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National Facility
Oceanographic Research Vessel

Sea-level Magnitudes and Variations Recorded by Continental Margin Sequences in the Marion Plateau, Northeast Australia: Surveys for Future Ocean Drilling.

CRUISE SUMMARY

RV FRANKLIN

FR 03/99

Depart Noumea 1000 hrs, Saturday 10 April 1999
Arrive Cairns 1300 hrs, Tuesday 4 May 1999.

Principal Investigators

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Project Description

The primary objective of FR 03/99 is to investigate the facies architecture and depositional history of sediments and carbonate platforms of the Marion Plateau, northeast Australia using a detailed grid of multi-channel seismic data. These data will enable investigation of the long-term evolution of carbonate/siliciclastic depositional environments on the Marion Plateau and the sequence geometries resulting from sea level variations occurring over different time scales. In addition, dredge and core samples collected will be used to characterise sediment physical properties near the seafloor. Seismic and sediment data collected during FR 03/99 will serve as site surveys for an Ocean Drilling Program (ODP) proposal which, if successful, would likely be drilled in early 2001.

Methods

A major objective of FR 03/99 (AGSO 209) was the collection of high resolution seismic data using the following equipment:

Cable:

24 Channel Innovative Transducers Inc. non-fluid stealth array cable consisting of 6 hydrophones per channel, 12.5 m group spacing, 30 m deck leader, 105 m tow leader, and 2 x 150 m active sections.

The streamer was set to maintain a subsurface depth of 5 m+/- 1 m using three Digicourse 5010 active birds.

Guns:

Two GI Guns which fire a generator pulse of 45 cubic inches followed by an injector suppression bubble of 105 cubic inches. The average shot spacing during the survey was 25 m.

Navigation System:

Navipac Helmsman, utilising differential GPS with reference to the Optus Townsville base station.

Acquisition System:

A 24-channel acquisition system was used to record raw seismic data on Exabyte tapes. Sample interval was 1 ms and record length was 3 sec. For lines with sonobuoys, the record length was increased to 6 sec. to accommodate the longer travel times of the sonobuoy signals. After the first seven recorded lines, the Stratavisor acquisition software was upgraded so that data recording occurred in SEG-Y format.

Processing System:

Seismic data were processed on an Ultrasparc workstation using DISCO/FOCUS software. The first lines which were not recorded in SEG-Y format had to be converted to SEG-Y format. Due to limitations of storage space on the workstation, this conversion could not be done for Line 20a and the second half of Line 4. All other major lines were processed with the same processing flow: Line geometries were defined and sonobuoy channels were written to disk. All 24-channels were recorded properly so that no bad channels had to be killed. The shot-sorted data were then converted to CMP sorted data. A water depth dependent gain and a bandpass filter were applied (20-25-400-500 Hz) and data were stacked using simple water depth dependent stacking velocities. This 6-fold brutestack was written to disk and printed after applying a 250 ms automatic gain control. During the processing flow, each 200th rawshot, a neartrace record, and velocity gathers every 2 km were written to disk.

Sea floor sediment samples were collected using pipe dredges, chain dredges, Van-Veen grab, and a one-ton gravity corer with 10 cm diameter barrels. Sea-floor photographs were taken using a Benthos deep-sea camera and flash mounted on the standard ORV Franklin CTD frame.

Results

Seismic Data

Seismic data collected during FR 03/99 (AGSO 209) provided excellent images of Oligocene-Recent sedimentation on the Marion Plateau. Over 1700 km of high-resolution seismic data of exceptional quality were obtained (Fig. 1; Table 1). Following the nomenclature of Pigram, 1993, these data enabled the identification of four unconformity-bounded megasequences (A-D) that overlie basement. These five seismic units can be mapped throughout the majority of the survey area. Data collected during FR 03/99 will provide an excellent database to further understand the development of the Marion Plateau carbonate platforms and sediment sequences. In addition to seismic data, sonobuoys (Table 2) were deployed to acquire accurate sonic travel times for the different lithologies which occur in the study area.

The following are preliminary descriptions of the major megasequences using data collected during FR 03/99. Further post-cruise processing and interpretation of the data will enable us to better understand the finer-scale depositional processes within sequences.

Basement

Seismic basement is characterised by a high-amplitude reflection at the interface with overlying sediments and numerous diffractions caused by the irregular bedrock surface. Further seismic processing, in particular data migration, will likely image the basement top with more accuracy. In some places, distinct morphologic structures, such as narrow highs and depressions, can be recognized clearly even on the unmigrated seismic profiles (Figs. 2 and 3). In general, the basement surface occurs at a similar two-way time depth with a slight eastward dip until the edge of the plateau where basement can be seen to downfault to the adjacent trough.

Megasequence A (Paleogene?-early Miocene)

Only a preliminary attempt was made to identify and map the unconformity overlying Megasequence A, the oldest depositional sequence over basement, as it is generally limited to the eastern slopes of the plateau over which we only had limited seismic coverage. When visible, this sequence is characterised as a thin unit with highly continuous reflections prograding westward over crystalline basement. Because Megasequence A overlies and infills basement irregularities, this results in an overall variability in thickness.

Megasequence B (early Miocene - middle Miocene)

Megasequence B, which overlies Megasequence A, is generally thicker in the west thinning eastward and southward. In the western part of the study area, Megasequence B is dominated by the early-middle Miocene MP2 carbonate platform (Fig. 2; shotpoints 203-1100). The upper portion of this platform is characterised by a generally transparent to chaotic sedimentary section with hummocky reflections representing a vertically aggrading carbonate platform likely to be dominated by shallow-water facies (Fig. 2; 0.5-0.6 sec TWT). Below these generally chaotic reflections is a sequence of moderately continuous reflections dipping to the east, indicating an eastward progradation of the platform margin over its slope (Fig. 2; 0.6-0.88 sec. TWT). The seismic character of reflections within this portion of MP2 are disturbed by the overlying platform facies, and also likely by sediment diagenetic alteration. Despite this, it is clear that these sediments grade eastward into a prograding sequence with more continuous reflections that can be consistently traced through the study area. The basinward transition of the upper "reefal" MP2 facies is not as continuous as for the lower prograding slope sediments, and in many instances, shows evidence of erosional channels adjacent to the platform margin indicating current re-working (Fig. 2). Seaward of these erosional channels the prograding sediment wedge can be easily traced along the regional seismic grid.

The nature of the Megasequence B upper boundary is variable. Over the MP2 platform the boundary is highly irregular and karstic in appearance with some evidence for localised erosion (Figs. 2 and 3). It is likely that this unconformity surface was subareally exposed near the end of the middle Miocene (~11 Ma). Basinward of MP2, the Megasequence B upper boundary represents a regional unconformity with some localised erosion over which the sediments of Megasequence C onlap from the south and southeast.

<u>Megasequence C (late middle Miocene - late Miocene)</u>

Megasequence C is generally thicker in the south and southeast of the study area. In the southern portion of the study area, Megasequence C is dominated by the seismically transparent, late middle Miocene-late Miocene, MP3 carbonate platform which was the main source of sediment for the prograding sequences of Megasequence C. This platform developed on the distal lowstand facies of the slope adjacent to the older MP2 carbonate platform. Presently, the MP3 surface occurs near the seafloor with the overlying sediment cover below seismic resolution (< 7 m) and is characterised by a very strong and continuous reflection with an overall hummocky appearance (Figure 4). Scattering of the seismic signal from the well indurated MP3 platform top makes it difficult to determine the nature of sediment deposition underneath this platform phase (Fig. 4). Previous work indicates that the MP3 carbonate platform was likely to have drowned near the end of the late Miocene.

Distinct differences in the nature of Megasequence C depositional sequences can be seen when comparing the north-west and south-east margins of MP3. The north-west margin of MP3 is characterised by prograding sequences of continuous, well-bedded reflections which are easily correctable over the study area. This portion of Megasequence C also contains some intervals where the reflections have a more chaotic nature which may result from sediment diagenesis, or more likely reflect the presence of drowned bioherms.

