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Continental Shelf Definition in the Kerguelen Plateau Region: Law of the Sea Survey 180, Preliminary Results

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Contents

Executive Summary

This report presents the preliminary results from the second of two surveys that were designed to acquire the necessary data to maximise the definition of the 'legal' Continental Shelf beyond the 200 nautical mile Australian Exclusive Economic Zone around the southern Kerguelen Plateau. Except for two lines on the northern flank of the William's Ridge feature, which were not acquired, all objectives of the cruise proposal were met. In addition, data in support of a proposed Ocean Drilling Program drilling site, as well as a short seismic line across part of the northern Labuan Basin, were recorded. This was further augmented, on the return transit to Fremantle, by an extensive seismic transect across the southwestern margin of the Naturaliste Plateau.

The cruise commenced in Fremantle, Australia, on Friday February 28, 1997, and ended in the same port on 15 April, 1997. In the Kerguelen Plateau region, deep-seismic lines totaling approximately 1500 km, with continuous bathymetry, were recorded along the proposed lines and extensions. The seismic line in the Naturaliste Plateau region was 430 km in length. Gravity was acquired continuously while magnetic data were recorded along all seismic lines and those transits to and from the survey area when weather conditions were favourable. Navigation was provided by two independent differential GPS systems for most of the survey. In addition, nineteen sonobuoys were successfully deployed in order to determine sonic velocities to enable computation of sediment thickness.

The survey lines for the Kerguelen Plateau region were designed to add to existing seismic and bathymetric data, and to provide both preliminary positions for the foot-of-slope and the 2500 metre isobath. In addition, those lines over the Labuan Basin were designed to determine the thickness of sediment beyond the Hedberg Line. In conjunction with existing data, all of these proposed lines were spaced at less than 60 nautical miles separation. Accurate Law of the Sea parameter determinations will await final processing of all the survey data.

The successful completion of the cruise means that Australia is now in a position to maximise its definition of 'legal' Continental Shelf beyond the Australian Exclusive Economic Zone for the eastern margins of the southern Kerguelen Plateau.

Introduction

Australia potentially has jurisdiction over an area of seabed and subsoil which is likely to be of the order of 1 million km^2 (Symonds & Willcox, 1989), in the form of 'legal' Continental Shelf (CS) beyond the Australian Exclusive Economic Zone (AEEZ), around its island territories of Heard and McDonald islands in the southern Indian Ocean. In order to delineate the outer limits of this area, Australia has to acquire relevant data to satisfy the requirements laid down in Article 76 (Appendix 1) of the 1982 United Nations Convention on the Law of the Sea (UNCLOS). The data must satisfy, at intervals no greater than 60 nautical miles (n mile), the following conditions:

- definition of the maximum cut-off, 100 n mile beyond the 2500 metre isobath;
- definition of the Hedberg Line, 60 n mile beyond the foot-of-slope (FoS); and
- determination of the sediment thickness distribution beyond the Hedberg Line, up to the maximum allowable claim in the first point above[1].

Planning for the UNCLOS surveying on the southern Kerguelen Plateau is presented in Borissova (1997). The potential for rough weather in the Southern Ocean, and the short summer season with suitable sea states, meant that two surveys were deemed necessary to acquire this information. This report[2] covers the preliminary results of the second of these cruises using RV *Rig Seismic* (Appendix 3); results from the first cruise are summarised in Ramsay et al. (in prep.).

The second Kerguelen Plateau cruise took place between 28 February and 15 April 1997. The survey concentrated on both the eastern margin of the southern Kerguelen Plateau and the adjacent Labuan Basin, as well as the William's Ridge protrusion further to the north (Figure 1). Previous coverage of both the Labuan Basin and the eastern margin of the plateau is limited to only a few bathymetric lines and three multi-channel seismic lines recorded on surveys 47 and 59 of the RV *Rig Seismic* and *Marion Dufresne*, respectively. These seismic lines are separated by more than 60 n mile so that subsurface coverage was not sufficient to make a maximum claim on the grounds of sediment thickness beyond the Hedberg Line. Therefore, to better define the sediment thickness, foot-of-slope (FoS) and 2500 m isobath positions, seismic lines KP-J to KP-N were proposed. Furthermore, the shorter lines KP-O to KP-S were added to define more clearly the 2500 m isobath and FoS points on the William's Ridge feature. This was needed to clarify the complex relationship between the Hedberg Line and 2500 m isobath plus 100 n mile maximum cut-off boundary (the isobath cut-off). Except for lines KP-Q, KP-R and KP-S, which had to be abandoned because of seismic cable problems (see Cruise Narrative section), all UNCLOS objectives were met.

