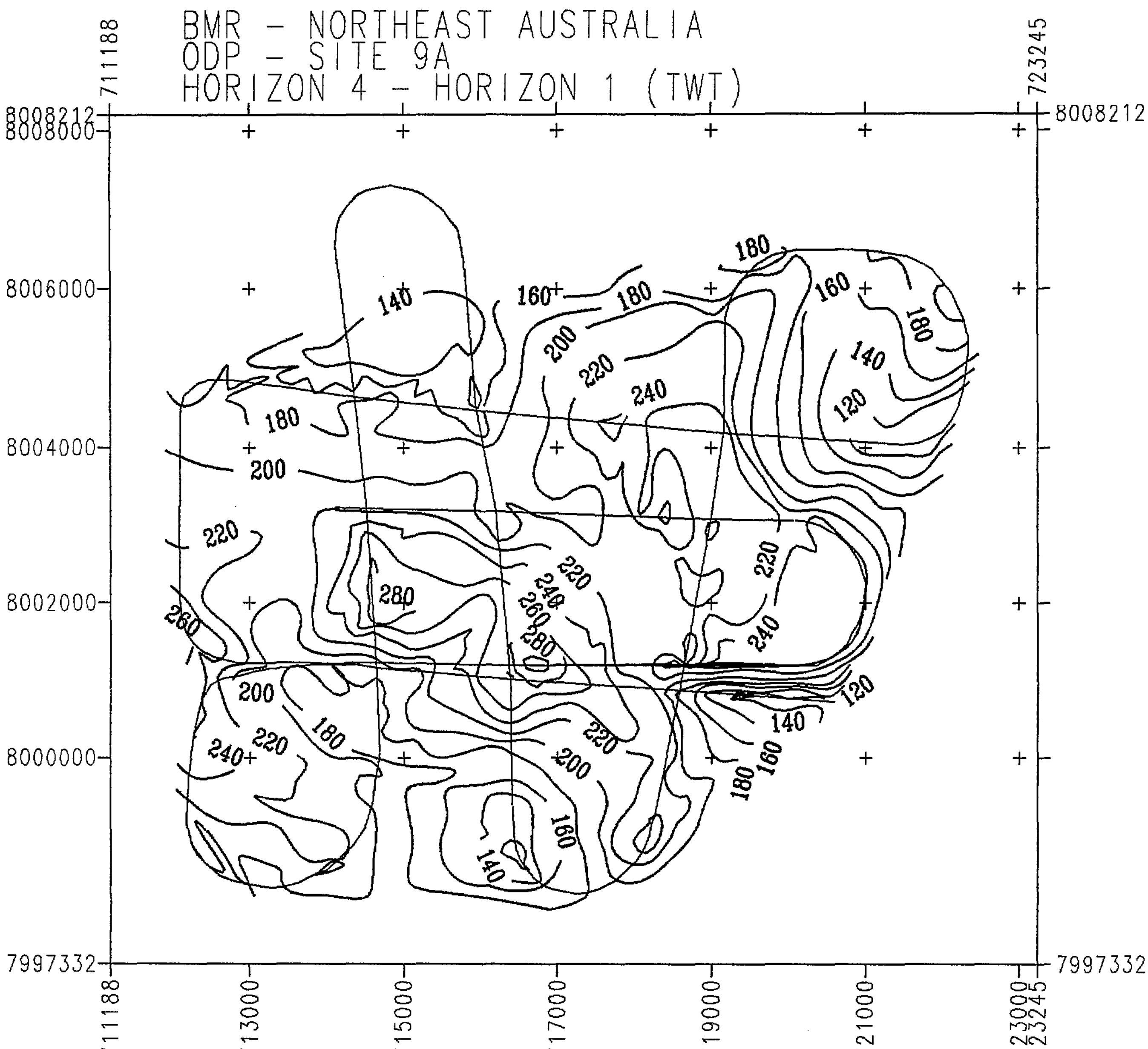

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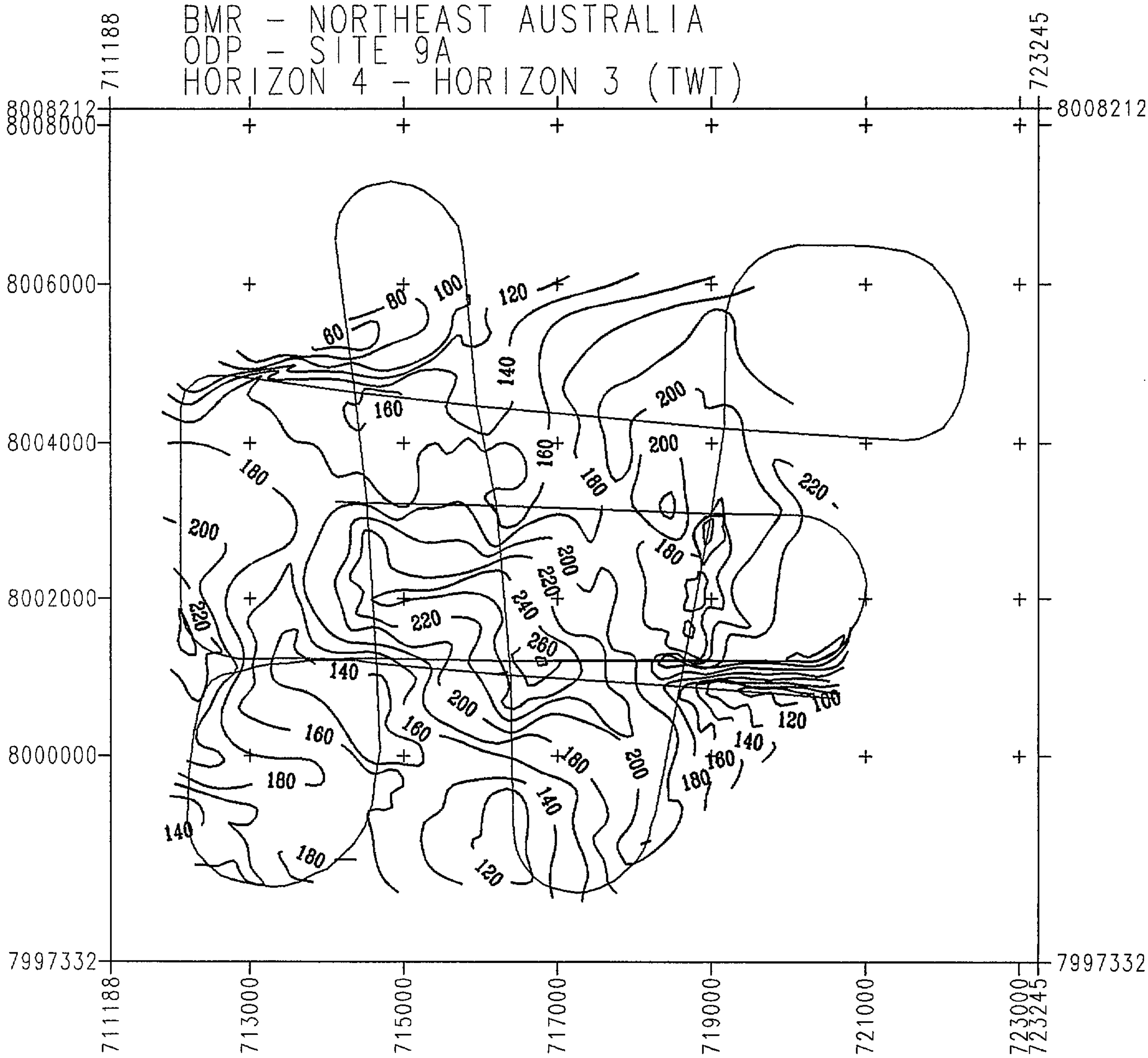

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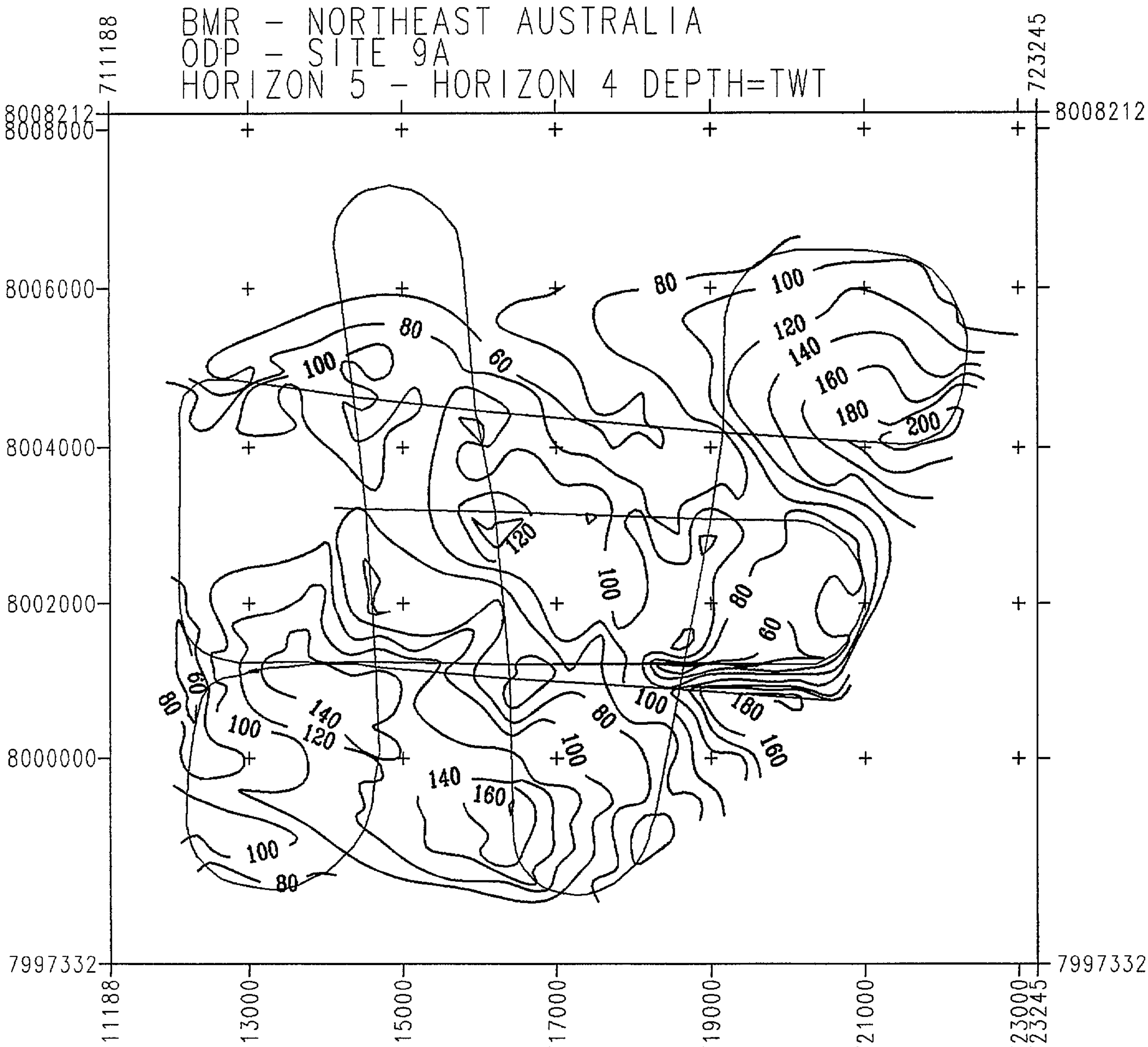

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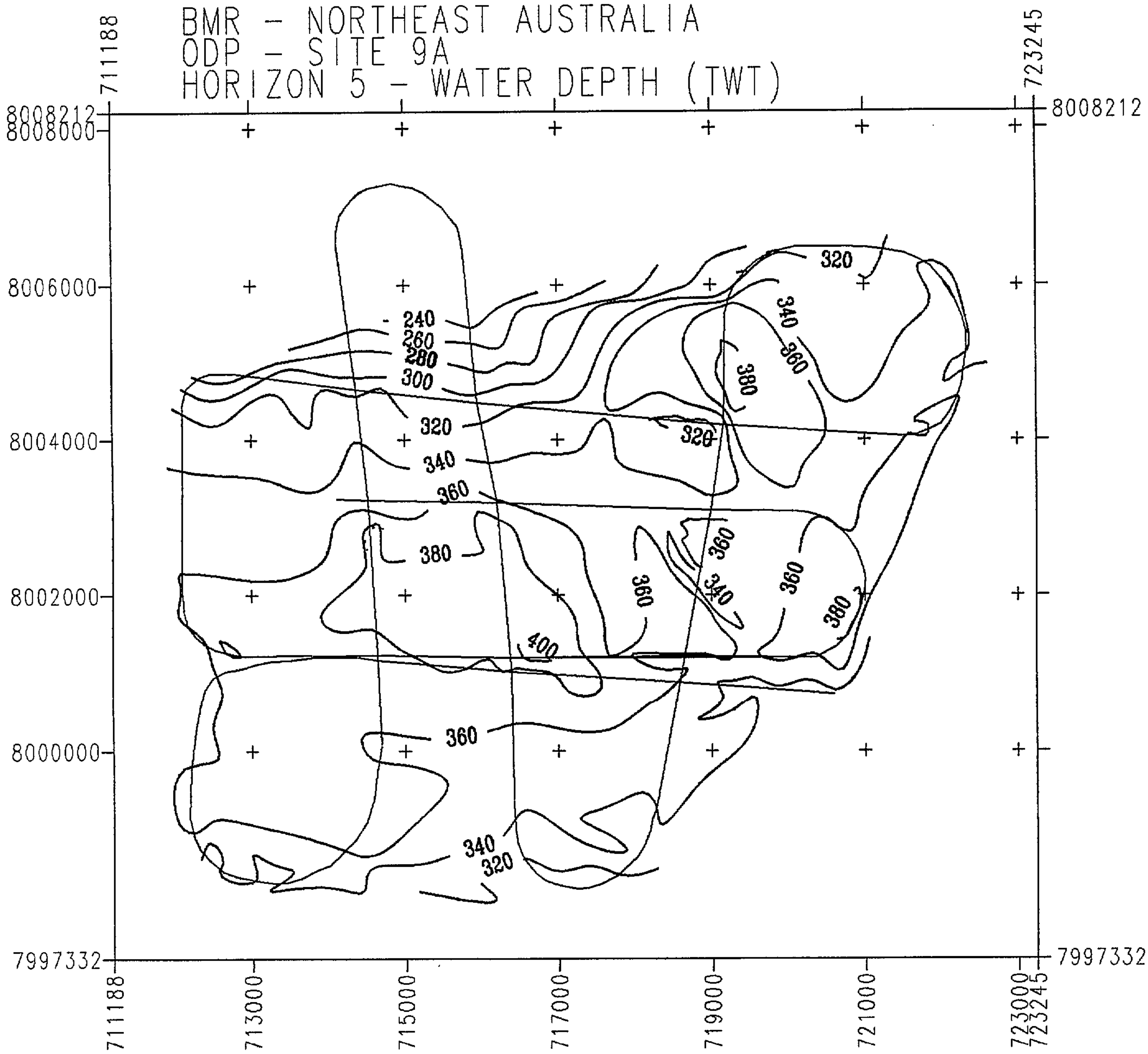

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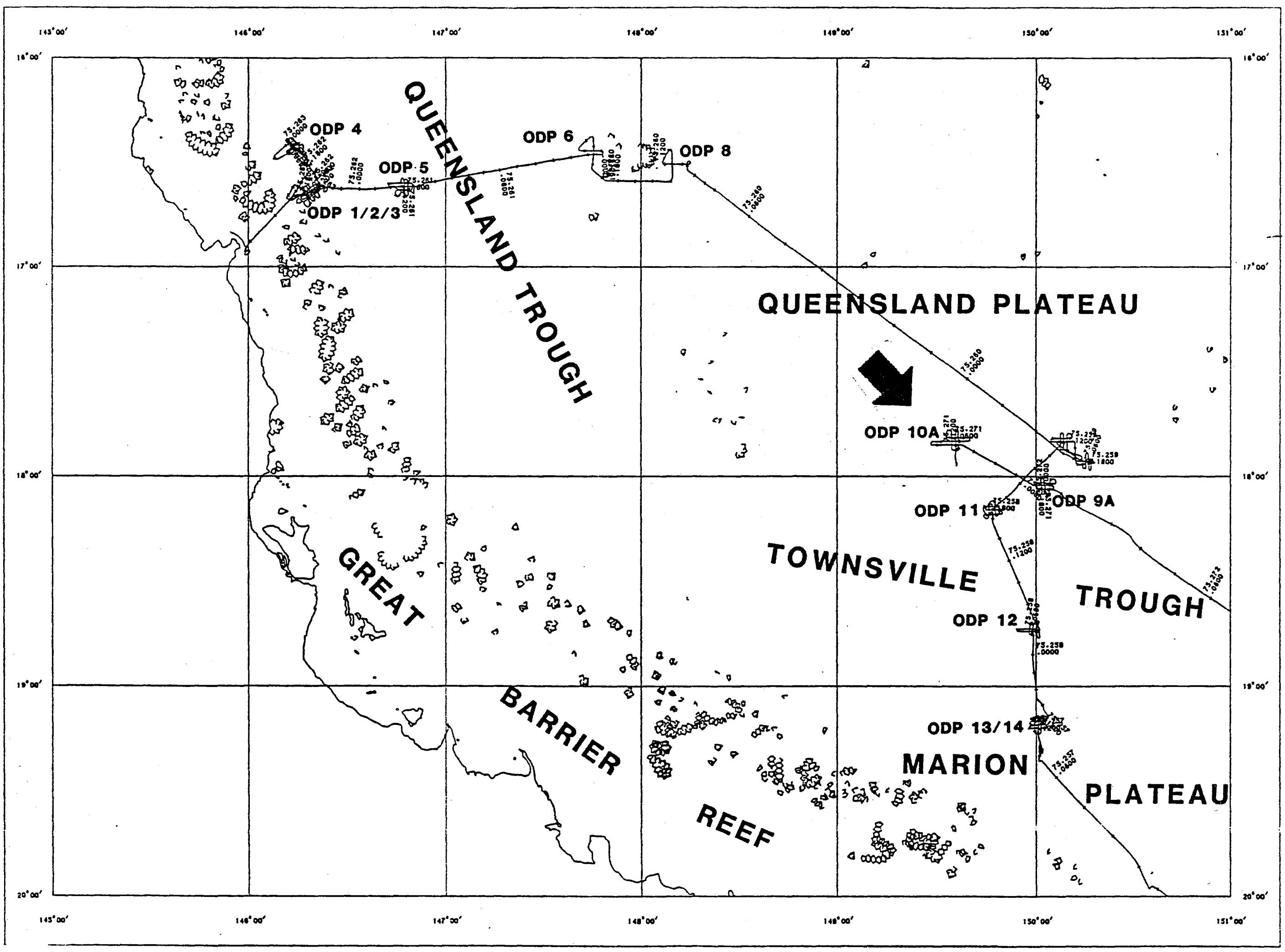
3.08 Site NEA 10A

NORTHEAST AUSTRALIA ODP SITES

SCALE 1:2000000 EDITION OF 1989/03/30



AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT

TRACK MAP

NORTHEAST AUSTRALIA ODP SITES

OVERVIEW - SITES NEA10A1 & NEA10A2

Sites 10A1 & 10A2 lie on the southern margin of the Queensland Plateau, between Flinders and Tregrosse Reefs. The sequences at these sites, together with site NEA 9A, will provide information detailing the factors controlling carbonate bank development on the Queensland Plateau. These sites, together with the complementary site NEA 9A in deeper water, will be compared with sites NEA 13 and NEA 14 on the northern margin of the Marion Plateau to enable more general conclusions regarding carbonate platform development. In addition, comparison of the progradational sequence at site10A2 with similar progradational geometries at sites 1-3 will permit evaluation of the differing responses of pure carbonate and mixed carbonate/siliciclastic sequences to sea-level fluctuations.

OBJECTIVES - SITES 10A1 & 10A2

1. To determine the age and facies of periplatform and reef sequences towards the margin of a carbonate platform complex.
2. To determine the Oligocene to Recent paleoceanographic and paleoclimatic signal in the reef and periplatform sequences.
3. To analyse the 'backstepping' history of the shallow carbonate banks of the Queensland Plateau.
4. To establish the relationship between sea level fluctuations and bank-derived carbonate facies.
5. To determine the late Cenozoic carbonate saturation history within the region.
6. To determine the diagenetic signal contained within periplatform sediments; in particular to establish the stability regimes of high magnesium calcite and aragonite within the platform margin environment.

PROGNOSIS - SITE 10A1

1. 64 m of latest Miocene to Recent periplatform ooze.
2. 56 m of Late Miocene carbonate gravel, sand, and mud.
3. 203 m of Early Miocene grainstone, packstone, and wackestone.
4. 177 m of latest Oligocene to Early Miocene packstone and wackestone.

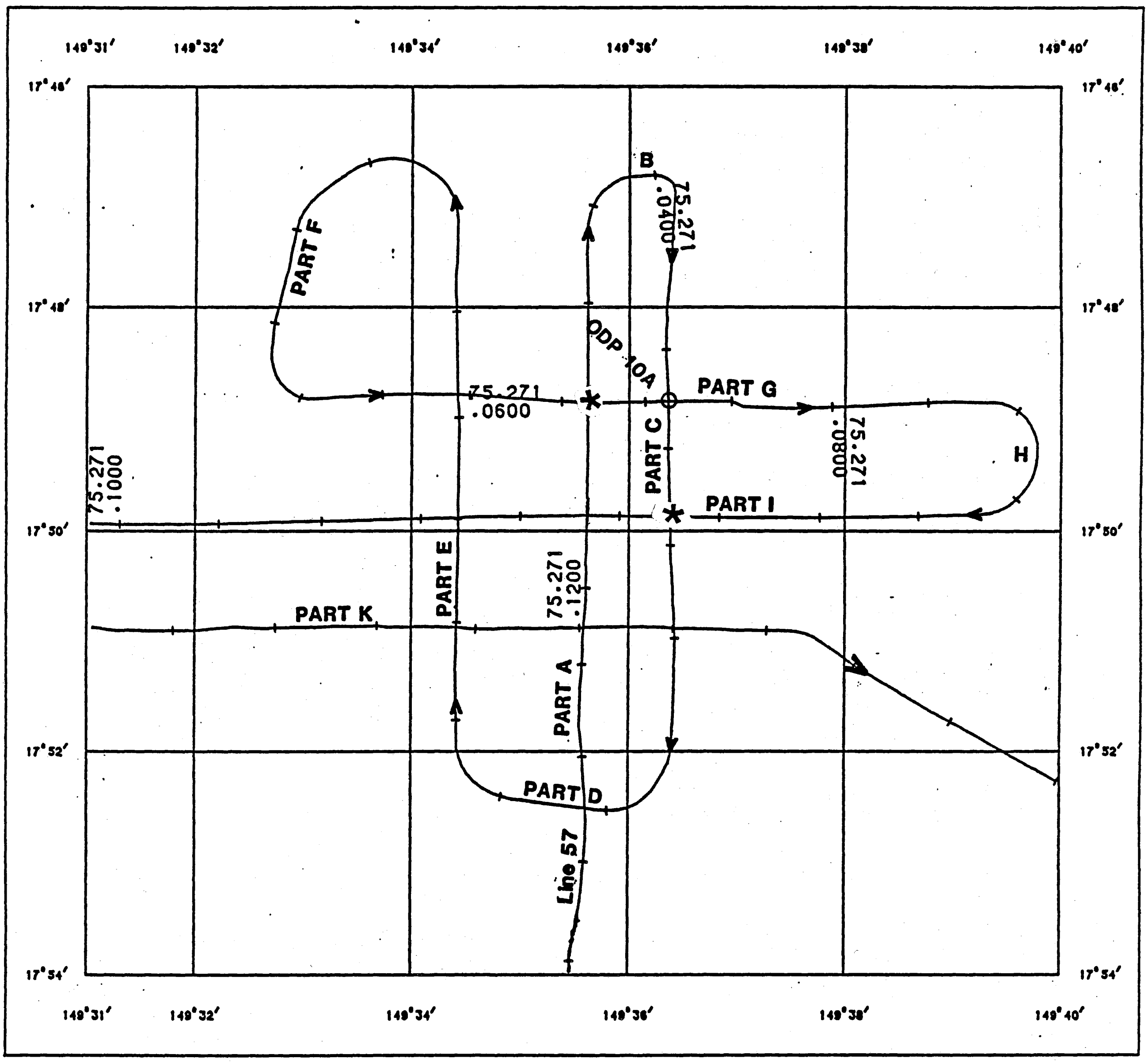
PROGNOSIS - SITE 10A2

1. 81 m of Pliocene to Recent periplatform ooze.
2. 107 m of Late Miocene carbonate gravel, sand, and mud.
3. 312 m of Early Miocene grainstone, packstone, and wackestone.

SCALE 1:100000

ODP SITE 10A

EDITION OF 1989/03/23



* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 10A

Site NEA 10A1

CHECK SHEET
JOIDES SAFETY REVIEW

Leg **133** *Site No.* **NEA 10A1** *Lat.* **17° 48.8'S** *Long.* **149° 36.3E**

Water Depth: **455 m.** *Dist. from Land:* **155 n.mi.** *Jurisdiction:* **AUSTRALIA**

General location or geomorphic province:
SOUTHERN QUEENSLAND PLATEAU

Upon what geophysical and/or geological data was this site selection made:
Seismic lines: **BMR LINE 75/057 (CROSSING 57C & 57G)**
Piston cores: **75PC08, (75GC28)**
DSDP holes: **NONE**
Other:

Proposed total penetration: **300 m.**
Probable sediment thickness: **1500 m.**

From previous DSDP drilling in this area, list all hydrocarbon occurrences of greater than background levels, give nature of show, age and depth of rock:
NO PREVIOUS DRILLING.

From available information, list all commercial drilling in this area that produced or yielded significant shows; give depths and ages of hydrocarbon bearing deposits:
NO COMMERCIAL DRILLING IN THIS AREA. NEAREST WELL IS APPROX. 425 n.mi. TO THE SOUTH - NO HYDROCARBONS ENCOUNTERED. OIL SHALES OCCUR ONSHORE IN EARLY TERTIARY NONMARINE BASINS 200 n.mi. TO SOUTH.

Is there any indication of gas hydrates at this location:
NO INDICATION; NO BSR PRESENT.

Is there any reason to expect any hydrocarbon accumulation at this site? Please comment.
NO. SHALLOW BASEMENT, ABSENCE OF STRUCTURE AND THERMALLY IMMATURE SECTION PRECLUDES POSSIBILITY OF HYDROCARBON OCCURRENCE.

What is your proposed drilling program?
APC/XCB TO 200 m.
RCB FROM 200 m. TO TD AT 300 m.

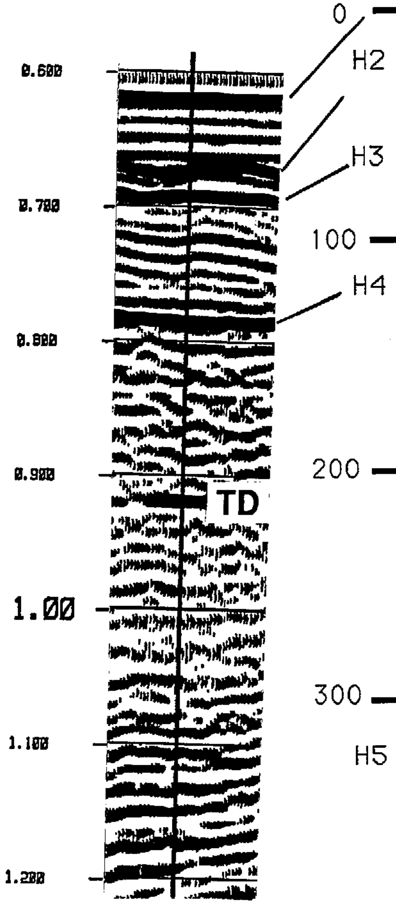
What is your proposed logging program?
NO LOGGING; WATER SAMPLE PACKER.

What "special" precautions will be taken during drilling?
STANDARD HYDROCARBON MONITORING.

What abandonment procedures do you plan to follow? (see Safety Manual, Sec. VIII, p. 22)
STANDARD PROCEDURES.

SUMMARY: What do you consider to be the major risks in drilling at this site?
NO MAJOR RISKS. SLIGHT CHANCE OF MINOR BIOGENIC GAS.

GRAPHIC SUMMARY: SITE NEA 10A1



Depth (m)	Age	Velocity (km/sec)	Lithology	Paleoenvironment	Sedim. Rate	Comments
0	Quaternary	1.6	carbonate sand & mud	periplatform ooze	25	
	[44] latest Miocene to Pliocene	1.6	carbonate sand & mud	periplatform ooze	25 m/my	?hardground - submarine cement
100	[64] Late Miocene	1.6	carbonate gravel, sand & mud	back reef/lagoon	15 m/my	
200	[120] late Early Miocene	2.4	grainstone, packestone & wackestone	?lagoon	25 m/my	section may have been subject to freshwater diagenesis
300	TD					
400						
500						

Site NEA 10A2

CHECK SHEET
JOIDES SAFETY REVIEW

Leg **133** *Site No.* **NEA 10A2** *Lat.* **17° 50.0'S** *Long.* **149° 30.8'E**

Water Depth: **505 m.** *Dist. from Land:* **155 n.mi.** *Jurisdiction:* **AUSTRALIA**

General location or geomorphic province:
SOUTHERN QUEENSLAND PLATEAU

Upon what geophysical and/or geological data was this site selection made:
Seismic lines: **BMR LINE 75/057I**
Piston cores:
DSDP holes: **NONE**
Other:

Proposed total penetration: **500 m.**
Probable sediment thickness: **1500+ m.**

From previous DSDP drilling in this area, list all hydrocarbon occurrences of greater than background levels, give nature of show, age and depth of rock:
NO PREVIOUS DRILLING.

From available information, list all commercial drilling in this area that produced or yielded significant shows; give depths and ages of hydrocarbon bearing deposits:
NO COMMERCIAL DRILLING IN THIS AREA. NEAREST WELL IS APPROX. 425 n.mi. TO THE SOUTH - NO HYDROCARBONS ENCOUNTERED. OIL SHALES OCCUR ONSHORE IN EARLY TERTIARY NONMARINE BASINS 200 n.mi. TO SOUTH.

Is there any indication of gas hydrates at this location:
NO INDICATION; NO BSR PRESENT.

Is there any reason to expect any hydrocarbon accumulation at this site? Please comment.
NO. SHALLOW BASEMENT, ABSENCE OF STRUCTURE AND THERMALLY IMMATURE SECTION PRECLUDES POSSIBILITY OF HYDROCARBON OCCURRENCE.

What is your proposed drilling program?
APC/XCB TO 120 m.
RCB FROM 120 m. TO TD AT 500 m.

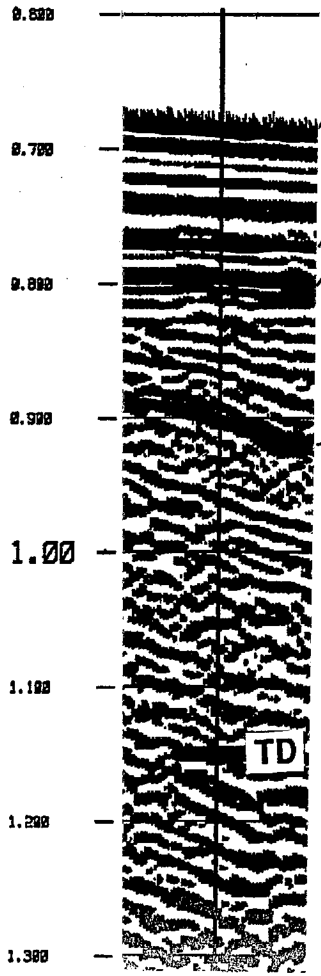
What is your proposed logging program?
SCHLUMBERGER LOGGING SUITE; WATER SAMPLE PACKER.

What "special" precautions will be taken during drilling?
STANDARD HYDROCARBON MONITORING.

What abandonment procedures do you plan to follow? (see Safety Manual, Sec. VIII, p. 22)
STANDARD PROCEDURES.