The south-east margin of MP3 consists of a thicker, more steeply prograding sequence of reflections which have some strong, continuous reflections which are easily mapped within the study area, whereas other intervals are characterised by reflections within the prograding sequence that are more hummocky in character and only moderately continuous (Fig. 4). These more disturbed sections may represent intervals with finer-scale high energy depositional processes, such as sand waves, or localised diagenesis of the metastable carbonate sediment.

The upper Megasequence C boundary is characterised by a very strong and hummocky karstic surface on top of the MP3 carbonate platform. Away from MP3, the sequence boundary has some local erosion and is of variable amplitude. The slope and basinal sediments of Megasequence C onlap onto Megasequence B and thicken to the southwest near MP3, the main source of sediment.

Megasequence D (Pliocene – Recent)

Megasequence D is a variably thick unit composed of Pliocene – Recent hemipelagic ooze. Sediments were deposited by currents in thick sediment drifts characterised by numerous large-scale erosional and downlap surfaces. The most striking characteristic of this sequence is the presence of spectacular prograding clinoforms and drift deposits (Figs. 3 and 5) with erosional truncations. The depositional pattern of these clinoforms over the survey area indicates that there is substantial re-working of the Pliocene sediments and that, due to the spatial distribution of sediment packages, chronostratigraphic age is likely to vary substantially in vertical sections. In general, Megasequence D thickens to the south.

Reference

Pigram, C. J., 1993. Carbonate platform growth, demise, and sea level record: Marion Plateau, north-east Australia. Dissertation, Australian National University, 316 pages and plates.

Sediment sampling

Sediment samples and seafloor photographs were collected at each proposed drillsite to characterise the nature of the seafloor and shallow subsurface. Sampling sites (Fig. 1; Table 3) were chosen using seismic data collected during this survey (FR 03/99 and AGSO 209). The following outlines the rationale for choosing drillistes and describes the sediment samples which were collected at each sampling site:

Site CS-01-A:

Rationale: Drilling at this site will give the age of the drowning of the MP2 platform; the age and duration of unconformities within and between the major sequence boundaries; the total thickness of MP2; the age of initial marine transgression over basement; the nature of the basement; the sedimentological nature of the MP2 platform; and it will enable the investigation of fluid flow processes within the Marion Plateau.

Sediment description: Three dredge samples were collected at this site. The periplatform sediments were dominated by a well-sorted winnowed (?) planktonic foraminifer grainstone with minor sediment 63 μm. Some of the sand-sized grains have been stained brown, possibly by phosphate coatings. Some burrows were seen which were filled with muddy green sediment. The coarse (>~450 μm) sediment fraction is dominated by shallow-water components. In addition to abundant pteropods and pteropod fragments, the samples had abundant echinoderms (sea urchin spines and "sea biscuits"), scaphopods, and large benthic foraminifers with some branching bryozoans, gastropods, and bivalves. The coarse fraction was characterised by a moderate fragmentation of components. In addition to un-indurated sediments, a piece of cemented foraminifer grainstone was recovered which had numerous worm tubes and encrusting bryozoans.

Site CS-02-A:

Rationale: Drilling at this site will define the age and facies of Megasequences B-D, particularly the prograding, proximal slope sediments of MP2; the age and duration of the unconformities within Megasequence B that can be carried into the platform; the age of initial marine transgression over basement; and the nature of the basement. Drilling at CS-02-A will also enable the calibration of regional seismic sequence stratigraphy and the investigation of fluid flow and diagenetic processes within the sediments adjacent to the MP2 platform.

Sediment description: The two dredge samples collected at this site were dominated by cemented, well-sorted foraminiferal grainstone pieces, rather than soft-sediments. The un-indurated periplatform sediments recovered were similar to those at CS-01-A. Many of the grains in both the indurated and un-indurated sediments are dark brown possibly due to phosphate overgrowths. The cemented grainstones were extensively encrusted by bryozoans and worm tubes. Un-indurated sediments recovered in the dredges were characterised by a well sorted matrix dominated by planktonic foraminifers. The coarse (>~450 μm) sediment fraction is dominated by abundant pteropods and shallow-water components including abundant bryozoans (branching and encrusting), solitary corals, echinoderms (sea urchin spines and "sea biscuits"), and large foraminifers, with some gastropods, bivalves, and rare crustacean fragments. In general, the coarse fraction has moderate fragmentation but some delicate components have been preserved. Within the samples there are also minor amounts of heavily phosphatised particles, including shark have been re-deposited and appear to be much older than the surrounding ...at.

Site CS-03-A:

Rationale: Drilling at this site will give information on the facies and age range of Megasequences B-D; the age of initial marine transgression over basement; the age and facies of lowstand MP2 deposits; the nature of basement; the lithologic signature of basinward unconformities; and will enable the calibration of regional seismic sequence stratigraphy.

Sediment description: One dredge and two gravity cores were collected at Site CS-03-A. The periplatform sediments were composed of a carbonate silty-sand dominated by foraminifers with pteropods and common shallow-water components in the coarse (>~450 μm) sediment. Color mottling was apparent in the dredge samples either due to burrowing or to the presence of diagenetic fronts in the sediment column. The coarse fraction contains abundant pteropods, gastropods, echinoderm spines, and scaphopods with large foraminifers, and bivalves also present. Fragmentation in the coarse sediments was low to moderate. Darkened grains were also seen which appear to be the result of phosphate and/or manganese coatings. Manganese coatings became more abundant downcore as shown by core catcher samples.

Site CS-04-A:

Rationale: Drilling at this site will give chronostratigraphic information for Megasequences A-D including the age of the initial marine transgression over basement and the age and facies of lowstand deposits. In addition, drilling will provide information on the nature of basement; Miocene-recent paleoceanography; and the calibration of regional seismic stratigraphy.

Sediment description: One dredge and two empty gravity cores were collected at Site CS-04-A. Despite its distal position on the Marion Plateau, sediments at this site were sandy with only minor silt and mud. Sand grains were primarily planktonic foraminifera some of which were brown indicating the presence of phosphate coatings. The washed fraction had abundant pteropods, solitary corals, scaphopods, and echinoderm spines with some gastropods, bivalves, and large portions of "sand dollars".

Site CS-05-A:

Rationale: Drilling at this site will give the age and facies of Megasequences B-D, particularly the initiation of the MP3 platform; the age and duration of Megasequence C unconformities which can be carried into the MP3 platform; the age of unconformities separating each sequence in the proximal slope adjacent to the platform; the age and nature of the condensed section equivalent to MP2; the nature of basement. Drilling will also enable the study of fluid flow processes within the MP3 platform; Pliocene-Recent paleoceanography from the Megasequence D drift deposit; and calibration of regional seismic stratigraphy.

Sediment description: Four gravity cores, two grabs, and one dredge sample were collected at CS-05-A. Sediments were cream-colored periplatform oozes with the sand-sized fraction dominated by planktonic foraminifera. Some concretions similar to the hardground surface sampled at Site CS-06-A were found. The coarse fraction was dominated by pteropods and shallow-water components including scaphopods, large foraminifera, and echinoderm spines with some gastropods, and bivalves. There was only minor fragmentation of the coarse fraction. Brown-stained (phosphatised?) components were common. Burrows and/or diagenetic fronts were visible in the dredge samples. Sediment in the core catcher samples appear to have more manganese coatings than the surficial dredge samples.

Site CS-06-A:

Rationale: Drilling at this site will provide information on the initiation and facies development of MP3; the paleowater depth of the initial phase of MP3; the age and duration of unconformities separating each platform phase; and the age and nature of the condensed section equivalent to MP2. Drilling will also enable the study of fluid flow processes within the Marion Plateau and the calibration of regional seismic stratigraphy.

Sediment description: Four dredge samples were collected at Site CS-06-A. As indicated by the strong seafloor reflection on the seismic section from this site, the seafloor is characterised by an iron-stained, bored and encrusted (both hard and soft organisms) hardground surface (Fig. 6). Bryozoans are common in both encrusting and branching forms. Many organisms on the surface of the crusts were still living at the time of recovery. The hardground appears to form an approximately 2 cm thick layer over the seafloor as several "plates" of similar thickness were recovered in the dredges collected (Fig. 6). Worm tubes are more extensive on the under-side surface of the crust and can be seen boring through to the surface. The matrix of the hardground is generally a cemented sandstone although finer-grained cemented intervals were also recovered. Some recovered pieces of the hardground are massive, others are more vesicular. In one of the dredges, highly phosphatised (?) shark teeth and gastropods were found which showed some rounding due to re-working.