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[1] The rules of Article 76 stipulate a "maximum allowable claim" as the greater of either 350 n mile from the baselines, or 100 n mile beyond the 2500 m depth contour; in much of the survey area under consideration here, the latter determination applies.

[2] The data, and the interpretations based on that data, contained in this report are preliminary only. It is not necessarily indicative or representative of the final information that might be used by Australia to support the location of the outer limit of the continental shelf beyond 200 nautical miles.

Along with the UNCLOS program requirements, two additional seismic lines were recorded in the Kerguelen Plateau area: line KIP-13A as a short seismic traverse across the proposed Ocean Drilling Program (ODP) drilling site ODP KIP-13A (Frey et al., 1996), scheduled for drilling in the 1998/99 southern hemisphere summer; and line KP-T, which was shot to extend RV *Rig Seismic* line 47/19 across the northern end of the Labuan Basin. Several days were lost due to two periods of inclement weather (see Cruise Narrative and weather details in Appendix 8).

The locations of all proposed UNCLOS features presented in this report will be subject to modification following final data processing. Note that the lines acquired on the cruise do not all correspond exactly to those planned. Some lines were extended and others were adjusted to avoid potential collision with icebergs[3]. Nevertheless, those changes required in the areas between the Hedberg Line and maximum claim boundary were such that the critical, less than 60 n mile, line separation limit was not compromised.

In this report each line is presented with summary information on the recording specifications used, the objectives of the profile, the broad geological features observed and those parameters of direct relevance to Australia's UNCLOS claim. However, more comprehensive information on day-to-day operations, data quality and acquisition performance can be found in the relevant survey and quality control reports. No detailed geological or morphological interpretation is presented, but this information can be found in the references cited.

Finally, an early return transit to Fremantle provided some available time in which to acquire seismic data along a 430 km north-south transect across the southern margin of the Naturaliste Plateau, a possible continental fragment off southwestern Australia. This line will aid in planning for a potential future LOS study of the region. Note that it was not acquired as part of the original Kerguelen Plateau program (Survey 180), and, therefore, is identified as a seismic line of Survey 187.

Survey Line Summary

The following listing represents the lines planned for and acquired in the survey area – both Kerguelen Plateau and the additional Naturaliste Plateau line – in acquisition order. Those in italics did not form part of the original cruise proposal.

Planned Line	Actual Line Recorded	Configuration Altered	Length (km)
KP-N	seismic line 180/01	yes - iceberg	~ 305
KIP-13A	*seismic line 180/02*	no	~ 76
KP-J	seismic line 180/03	yes - iceberg, guns	~ 110
KP-J	seismic line 180/04	yes - iceberg, extended	~ 25
KP-K	seismic line 180/05	yes - iceberg	~ 210

[3] Note that icebergs also produce bergy bits and the smaller growlers, which are broken off sections of ice that are generally not discernible by radar. Bergy bits half the size of the RV *Rig Seismic* were seen visually, but did not provide a radar signature. The danger of structural damage from a direct or side-on collision was taken into account when considering the degree of course deviations around a sighted iceberg.

KP-L	seismic line 180/06	yes - extended	~ 355
KP-M	seismic line 180/07	yes - extended	~ 285
KP-T	*seismic line 180/08*	no	~ 120
KP-O	bathymetry line 180/09	yes - shortened	~ 180
KP-P	bathymetry line 180/10	no	~ 100
KP-Q	abandoned - see narrative		
KP-R	abandoned - see narrative		
KP-S	optional - not acquired		
NP-1	*seismic line 187/01*	no	~ 430

The proposed and actual Survey 180 lines are shown in Figure 1. A total of approximately 1900 km of seismic data were acquired, together with some 2200 km of bathymetry data, in addition to continuous bathymetric profiling during all transits.

Line Descriptions and Onboard Interpretation

It should be emphasised that the following line descriptions, and the interpretation of Law of the Sea (LOS) parameters, in particular, are preliminary and may not necessarily represent the arguments that will be put forward by the Australian Government in its submission supporting 'legal' Continental Shelf in the survey area.

The following descriptions give a broad overview of the rationale behind the lines acquired on Survey 180. Line 187/01 is included as part of the Naturaliste Plateau LOS survey requirement, now partially completed. Much of the discussion is based on either single-channel monitor sections or brute stacks off the ship (Figure 2). Additional information on sonobuoy deployment can be found in Appendix 6. While UNCLOS picks are discussed here, a more comprehensive summary is included as Appendix 7. A general narrative on sea state and equipment condition is contained in the following section.