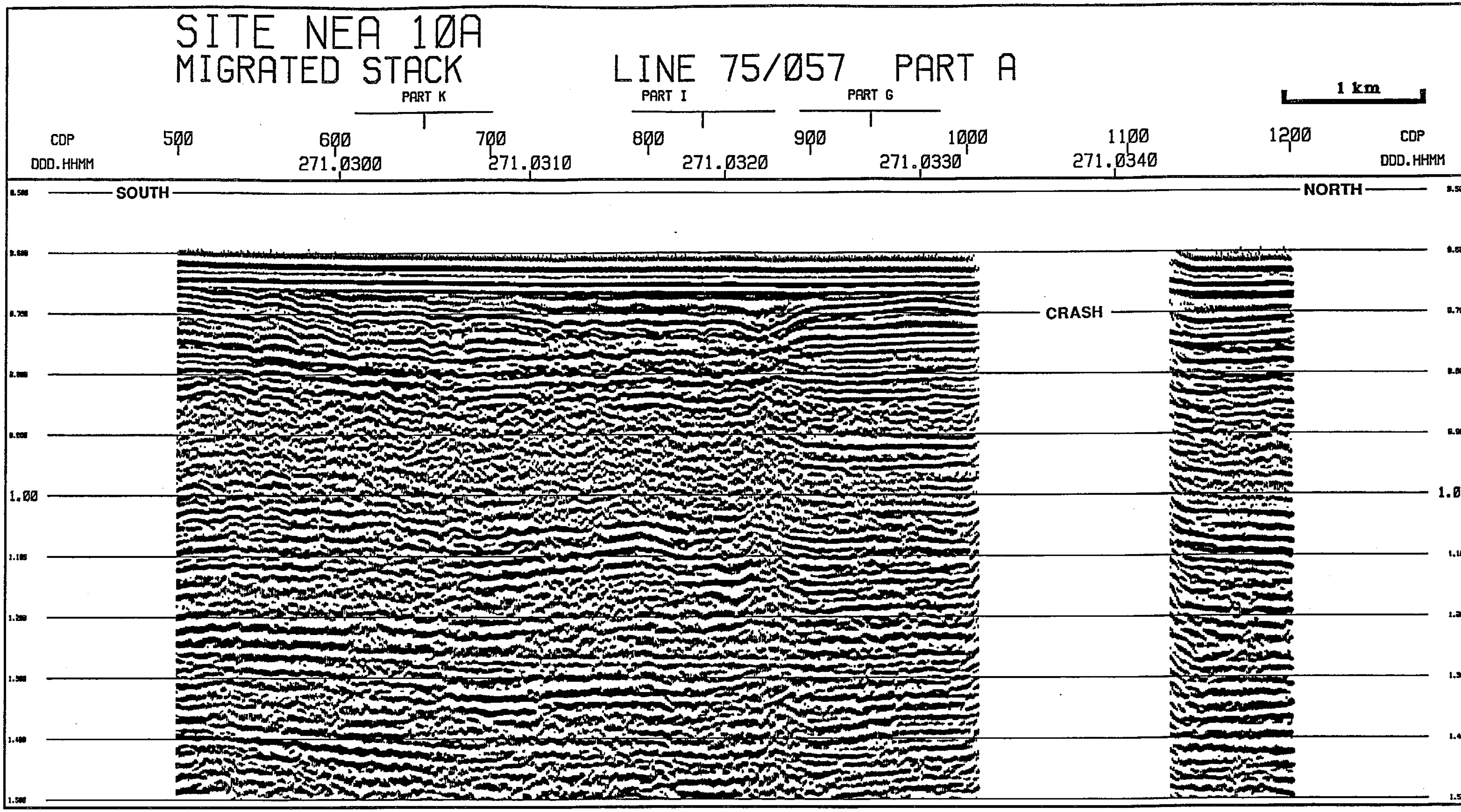
SUMMARY: What do you consider to be the major risks in drilling at this site?
NO MAJOR RISKS. SLIGHT CHANCE OF MINOR BIOGENIC GAS.

GRAPHIC SUMMARY: SITE NEA 10A2



Key Reflectors	Depth (m)	Age	Velocity (km/sec)	Lithology	Paleoenvironment	Sedim. Rate	Comments
	0	Quaternary Pliocene	1.65	carbonate sand & mud	periplatform ooze	30 m/my	
H2		[60]	1.65	as above	periplatform ooze		
H3	100	[81] Late Miocene	2.15	grainstone & packstone	prograding reef slope	20 m/my	
H4	200	[188]	2.15				
	300	[258] Early Miocene	2.5	wackestone, packstone & mudstone	carbonate platform		section may have been subjected to freshwater diagenesis
	400						
	500 (TD)						

JOIDES Safety Review Check Sheet - Site 10A2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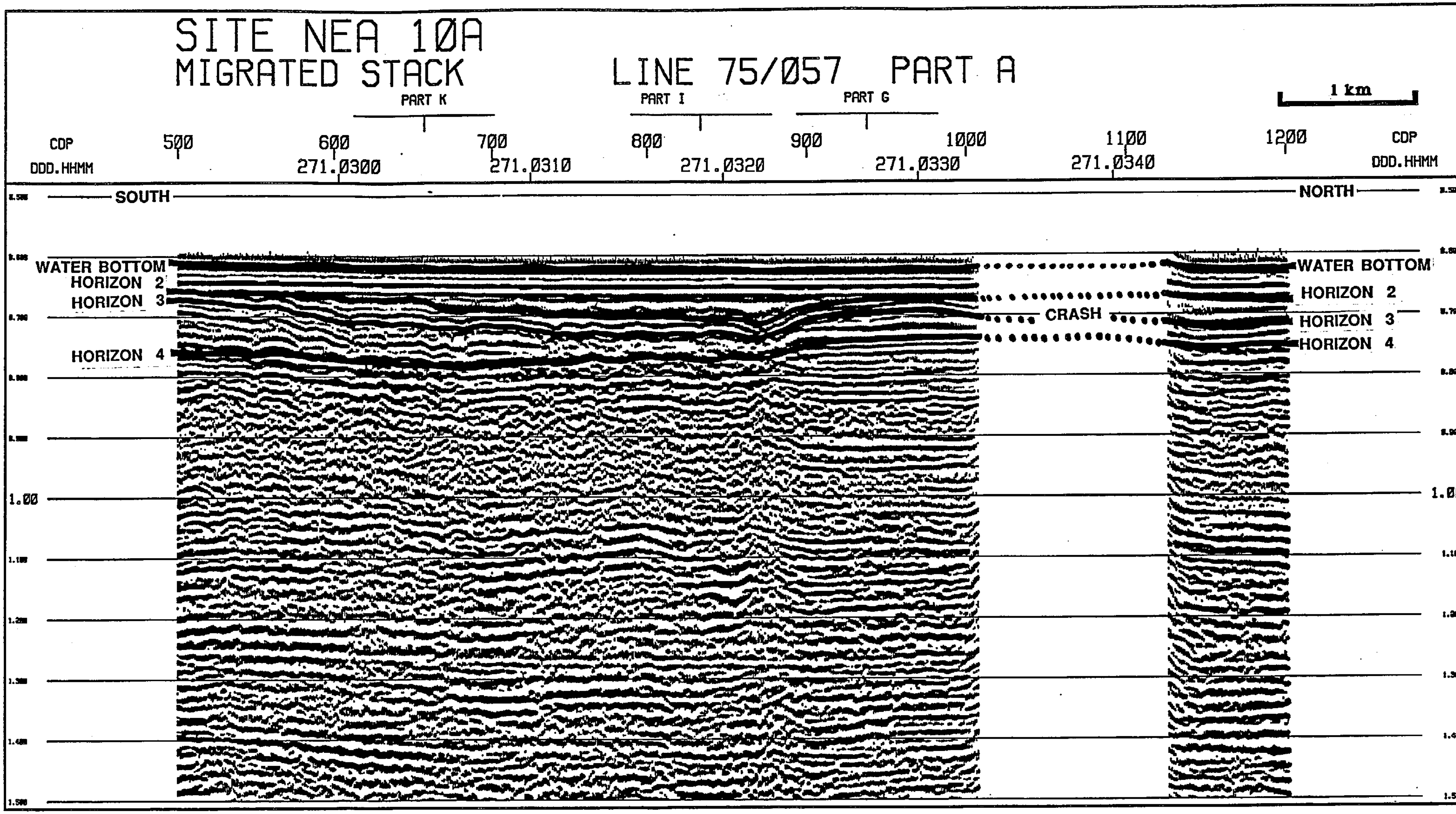
MIGRATED STACK
LINE 75/057 PART A
PART K
PART I
PART G
1 km
CDP
DDD.HHMM
500
600
700
800
900
1000
1100
1200
271.0300
271.0310
271.0320
271.0330
271.0340
SOUTH
NORTH
CRASH
1.00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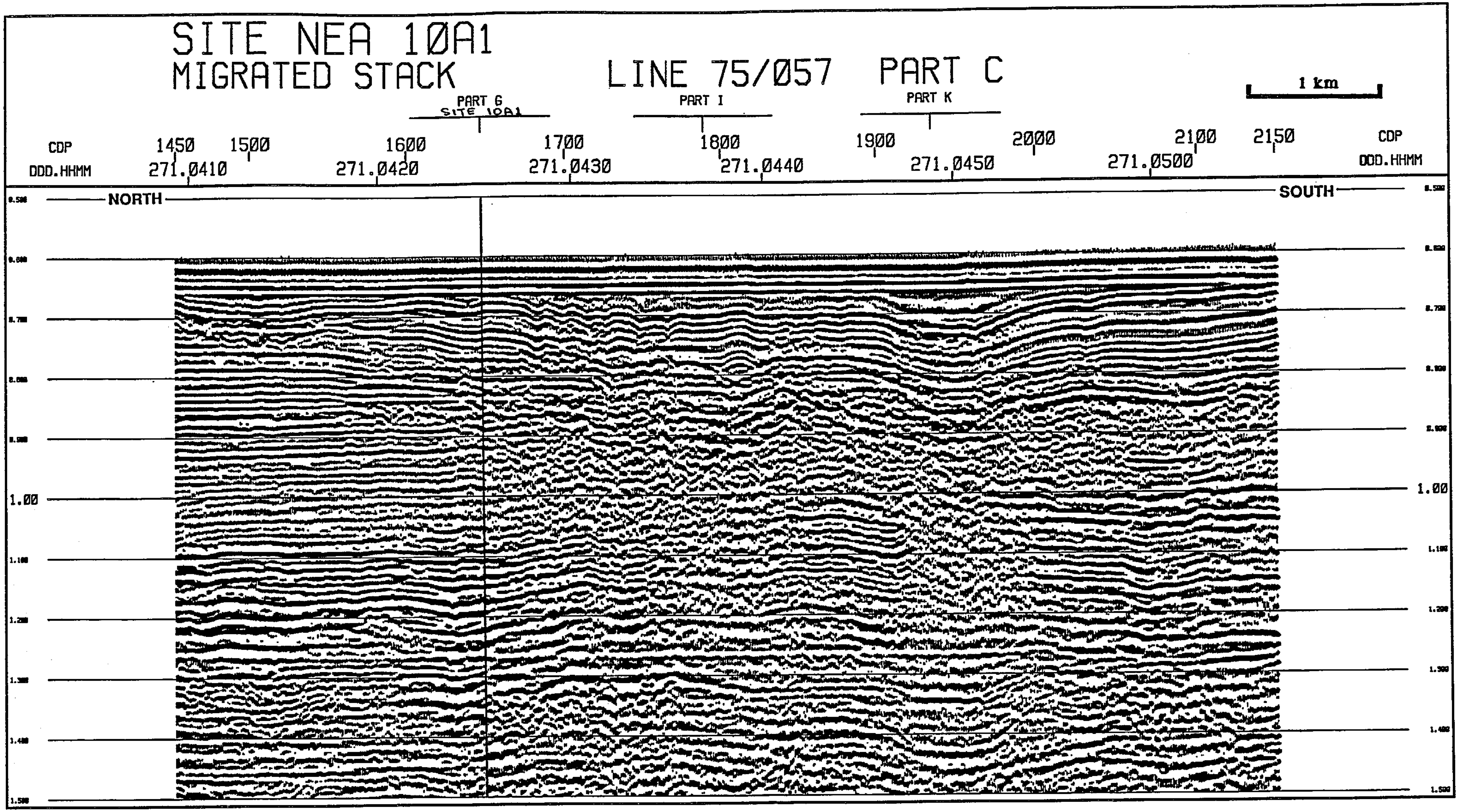
MIGRATED STACK
LINE 75/057 PART A
PART K
PART I
PART G
1 km
CDP
DDD.HHMM
500
600
700
800
900
1000
1100
1200
271.0300
271.0310
271.0320
271.0330
271.0340
SOUTH
NORTH
WATER BOTTOM
HORIZON 2
HORIZON 3
HORIZON 4
CRASH
1.00


SITE NEA 10ØA1
MIGRATED STACK
LINE 75/Ø57 PART C
1 km
PART G
SITE 10A1
PART I
PART K
CDP
DDD.HHMM
1450
1500
1600
1700
1800
1900
2000
2100
2150
271.0410
271.0420
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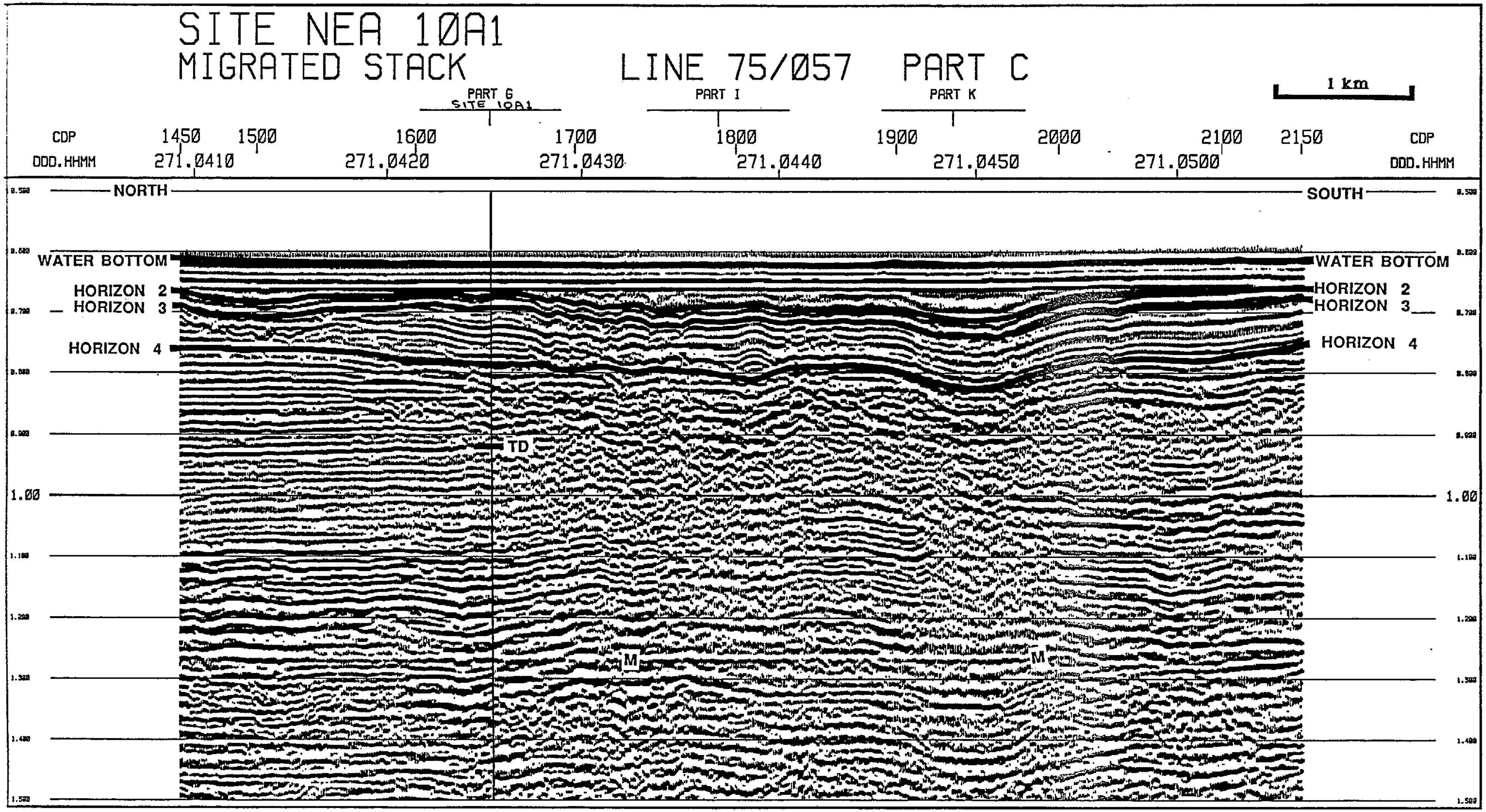
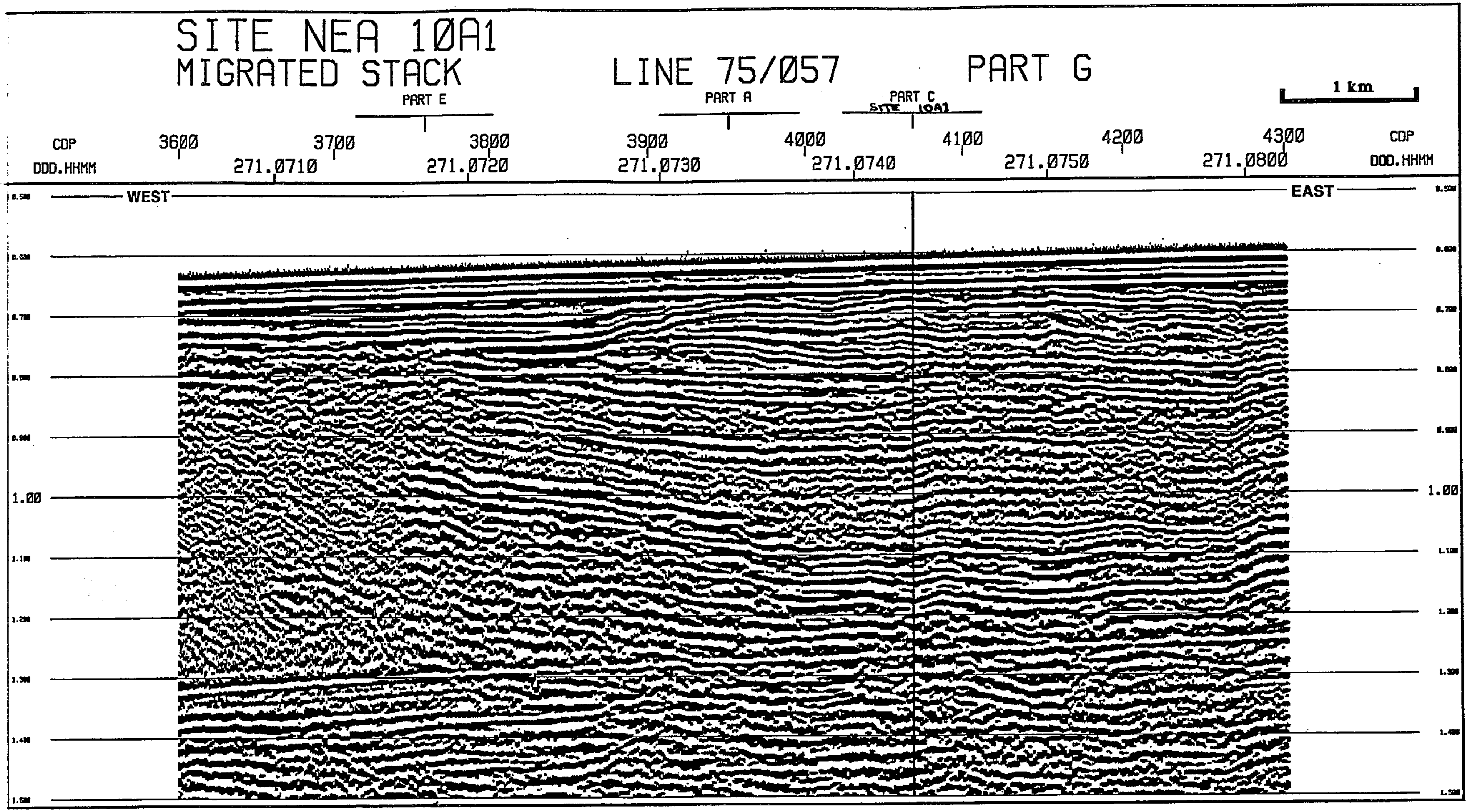
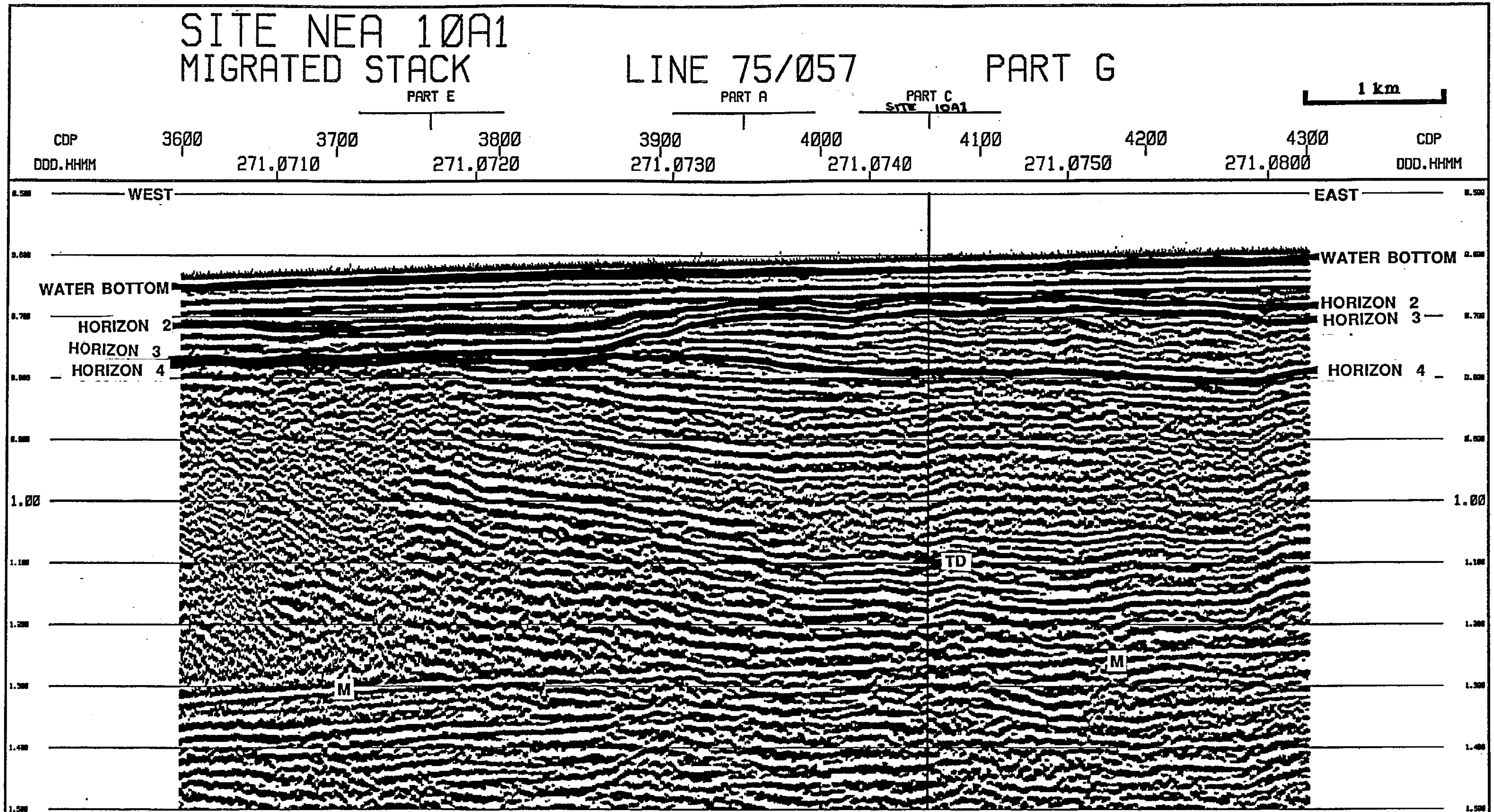
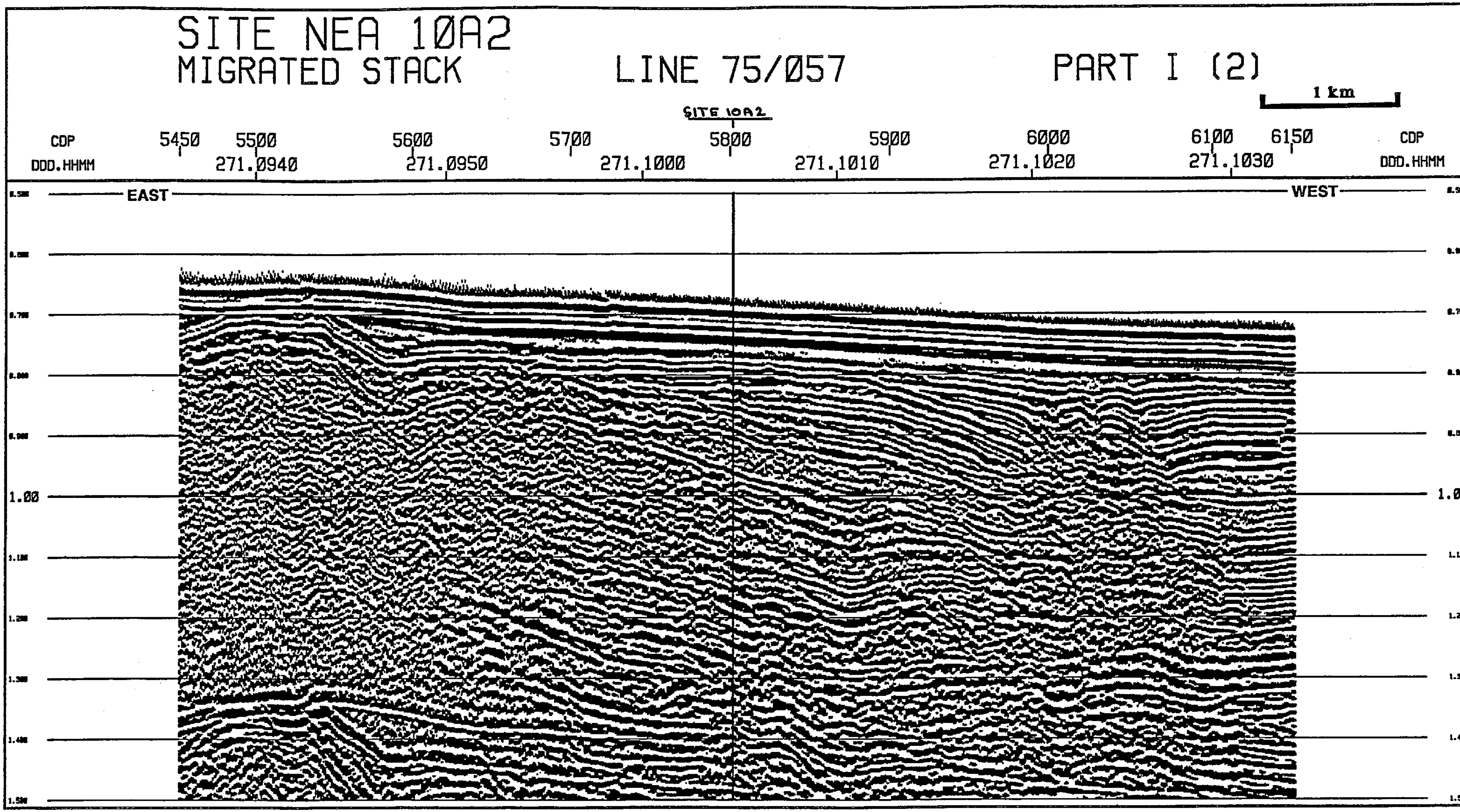
271.0440
271.0450
271.0500
CDP
DDD.HHMM
NORTH
SOUTH
1.00
1.00



SITE NEA 10Ø1
MIGRATED STACK
LINE 75/Ø57 PART C
1 km
PART G
SITE 10A1
PART I
PART K
CDP
DDD.HHMM
1450
1500
1600
1700
1800
1900
2000
2100
2150
271.0410
271.0420
271.0430
271.0440
271.0450
271.0500
NORTH
SOUTH
WATER BOTTOM
HORIZON 2
HORIZON 3
HORIZON 4
TD
M
1.00


SITE NEA 10Ø1
MIGRATED STACK
LINE 75/Ø57
PART G
1 km
PART E
PART A
PART C
SITE 10A1
CDP
DDD.HHMM
36ØØ
37ØØ
38ØØ
39ØØ
4ØØØ
41ØØ
42ØØ
43ØØ
271.Ø71Ø
271.Ø72Ø
271.Ø73Ø
271.Ø74Ø
271.Ø75Ø
271.Ø8ØØ
CDP
DDD.HHMM
WEST
EAST
1.ØØ
1.ØØ


SITE NEA 10Ø1
MIGRATED STACK
LINE 75/Ø57
PART G
PART E
PART A
PART C
SITE 10A1
1 km
CDP
DDD.HHMM
3600
3700
3800
3900
4000
4100
4200
4300
271.0710
271.0720
271.0730
271.0740
271.0750
271.0800
WEST
EAST
WATER BOTTOM
HORIZON 2
HORIZON 3
HORIZON 4
1.00
TD
M
M
WATER BOTTOM
HORIZON 2
HORIZON 3
HORIZON 4


SITE NEA 10Ø A2
MIGRATED STACK
LINE 75/Ø57
PART I (2)
1 km
SITE 10A2
CDP
DDD.HHMM
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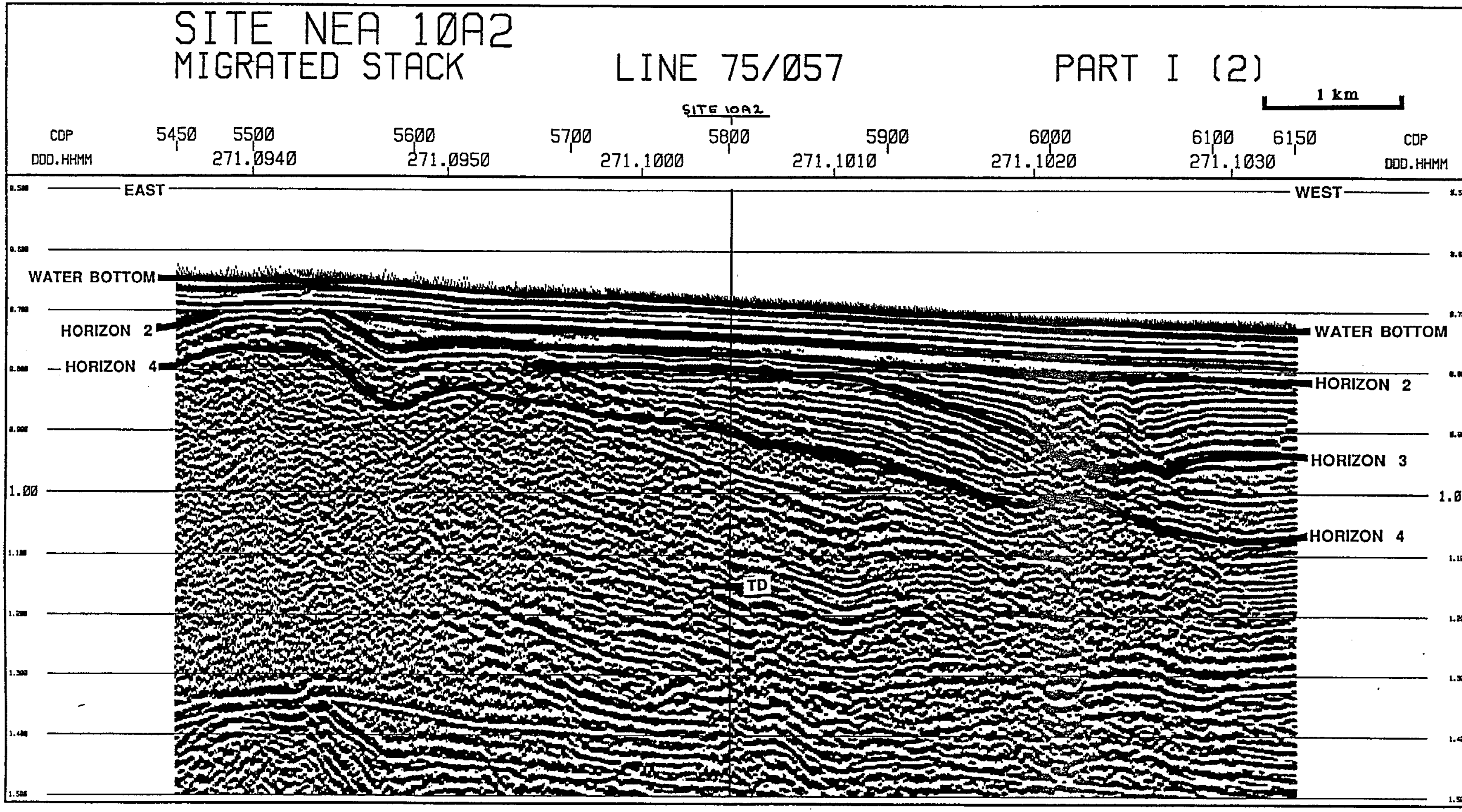
5600
5700
5800
5900
6000
6100
6150
271.0940
271.0950
271.1000
271.1010
271.1020
271.1030
CDP
DDD.HHMM
EAST
WEST
1.00
1.00