S-07-A:

Rationale: Drilling at this site will provide the age and facies of Megasequence B-D, particularly the initiation of the MP3 platform; the paleowater depth of the initial phase of MP3; the age and duration of unconformities separating each platform phase; the age and nature of the condensed section equivalent to MP2, and the nature of basement. Drilling will also detail the nature of mounds imaged in seismic data at the base of Megasequence C and will enable the calibration of regional seismic stratigraphy.

Sediment description: One dredge and one gravity core were collected at this site. The recovered sediments consisted of a periplatform silty-sandy ooze dominated by foraminifera. Some grains appear to have been phosphatised. In the dredge sample, distinct green-cream and cream colored intervals were seen which are likely to reflect diagenetic horizons in the surficial sediment. Unlike at other sites, not many large bioclasts were found after sieving.

Site CS-08-A:

Rationale: Drilling at this site will provide the age and facies of Megasequences A-D; the paleowater depth of the initial phase of MP3; the duration of unconformities separating each platform phase; and the nature of basement. Drilling will also enable the calibration of regional seismic stratigraphy and the study of fluids possibly flowing out of the MP3 platform.

Sediment description: One dredge and three gravity cores were collected at this site. The sediments consisted of a cream-colored periplatform ooze silty-sand ooze dominated by foraminifera with pteropods and some shallow-water components. Some grains appear to have been phosphatised. Burrows were seen in the dredge samples. The coarse-grained component of the sediment is dominated by abundant scaphopods, echinoderm spines and darkened grains.

Figure Captions

Figure 1. Map showing the location of regional seismic lines and site specific seismic grids.

Figure 2. Enlarged view of seismic line Mar/12 showing the drowned early-middle Miocene carbonate platform, MP2 (shotpoints 203-1100) with its adjacent prograding slope sediments of Megasequence B. The slope sediments underlie the shallow water carbonates (inclined reflections) indicating an eastward progradation of the platform margin.

Figure 3. Seismic line Mar/12. During deposition of Megasequence D, a wide channel was established between the edge of the MP2 carbonate platform (shotpoints 703–1200) and a thick sediment drift in the basin. This channel became subsequently infilled by another drift package, that buried the former platform margin.

Figure 4. Seismic line Mar/07B showing sediments from Megasequences B, C, and D. Within Megasequence C, the late middle-late Miocene MP3 carbonate platform (shotpoints 3453-5380) can be clearly seen. At the base of slope of Megasequence B, several downlapping units stack to a prograding base-of-slope complex that is characterised at its base by a distinct downlap surface (shotpoints 3700-3900, 0.80 ms twt).

Figure 5. Seismic line Mar/10 showing the eastern edge of MP2 (shotpoints 3952-3800) with adjacent slope sediments. These slope sediments and a thin Megasequence C are overlain by a thick succession of Megasequence D that is geometrically characterised by prograding clinoforms.

Figure 6. The iron-stained, highly bored and encrusted hardground surface recovered from Site CS-06-A. The hardground is highly pitted and is encrusted with both hard and soft organisms. Bryozoans are common in both encrusting and branching forms. Many worm tubes are seen boring through the hardground surface. The matrix of the hardground is a cemented sandstone.

Cruise Narrative

(All times in this narrative are Australian Eastern Standard Time unless noted. Start and finish times and locations for regional seismic lines are summarised in Table 1. Sampling locations are summarised in Table 3.)

Saturday, 10 April – Tuesday, 13 April

ORV Franklin departed the Passenger Terminal, Noumea, New Caledonia at 1000 (local time) and began the transit to Mackay, Australia to pick up additional freight. Anchored off Mackay at 2030 (13/4) to await transit into port in the morning.

Wednesday, 14 April – Thursday, 15 April

Docked at Mackay at 0845 on 14/4. Seismic streamer was loaded onto the reel and birds to keep streamer at a constant depth were assembled and checked. Waited in port until Thursday morning for lithium batteries to be used in birds. They did not arrive, thus we will rely on alkaline batteries. ORV Franklin departed Mackay at 0950. During transit to Hydrographers passage we stopped to check the gun configuration for the two GI guns and operation of the streamer before leaving the protection of the reef. Despite this protection, the swell was still 1-1.5 m.

Friday, 16 April

Exited through Hydrographers Passage near 0300 to swell heights of up to 2.5 m. Despite the fact that the sea state was borderline for successful data collection, the 24-streamer and two GI-guns were deployed at 0931. Data was noisy and the birds worked hard to keep the streamer at the proper depth. Seas and winds increased throughout the day. By 2000 sea state was determined to be too rough and gear was brought back on board to await calmer seas. Seven XBT's were attempted during seismic data collection. None operated properly as we later found out that they were grounding out on the GI guns.

Saturday, 17 April – Sunday, 18 April

Regional seismic grid was reassessed in the light of lost time due to weather and unscheduled trip to Mackay. To save time the remainder of lines Mar/03 and part of Mar/04 were abandoned and we began transit to a position along line Mar/04 25 km to the south to arrive near 0500 on 18/4. Weather eased slightly and seismic gear (minus 3.5 kHz) was deployed at 1500. Data collected along Mar/04 has significantly lower noise than previous deployment possibly due to weight added to streamer and the different angle of the swell.

Monday, 19 April

Line Mar/04 finished at 1253 and line Mar/20 began at 1644. Three sonobuoys were attempted and none provided a proper signal as it appears that we were provided with incorrect frequencies.

Tuesday, 20 April – Wednesday, 21 April

Data collection for Mar/20 continued until 1603 (20/4). Seas are continuing to slowly moderate but winds are still fresh (20 knots). Line Mar/10 began at 1823 (20/4). Corrected sonobuoy frequencies sent from AGSO and two successful deployments were made along Mar/10 (Table 2). Line Mar/10 was completed at 2355 (20/4). Began data collection on Mar/08 at 0044 (21/4) and completed line at 1240. Mar/07 began at 1602. All seismic data collected so far are of very high quality. Sonobuoy deployed along Mar/07.

Thursday, 22 April

Seas and wind have continued to calm. End of line for Mar/07 was reached at 0256. Data collection on Mar/17 began at 0643 and a sonobuoy was deployed near site CS-03-A. Mar/17 was completed at 2059. Start of line for Mar/15 occurred at 2311.

Friday, 23 April- Sunday, 25 April

End of line for Mar/15 at 1245 and Mar/13 started at 1531 (23/4). Sampling sites (Table 3) were selected using available data. Mar/13 completed at 0641 (24/4) and line Mar/12 began at 0807 (24/4). Mar/12 end of line at 2224 (24/4) and start of line Mar/10b occurred at 0147 (25/4). Line Mar/10b completed at 1545 (25/4). Approximately 20 km of Mar/20 was re-shot after Mar/10b as these data could not be printed at the time they were collected. Data collection for Mar/20b began at 1945 (25/4). 3.5 kHz towfish was re-deployed at 2345 (25/4).

Monday, 26 April

Halfway through Mar/20b the acquisition system crashed and we made a circle back onto the line while the system was re-started. As a result, the rest of the line was labelled Mar/20c. Acquisition of Mar/20c began at 0003 (26/4) and was completed at 0403. Most of regional grid has now been collected. Collection of detailed, 1 nmi grids over sampling sites began at 0500 with site CS-02-A which ended at 1040. The grid over CS-01-A was begun at 1215 and ended at 2330 and transit to the start of Mar/43-44.

Tuesday, 27 April

Mar/43-44 started 0014 and continued until 0954 near Site CS-03-A. At 1045 the grid over CS-03-A was started and it was finished at 1711 at which time we began the transit to CS-07-A.This transit time was used for system and compressor maintenance. The detailed grid over CS-07-A was started at 2106. The excellent weather since 25/4 has continued with low winds and flat seas.