SITE NEA 10Ø2
MIGRATED STACK
LINE 75/Ø57
PART I (2)
1 km
SITE 10A2
CDP
DDD.HHMM
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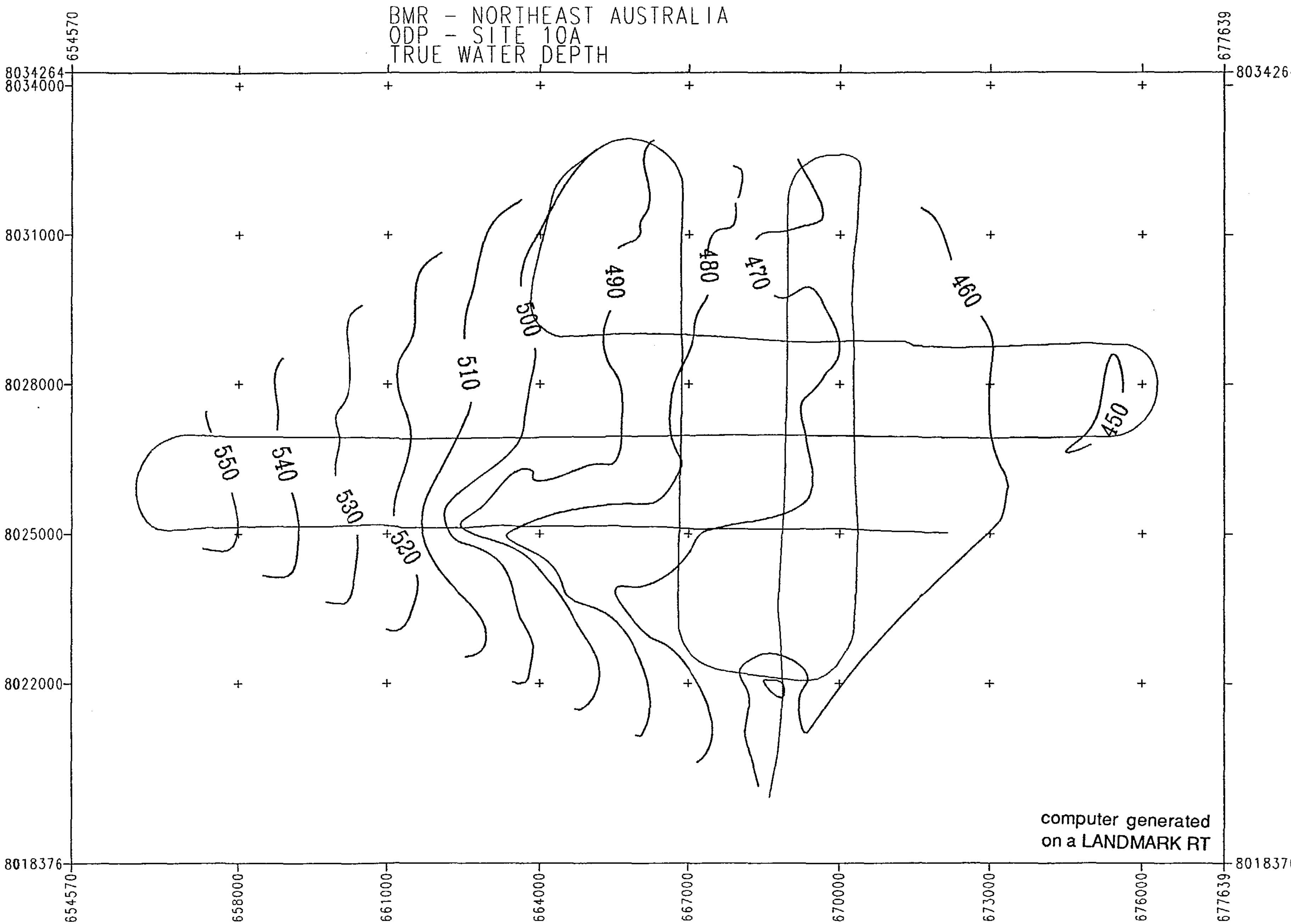
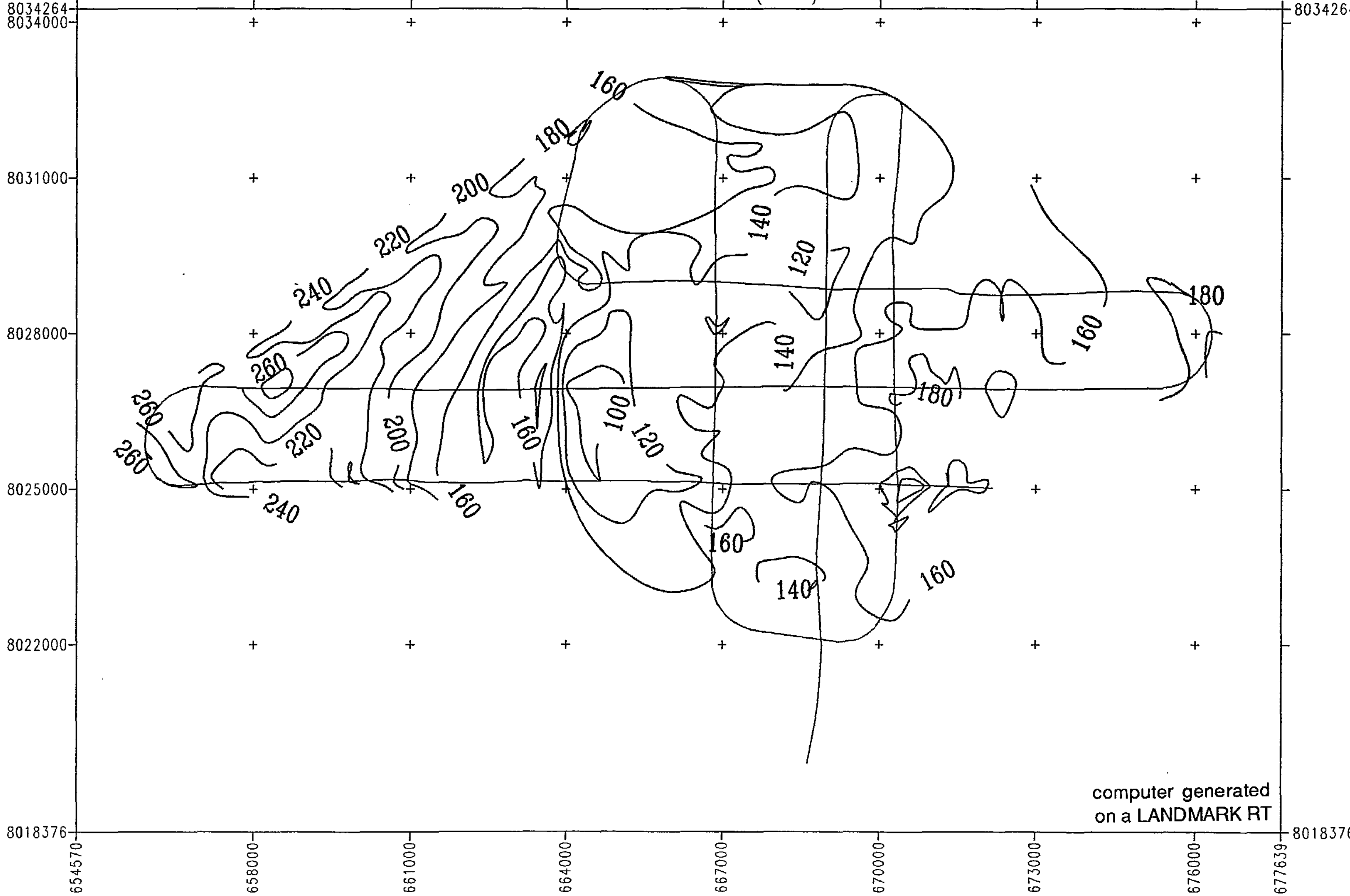
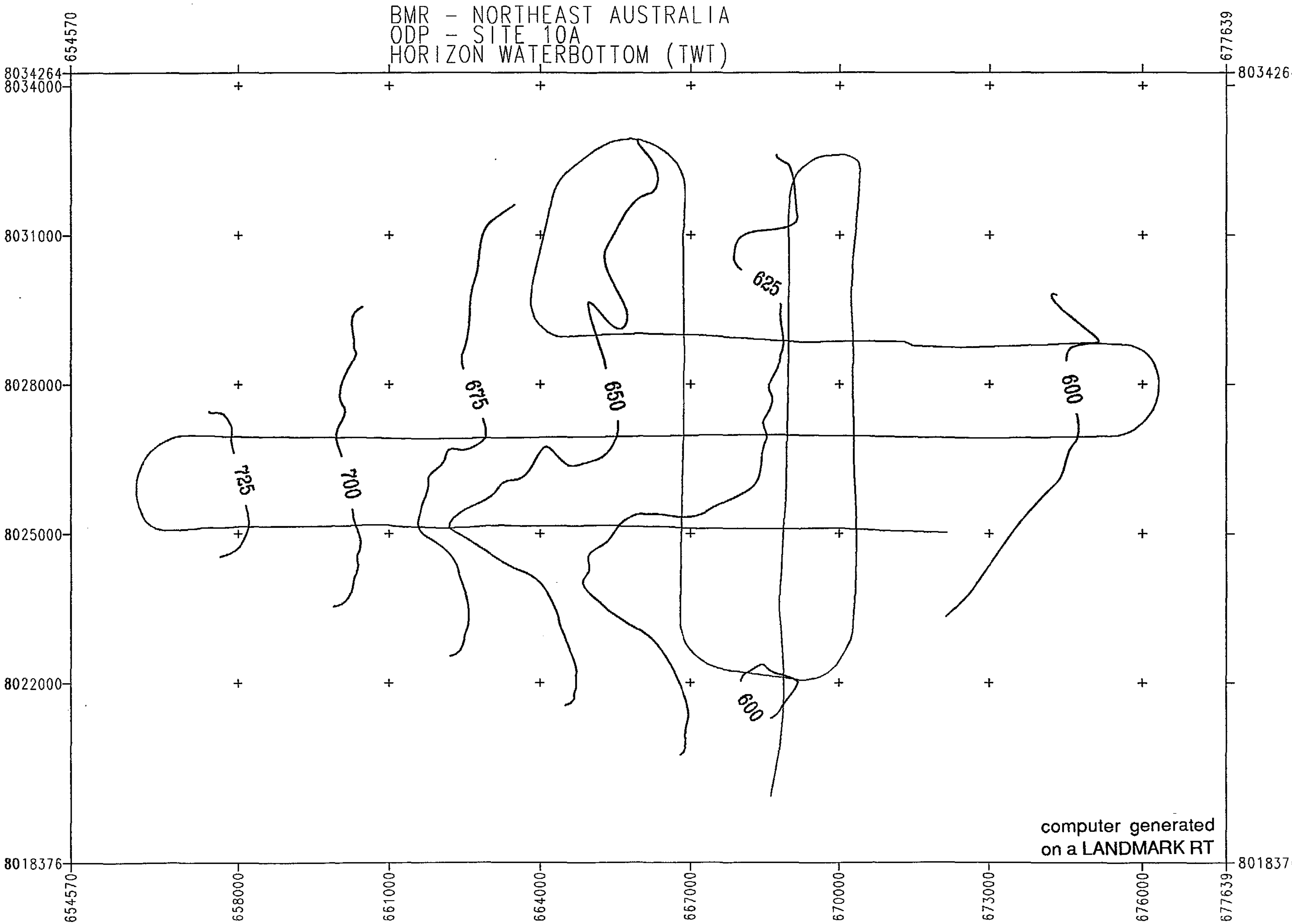
5500
5600
5700
5800
5900
6000
6100
6150
271.Ø940
271.Ø950
271.1000
271.1Ø10
271.1Ø20
271.1Ø30
CDP
DDD.HHMM
EAST
WEST
WATER BOTTOM
HORIZON 2
HORIZON 4
WATER BOTTOM
HORIZON 2
HORIZON 3
HORIZON 4
TD
1.ØØ
1.ØØ


BMR - NORTHEAST AUSTRALIA
ODP - SITE 10A
TRUE WATER DEPTH
654570
677639
8034264
8034000
8031000
8028000
8025000
8022000
8018376
658000
661000
664000
667000
670000
673000
676000
550
540
530
520
510
500
490
480
470
460
450
computer generated
on a LANDMARK RT

BMR - NORTHEAST AUSTRALIA
ODP - SITE 10A
HORIZON 4 - WATERBOTTOM (TWT)




BMR - NORTHEAST AUSTRALIA
ODP - SITE 10A
HORIZON WATERBOTTOM (TWT)
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677639
8034264
8034000
8031000
8028000
8025000
8022000
8018376
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670000
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676000
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650
625
600
600
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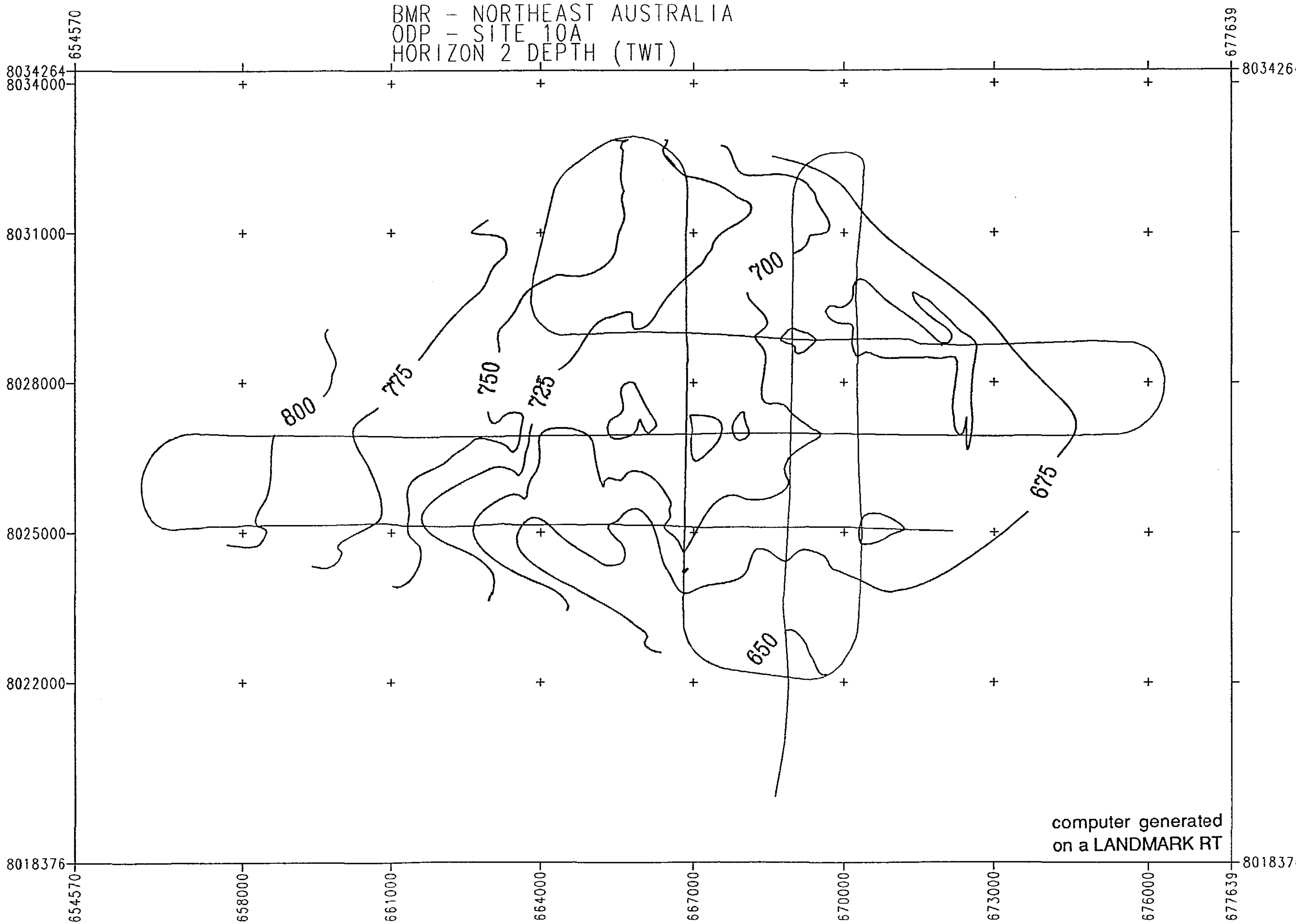
on a LANDMARK RT


BMR - NORTHEAST AUSTRALIA
ODP - SITE 10A
HORIZON 2 DEPTH (TWT)
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677639
8034264
8034000
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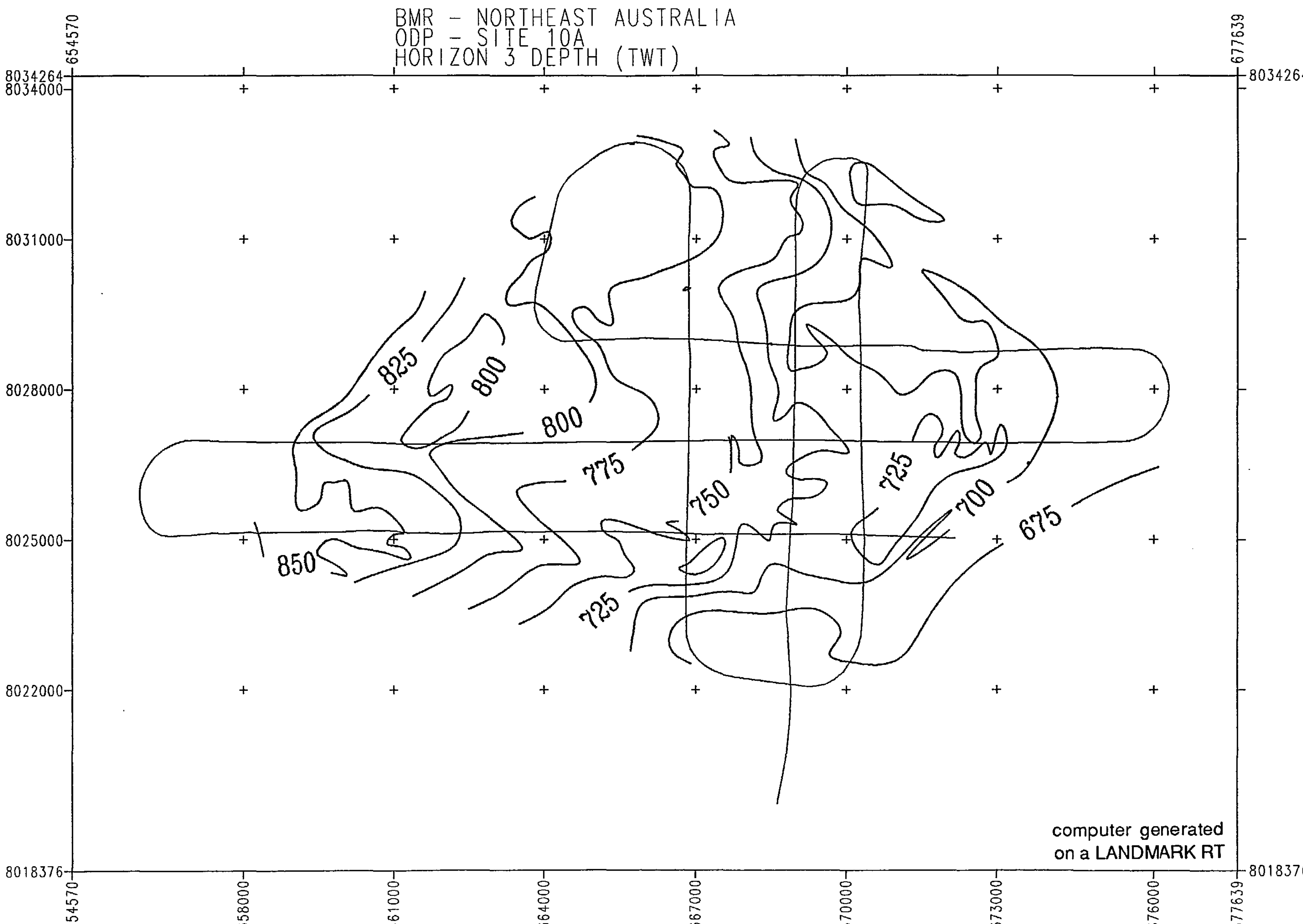
8028000
8025000
8022000
8018376
658000
661000
664000
667000
670000
673000
676000
800
775
750
725
700
675
650
computer generated
on a LANDMARK RT


BMR - NORTHEAST AUSTRALIA
ODP - SITE 10A
HORIZON 3 DEPTH (TWT)
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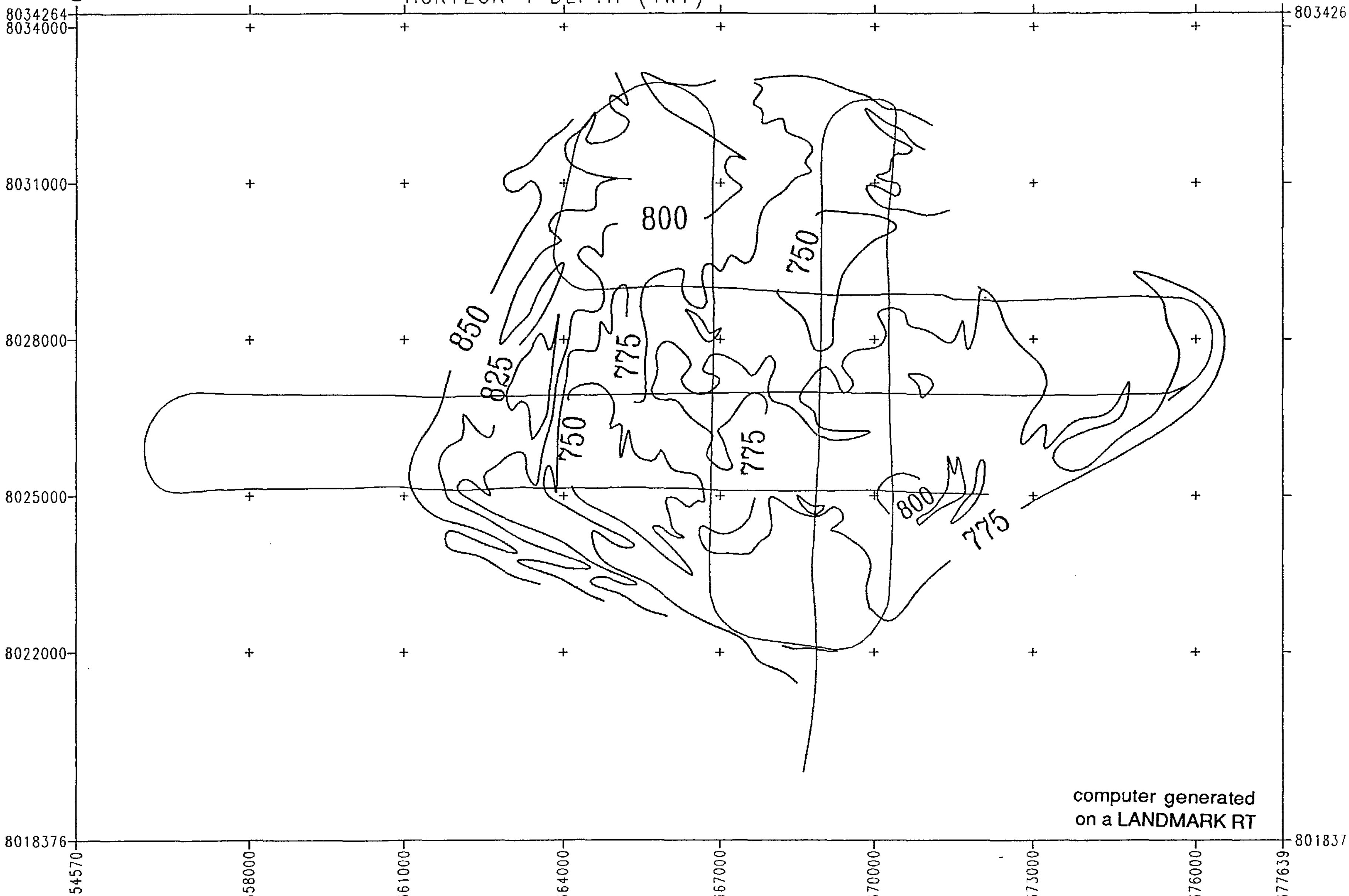
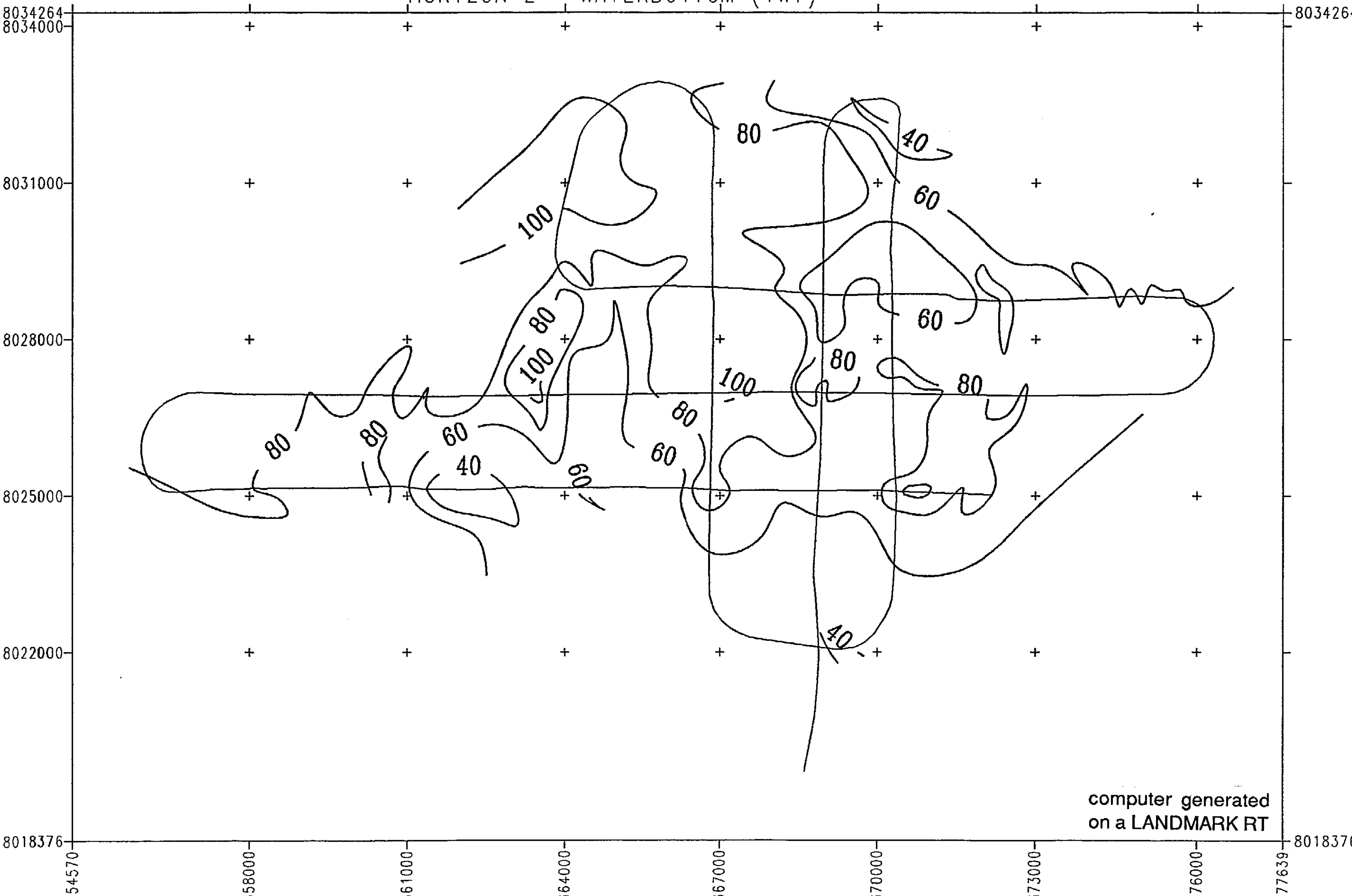
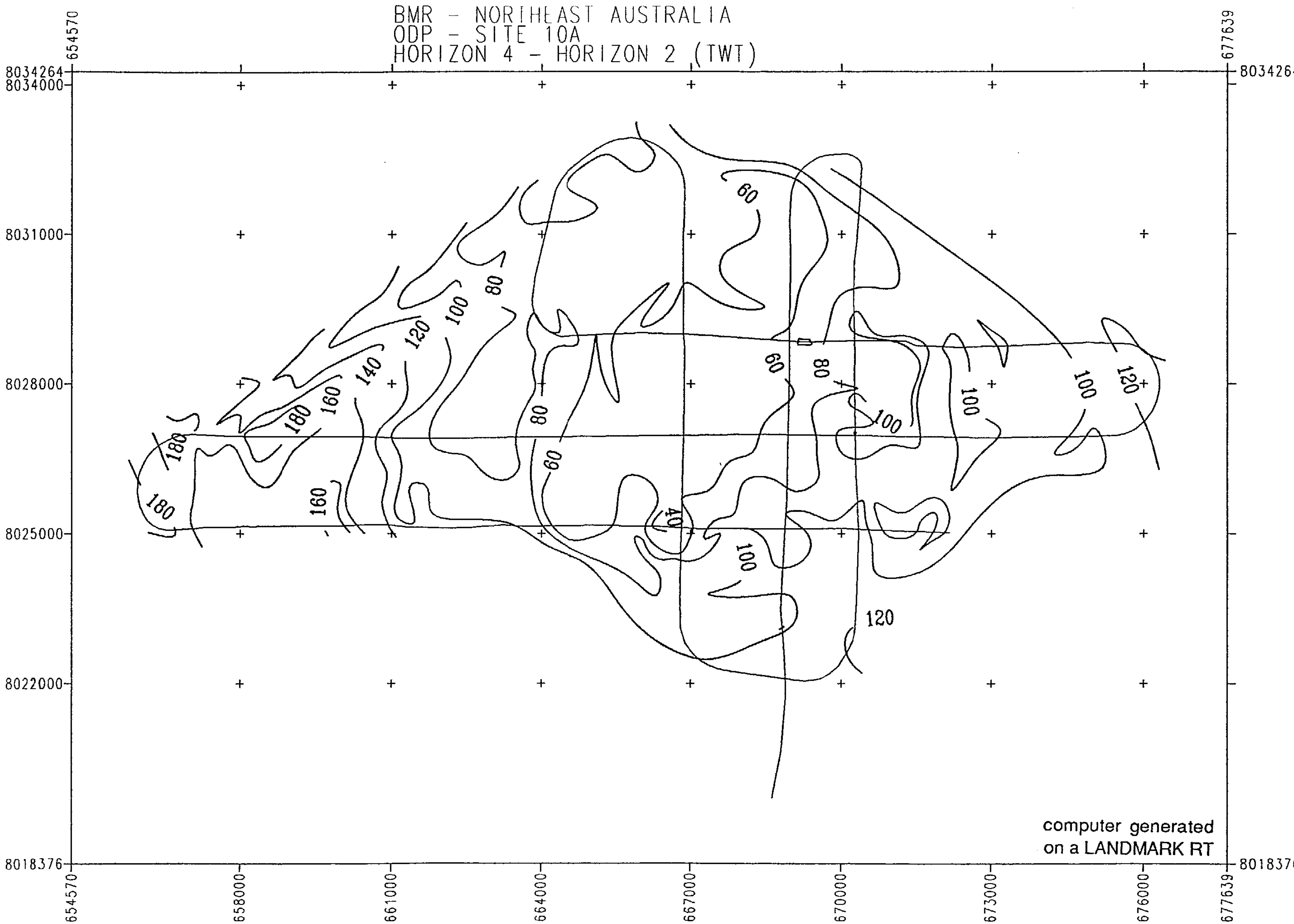
677639
8034264
8034000
8031000
8028000
8025000
8022000
8018376
658000
661000
664000
667000
670000
673000
676000
850
825
800
800
775
750
725
725
700
675
computer generated
on a LANDMARK RT

BMR - NORTHEAST AUSTRALIA
ODP - SITE 10A
HORIZON 4 DEPTH (TWT)



BMR - NORTHEAST AUSTRALIA
ODP - SITE 10A
HORIZON 2 - WATERBOTTOM (TWT)




BMR - NORTHEAST AUSTRALIA
ODP - SITE 10A
HORIZON 4 - HORIZON 2 (TWT)
654570
677639
8034264
8034000
8031000
8028000
8025000
8022000
8018376
658000
661000
664000
667000
670000
673000
676000
60
80
100
120
140
160
180
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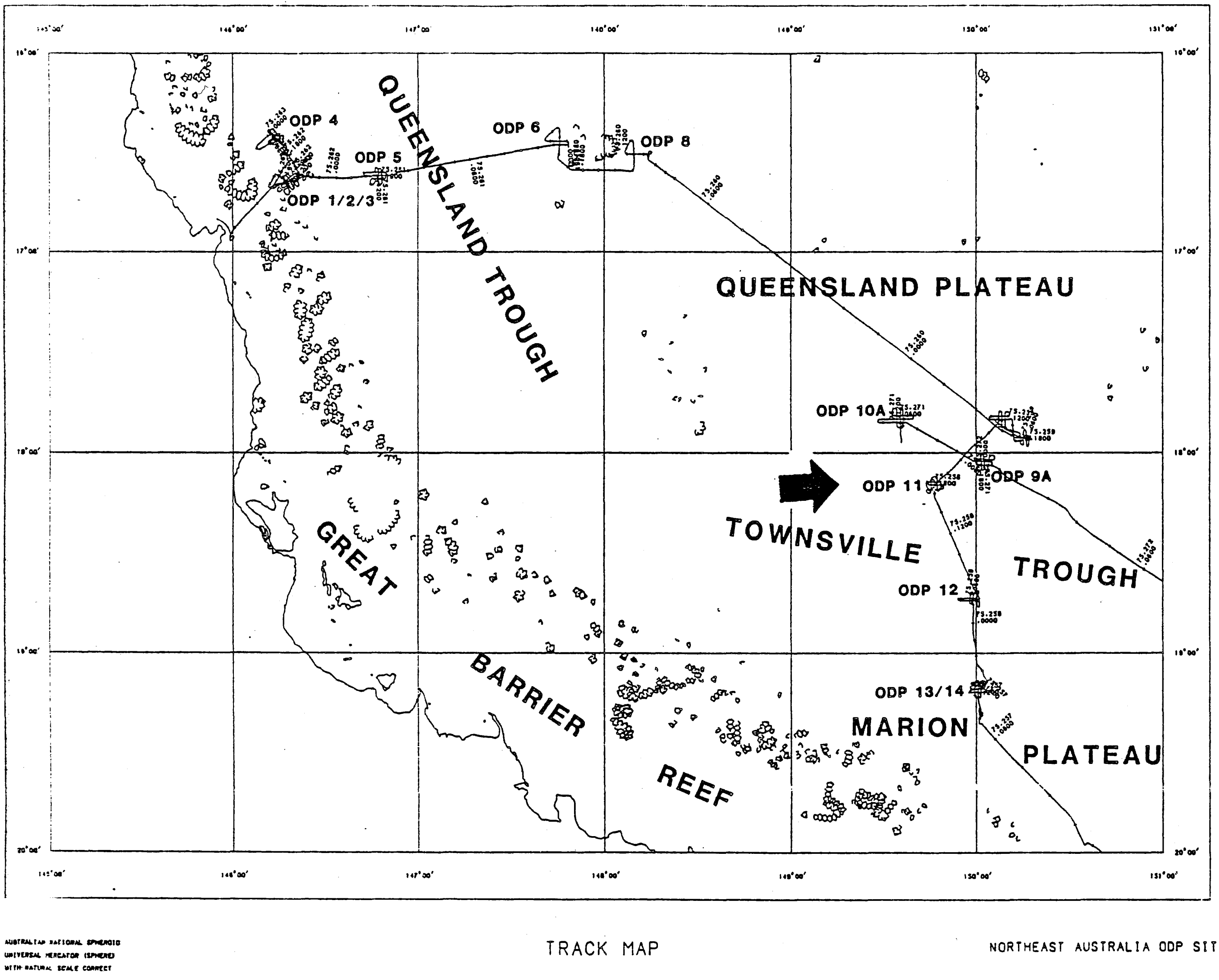
on a LANDMARK RT

3.09 Site NEA 11

NORTHEAST AUSTRALIA ODP SITES

SCALE 1:2000000 EDITION OF 1989/03/30



TRACK MAP

NORTHEAST AUSTRALIA ODP SITES

OVERVIEW - SITE NEA11

Site 11 lies towards the northern margin of the Townsville Trough, on the lower slope of the Queensland Plateau. This site will provide a relatively complete, high resolution depositional record in the upper part of the trough sequence. It will form a basis for comparison of event stratigraphy between the Queensland and Marion Plateau platform sequences. It will provide a detailed paleoceanographic history throughout the late Cenozoic during the transitions from temperate to subtropical and from subtropical to tropical climatic regimes.

OBJECTIVES - SITE 11

1. To determine the age and facies of a lower slope sequence adjacent to the Queensland Plateau.
2. To understand the interaction between carbonate platform margin-dominated processes (sediment gravity flows) and trough pelagic and contourite-dominated depositional processes, particularly as a function of sealevel.
3. To derive a high resolution paleoceanographic record reflecting late Cenozoic climatic variation.

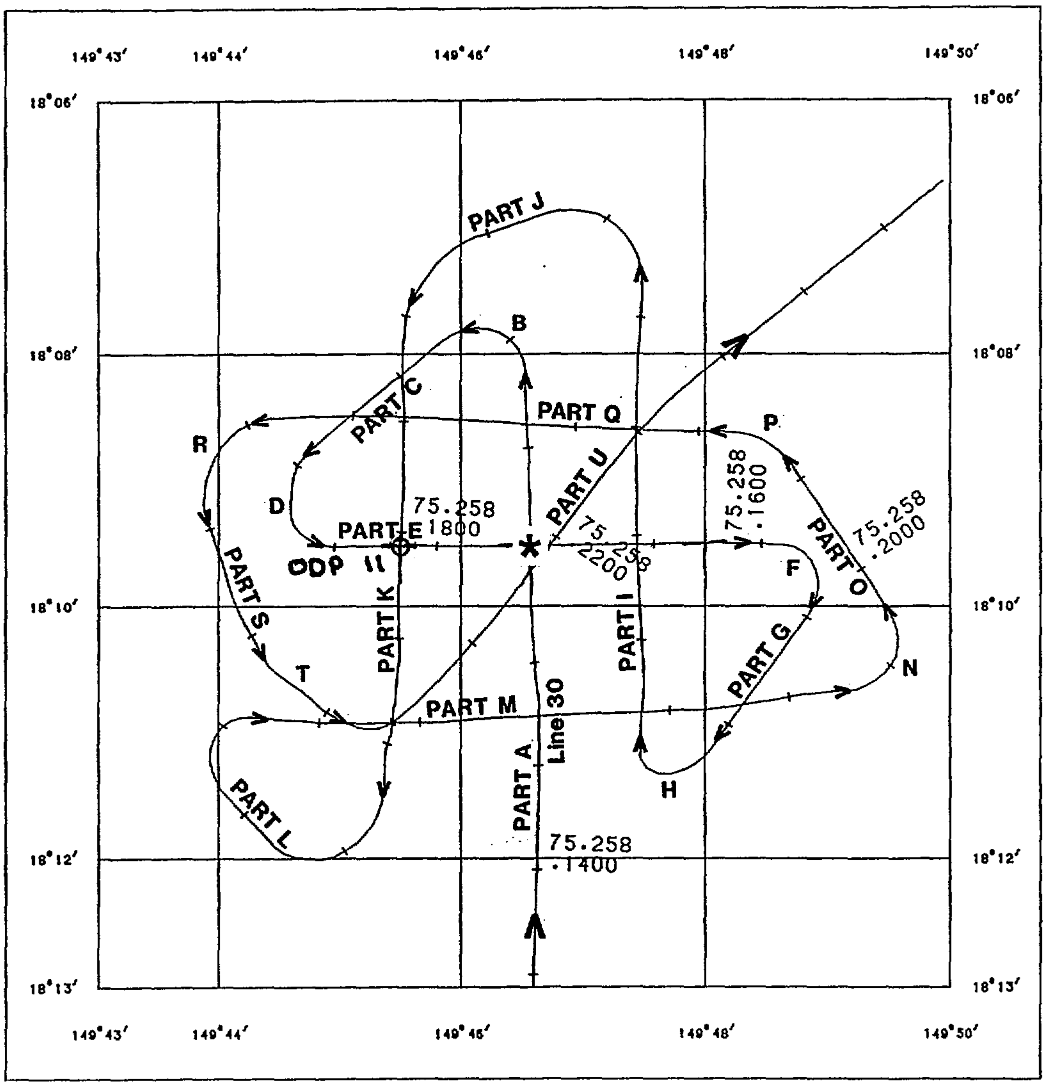
PROGNOSIS - SITE 11

1. 410 m of Middle Miocene to Recent periplatform gravel, sand, and mud.
2. 255 m of Early Miocene platform debris apron rudstone, wackestone, and packstone.
3. 35 m of ?Oligocene shallow marine siliciclastic sandstone and mudstone, possibly with wackestone interbeds towards the top.

ODP SITE 11

SCALE 1:100000

EDITION OF 1989/03/29



* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP

ODP SITE 11

CHECK SHEET
JOIDES SAFETY REVIEW

Leg **133** *Site No.* **NEA 11** *Lat.* **18° 09.5'S** *Long.* **149° 46.7'E**

Water Depth: **1005 m.** *Dist. from Land:* **135 n.mi.** *Jurisdiction:* **AUSTRALIA**

General location or geomorphic province:
Northern Townsville Trough.

Upon what geophysical and/or geological data was this site selection made:
Seismic lines: **BMR LINE 75/030 (CROSSING 30E & 30K)**
Piston cores: **75PC07, (75GC30)**
DSDP holes: **NONE**
Other:

Proposed total penetration: **700 m.**
Probable sediment thickness: **1500 m.**

From previous DSDP drilling in this area, list all hydrocarbon occurrences of greater than background levels, give nature of show, age and depth of rock:
NO PREVIOUS DRILLING.

From available information, list all commercial drilling in this area that produced or yielded significant shows; give depths and ages of hydrocarbon bearing deposits:
NO COMMERCIAL DRILLING IN THIS AREA. NEAREST WELL IS APPROX. 355 n.mi. TO THE SOUTH - NO HYDROCARBONS ENCOUNTERED. OIL SHALES OCCUR ONSHORE IN EARLY TERTIARY NONMARINE BASINS 160 n.mi. TO SOUTH.

Is there any indication of gas hydrates at this location:
NO INDICATION; NO BSR PRESENT.

Is there any reason to expect any hydrocarbon accumulation at this site? Please comment.
NO. ABSENCE OF STRUCTURE AND THERMALLY IMMATURE SECTION PRECLUDES POSSIBILITY OF HYDROCARBON OCCURRENCE.

What is your proposed drilling program?
APC/XCB TO 405 m. (SECOND APC TO 200 m.)
RCB FROM 405 m. TO TD AT 700 m.

What is your proposed logging program?
SCHLUMBERGER LOGGING SUITE; VERTICAL SEISMIC PROFILE.

What "special" precautions will be taken during drilling?
STANDARD HYDROCARBON MONITORING.

What abandonment procedures do you plan to follow? (see Safety Manual, Sec. VIII, p. 22)
STANDARD PROCEDURES.

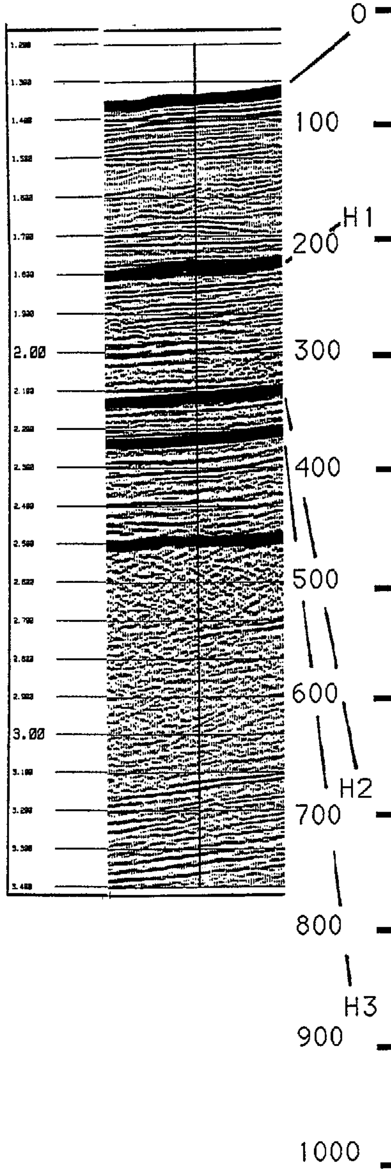
SUMMARY: What do you consider to be the major risks in drilling at this site?
NO MAJOR RISKS. SLIGHT CHANCE OF MINOR BIOGENIC GAS.

Please answer each question as carefully as possible, using extra pages if need be. The information you provide here will be an important factor in the Safety Review.

R9000607

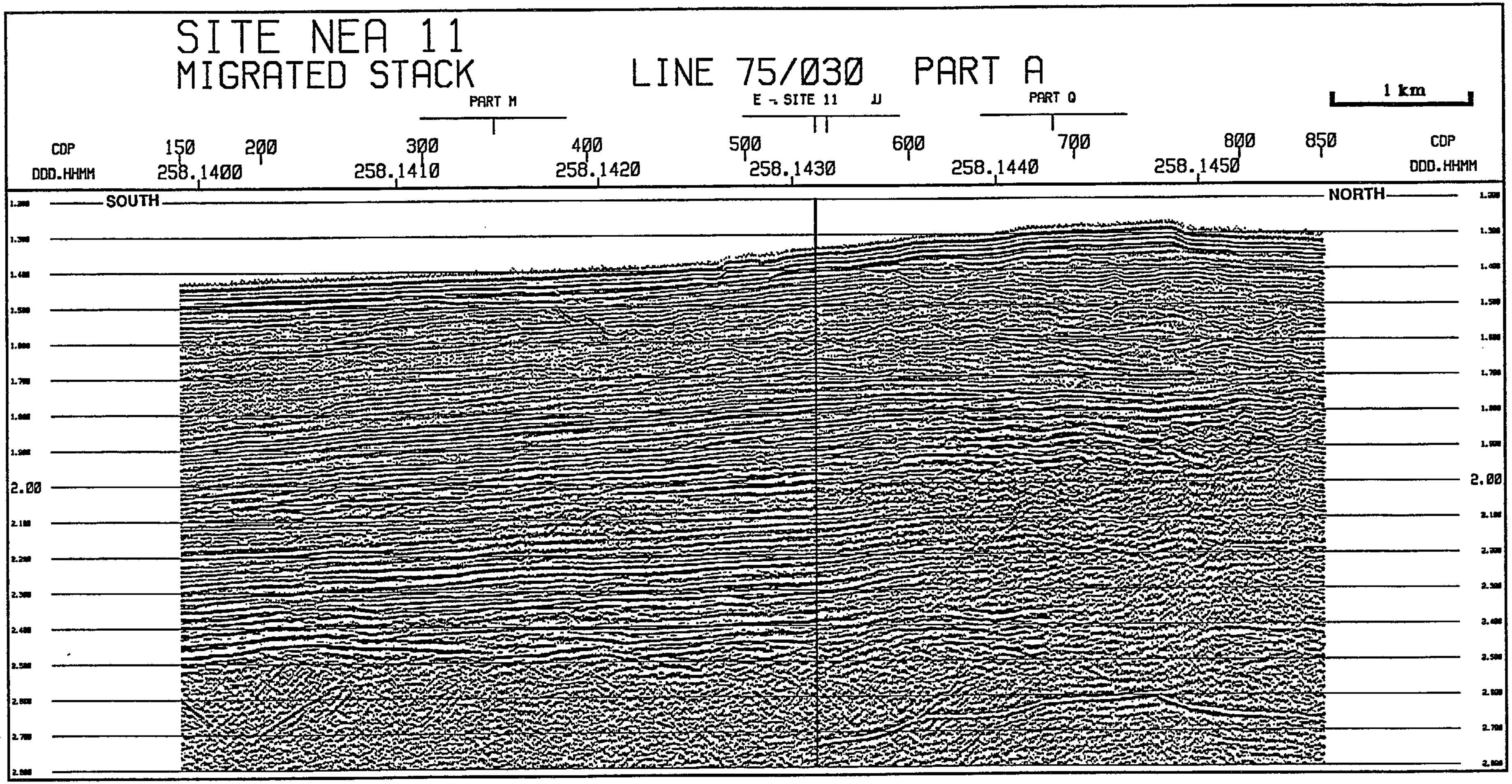
GRAPHIC SUMMARY: SITE NEA 11

Key Reflectors / Depth (m)

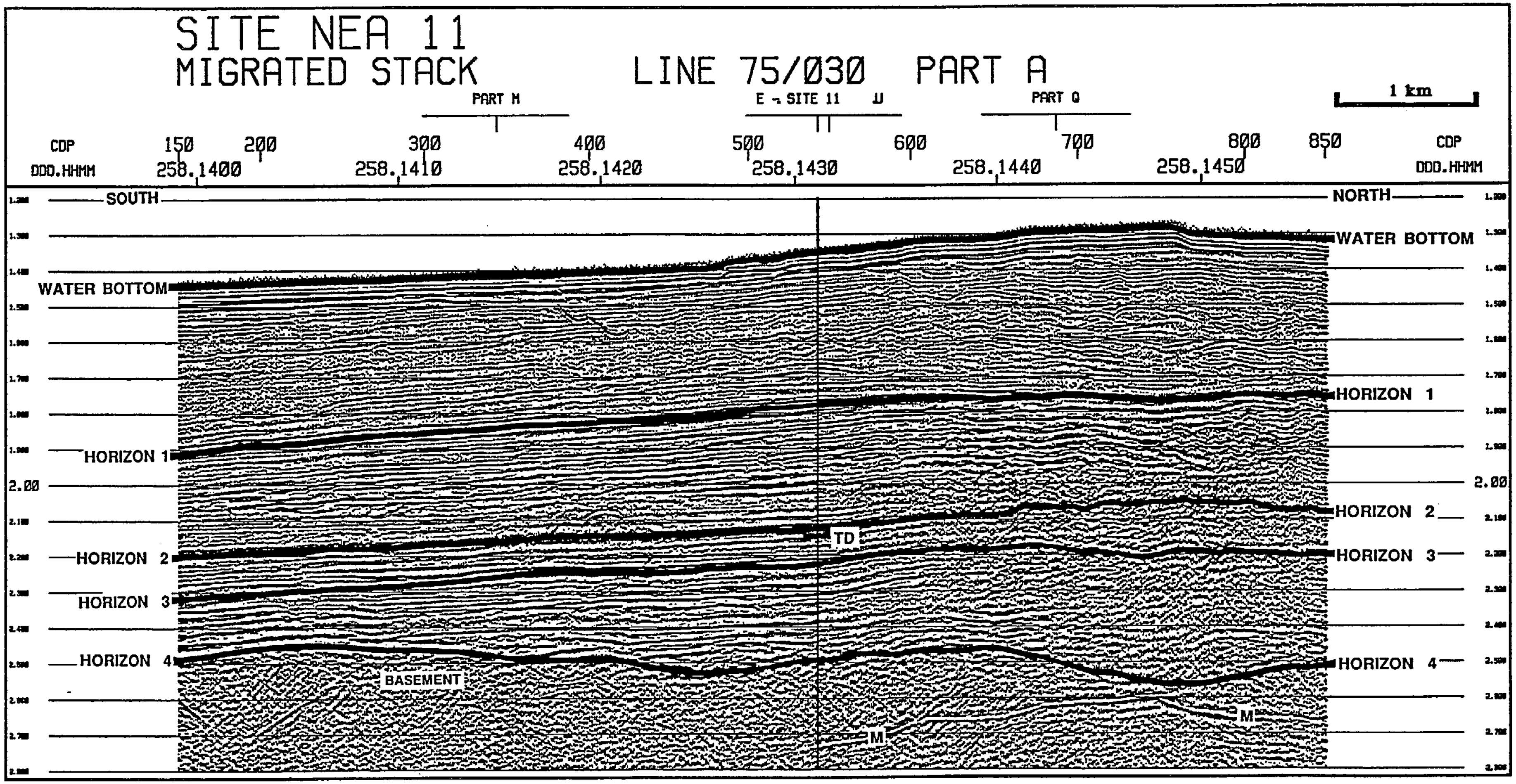


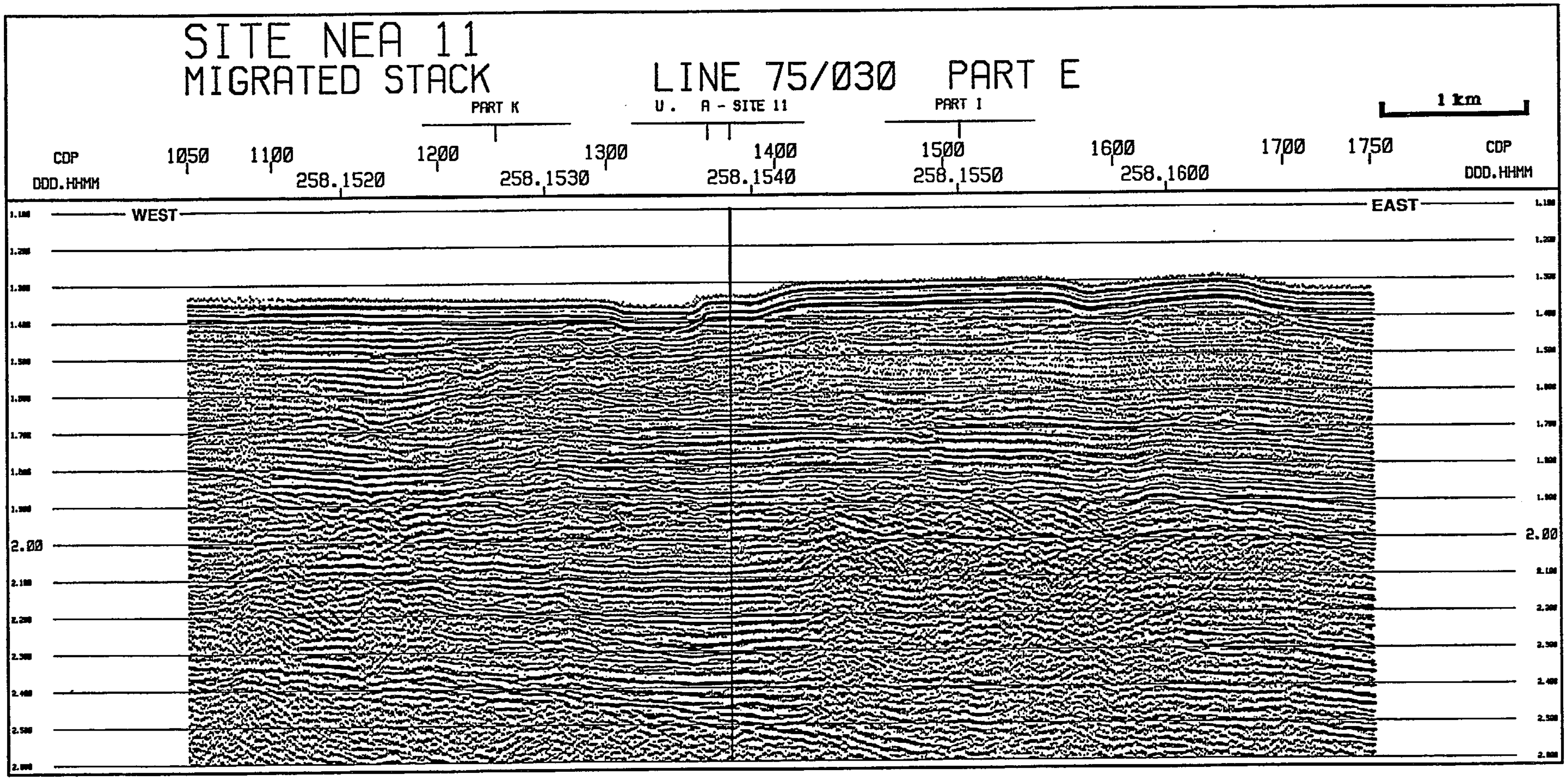
Depth (m)	Age	Velocity (km/sec)	Lithology	Paleoenvironment	Sedim. Rate	Comments
0	Late Pliocene to Recent	1.90	interbedded carbonate sand and mud /ooze	pelagic - outer slope of plateau	45 m/my	periplatform carbonates
[135]	Pliocene	2.0	as above /ooze	pelagic	40 m/my	as above
[195]	Late Miocene	2.1	as above/ooze	pelagic	35 m/my	as above
[405]	Early to Middle Miocene	2.3	wackestone, packstone	mid slope	25 m/my	distal carbonate platform apron
[681]	?Oligocene to Early Miocene	3.0	siliciclastic sandstone, mudstone and wackestone	shallow marine	20 m/my	
[876] TD						

JOIDES Safety Review Check Sheet - Site NEA 11

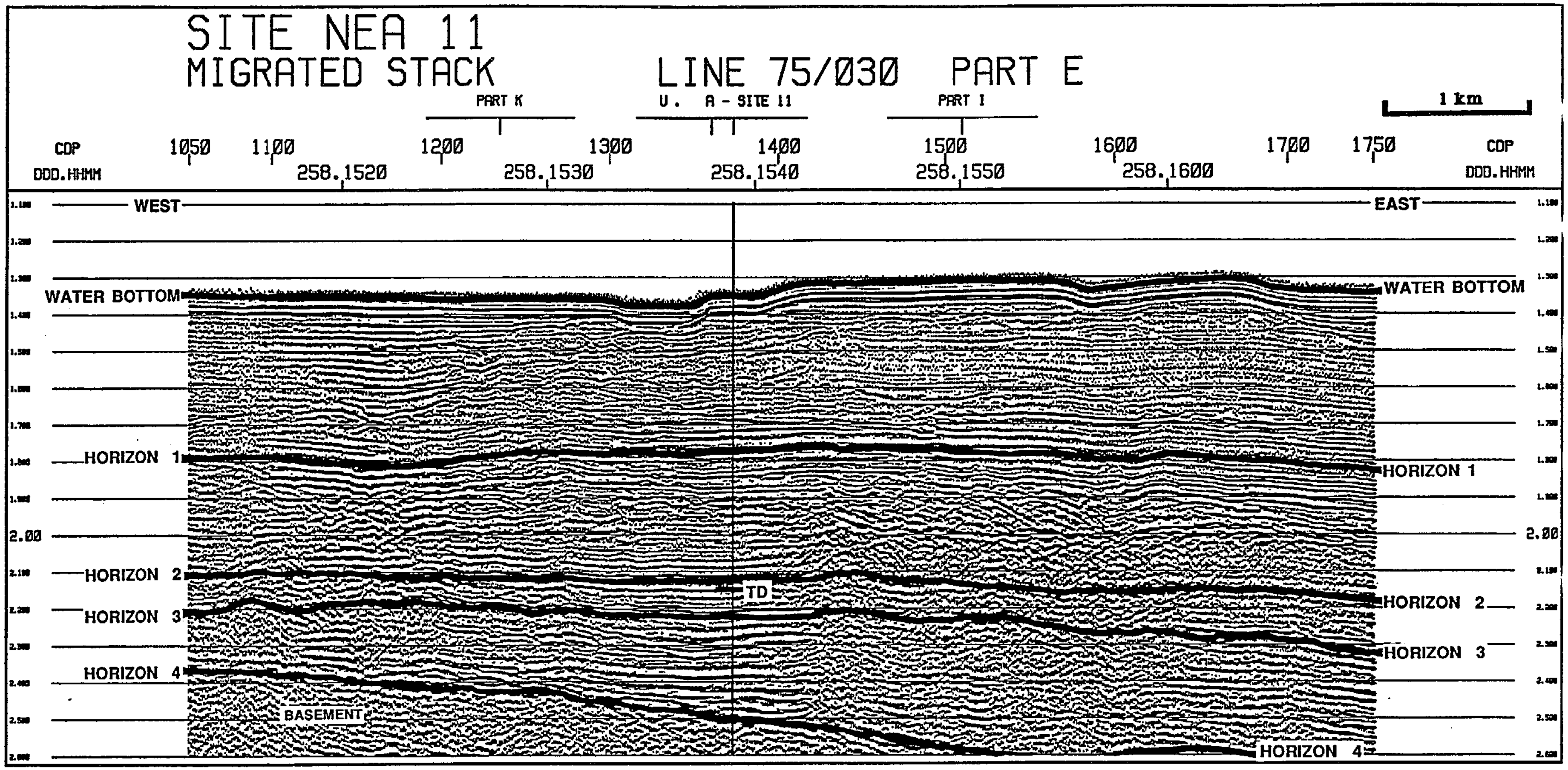


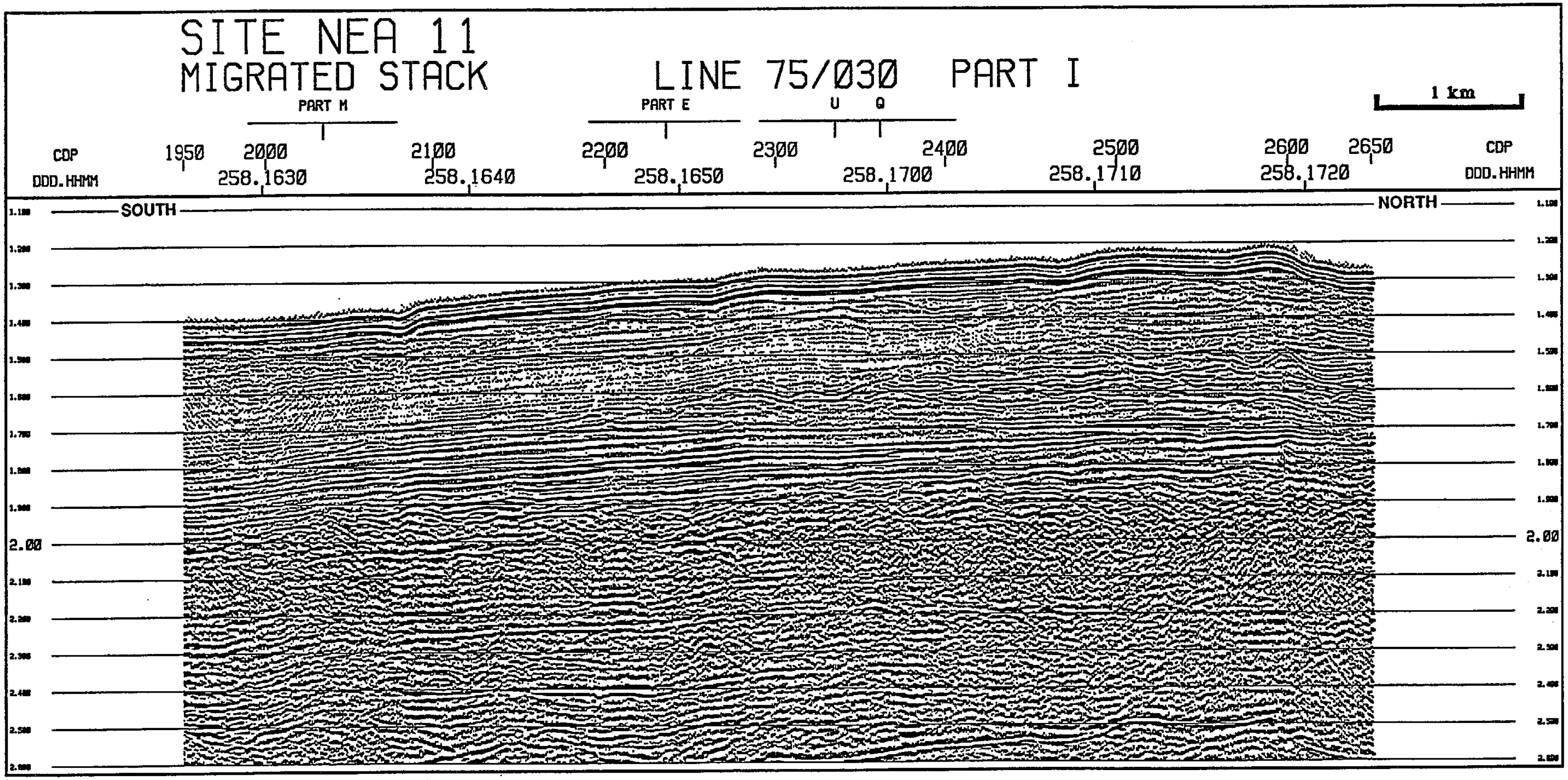
SITE NEA 11
MIGRATED STACK
LINE 75/030 PART A
PART M
E - SITE 11
JJ
PART Q
1 km
CDP
DDD.HHMM
150
200
300
400
500
600
700
800
850
258.1400
258.1410
258.1420
258.1430
258.1440
258.1450
SOUTH
NORTH
2.00


SITE NEA 11
MIGRATED STACK
LINE 75/Ø3Ø PART A
PART M
E ¬ SITE 11
PART Q
1 km
CDP
DDD.HHMM
15Ø
2ØØ
3ØØ
4ØØ
5ØØ
6ØØ
7ØØ
8ØØ
85Ø
258.14ØØ
258.141Ø
258.142Ø
258.143Ø
258.144Ø
258.145Ø
SOUTH
NORTH
WATER BOTTOM
HORIZON 1
2.ØØ
HORIZON 2
HORIZON 3
HORIZON 4
TD
BASEMENT
M

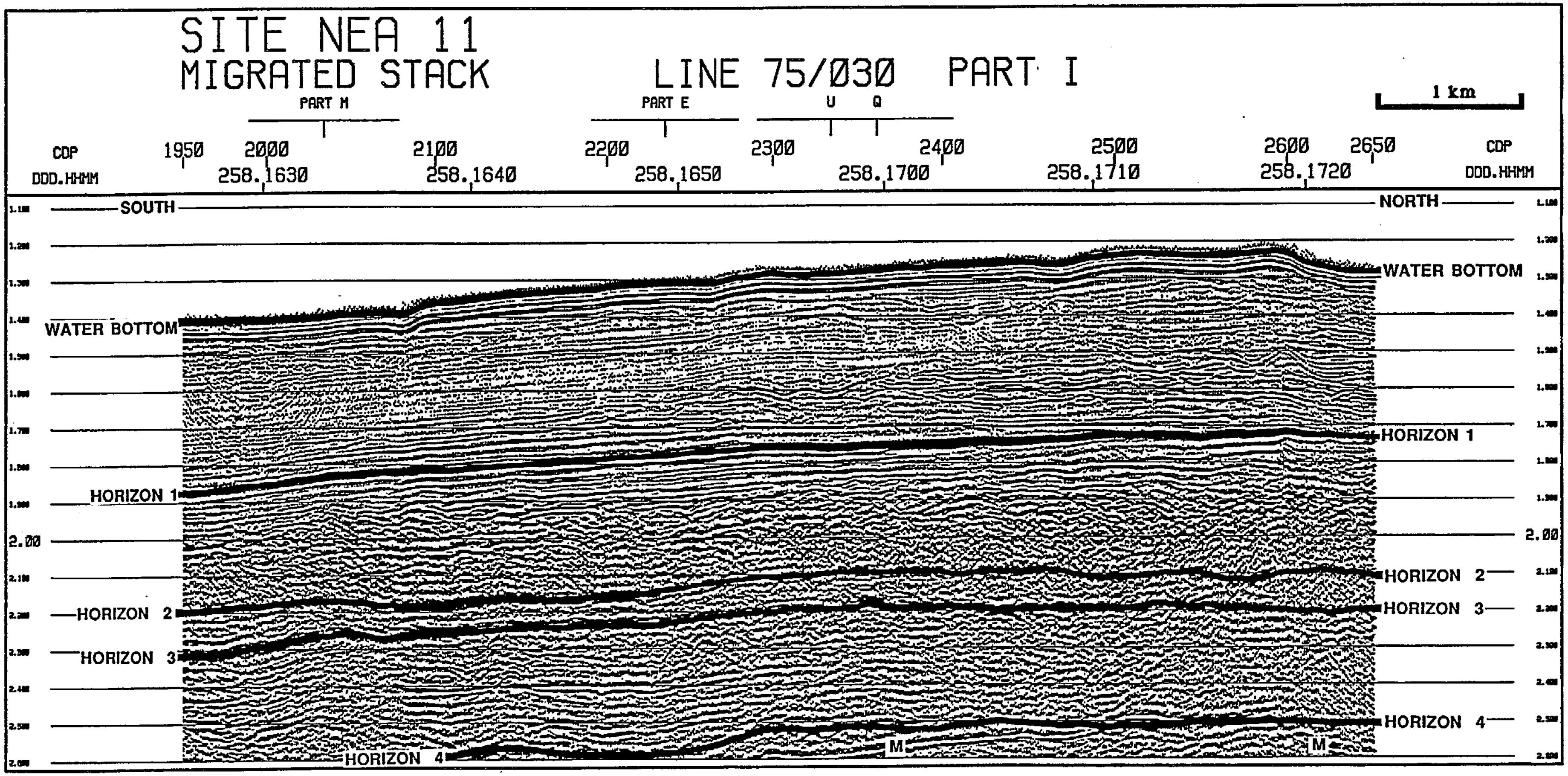


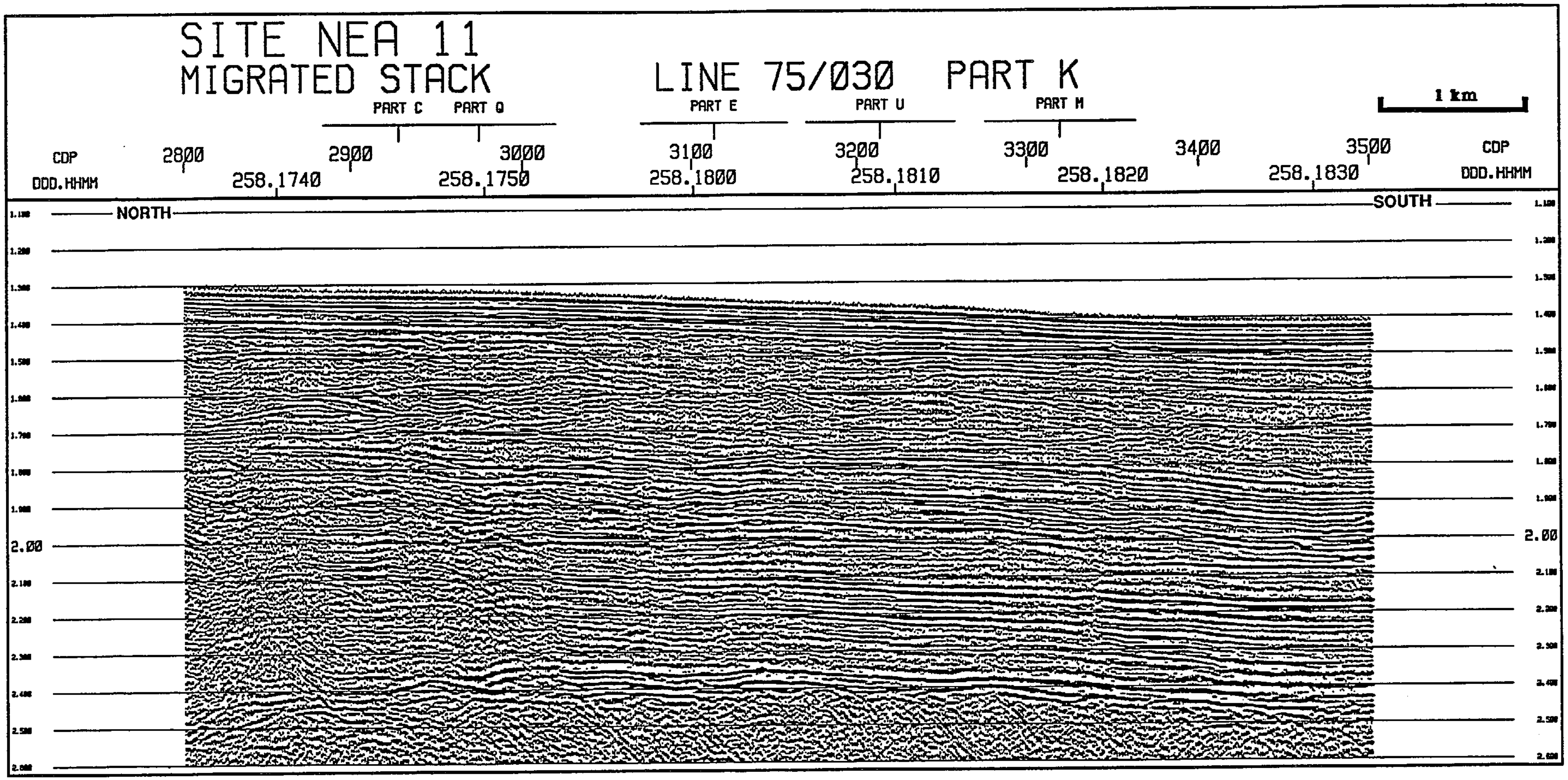
SITE NEA 11
MIGRATED STACK
LINE 75/030 PART E
PART K
U. A - SITE 11
PART I
1 km
CDP
DDD.HHMM
1050
1100
1200
1300
1400
1500
1600
1700
1750
258.1520
258.1530
258.1540
258.1550
258.1600
WEST
EAST
2.00