Wednesday, 28 April

The grid for CS-07-A was completed at 0336. There was a small transit to CS-05-A and the grid was begun at 0534. CS-05-A was completed at 1201. The grid for site CS-06-A was reduced to give more time for extra lines to the east of MP3. There was a 1.5 hr transit from CS-05-A to CS-06-A and the lines for the latter site were shot between 1355 and 1429. Line Mar/70 was started at 1513 and completed at 2116. At clover-leaf turn was made to line Mar/71 which was started at 2147.

Thursday, 29 April - Friday, 30 April

Line Mar/71 was completed at 0047 (29/4) after which a turn was made into Line Mar/72 which was started at 0111 (29/4) and completed at 0759 (29/4). After line Mar/72, some time was used to look at the low amplitude signal of channel 4. The last survey grid over CS-08-A was begun at 1101 (29/4) and completed at 1721 (29/4). This completed the seismic component of the survey and all seismic gear was brought on board, cleaned, and stowed. Sampling gear was set up to begin the sediment sampling program.

At site CS-08-A we collected one dredge sample, three gravity cores, and a photography/CTD deployment. Dredge (DR) 01 was full of soft sediment, thus we went ahead and deployed the gravity core with recovery of 0.51, 0.27, and 0.84 m respectively for cores GR-01, 02, and 03. After coring was completed near 0030 (30/4) the camera was deployed (DIP-01).

0130 (30/4) depart for sampling site CS-06-A. Four dredge samples were collected at site CS-06-A, three on the main site and one at a nearby alternate location. No gravity cores or grabs were attempted as the seafloor was well indurated which would have prevented penetration. After completion of DR-04, the camera/CTD was deployed at the primary CS-06-A sampling site at 0645 (DIP-02). We moved off site one kilometer and took one dredge sample (DR-05) and deployed the camera/CTD (DIP-03).

After a 45 minute transit to CS-05-A we first collected a dredge sample at the primary site which showed the seafloor to be soft enough to collect gravity cores. Thus, we collected two gravity cores (GC-04 and 05) which were 0.51 and 0.87 m in length respectively. Camera/CTD DIP-04 was deployed at the end of sampling of the CS-05-A primary site. We then moved a kilometer to the side (alternate site 7) and collected two grab samples one of which did not trigger whereas the other collected a small amount of sediment. At this first alternate site we also collected a gravity core (GR-06) which was 1.48 m in length. The camera/CTD was then deployed at CS-05-A alternate 7 (DIP-5). We then moved again approximately a kilometer to CS-05-A alternate site 10 where we collected GC-07 which was empty. We then began the short transit to CS-07-A.

At CS-07-A we collected one dredge sample and one gravity core. We first deployed the dredge (DR-07), which was nearly full of sandy-silty sediment and thus we attempted a 5 m gravity core (GC-08) which recovered 2.73 m of sediment. After coring, the camera/CTD was deployed (DIP-06).

Saturday, 1 May

After completion of Site CS-07-A we transited 1.5 hours to CS-03-A where we collected one dredge and two gravity cores. The dredge was 3/4 full, and the sediment was soft enough to core so we deployed GC-09 which recovered 2.7 m and then GC-10 which recovered 3.73 m. After coring the camera/CTD (DIP-07) was deployed.

After an approximately 2.5 hour transit to site CS-01-A a pipe dredge was deployed which came up empty (DR-09). As a result, a combination chain and pipe dredge was deployed (DR-10) which recovered a cemented hardground and sandy periplatform ooze which could not be cored and thus another dredge was deployed instead (DR-11) which was 1/2 full. After dredging was completed, the camera/CTD was deployed DIP-08.

There was only a small transit to CS-02-A we arrived at 1245 and deployed the pipe dredge (DR-12) which recovered large concretions and a well-sorted sandy sediment similar to that at Site CS-01-A. Again, these sediments were not suitable for coring and we instead opted for a combination chain and pipe dredge (DR-13) which arrived on deck nearly full of cemented grainstones. After dredging was completed the camera/CTD was deployed (DIP-09).

After a 4.5 hour transit we arrived at the final sampling site CS-04-A at 1930. We first deployed a dredge (DR-14) to asses the seafloor conditions. The dredge was nearly full of very sandy sediment which we were not able to core despite two attempts (GC-11 and GC-12). After coring, we deployed the camera/CTD (DIP-10). This completed the work for the survey, and we began transit back to Cairns at 2300. Good weather held out until the end of the survey despite predictions it would deteriorate.

Sunday, 2 May - Tuesday, 4 May

The transit to Cairns continued. On 3/5 the seas increased (1-1.5 m within the reef) along with stronger winds (>15 knots) but abated later in the day. Despite our bad weather at the start of the cruise, overall, the weather was very good with low winds and nearly flat seas since 25/4.

Although the calm weather helped us make up time lost at the start of the survey, the most significant time was gained from the surprising lack of maintenance time needed for the seismic equipment. The time gained was used for additional seismic acquisition.

Overall impressions of FR 03/99

The seismic acquisition program undertaken during FR 03/99 was the most ambitious survey yet undertaken on ORV Franklin. Despite the limitation of available deck space, which was mostly taken up by the compressor container and seismic reel, ORV Franklin proved to be a highly suitable platform for high-resolution seismic surveys. Hopefully, the vessel will be used more for this purpose in the future.

The scientific party would like to thank the Master and crew of ORV Franklin for their willing assistance and support of our efforts and for helping make FR03/99 a great success.

Personnel

Scientific Party

Alexandra Isern	University of Sydney, Chief Scientist
Flavio Anselmetti	Swiss Federal Institute of Technology
Philipp Heck	Swiss Federal Institute of Technology
David Stone	University of Sydney
Steve Wiggins	AGSO
Craig Wintle	AGSO
Steve Thomas	AGSO
Lyndon O'Grady	AGSO
John Ryan	AGSO
Bernadette Heaney	CMR , Computing
Mark Underwood	CMR , Cruise Manager / Electronics

Crew

Neil Cheshire	Master
Arthur Staron	First Officer
Paul Ware	Second Officer
Gordon Gore	Chief Engineer
Dave Jonkers	First Engineer
Dennis Cashman	Electrical Engineer
Bill Hughes	Bosun
Paul Bailey	IR
Simon Smeaton	IR
Terry Ganim	IR
Phillip French	Greaser
Ron Culliney	Steward
Gary Hall	Chief Cook
Robert Prengkerego	First Cook