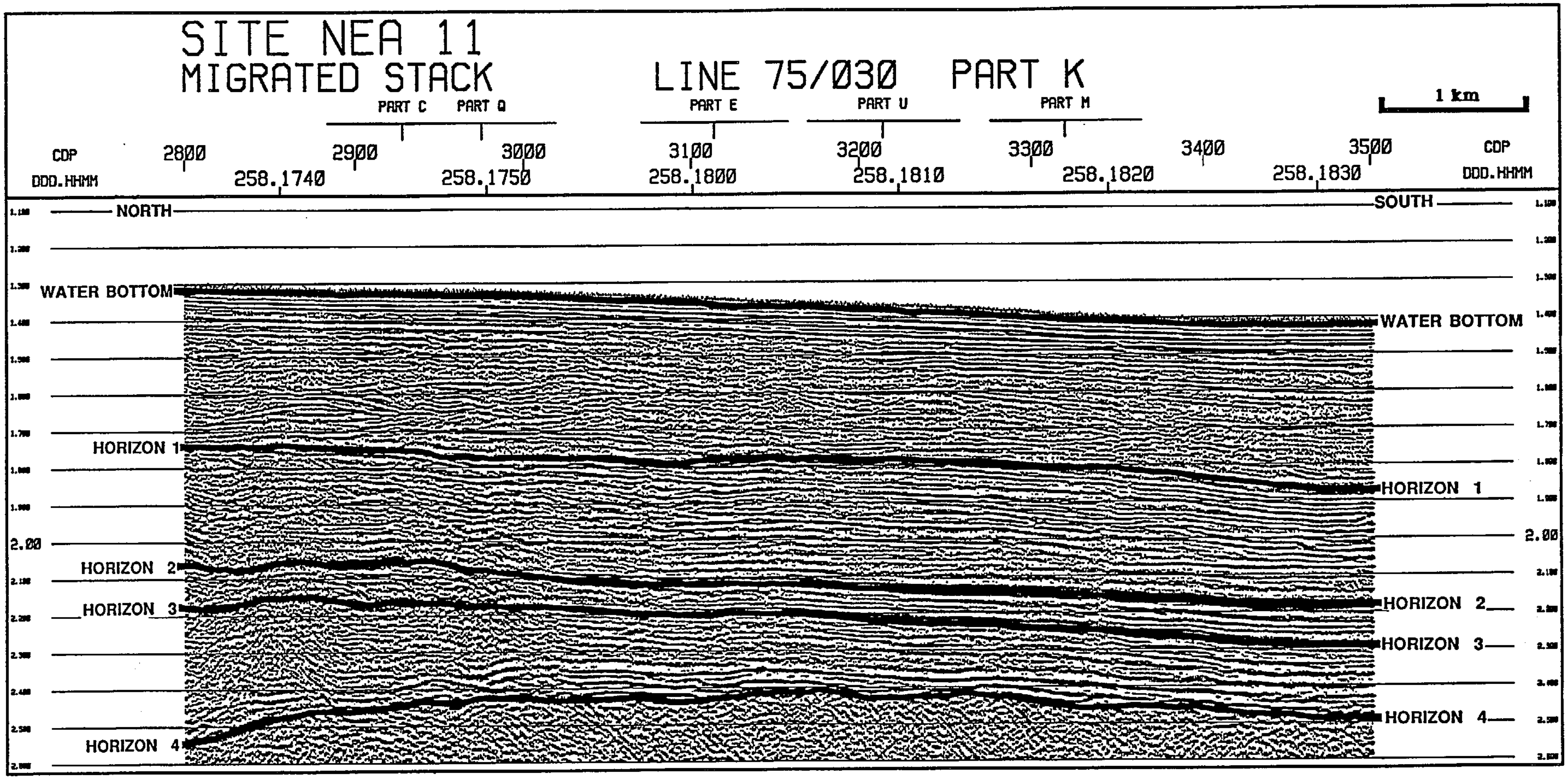

SITE NEA 11
MIGRATED STACK
LINE 75/030 PART E
PART K
U. A - SITE 11
PART I
1 km
CDP
DDD.HHMM
1050 1100 1200 1300 1400 1500 1600 1700 1750
258.1520 258.1530 258.1540 258.1550 258.1600
WEST
EAST
WATER BOTTOM
HORIZON 1
HORIZON 2
HORIZON 3
HORIZON 4
TD
BASEMENT
2.00



SITE NEA 11
MIGRATED STACK
LINE 75/030 PART I
1 km
PART M
PART E
U Q
CDP
DDD.HHMM
1950 2000 2100 2200 2300 2400 2500 2600 2650
258.1630 258.1640 258.1650 258.1700 258.1710 258.1720
SOUTH
NORTH
2.00


SITE NEA 11
MIGRATED STACK
LINE 75/030 PART I
1 km
PART M
PART E
U
Q
CDP
DDD.HHMM
1950
2000
2100
2200
2300
2400
2500
2600
2650
258.1630
258.1640
258.1650
258.1700
258.1710
258.1720
SOUTH
NORTH
WATER BOTTOM
HORIZON 1
HORIZON 2
HORIZON 3
HORIZON 4
M
2.00


SITE NEA 11
MIGRATED STACK
LINE 75/030 PART K
PART C
PART Q
PART E
PART U
PART M
1 km
CDP
DDD.HHMM
2800
2900
3000
3100
3200
3300
3400
3500
258.1740
258.1750
258.1800
258.1810
258.1820
258.1830
NORTH
SOUTH
2.00

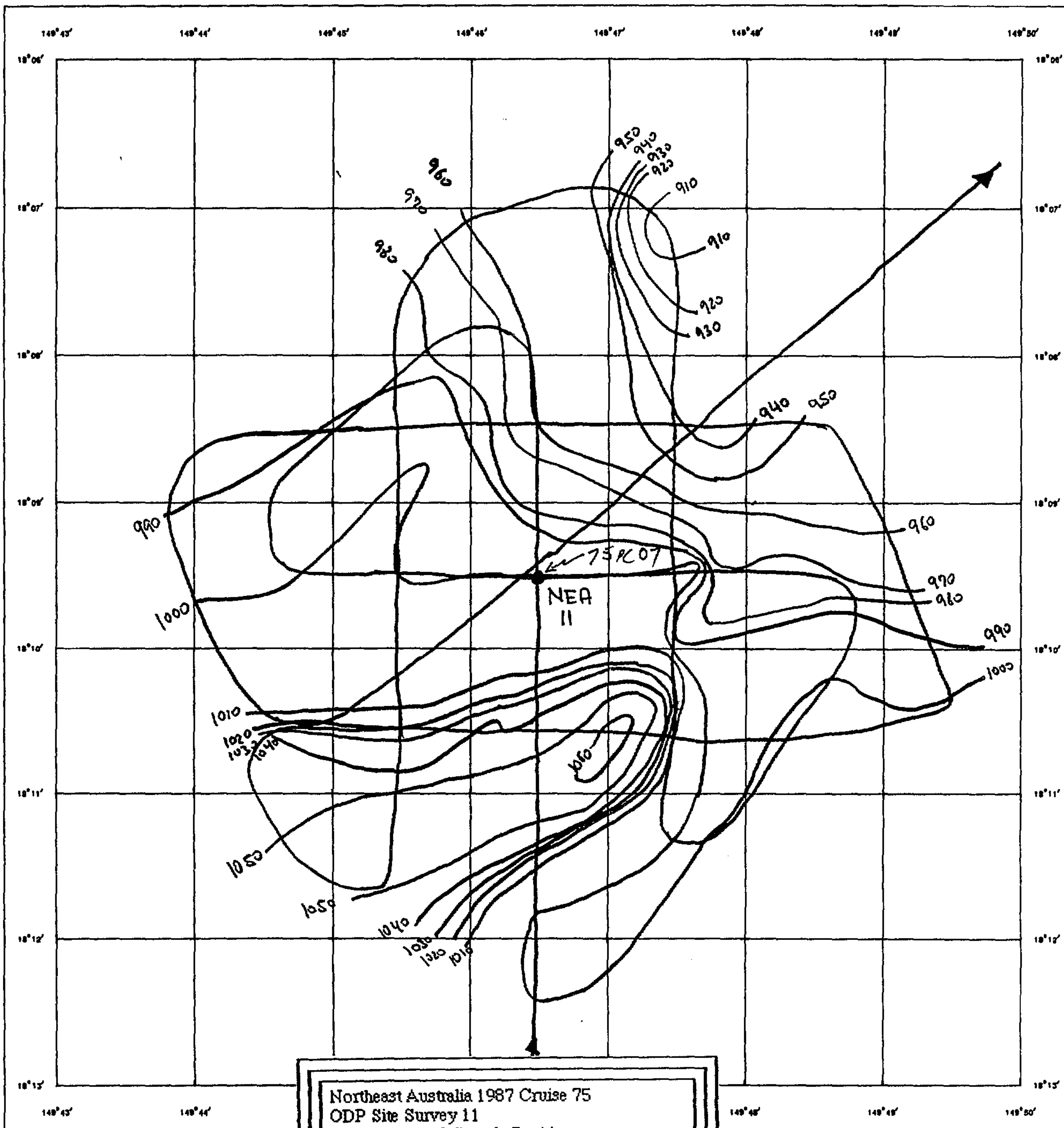

SITE NEA 11
MIGRATED STACK
LINE 75/Ø3Ø PART K
PART C
PART Q
PART E
PART U
PART M
1 km
CDP
DDD.HHMM
28ØØ
29ØØ
3ØØØ
31ØØ
32ØØ
33ØØ
34ØØ
35ØØ
258.174Ø
258.175Ø
258.18ØØ
258.181Ø
258.182Ø
258.183Ø
NORTH
SOUTH
WATER BOTTOM
HORIZON 1
HORIZON 2
HORIZON 3
HORIZON 4
2.ØØ

O.D.P.SITE SURVEY

SCALE 1:50000

NEA 11

EDITION OF 1987/10/02



Northeast Australia 1987 Cruise 75
ODP Site Survey 11
Bathymetry and Sample Positions
Contour Interval - 10m
Site Position - Time - 258/1431GMT
Lat. 18 09.5'S
Long. 149 46.5'E

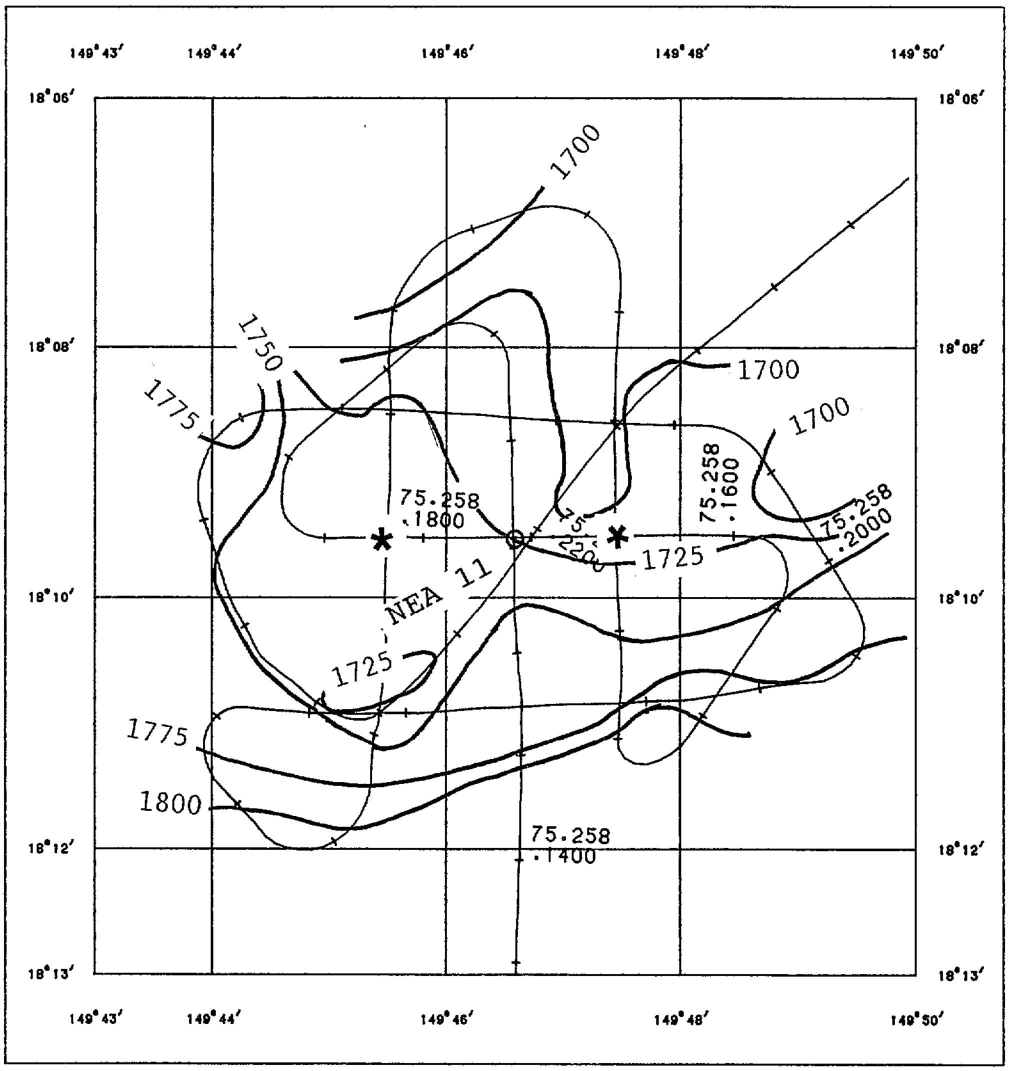
AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR PROJECTION
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

O.D.P.SITE SURVEY
NEA 11

ODP SITE 11

SCALE 1:100000 EDITION OF 1989/03/29

HORIZON 1 DEPTH (TWT)



* ALTERNATE SITE

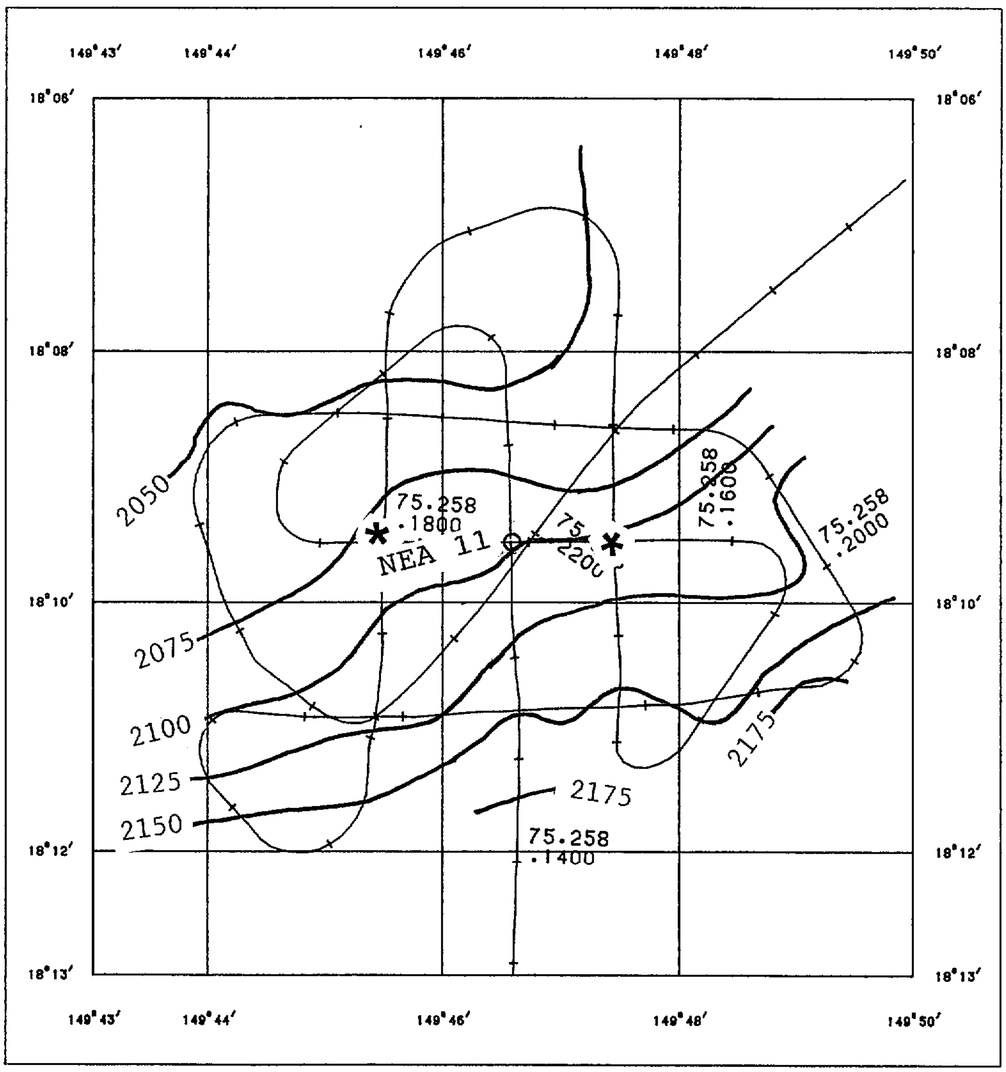
AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP ODP SITE 11

ODP SITE 11

SCALE 1:100000 EDITION OF 1989/03/29

HORIZON 2 DEPTH (TWT)



* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

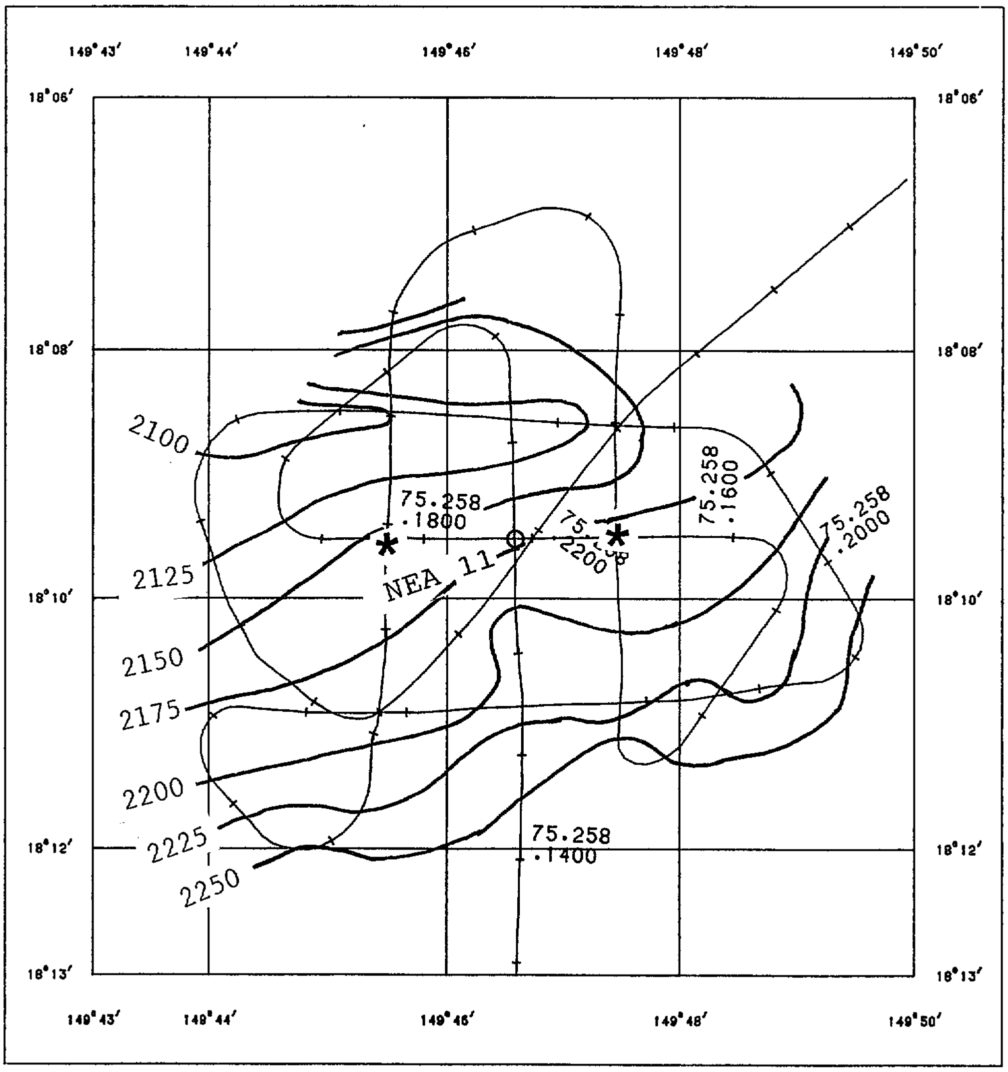
TRACK MAP ODP SITE 11

ODP SITE 11

SCALE 1:100000

EDITION OF 1989/03/29

HORIZON 3 DEPTH (TWT)



* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP ODP SITE 11

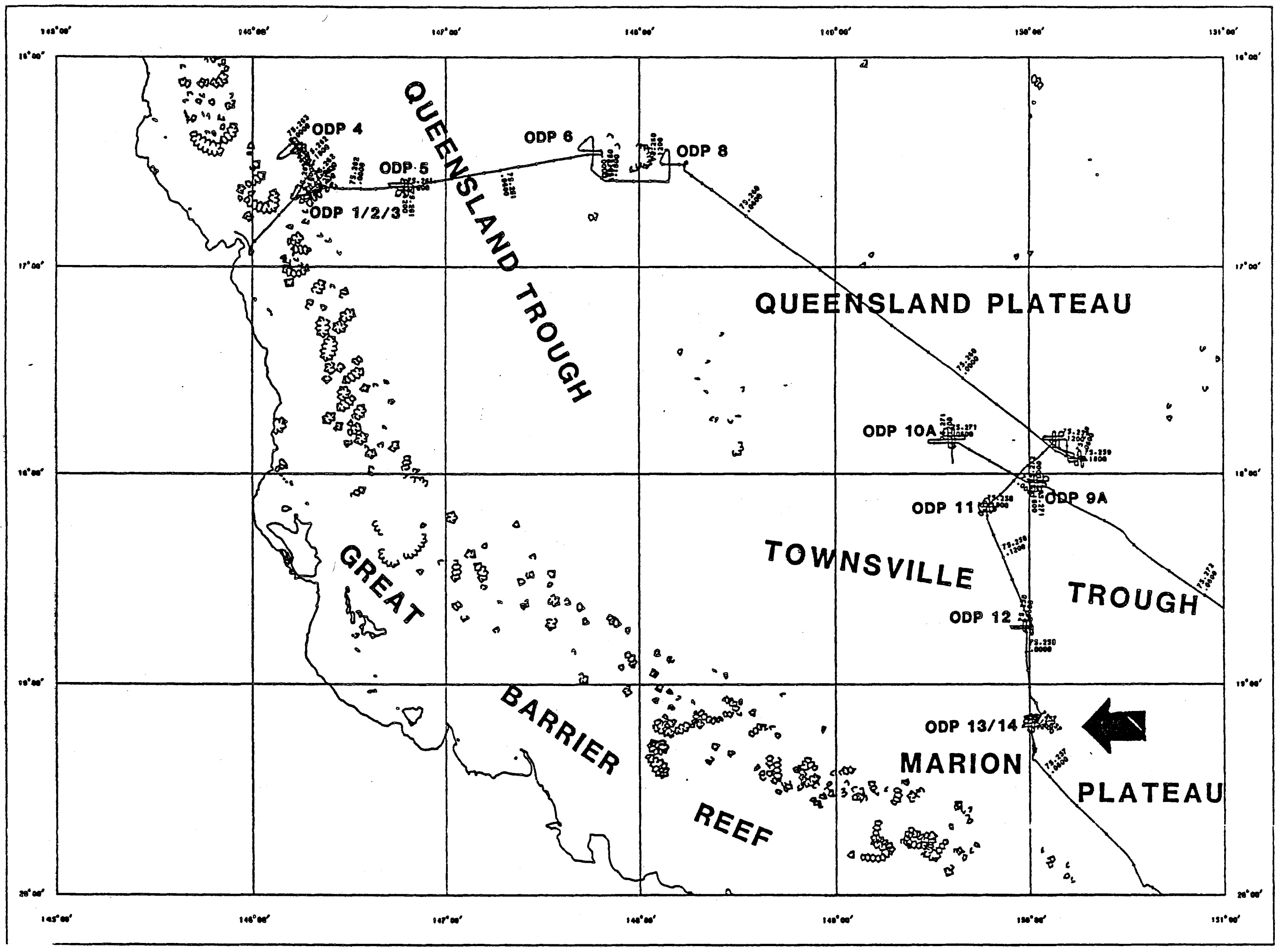
3.10 Sites NEA 13 and 14

[THESE SITES WILL BE CONSIDERED TOGETHER AS THEY HAVE A COMMON SEISMIC GRID]

NORTHEAST AUSTRALIA ODP SITES

SCALE 1:2000000

EDITION OF 1989/03/30



TRACK MAP

NORTHEAST AUSTRALIA ODP SITES

OVERVIEW - SITES NEA13 AND NEA14

Sites 13 and 14 lie on the northwestern margin of the Marion Plateau, on the southern edge of the Townsville Trough. The Marion Plateau cover sequence, of Miocene age, is comprised of several phases of superimposed carbonate platform growth separated by areas of detrital deposition. Site 13 will drill through the edge of one of the later phases of carbonate platform growth, before penetrating the uppermost part of the oldest platform complex. Site 14 is sited to recover current-reworked peri-platform sediments in front of the earliest phase of Miocene carbonate platform growth.

OBJECTIVES - SITE 13

1. Determine the minimum position and timing of the Middle Miocene eustatic highstand.
2. Determine the nature and age of two phases of carbonate platform growth, thereby defining the paleoclimatic and paleoceanographic regimes at two times during the Neogene.
3. Determine the cause and timing of the demise of two phases of carbonate platform accretion, as a key to understanding the controls on carbonate platform development.
4. Determine the nature and age of the sequence overlying the carbonate platforms, in order to understand the paleoclimatic and paleoceanographic regime at a time when carbonate platform facies were not deposited.

PROGNOSIS - SITE 13

1. 110 m of Plio-Pleistocene current-winnowed peri-platform sediment.
2. 35 m of ?Late Miocene to Pliocene in-situ and detrital carbonate mound facies (probably warm subtropical to tropical).
3. Major unconformity.
4. 115 m of late Early to early Middle Miocene subtropical carbonate mound facies.

OBJECTIVES - SITE 14

1. Determine the cause and timing of the demise of the oldest phase of carbonate platform accretion, as a key to understanding the controls on carbonate platform development.
2. Determine the nature and age of the peri-platform sequence deposited throughout much the Neogene, both during and between periods of carbonate platform growth. This sequence will contain a record of the paleoclimatic and paleoceanographic factors controlling carbonate platform development from the late Early Miocene, including the transition from subtropical to tropical climates.

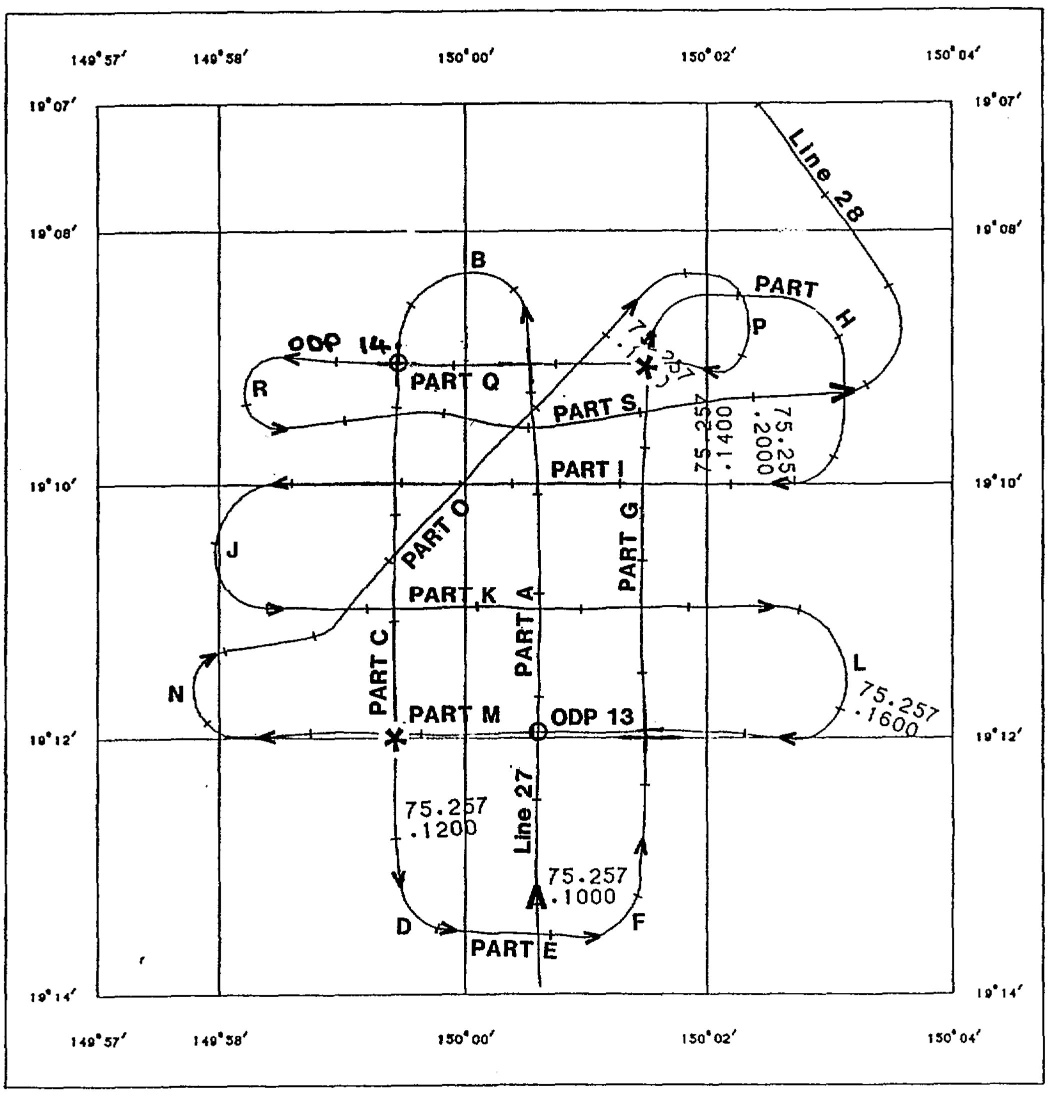
PROGNOSIS - SITE 14

1. 55 m of Plio-Pleistocene peri-platform ooze.
2. 240 m of ?latest Miocene to Pliocene peri-platform sediment.
3. Major unconformity.
4. 105 m of Early Miocene subtropical carbonate platform detritus.

ODP SITES 13 & 14

SCALE 1:100000

EDITION OF 1989/03/30



* ALTERNATE SITE

AUSTRALIAN NATIONAL SPHEROID
UNIVERSAL MERCATOR (SPHERE)
WITH NATURAL SCALE CORRECT
AT LATITUDE 33 00

TRACK MAP . ODP SITES 13 & 14

CHECK SHEET

JOIDES SAFETY REVIEW

Leg **133** *Site No.* **NEA 13** *Lat.* **19^{o} 12.0'S** *Long.* **150^{o} 0.6'E**

Water Depth: **426 m.**
Dist. from Land: **85 n.mi.**
Jurisdiction: **AUSTRALIA**

General location or geomorphic province:
NORTHWESTERN MARION PLATEAU.

Upon what geophysical and/or geological data was this site selection made:
Seismic lines: **BMR LINE 75/027 (CROSSING 27A & 27M)**
Piston cores:
DSDP holes: **NONE**
Other:

Proposed total penetration: **250 m.**
Probable sediment thickness: **2500 m.**

From previous DSDP drilling in this area, list all hydrocarbon occurrences of greater than background levels, give nature of show, age and depth of rock:
NO PREVIOUS DRILLING.

From available information, list all commercial drilling in this area that produced or yielded significant shows; give depths and ages of hydrocarbon bearing deposits:
NO COMMERCIAL DRILLING IN THIS AREA. NEAREST WELL IS APPROX. 240 n.mi. TO THE SOUTH - NO HYDROCARBONS ENCOUNTERED. OIL SHALES OCCUR ONSHORE IN EARLY TERTIARY NONMARINE BASINS 250 n.mi. TO SOUTH.

Is there any indication of gas hydrates at this location:
NO INDICATION; NO BSR PRESENT.

Is there any reason to expect any hydrocarbon accumulation at this site? Please comment.
NO. SHALLOW BASEMENT, ABSENCE OF STRUCTURE AND THERMALLY IMMATURE SECTION PRECLUDES POSSIBILITY OF HYDROCARBON OCCURRENCE.

What is your proposed drilling program?
APC/XCB TO 110 m.
RCB FROM 110 m. TO TD AT 250 m.

What is your proposed logging program?
NO LOGGING.

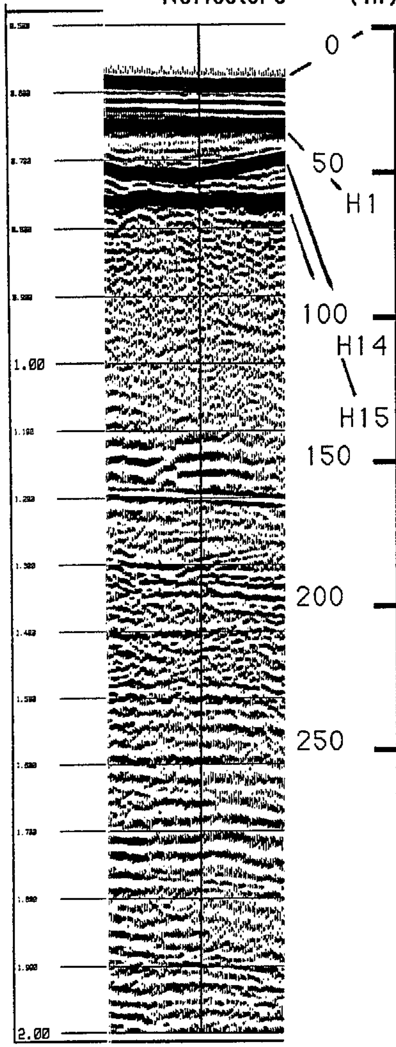
What "special" precautions will be taken during drilling?
STANDARD HYDROCARBON MONITORING.

What abandonment procedures do you plan to follow? (see Safety Manual, Sec. VIII, p. 22)
STANDARD PROCEDURES.

SUMMARY: What do you consider to be the major risks in drilling at this site?
NO MAJOR RISKS. SLIGHT CHANCE OF MINOR BIOGENIC GAS.

Please answer each question as carefully as possible, using extra pages if need be. The information you provide here will be an important factor in the Safety Review.

GRAPHIC SUMMARY: SITE NEA 13



Lithology column	Age	Velocity (km/sec)	Lithology	Paleoenvironment	Sedim. Rate	Comments
	Pliocene to Recent [110]	1.60	interbedded sandstone/gravel and packstone/grainstone	hemipelagic - plateau outer margin	21.0 m/my	condensed section subject to current winnowing. Coarse, cemented, lag deposits.
	?Late Miocene to Pliocene [135]	2.15	packstone/grainstone	backreef	9.0 m/my	may have been subject to freshwater diagenesis
	Early Miocene [250]	2.50	boundstone/packstone/grainstone	reef to backreef or lagoon		
TD						

JOIDES Safety Review Check Sheet - Site NEA 13

CHECK SHEET

JOIDES SAFETY REVIEW

Leg **133** *Site No.* **NEA 14** *Lat.* **19° 9.0'S** *Long.* **150° 0.5'E**

Water Depth:	*Dist. from Land:*	*Jurisdiction:*
456 m.	**85 n.mi.**	**AUSTRALIA**

General location or geomorphic province:
NORTHWESTERN MARION PLATEAU.

Upon what geophysical and/or geological data was this site selection made:
Seismic lines: **BMR LINE 75/027 (CROSSING 27C & 27Q)**
Piston cores: **75PC09**
DSDP holes: **NONE**
Other:

Proposed total penetration: **400 m.**
Probable sediment thickness: **2500 m.**

From previous DSDP drilling in this area, list all hydrocarbon occurrences of greater than background levels, give nature of show, age and depth of rock:
NO PREVIOUS DRILLING.

From available information, list all commercial drilling in this area that produced or yielded significant shows; give depths and ages of hydrocarbon bearing deposits:
NO COMMERCIAL DRILLING IN THIS AREA. NEAREST WELL IS APPROX. 250 n.mi. TO THE SOUTH - NO HYDROCARBONS ENCOUNTERED. OIL SHALES OCCUR ONSHORE IN EARLY TERTIARY NONMARINE BASINS 250 n.mi. TO SOUTH.

Is there any indication of gas hydrates at this location:
NO INDICATION; NO BSR PRESENT.

Is there any reason to expect any hydrocarbon accumulation at this site? Please comment.
NO. SHALLOW BASEMENT, ABSENCE OF STRUCTURE AND THERMALLY IMMATURE SECTION PRECLUDES POSSIBILITY OF HYDROCARBON OCCURRENCE.

What is your proposed drilling program?
APC/XCB TO 295 m (SECOND APC TO 55 m).
RCB FROM 295 m. TO TD AT 400 m.

What is your proposed logging program?
SCHLUMBERGER LOGGING SUITE.

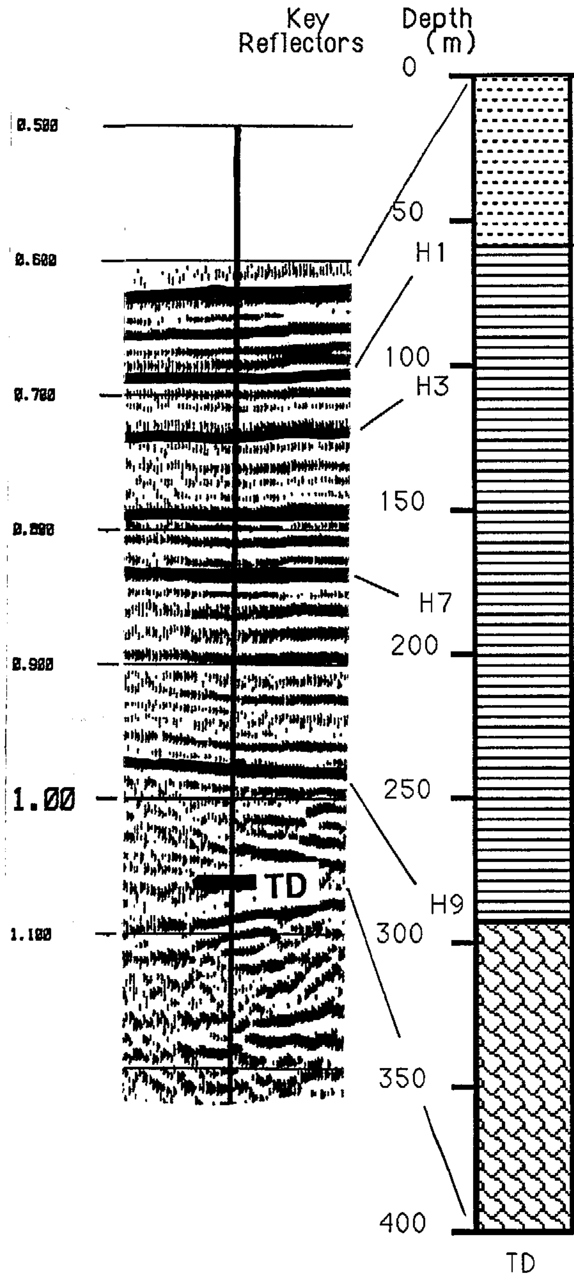
What "special" precautions will be taken during drilling?
STANDARD HYDROCARBON MONITORING.

What abandonment procedures do you plan to follow? (see Safety Manual, Sec. VIII, p. 22)
STANDARD PROCEDURES.

SUMMARY: What do you consider to be the major risks in drilling at this site?
NO MAJOR RISKS.

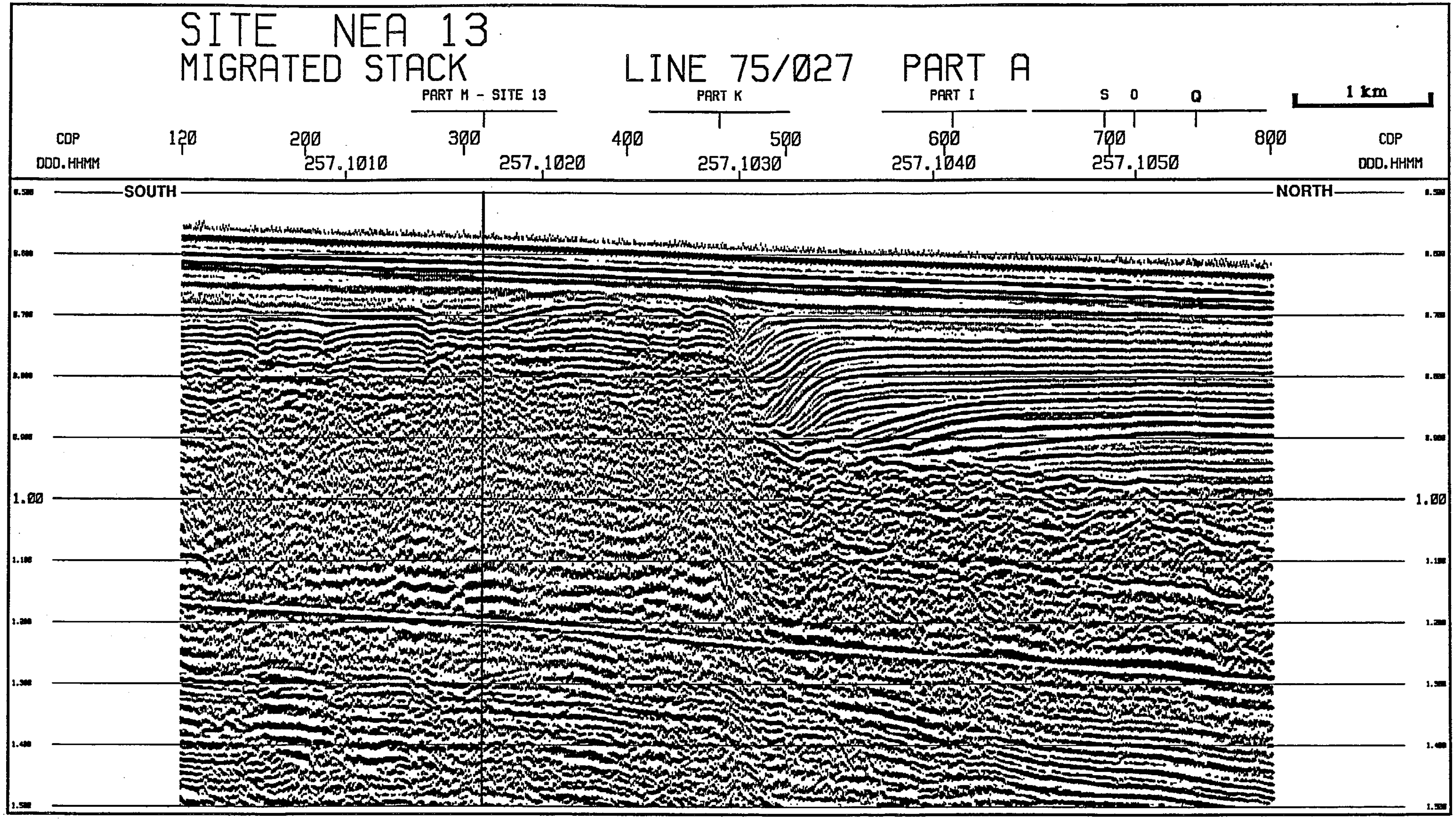
Please answer each question as carefully as possible, using extra pages if need be. The information you provide here will be an important factor in the Safety Review.

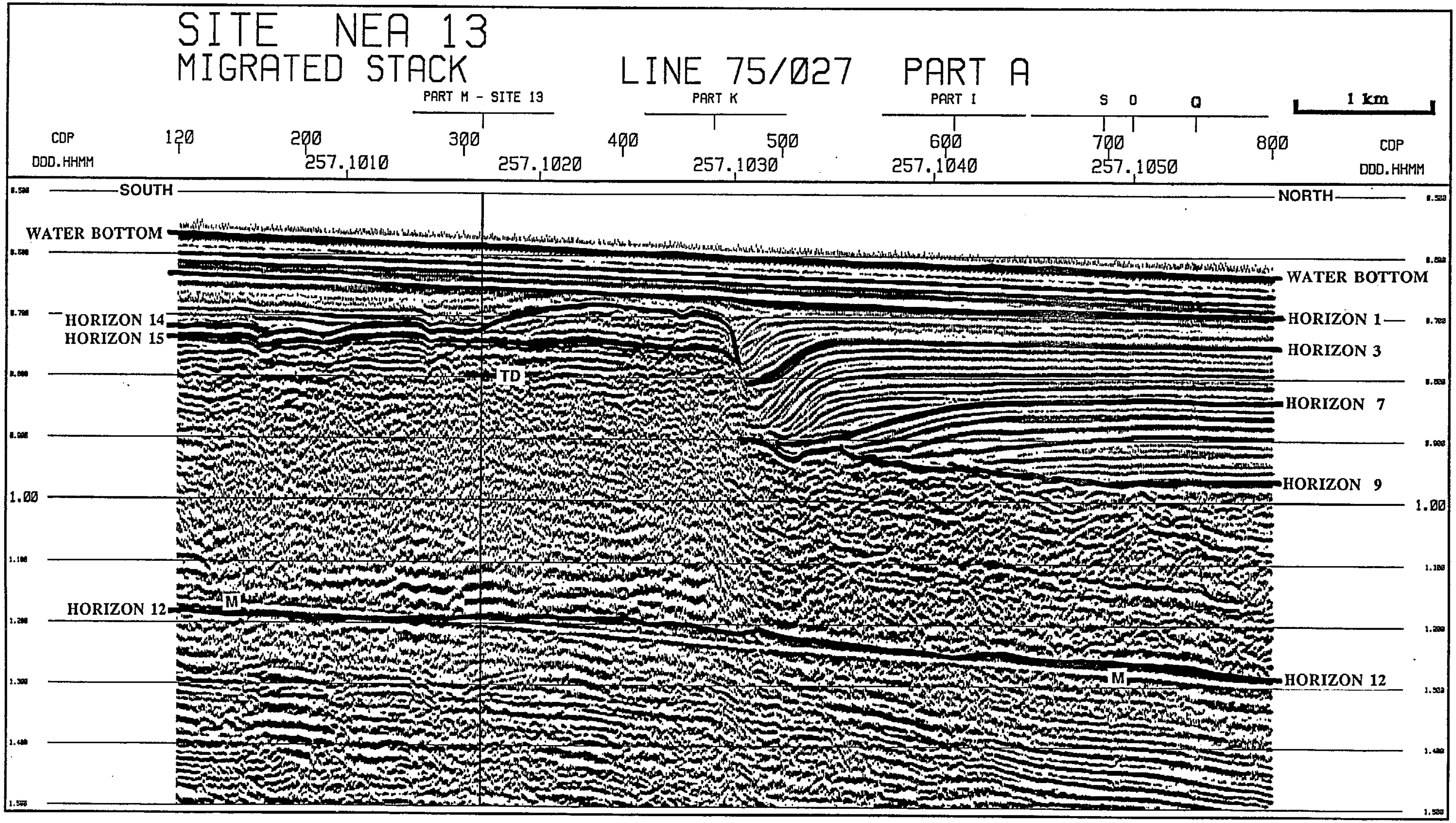
GRAPHIC SUMMARY: SITE NEA 14

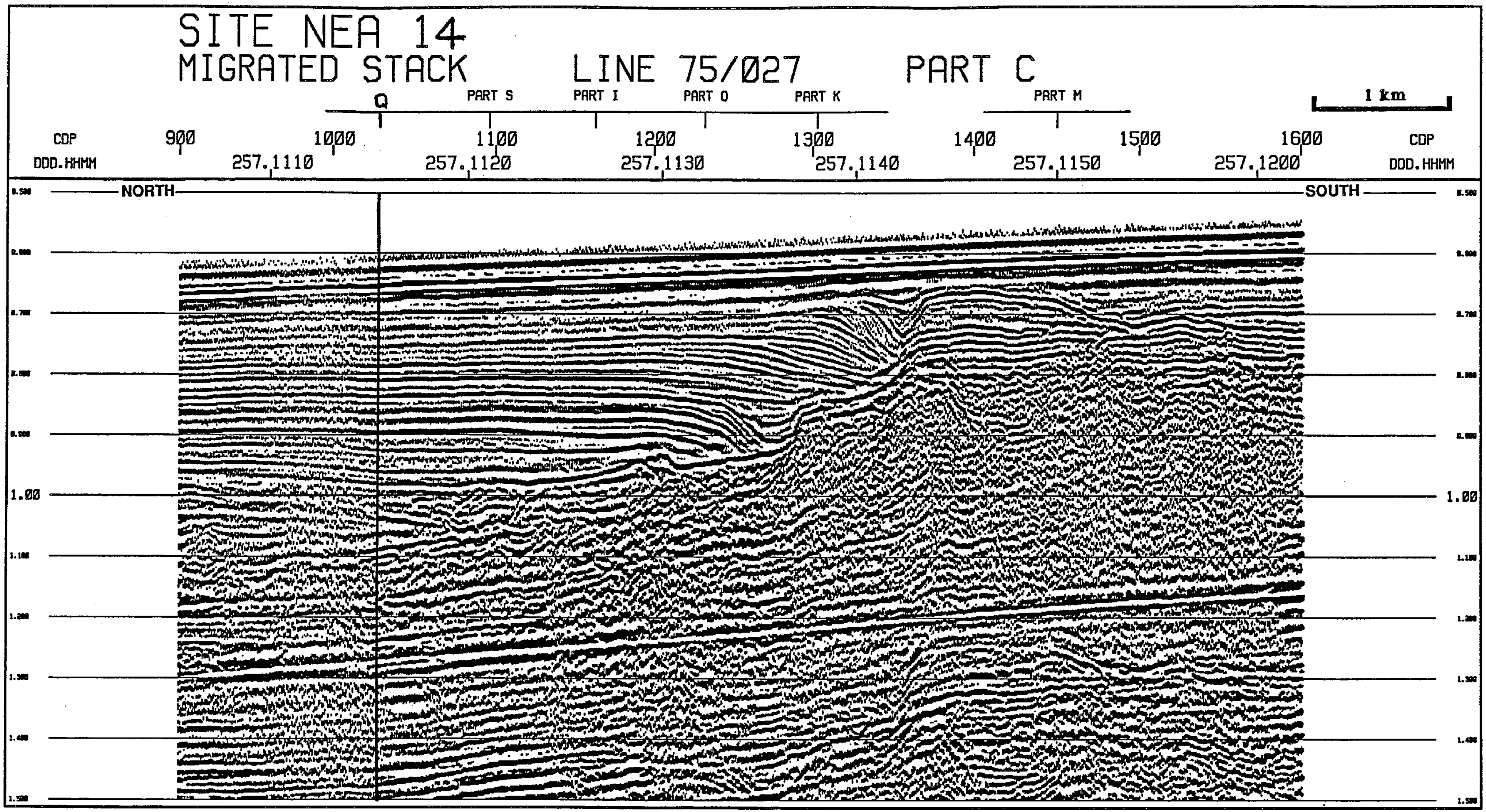


Age	Velocity (km/sec)	Lithology	Paleoenvironment	Sedim. Rate	Comments
Pliocene to Recent	1.60	mud/ooze	pelagic - plateau outer margin	27.5 m/my	
[55] [101] Late Miocene and [178] Pliocene	1.80	mudstone/ wackestone	top of slope - adjacent to carbonate platform margin	24.5 m/my	downlapping / onlapping contourite package
[295] Early Miocene	2.50	rudstone/ wackestone/ packstone	carbonate platform debris apron		

JOIDES Safety Review Check Sheet - Site NEA14


SITE NEA 13
MIGRATED STACK
LINE 75/Ø27 PART A
PART M - SITE 13
PART K
PART I
S O Q
1 km
CDP
DDD.HHMM
12Ø
2ØØ
3ØØ
4ØØ
5ØØ
6ØØ
7ØØ
8ØØ
257.1Ø1Ø
257.1Ø2Ø
257.1Ø3Ø
257.1Ø4Ø
257.1Ø5Ø
SOUTH
NORTH
1.ØØ


SITE NEA 13
MIGRATED STACK
LINE 75/027 PART A
PART M - SITE 13
PART K
PART I
S O Q
1 km
CDP
DDD.HHMM
120
200
300
400
500
600
700
800
257.1010
257.1020
257.1030
257.1040
257.1050
SOUTH
NORTH
WATER BOTTOM
HORIZON 14
HORIZON 15
TD
HORIZON 12
M
HORIZON 1
HORIZON 3
HORIZON 7
HORIZON 9
1.00


SITE NEA 14
MIGRATED STACK LINE 75/027 PART C
Q
PART S
PART I
PART O
PART K
PART M
1 km
CDP
DDD.HHMM
900
1000
1100
1200
1300
1400
1500
1600
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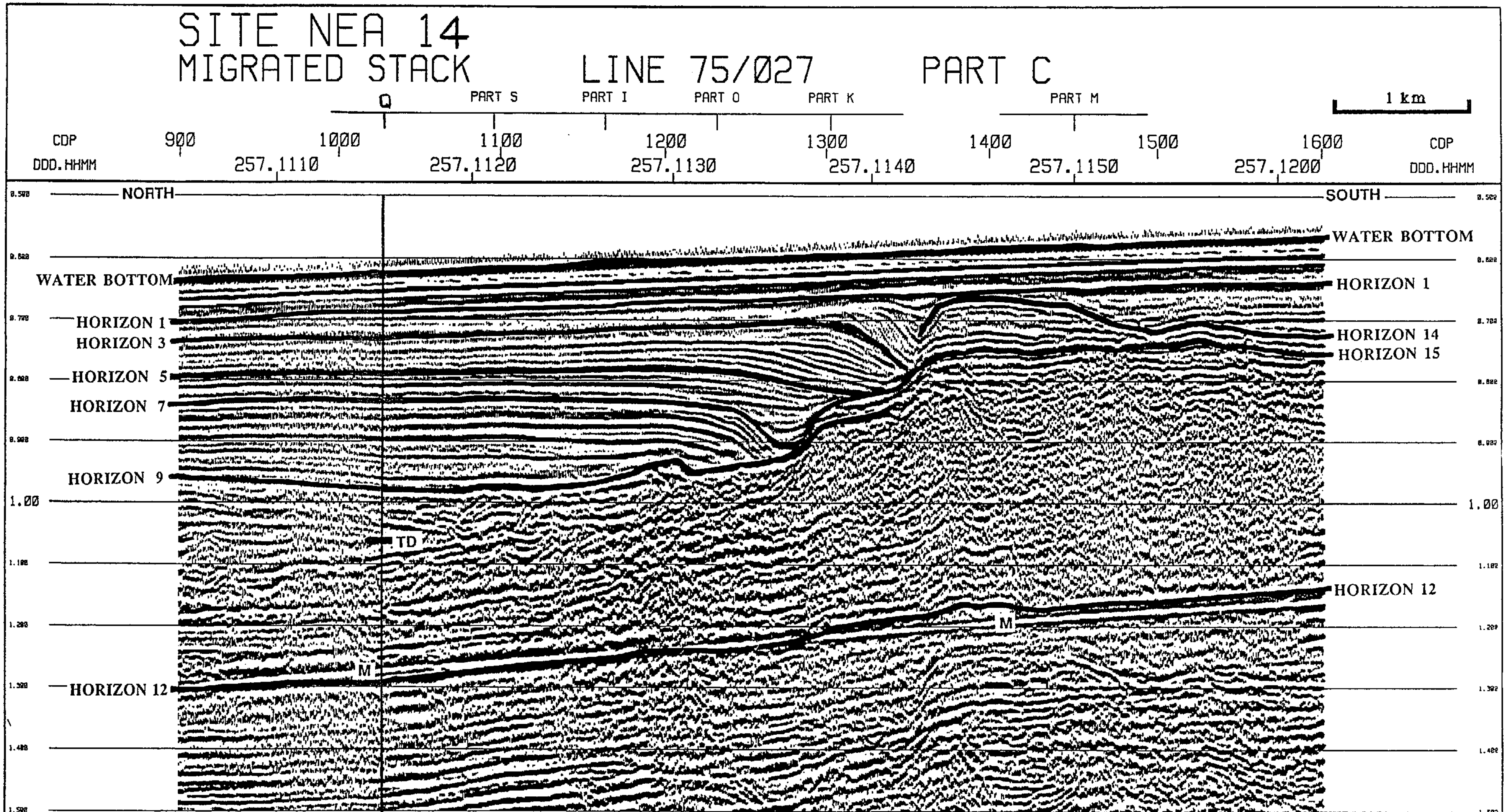
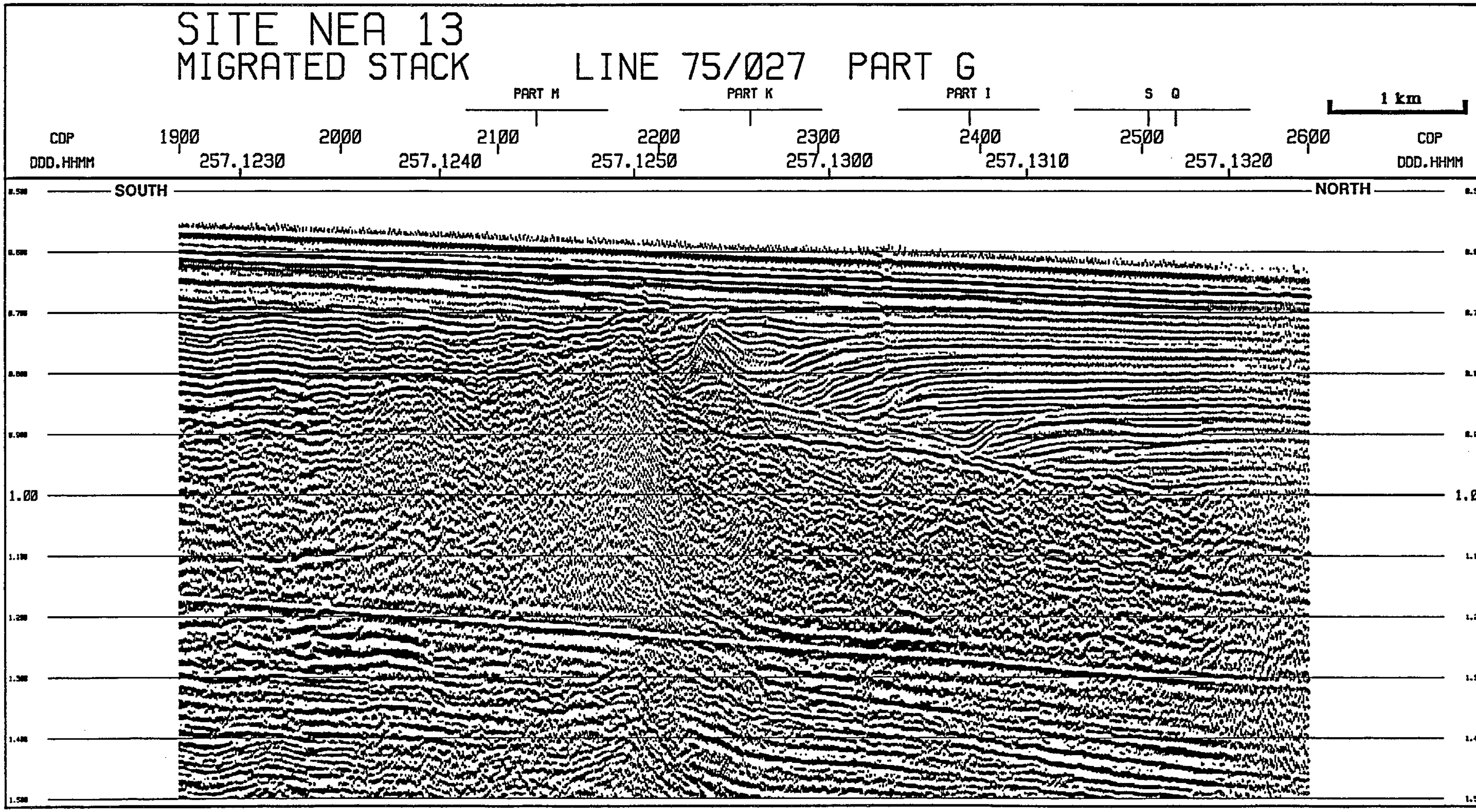
257.1120
257.1130
257.1140
257.1150
257.1200
NORTH
SOUTH
1.00


SITE NEA 14
MIGRATED STACK
LINE 75/027
PART C
Q
PART S
PART I
PART O
PART K
PART M
1 km
CDP
DDD.HHMM
900
1000
1100
1200
1300
1400
1500
1600
257.1110
257.1120
257.1130
257.1140
257.1150
257.1200
NORTH
SOUTH
WATER BOTTOM
HORIZON 1
HORIZON 3
HORIZON 5
HORIZON 7
HORIZON 9
HORIZON 12
HORIZON 14
HORIZON 15
TD
M
1.00