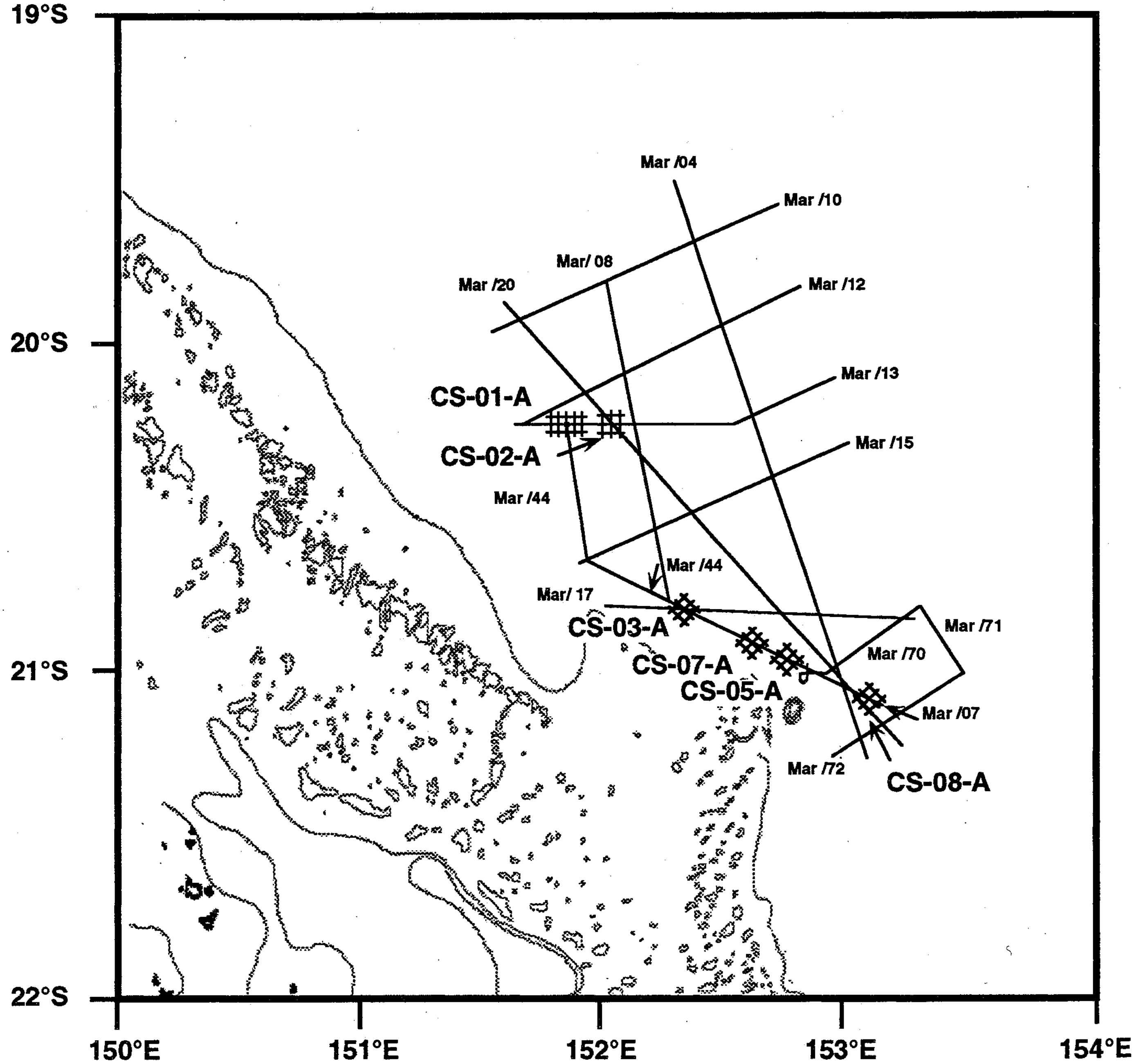

19°S
20°S
21°S
22°S
150°E
151°E
152°E
153°E
154°E
Mar /04
Mar /10
Mar/ 08
Mar /20
Mar /12
Mar /13
Mar /15
CS-01-A
CS-02-A
Mar /44
Mar /44
Mar/ 17
CS-03-A
Mar /71
Mar /70
CS-07-A
CS-05-A
Mar /07
Mar /72
CS-08-A

Figure 1

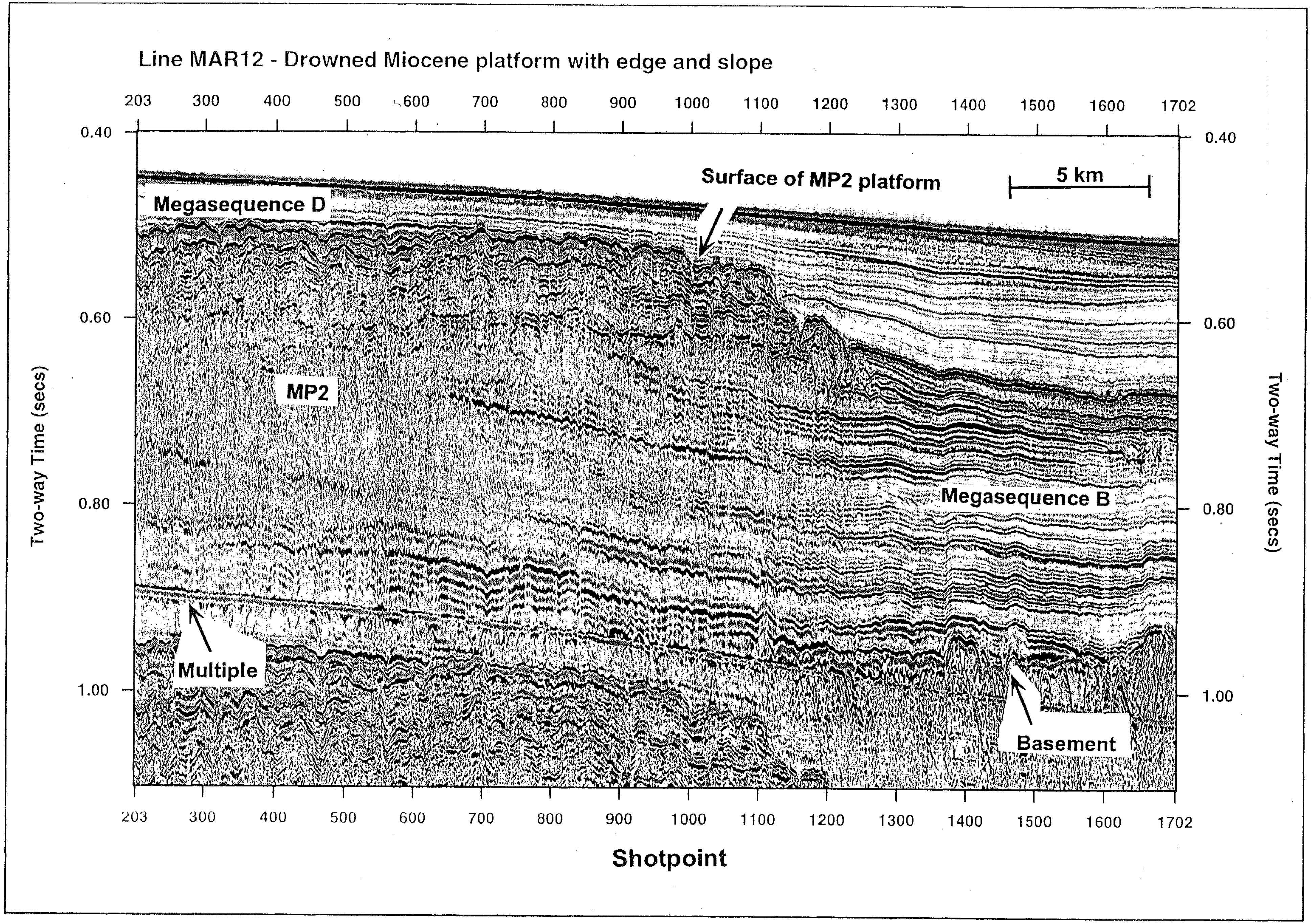
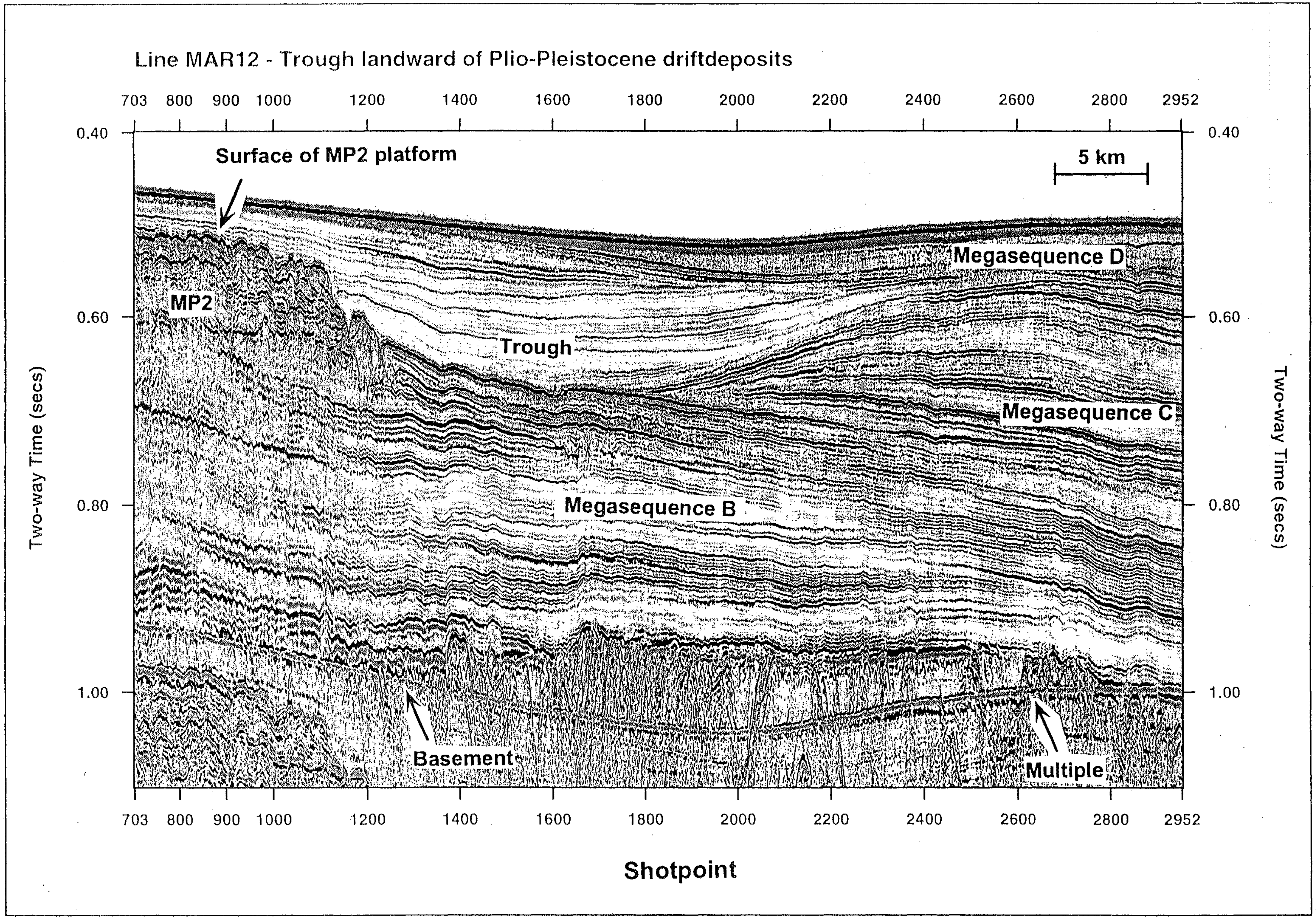