SITE NEA 13
MIGRATED STACK
LINE 75/Ø27 PART G
PART M
PART K
PART I
S Q
1 km
CDP
DDD.HHMM
19ØØ
2ØØØ
21ØØ
22ØØ
23ØØ
24ØØ
25ØØ
26ØØ
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257.124Ø
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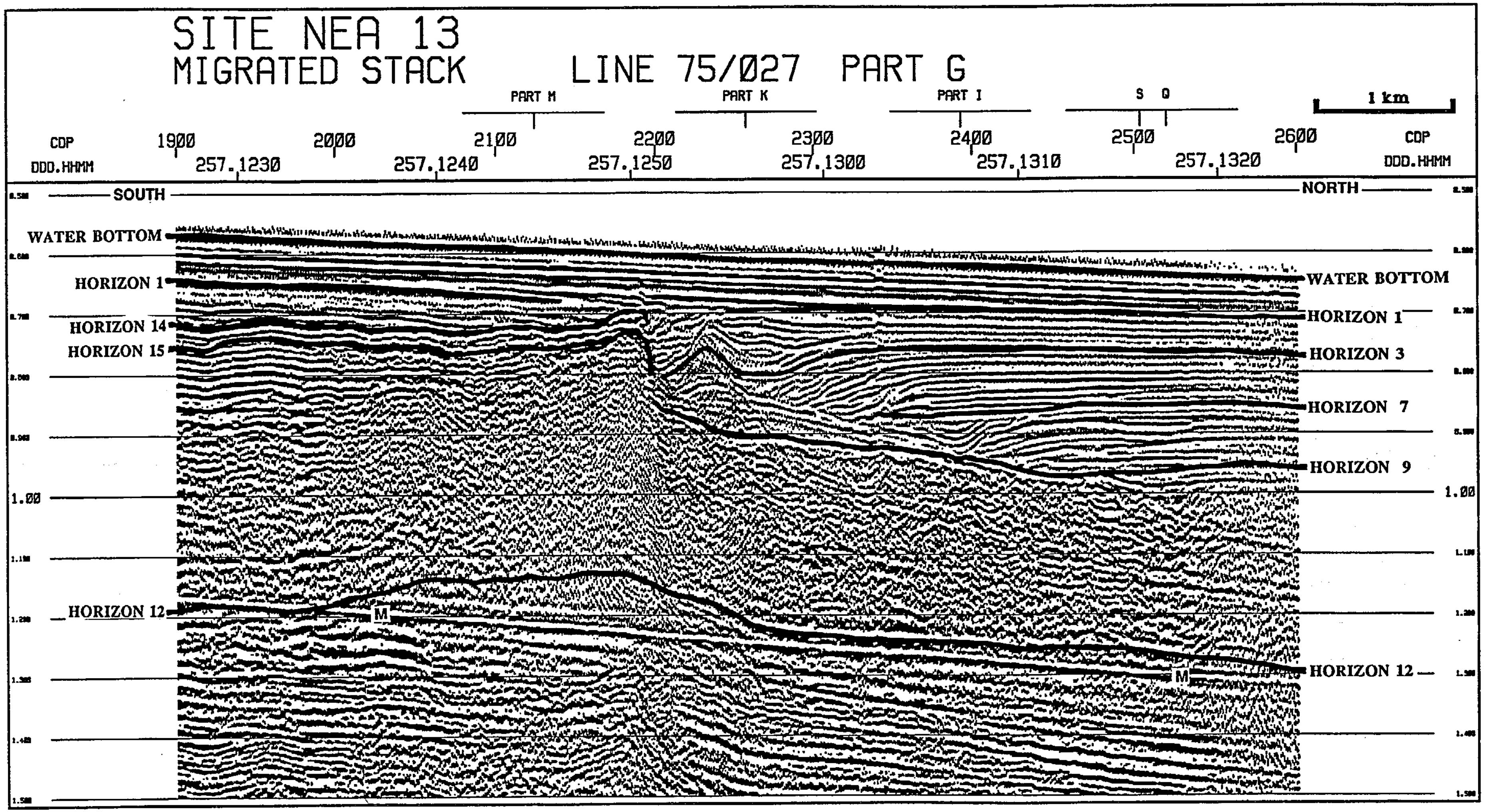
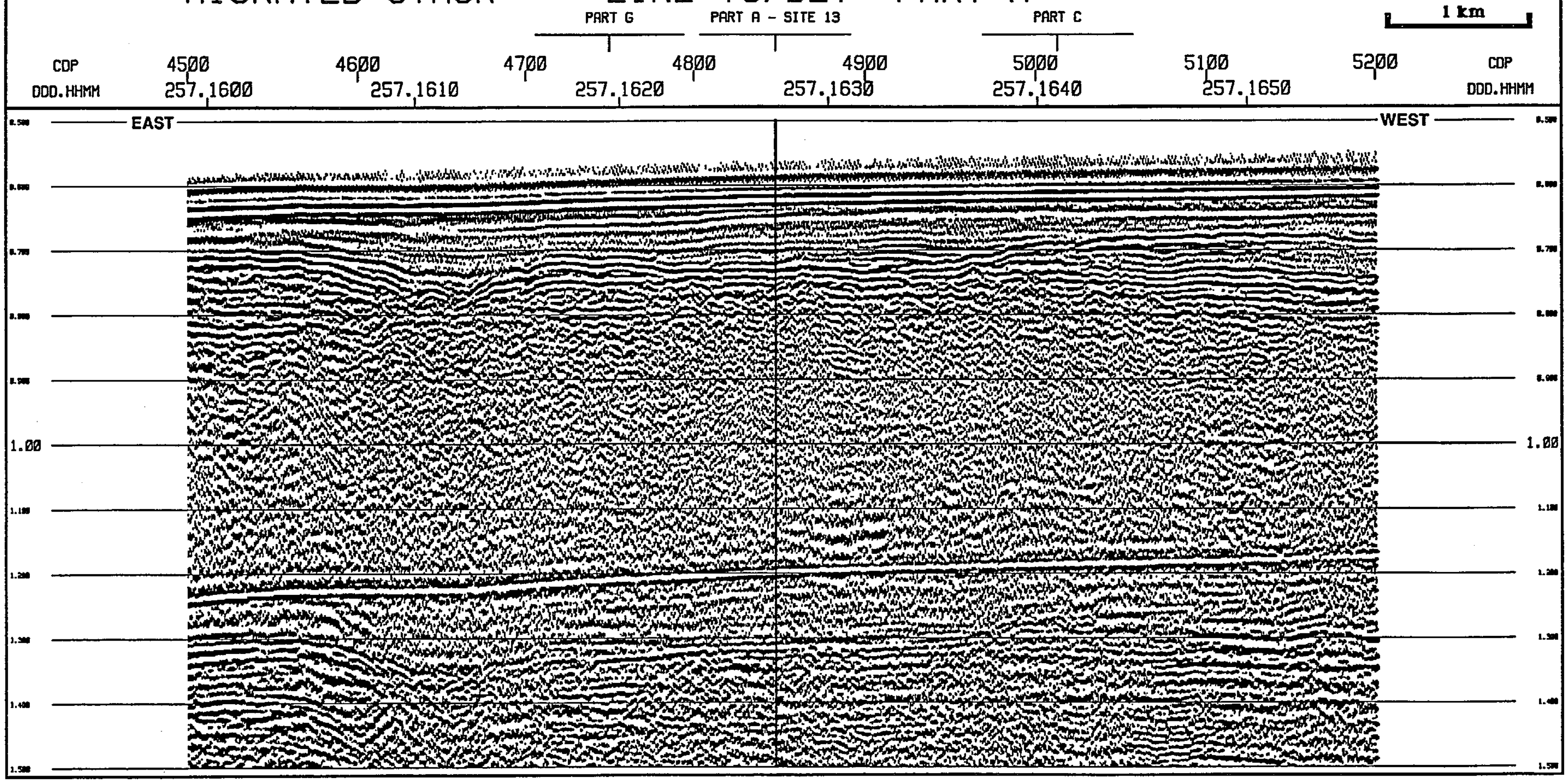
257.131Ø
257.132Ø
SOUTH
NORTH
1.ØØ

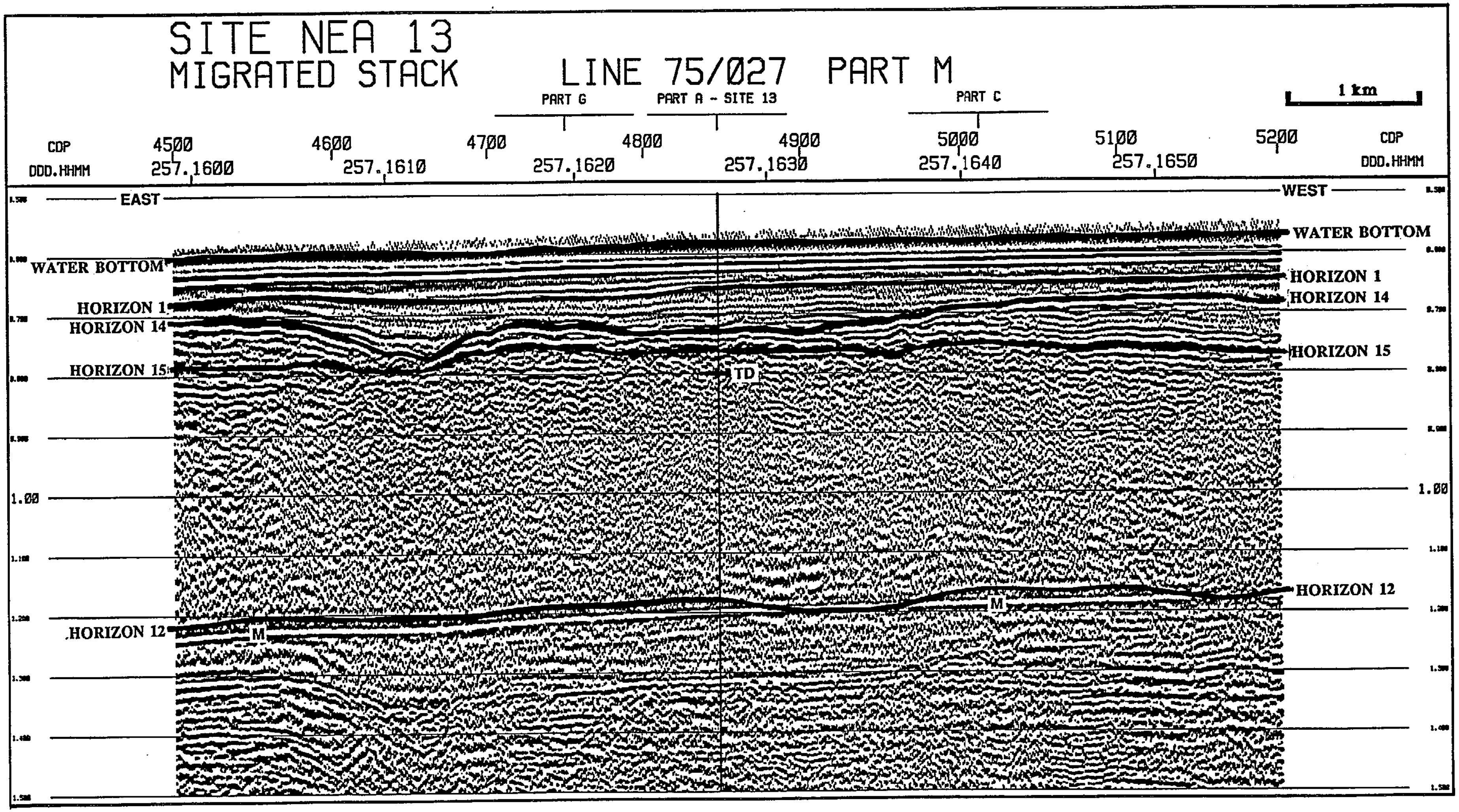


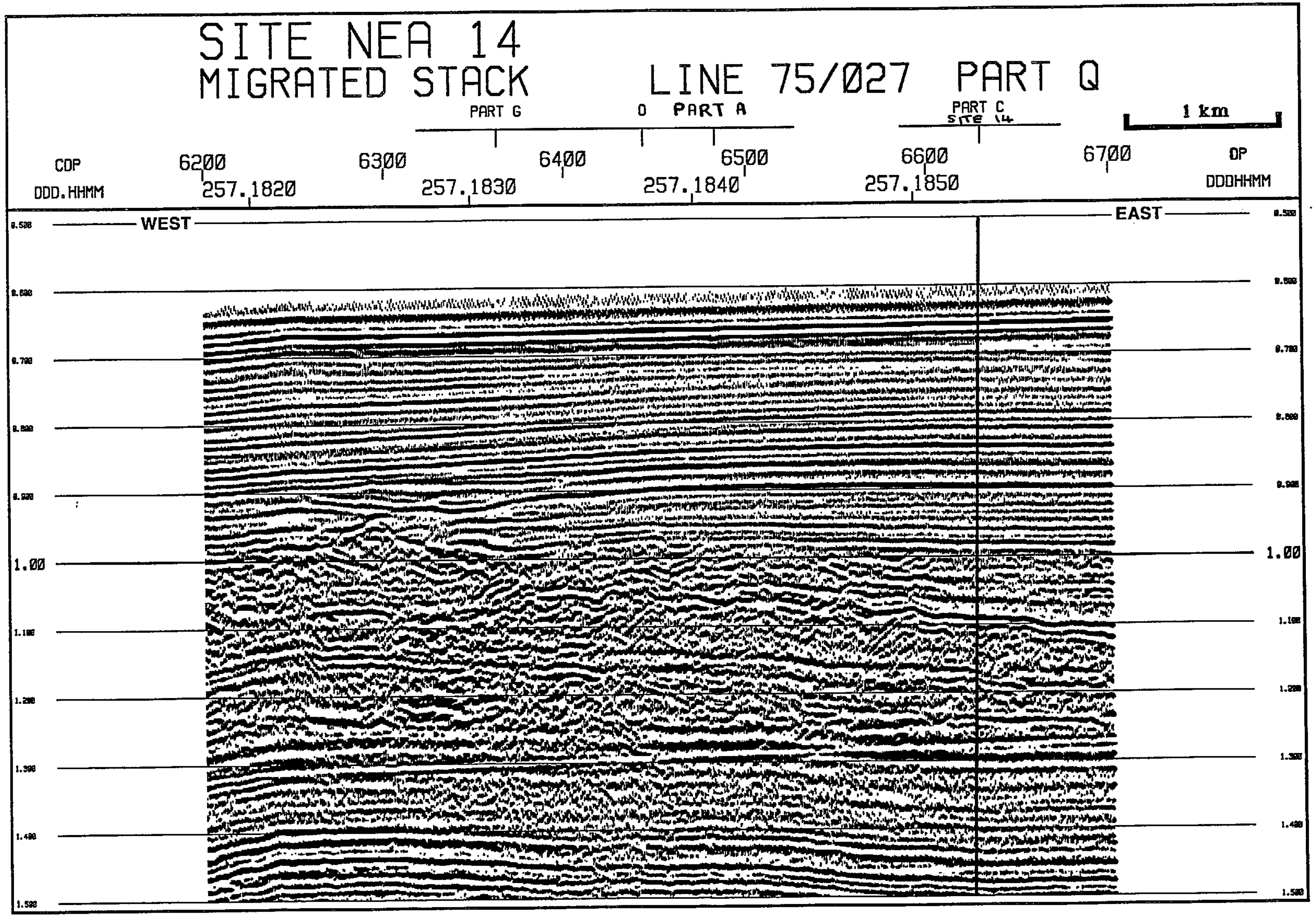
SITE NEA 13
MIGRATED STACK
LINE 75/027 PART G
PART M
PART K
PART I
S Q
1 km
CDP
DDD.HHMM
1900
2000
2100
2200
2300
2400
2500
2600
257.1230
257.1240
257.1250
257.1300
257.1310
257.1320
CDP
DDD.HHMM
SOUTH
NORTH
WATER BOTTOM
HORIZON 1
HORIZON 14
HORIZON 15
HORIZON 12
M
WATER BOTTOM
HORIZON 1
HORIZON 3
HORIZON 7
HORIZON 9
HORIZON 12
M
1.00
1.00

SITE NEA 13

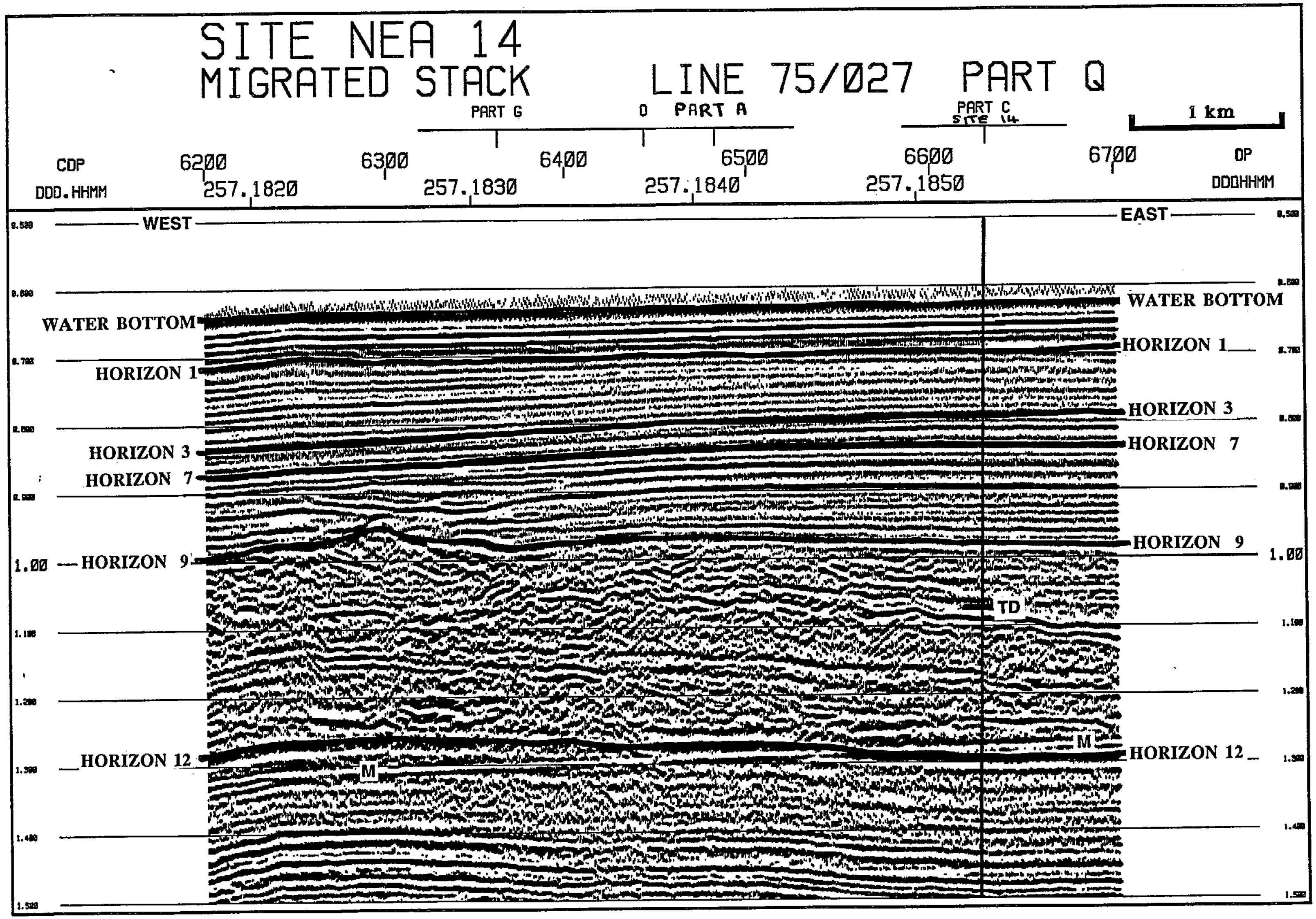
MIGRATED STACK LINE 75/027 PART M




SITE NEA 13
MIGRATED STACK
LINE 75/027 PART M
PART G
PART A - SITE 13
PART C
1 km
CDP
DDD.HHMM
4500
4600
4700
4800
4900
5000
5100
5200
257.1600
257.1610
257.1620
257.1630
257.1640
257.1650
CDP
DDD.HHMM
EAST
WEST
WATER BOTTOM
HORIZON 1
HORIZON 14
HORIZON 15
TD
1.00
HORIZON 12
M
WATER BOTTOM
HORIZON 1
HORIZON 14
HORIZON 15
1.00
HORIZON 12
M



SITE NEA 14
MIGRATED STACK
LINE 75/027 PART Q
PART G
O PART A
PART C
SITE 14
1 km
CDP
6200
6300
6400
6500
6600
6700
DP
DDD.HHMM
257.1820
257.1830
257.1840
257.1850
DDDHHMM
WEST
EAST
1.00
1.00



SITE NEA 14
MIGRATED STACK
LINE 75/027 PART Q
PART G
D PART A
PART C
SITE 14
1 km
CDP
6200
6300
6400
6500
6600
6700
DP
DDD.HHMM
257.1820
257.1830
257.1840
257.1850
DDDHHMM
WEST
EAST
WATER BOTTOM
HORIZON 1
HORIZON 3
HORIZON 7
HORIZON 9
1.00
TD
M
HORIZON 12

The following horizon depth and isochron maps (in two-way-time) are included:

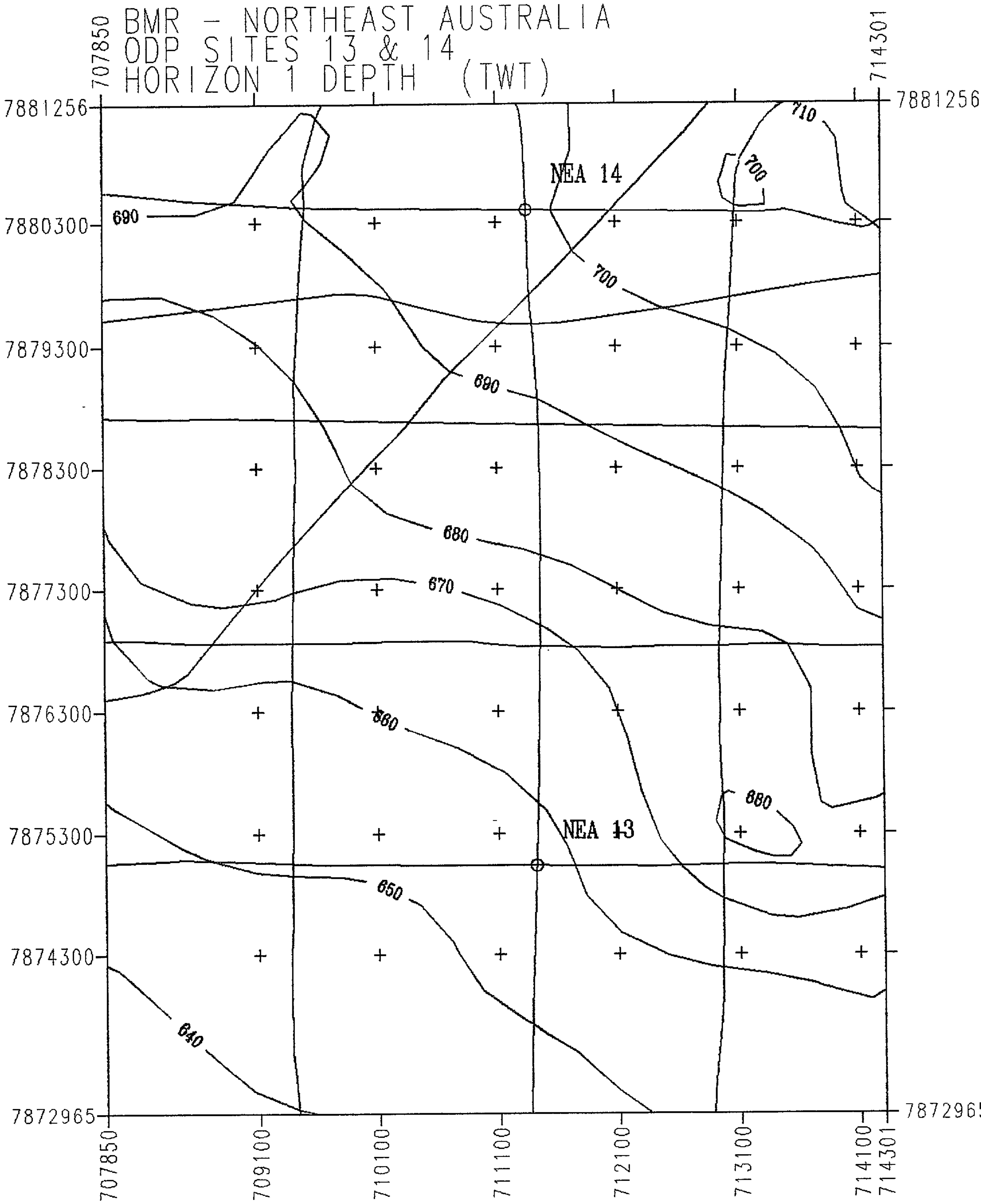
DEPTH MAPS:

	SITE 13 ("Reef")		SITE 14 ("Contourites")
		WATER BOTTOM	
		HORIZON 1	
HORIZON 14			HORIZON 3
HORIZON 15			HORIZON 7
			HORIZON 9
		COMPOSITE HORIZON 15 / HORIZON 7	
		HORIZON 12	

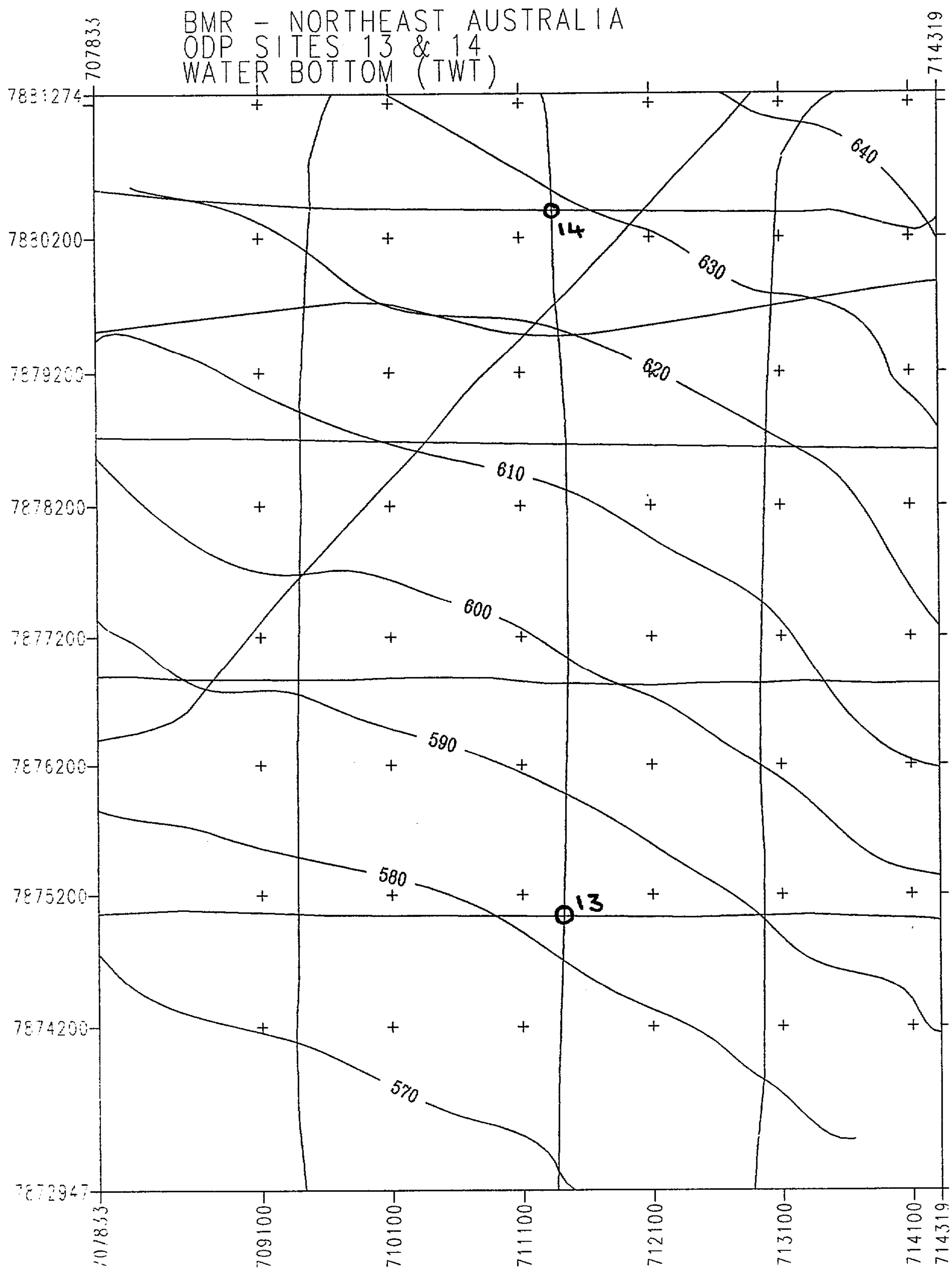
ISOCHRON MAPS:

WATER BOTTOM TO HORIZON 12

HORIZON 14 TO HORIZON 15



computer generated
on a LANDMARK RT



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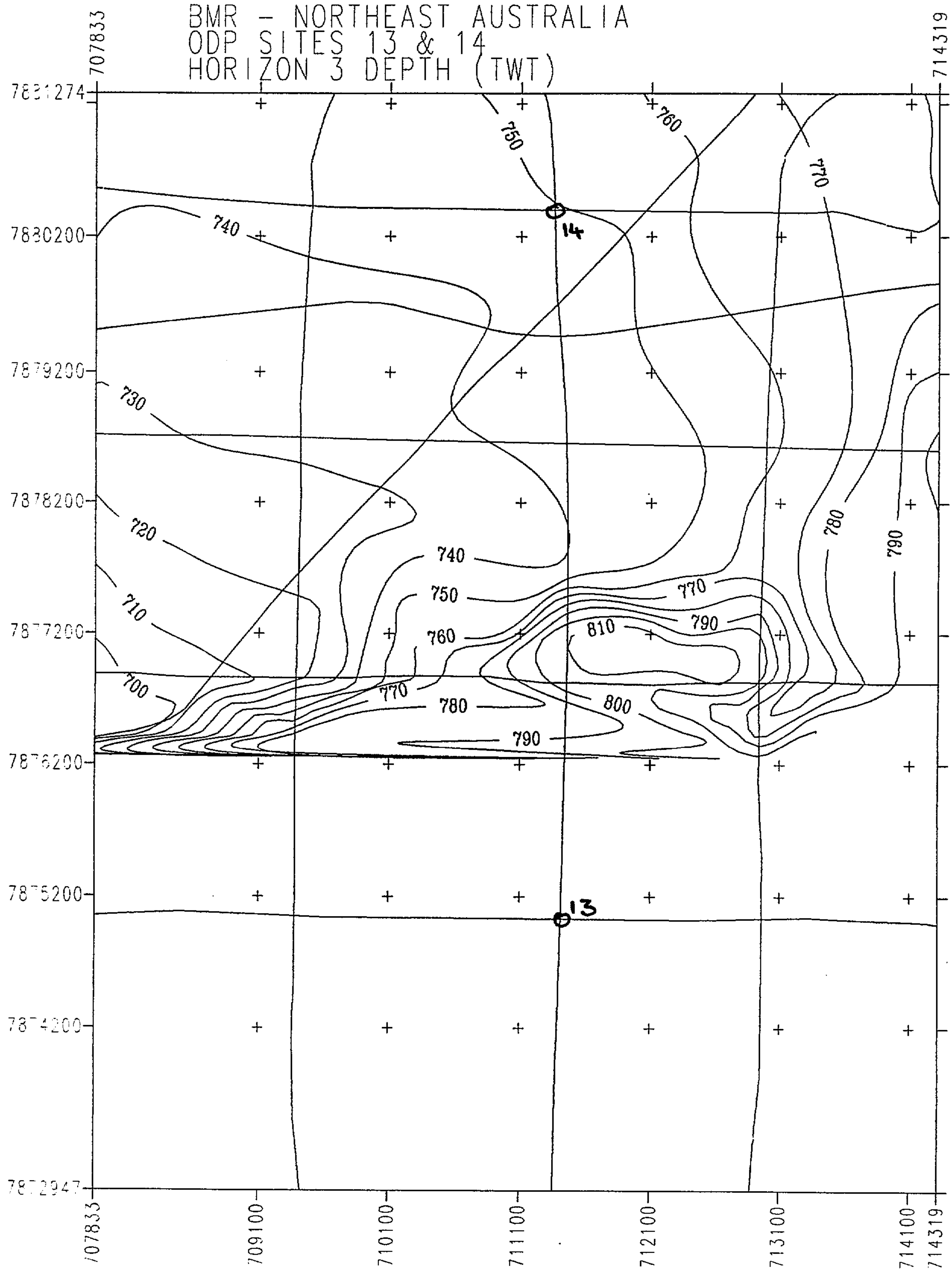

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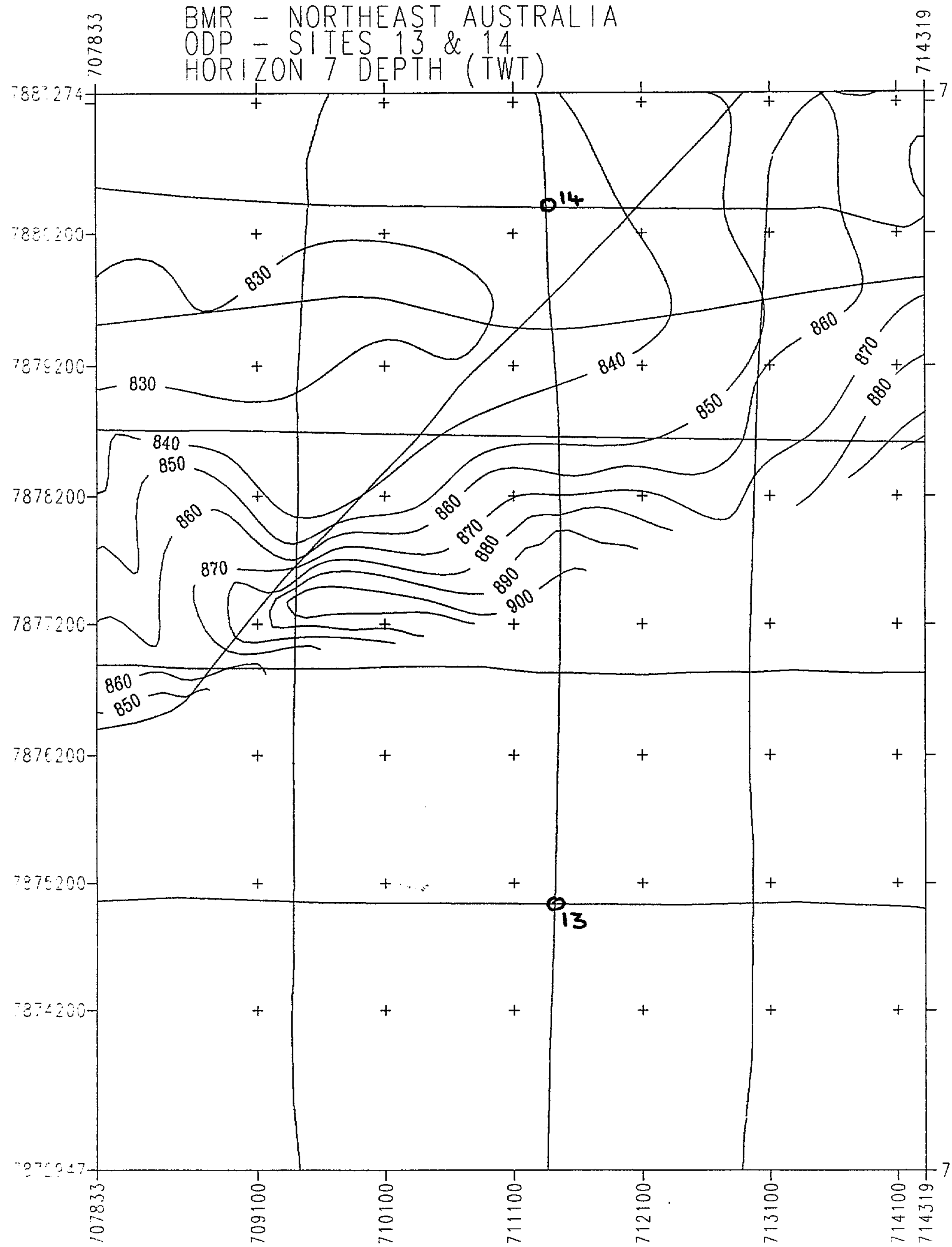