Line MAR12 - Drowned Miocene platform with edge and slope
203
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1702
0.40
0.60
0.80
1.00
Two-way Time (secs)
Surface of MP2 platform
5 km
Megasequence D
MP2
Megasequence B
Multiple
Basement
Shotpoint

Figure 2



Line MAR12 - Trough landward of Plio-Pleistocene driftdeposits
703
800
900
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
2952
0.40
0.60
0.80
1.00
Two-way Time (secs)
Surface of MP2 platform
5 km
MP2
Trough
Megasequence D
Megasequence C
Megasequence B
Basement
Multiple
Shotpoint

Figure 3

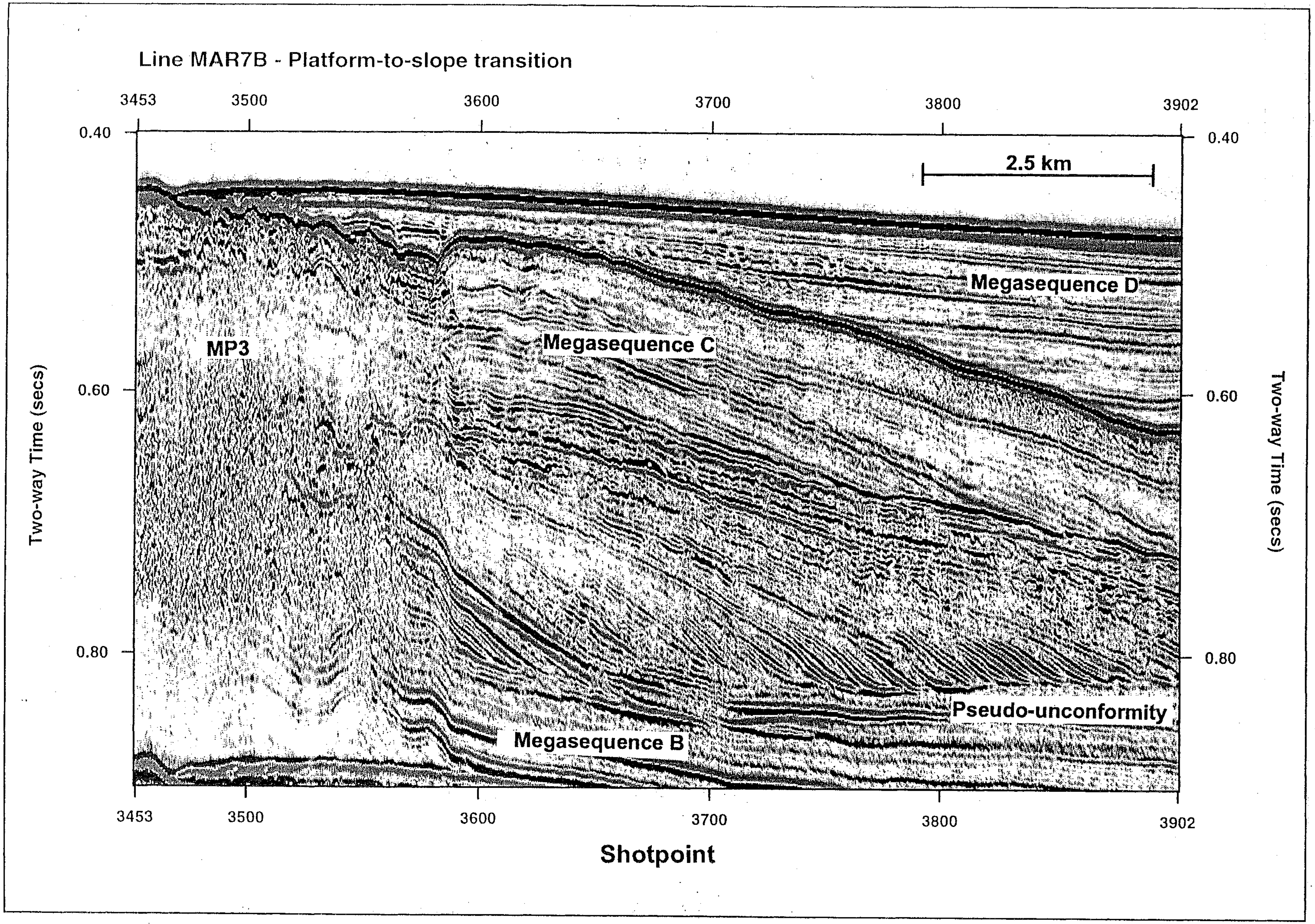

Line MAR7B - Platform-to-slope transition
3453
3500
3600
3700
3800
3902
0.40
0.60
0.80
Two-way Time (secs)
2.5 km
Megasequence D
Megasequence C
MP3
Pseudo-unconformity
Megasequence B
Shotpoint

Figure 4

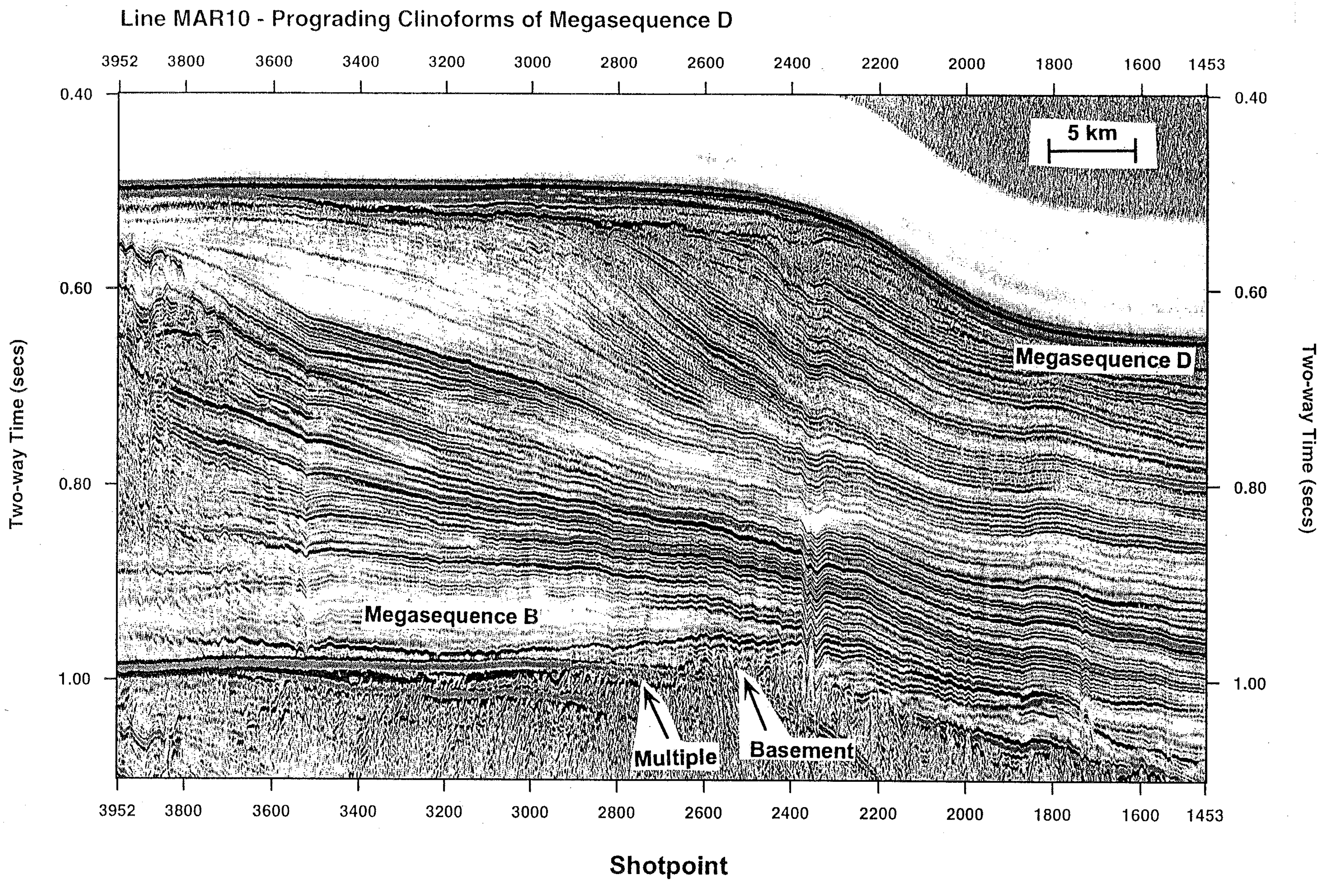

Line MAR10 - Prograding Clinoforms of Megasequence D
3952
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1453
0.40
0.60
0.80
1.00
Two-way Time (secs)
5 km
Megasequence D
Megasequence B
Multiple
Basement
Shotpoint

Figure 5

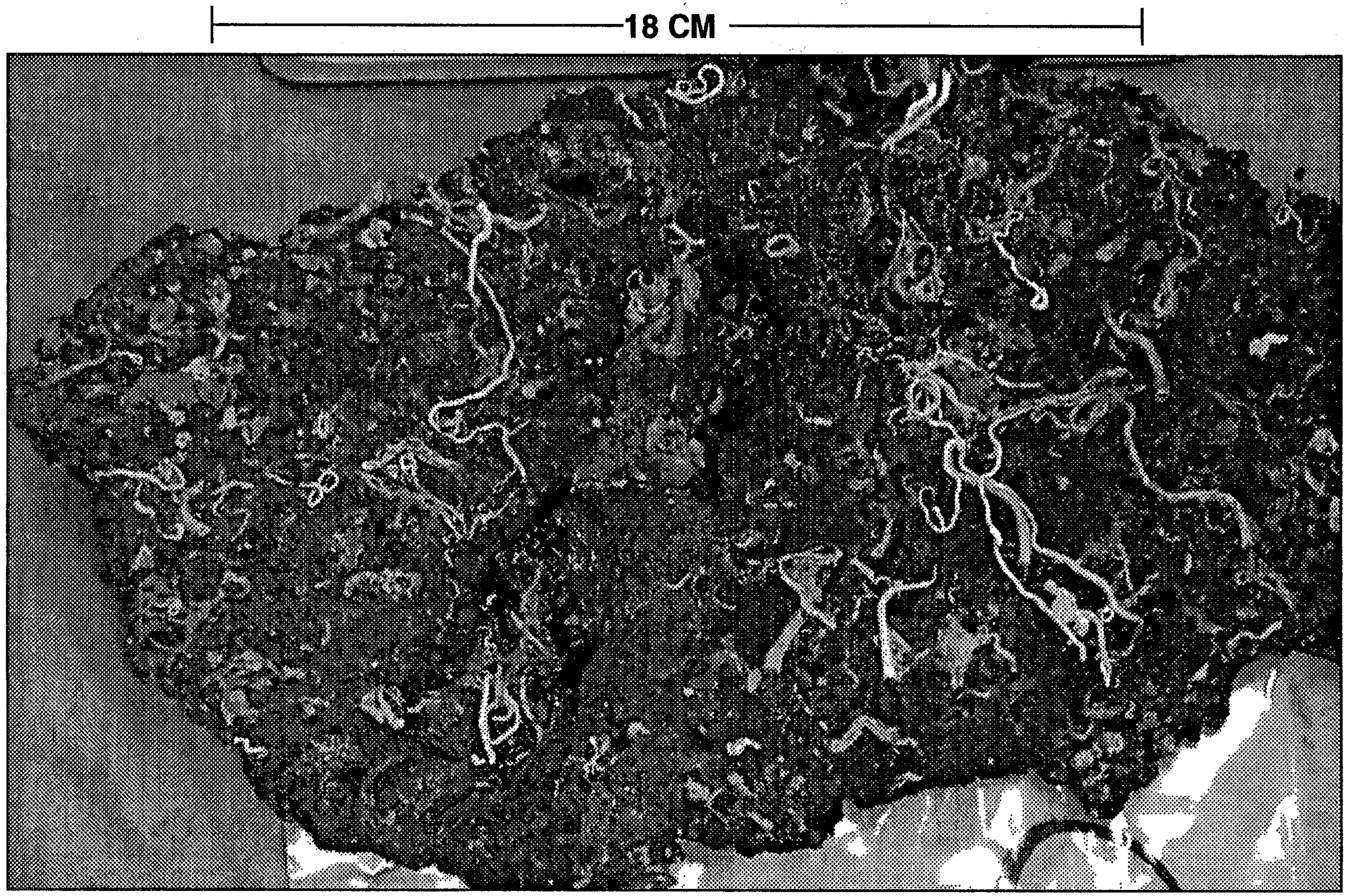


Figure 6

Table 1: Summary of local and regional high-resolution seismic lines collected during FR 03/99