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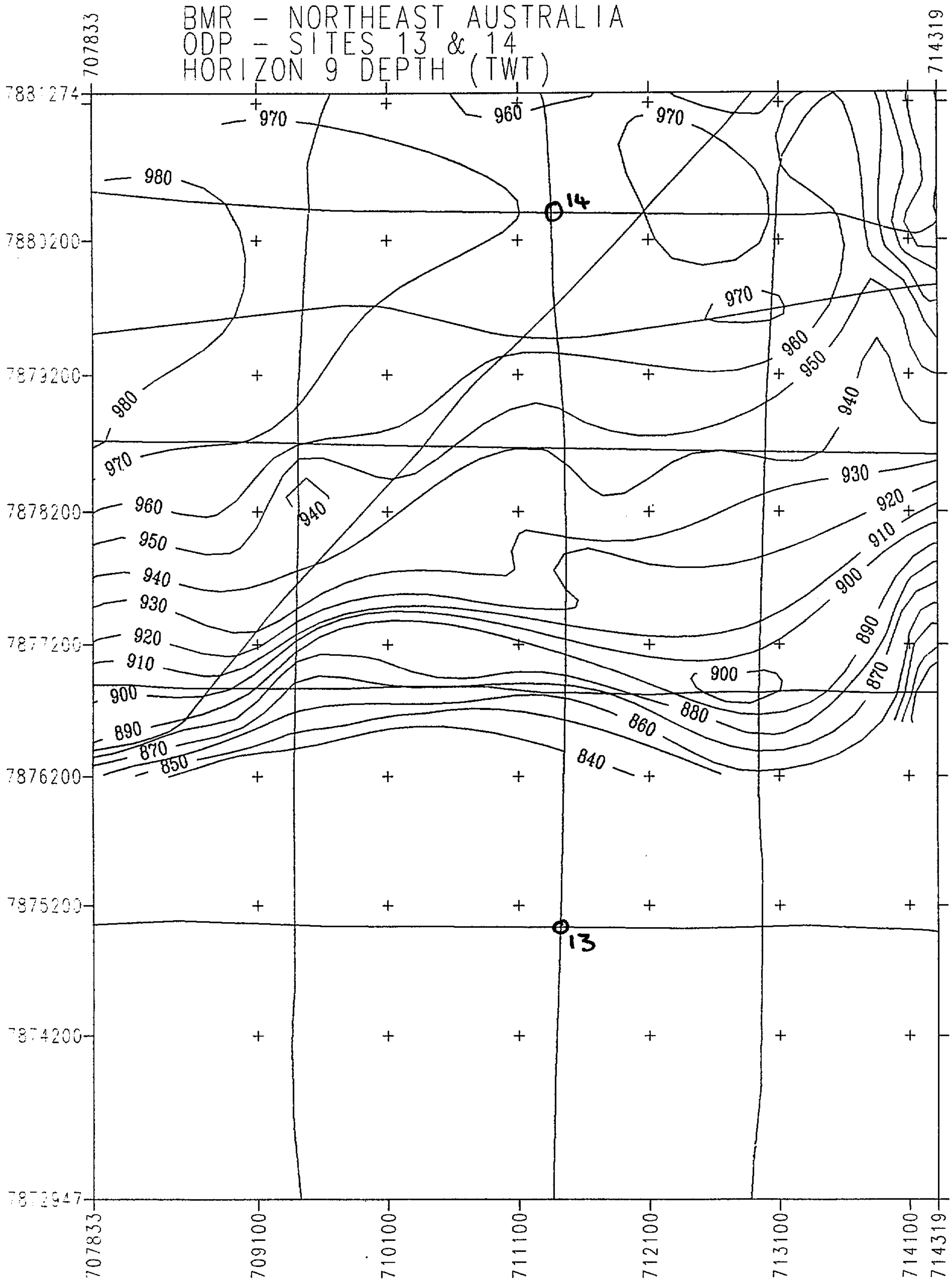

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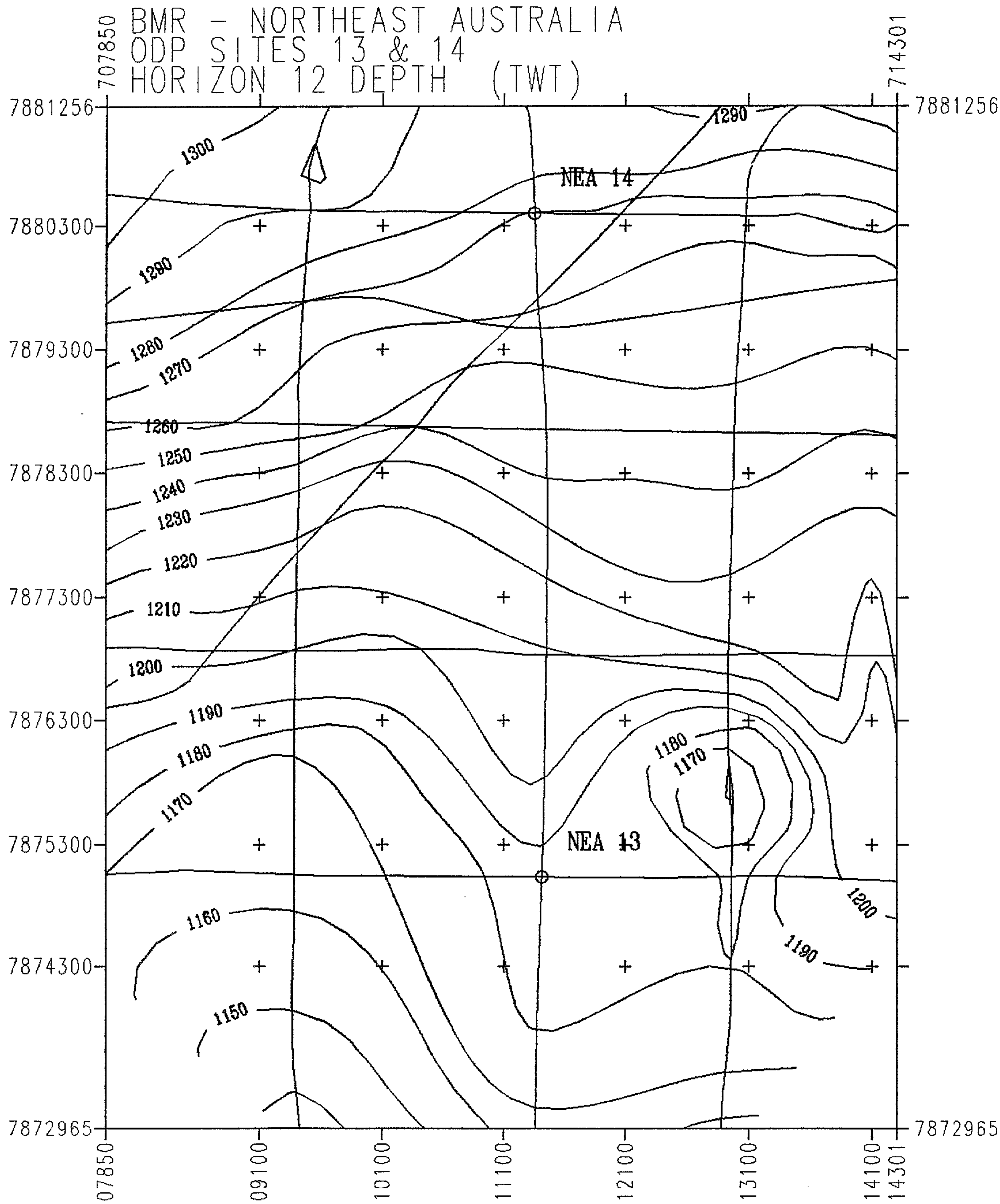

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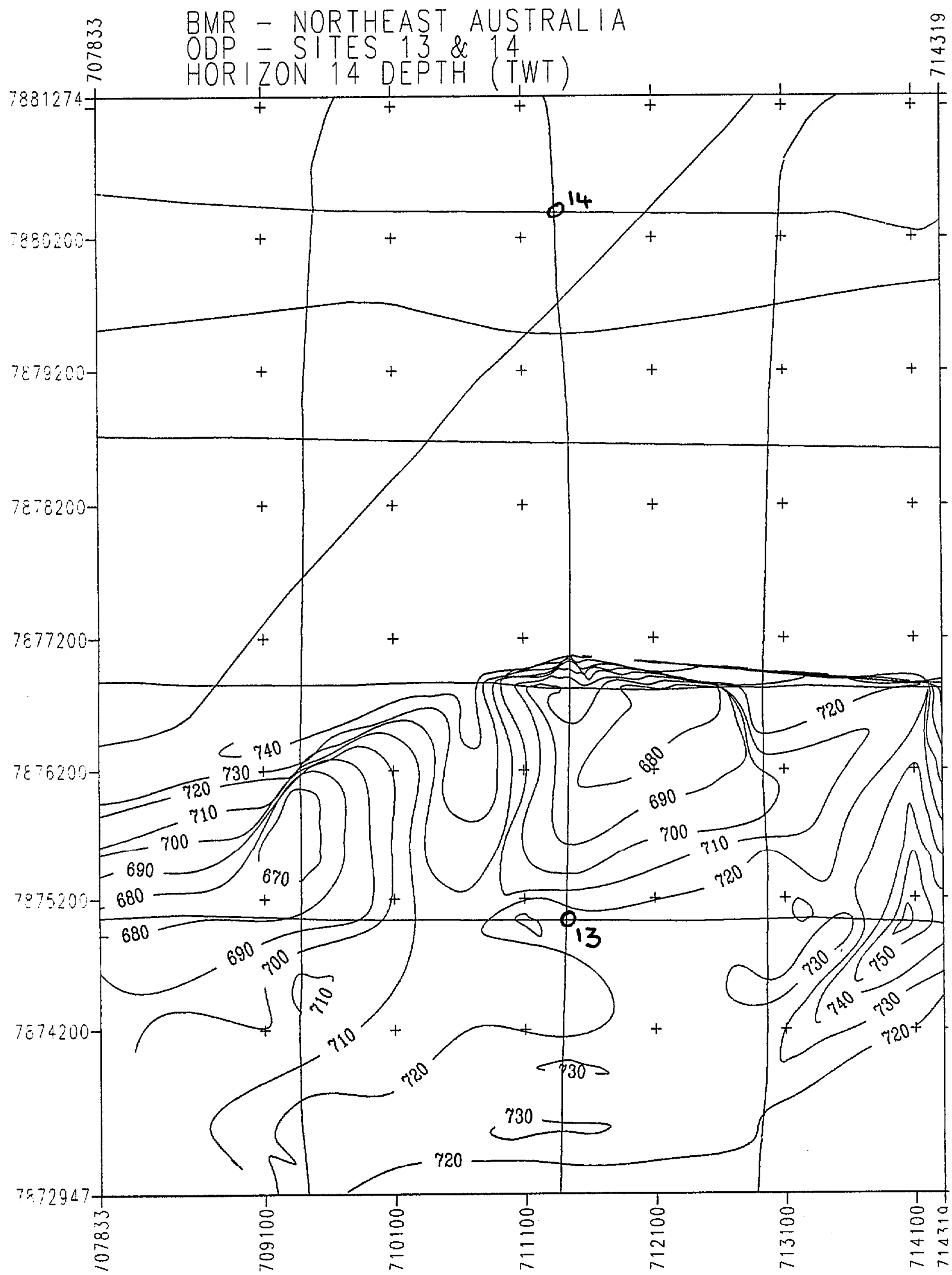

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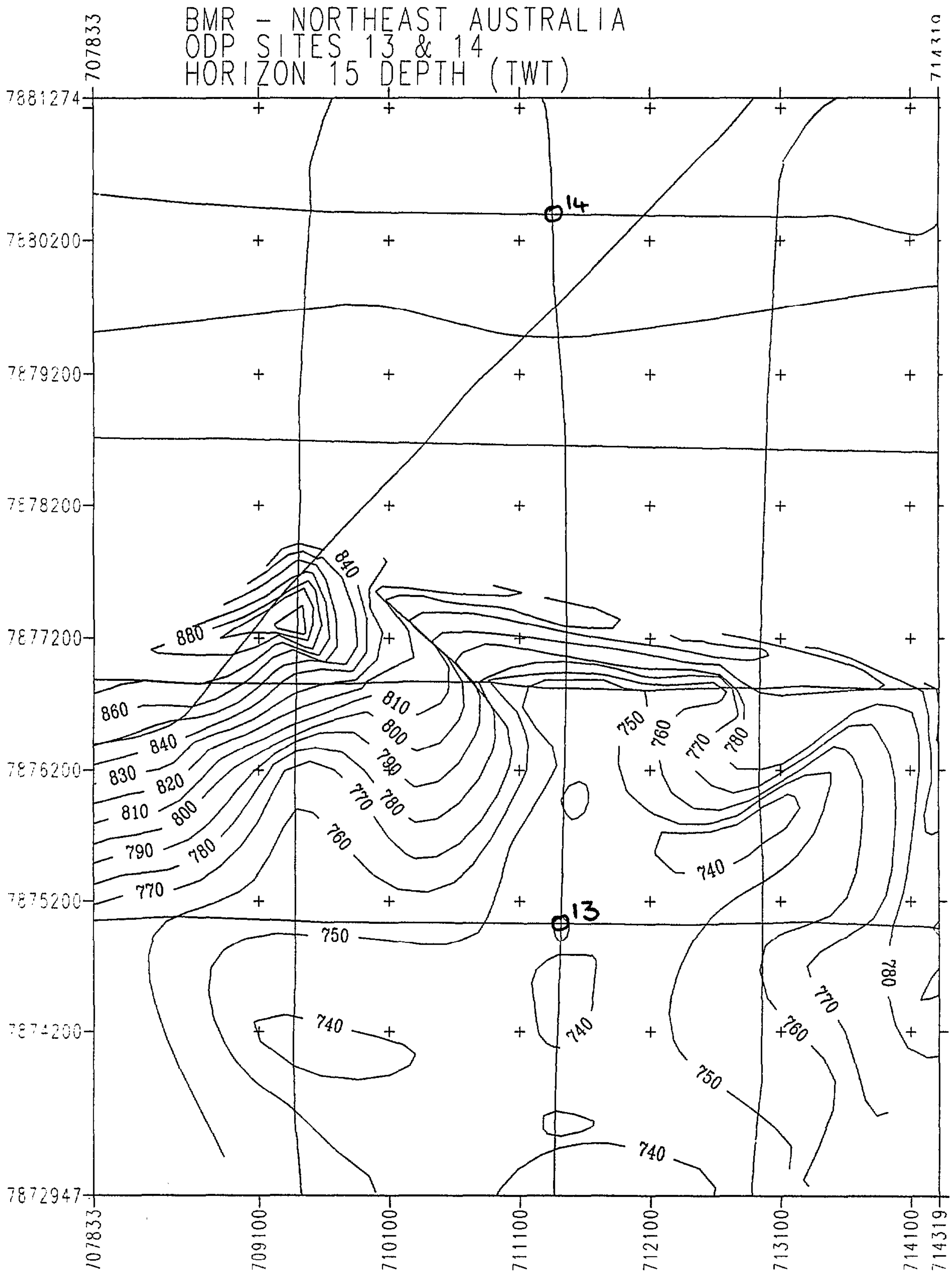

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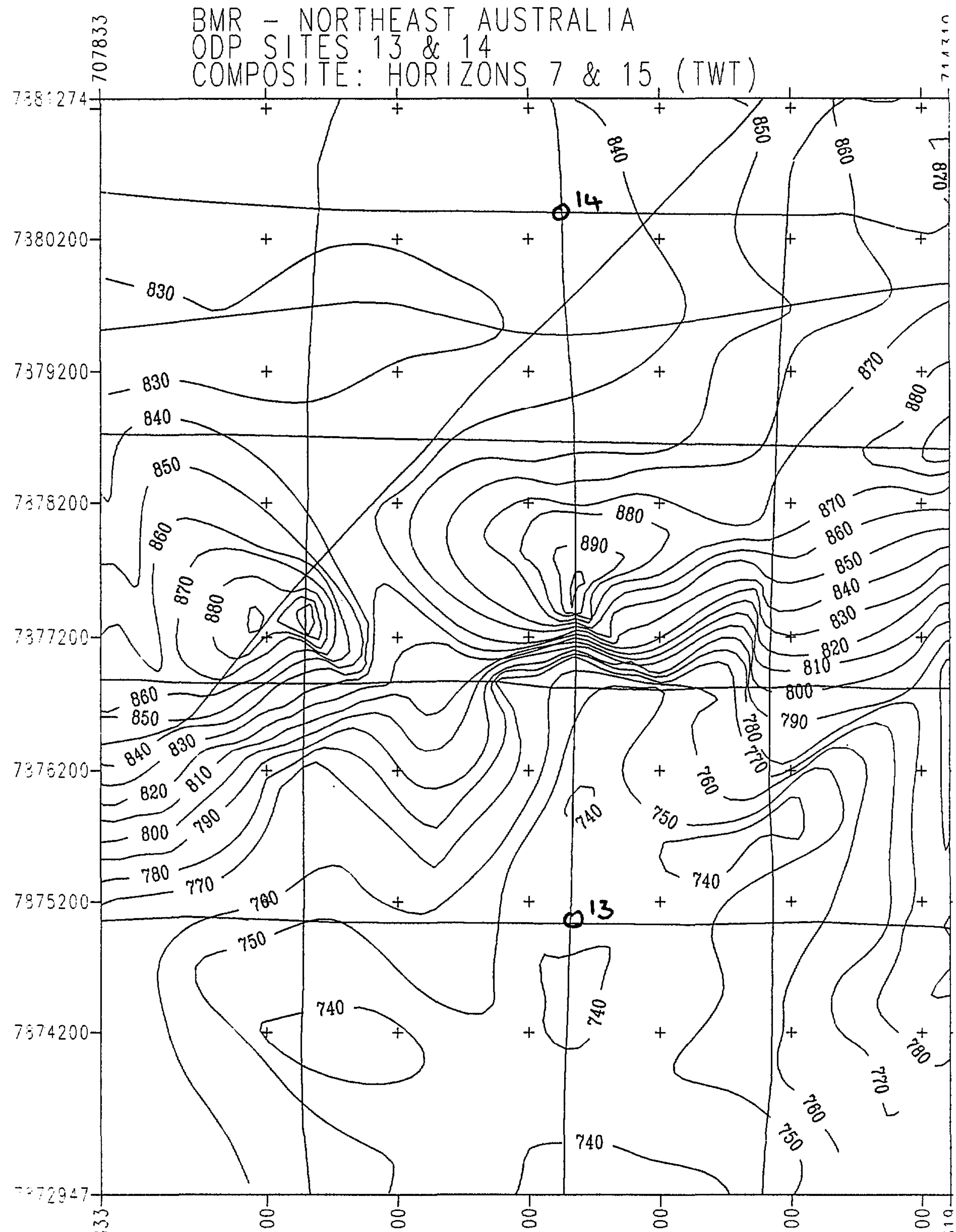
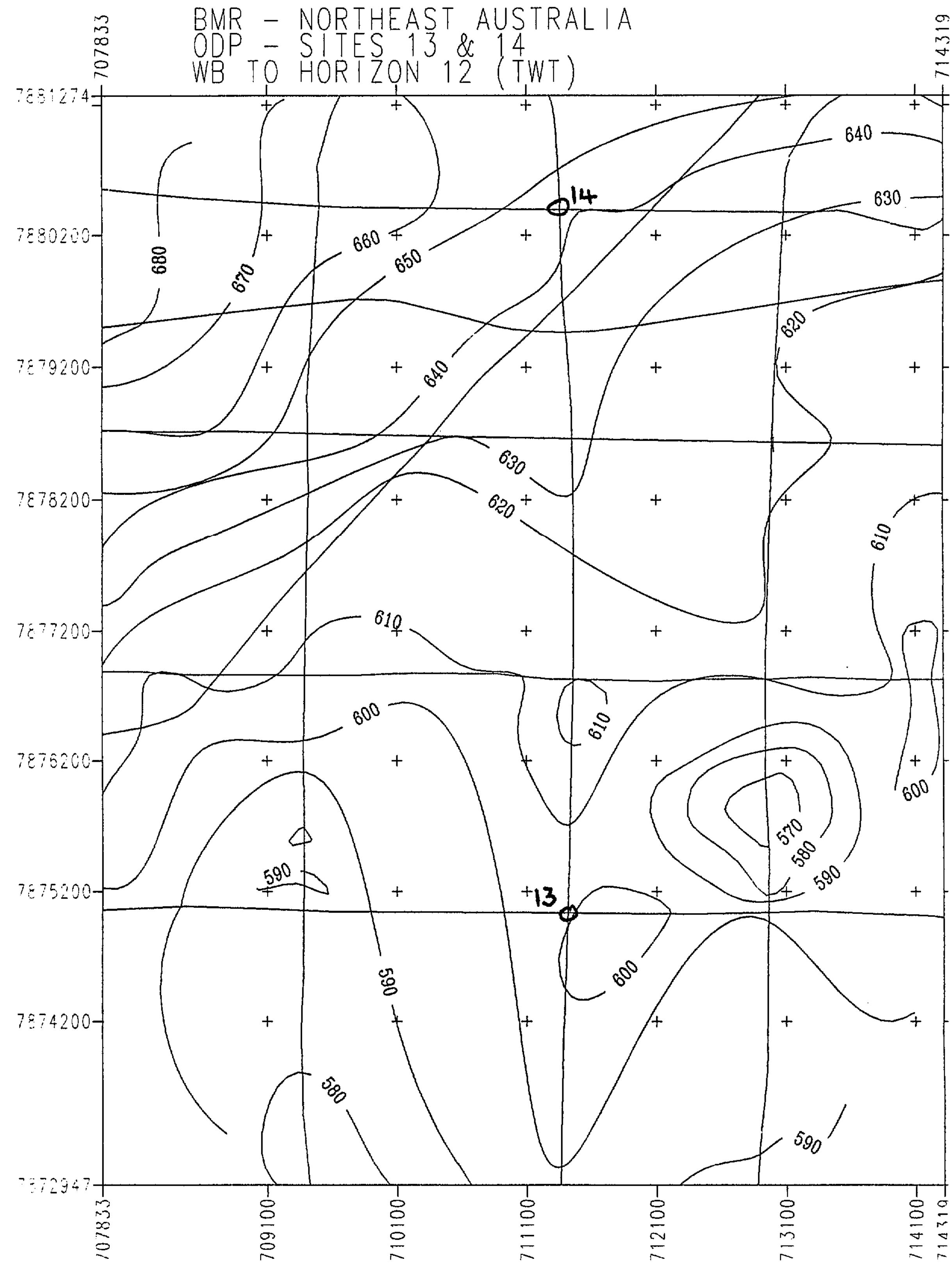


computer generated
on a LANDMARK RT



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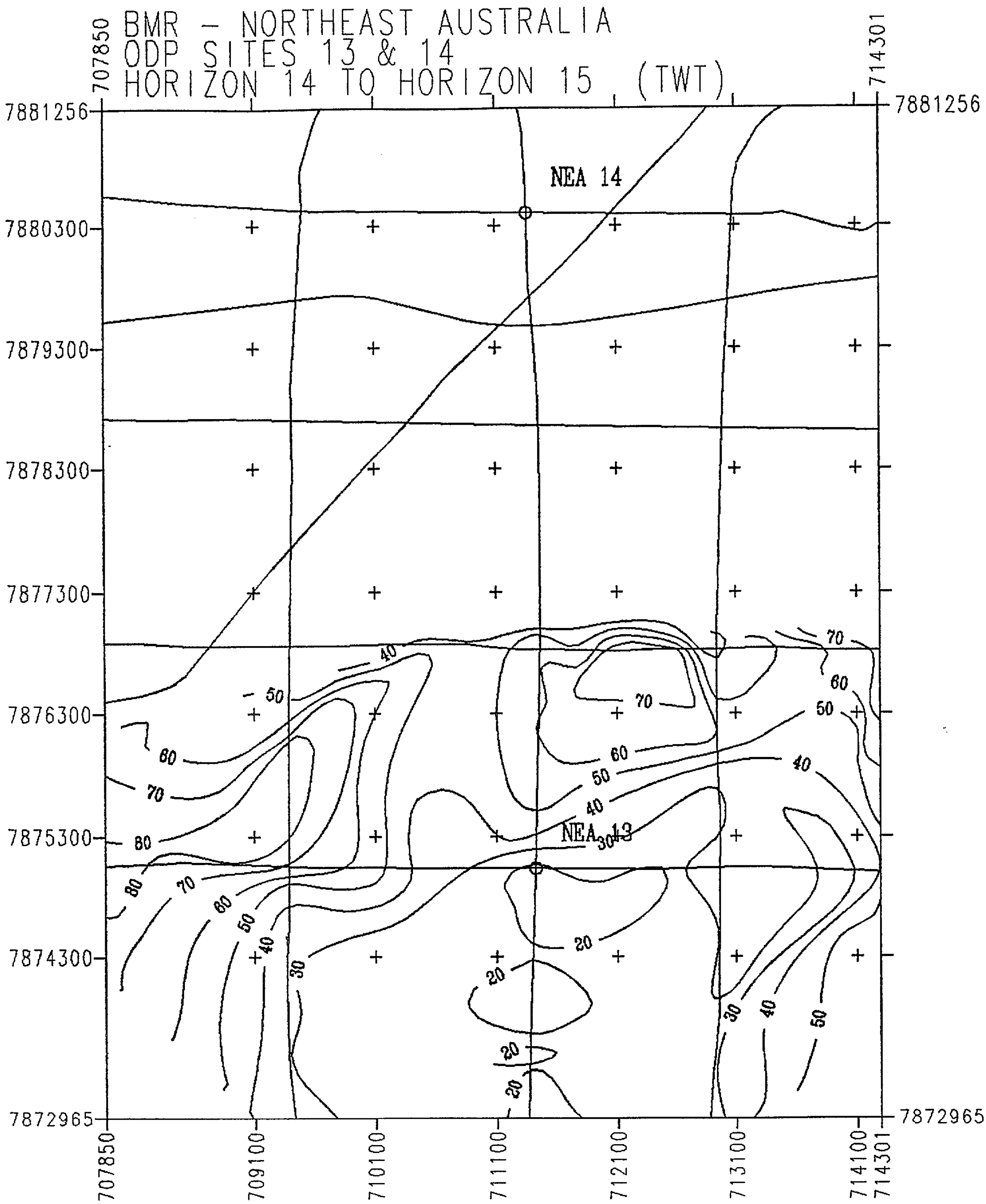

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5.0 Appendix

The ANCHOR CAY No. 1 well - summary of well completion report.

ANCHOR CAY #1

Tenneco - Signal
Drilled: 1969

Compiled by J. Colwell, BMR 1983.

Stratigraphy intersected in Anchor Cay #1.

0' - 2750'	Recent, Pleistocene, Pliocene. No circulated samples from 0-980' - samples from driving bit cone only, therefore poor control. No samples 0-240'. 240'-980'. Very poor control etc. - Some sandstone, and coral debris (near base). 980'-1160' Coral debris 1160'-1308' Lost circulation 1308'-1510' Mudstone with minor coral debris mudstone contains minor black/green volcanics. 1510'-2020' Coral debris - white, chalky, bery fossiliferous. 2020'-2380' Limestone, uniformly graded biomicrite, some argillaceous mudstone. 2380'-2460' Marl. 2460'-2750' Limestone in places very marly.
2750'-3650'	Miocene (upper-middle Taurian) - boundary determined on a faunal basis. 2750'-3021' Limestone, as above, occasional oolites or algal balls. 3021'-3130' No samples. 3130'-3650' Limestone with some porous, calcarerite with some calcirudite.
3650'-3950'	Miocene, Lower Taurian. (formation boundary determined on faunal basis). 3650'-3760' Limestone as above. 3760'-3950' Dolomite, calcareous in part, slightly fossiliferous.
3950'-5870'	Miocene, Kererua. 3950'-4170' Mudstone and marl, light to medium grey, very cherty. 4170'-4990' Limestone and marl. In places very cherty. 4990'-5870' Marlstone & limestone, alternating.
5870'-6800'	Upper Eocene. 5870'-6260' Argillaceous limestone, white crystalline to medium grey fossiliferous Lst., contains qtz grains. 6260'-6800' Limestone, very cherty, some dolomite.
6800'-6950'	Middle or lower Eocene. (Boundary determined on, in faunal basis). 6800'-6870' Limestone as above 6870'-6950' Shale (Variegated red, yellow and ochre

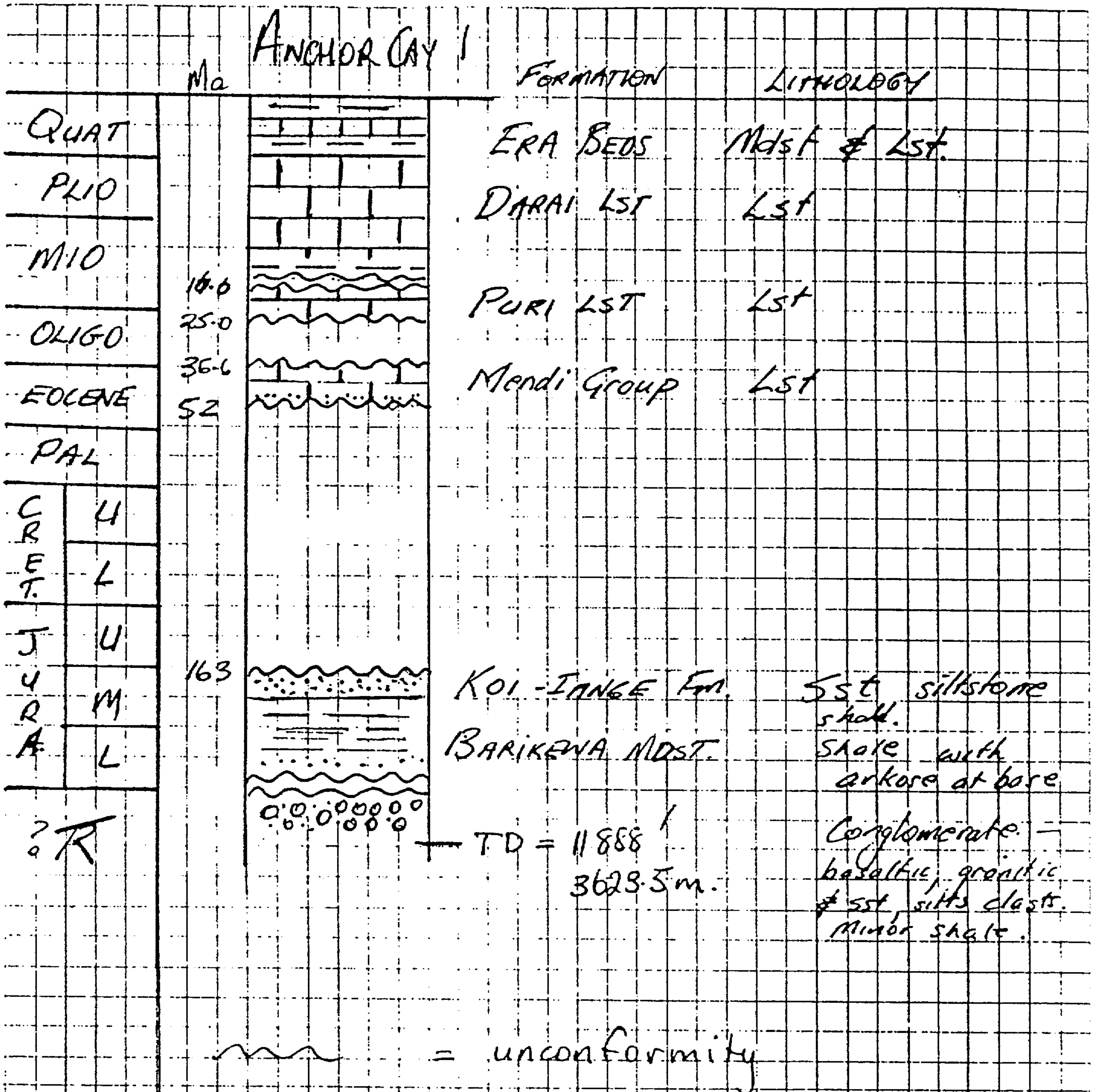
soft, loose quartz grains, leached)

6950'-11888'(TD) Mesozoic section

Consists of sandstones alternating with shales; chalcopyrite and pyrite common; some granite outwash deposits; shale, conglomerate & sandstone interbeds. Slate & sandstone are commonly pyritic. Based upon Palmieri's work (included in the well completion report), the Mesozoic section can be divided into 3 depositional environments, as follows-

PARALIC	1. "Molasse" segment from 6950' to 7650' with grey lithic quartzose micaceous sandstones and siltstones, showing cross bedding.
'STARVED' MARINE EUXINIC	2. "Euxinic" sequence (restricted circulation) from 7650' to 10850' with black slates and black mudstones showing pyrite aggregates.
EPICONTINENTAL	3. "Flysch" sequence from 10850'-11 888' with interbedding of shales, mudstones and sandstones showing graded bedding.

NOTE: Disagreement amongst palaeontologists on completeness of the Tertiary section.


ANCHOR CAY 1
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163
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Mdst & Lst.
DARAI LST
Lst
PURI LST
Lst
Mendi Group
Lst
KOI-IANGE Fm.
Sst siltstone shale.
BARIKEWA MDST.
Shale with arkose at base
Conglomerate - basaltic, granitic & sst silts clasts. Minor shale.
TD = 11888'
3623.5m.
= unconformity

6.0 Acknowledgements

The assistance provided by Landmark Graphics Corporation, Houston, in providing a LANDMARK RT interactive seismic interpretation and display workstation to André Droxler and Peter Vail at Rice University for analysis of the BMR seismic data from northeast Australia, under their University Partnership Program, is gratefully acknowledged. In addition, BHP Petroleum Pty Ltd is thanked for providing access to a LANDMARK RT for much of the preliminary work for this project. A special thanks is due to Ms Stephanie Staples, manager of the LANDMARK workstation at Rice University, for her enthusiastic and extremely competent assistance.