Regional

Line	UTC Start	Local time Start	UTC End	Local Time End	First Shot Point	Last Shot Point	Start Latitude (°S)	Start Longitude (°E)	End Latitude (°S)	End Longitiude (°E)
Mar/02	105:23.31	16/4 0931	106:03.37	16/4 1337	1	1466	19°16'93.37	150°00'43.52	18°58'12.89	149°59'33.64
Mar/03	106:04.56	16/4 1500	106:09.59	16/4 2200	20	1715	18°58'13.90	149°56'33.33	18°59'46.72	150°20'43.61
Mar/04	108:05.12	18/4 1510	109:02.52	19/4 1253	1	7874	19°34'56.75	152°18'08.77	21°13'43.75	153°02'41.31
Mar/07	111:06.01	21/4 1602	111:16.56	22/4 0256	1	3914	20°46'40.51	152°13'51.38	21°05'26.12	153°06'24.94
Mar/08	110:14.44	21/4 0044	111:02.34	21/4 1240	1	4385	19°48'34.29	151°58'36.04	20°46'33.51	152°13'47.37
Mar/10	110:08.23	20/4 1823	110:13.35	20/4 2355	1	1786	19°56'09.99	151°34'15.73	19°48'37.49	151°58'15.41
Mar/10B	114:15.45	25/4 0147	115:05.45	25/4 1545	9	5046	19°04'13.42	152°41'11.69	19°56'30.65	151°33'64.16
Mar/12	113:22.07	24/4 0807	114:12.24	24/4 2224	1	5194	20°14'87.32	151°36'90.81	19°49'49.23	152°46'43.35
Mar/13	113:05.31	23/4 1531	113:20.41	24/4 0641	1	5494	20°09'55.44	152°54'21.07	20°14'27.33	151°36'54.13
Mar/15	112:13.10	22/4 2311	113:02.45	23/4 1245	1	4877	20°39'47.76	151°52'00.18	20°18'09.58	152°59'02.82
Mar/17	111:20.42	22/4 0643	112:10.59	22/4 2059	3	5221	20°49'55.37	153°14'24.96	20°47'45.25	151°58'48.42
Mar/20	109:06.44	19/4 1644	110:06.03	20/4 1603	1	8696	21°10'24.03	153°09'46.90	19°54'23.65	151°34'37.33
Mar/20B	115:09.16	25/4 1916	115:12.54	25/42254	1	1223	19°53'35.20	151°33'53.90	20°04'36.21	151°47'14.58
Mar/20C	115:14.03	26/4 0003	115:18.03	26/4 0403	1	1420	20°03'09.27	151°45'25.43	20°15'32.24	152°00'50.22
Mar/43-44	116:14.14	27/4 0014	116:23.54	27/4 0954	2	3584	20°14'34.37	151°44'44.73	20°47'32.84	152°16'30.26
Mar/69	118:03.55	28/4 1355	118:04.29	28/4 1429	21	232	20°58'35.33	152°50'36.60	21°01'23.39	152°50'21.82
Mar/70	118:05.13	28/4 1513	118:11.16	28/4 2116	21	226	21°00'22.38	15249'13.24	20°47.28.98	152°17.44.59
Mar/71	118:11.47	28/4 2147	118:14.47	29/4 0047	21	1189	20°47'27.75	153°17'44.50	21°00'12.65	153°27'09.56
Mar/72	118:15.11	29/4 0111	118:21.59	29/4 0759	21	2519	21°00'00.18	153°27'00.01	21°15'06.86	152°54'43.60

Local Grids

Line	UTC Start	Local time Start	UTC End	Local Time End	First Shot Point	Last Shot Point
CS-01-A	116:02.14	26/4 1214	116:12.28	26/4 2228	20	2599
CS-02-A	115:18.42	26/4 0442	116:00.14	26/4 1012	1	1468
CS-03-A	117:00.45	27/4 1045	117:07.11	27/4 1711	1	1508
CS-05-A	117:19.34	28/4 0534	118:02.01	28/4 1201	19	1520
CS-07-A	117:11.06	27/4 2106	117:17.36	28/4 0336	21	1525
CS-08-A	119:01.01	29/4 1101	119:07.21	29/4 1721	21	1525

Table2: Sonobuoy sampling sites

Sonobuoy Number	Seismic Line	Shot Number	Latitude	Longitude
1	Mar/10	244	19°35'17.29	152°38'01.58
2	Mar/10	1369	19°40'23.55	152°22'51.68
3	Mar/07	2819	21°00'27.85	152°51'37.96
4	Mar/17	3890	20°48'01.04	152°18'07.14

Table 3: Sampling sites and data collected at each site

Site	Water Depth		Photography/CTD	Number
CS-01-A	342 m	Latitude	20°14.380 S	Dip 8
		Longitude	151°47.460 E	
CS-02-A	367 m	Latitude	20°14.525 S	Dip 9
		Longitude	151°59.044 E	
CS-03-A	320 m	Latitude	20°47.511 S	Dip 7
		Longitude	152°16.510 E	
CS-04-A	431 m	Latitude	20°24.207 S	Dip 10
		Longitude	152°40.491 E	
CS-05-A Primary Site	314 m	Latitude	20°57.848 S	Dip 4
		Longitude	152°43.926 E	
CS-05-A Alternate Site 7	327 m	Latitude	20°57.000 S	Dip 5
		Longitude	152°43.007 E	
CS-06-A Primary Site	324 m	Latitude	21°00.379 S	Dip 2
		Longitude	152°51.374 E	
CS-06-A Alternate Site 2	310 m	Latitude	21°00.286 S	Dip 3
		Longitude	152°49.991 E	
CS-07-A	324 m	Latitude	20°54.609 S	Dip 6
		Longitude	152°34.943 E	
CS-08-A	342 m	Latitude	21°04.643 S	Dip 1
		Longitude	153°04.040 E	

Site	Water Depth		Gravity Core	Core Number	Length (m)
CS-03-A	320 m	Latitude	20°47.544 S	GC-09	2.7
		Longitude	152°16.520 E		
	320 m	Latitude	20°47.576 S	GC-10	3.73
		Longitude	152°16.459 E		
CS-04-A	414 m	Latitude	20°24.220 S	GC-11	0
		Longitude	152°40.461 E		
	414 m	Latitude	20°24.219 S	GC-12	0
		Longitude	152°40.469 E		
CS-05-A Primary Site	314 m	Latitude	20°57.856 S	GC-04	0.51
		Longitude	152°43.973 E		
	314 m	Latitude	20°57.853 S	GC-05	0.87
		Longitude	152°43.964 E		
CS-05-A Alternate Site 7	327 m	Latitude	20°57.018 S	GC-06	1.48
		Longitude	152°43.003 E		
CS-05-A Alternate Site 10	321 m	Latitude	20°57.308 S	GC-07	0
		Longitude	152°42.494 E		
CS-07-A	325 m	Latitude	20°54.641 S	GC-08	2.73
		Longitude	152°35.049 E		
CS-08-A	343 m	Latitude	21°04.587 S	GC-01	0.51
		Longitude	153°03.975 E		
	343 m	Latitude	21°04.568 S	GC-02	0.27
		Longitude	153°03.986 E		
	343 m	Latitude	21°04.566 S	GC-03	0.84
		Longitude	153°03.968 E		

Site	Water Depth		Dredge	Dredge Number
CS-01-A	342 m	Latitude	20°14.478 S	DR-09
		Longitude	151°47.485 E	
	342 m	Latitude	20°14.471 S	DR-10
		Longitude	151°47.523 E	
	342 m	Latitude	20°14.490 S	DR-11
		Longitude	151°47.530 E	
CS-02-A	367 m	Latitude	20°14.629 S	DR-12
		Longitude	151°59.081 E	
	366 m	Latitude	20°14.504 S	DR-13
		Longitude	151°58.98 E	
CS-03-A	320 m	Latitude	20°47.546 S	DR-08
		Longitude	152°16.504 E	
CS-04-A	414 m	Latitude	20°24.504 S	DR-14
		Longitude	152°40.458 E	
CS-05-A Primary Site	314 m	Latitude	20°57.875 S	DR-06
		Longitude	152°44.003 E	
CS-06-A Primary Site	301 m	Latitude	21°00.564 S	DR-02
		Longitude	152°51.426 E	
	299 m	Latitude	21°00.486 S	DR-03
		Longitude	152°51.327 E	
	299 m	Latitude	21°00.473 S	DR-04
		Longitude	152°51.379 E	
CS-06-A Alternate Site 2	311 m	Latitude	21°00.243 S	DR-05
		Longitude	152°50.114 E	
CS-07-A	325 m	Latitude	20°54.669 S	DR-07
		Longitude	152°35.081 E	
CS-08-A	342 m	Latitude	21°04.526	DR-01
		Longitude	153°03.764	

Site	Water Depth		Grab	Grab Number
CS-05-A Alternate Site 7	327 m	Latitude	20°57.025 S	GR-01
		Longitude	152°43.000 E	
	327 m	Latitude	20°57.033 S	GR-02
		Longitude	152°43.010 E	