Line 180/01 - Labuan Basin and eastern Kerguelen Plateau (Fig. 2a)

Source: 1500/3000 in^3 sleeve guns
Streamer: 3000 m, 240 channels
Record: 16 seconds, 4 ms sample
Orientation: E then NE

Objective: Line KP-N was designed to test the position of the FoS and the sediment thickness between the Hedberg Line and maximum cut-off boundary in an area 60 n mile to the north of, and parallel to, KP-M.

Actual configuration: The line began to the northeast of the proposed start-of-line (SOL), to complete a transect of the Labuan Basin, and ran southwest down the planned direction till about shot point (SP) 4500, when a field of icebergs required a series of deviations to run due west, where it finished well to the northwest of the proposed end-of-line (EOL). While the initial part of the line to determine sediment thickness was not altered, the intended FoS was missed. However, this was compensated for by running the line due west, until another FoS was reached, then continuing on to tie with line 47/19.

Sediment: To the northeast, the line terminates on oceanic crust and is dominated by the depocentre of the eastern Labuan Basin, containing up to 2300 ms two-way time (TWT) of sediment. The sedimentary section is masked by large-scale diffractions, which are interpreted to be due to widespread volcanics. The sedimentary section then thins southwestwards over a basement high, which crops out at about SP 3300. The sediment thickness then generally increases to the southwest and west into the western Labuan Basin until about SP 5100, where up to 2000 ms TWT of sediment is present. Sediment then thins to the west where it onlaps basement on the eastern margin of the Kerguelen Plateau. At least three megasequences can be identified in the western Labuan Basin (A, B, C in Fig. 2(a)). Megasequence A appears to be deposited in a syn-rift environment. The uppermost layers of megasequence C show evidence of current erosion that is probably the result of the Antarctic Circumpolar Current, which has been active since the Oligocene (Kennett and Watkins, 1976).

Basement: Basement is readily identified across most of the line, but is masked underneath the eastern Labuan Basin by broad diffractions in the overlying section. It is strongly faulted in the western Labuan Basin, where it predominantly forms a series of steep, west-dipping fault blocks. Several of the bounding faults propagate through the sedimentary section to the seafloor. This indicates a period of extensional movement in the crust and some more recent reactivation.

Initial UNCLOS parameters: Both the FoS and edge-of-abyssal plain (EoAP) are found at approximately SP 7000. Without a comprehensive velocity interpretation, the sediment thickness at the Hedberg Line (about SP 4800) and just beyond does not appear to support an extended claim in this area.

Line 180/02 - proposed ODP KIP13A drill site (Fig. 2b)

Source: 3000 in^3 sleeve guns
Streamer: 3000 m, 240 channels
Record: 16 seconds, 2 ms sample
Orientation: SE

Objective: Seismic line KIP-13A was planned to acquire geological information for about 40 km on either side of the proposed ODP site KIP13A (Frey et al., 1996) in a northwest-southeast direction.

Actual configuration: The line was commenced 5 km after the proposed SOL at the northwestern end, because of gun deployment problems.

Sediment: The section is made up of a veneer of sediment averaging 600 ms TWT in thickness and thickening to the southeast. Reflectors are continuous and mostly of uniform amplitude. The section is characterised by several down-to-basin faults to the southeast of the proposed drill site.

Basement: Basement is a strong, continuous reflective event in the northwest but dislocated by faulting in the southeast. Low amplitude, north-dipping reflectors (SP 1900-2500, Fig. 2(b)) are evident within basement in the brute-stack section; these may be seaward-dipping

reflectors indicating volcanic flows seaward of the main volcanic centres on the central plateau terrain (Schlich et al., 1993).

Initial UNCLOS parameters: This line was not acquired for LOS purposes and neither a FoS pick nor the 2500 m isobath were intersected.

Line 180/03 - south-eastern Kerguelen Plateau margin (Fig. 2c)

Source: 3000 in^3 sleeve guns
Streamer: 3000 m, 240 channels
Record: 16 seconds, 2 ms sample
Orientation: SE then E

Objective: Line KP-J was designed to test for the 2500m isobath and FoS positions on a protrusion of the plateau, as well as sediment thickness beyond the Hedberg Line near the southern extremity of the eastern margin of the Kerguelen Plateau.

Actual configuration: Line 180/03 comprises the western half of the originally proposed line KP-J (Fig. 1). Several deviations were made to avoid an iceberg and then re-join the proposed line. Very cold water conditions created problems with the guns whilst in operation (see Narrative) and seismic acquisition was ended prematurely midway down the line.

Sediment: The flank of the plateau is covered by about 200 ms TWT of sediment. The reflectors are continuous for the most part, with some dislocations due to basement faulting. Sediment thickens markedly into the Labuan Basin, where the sedimentary section appears to comprise at least two megasequences. The lower sequence is characterised by divergent reflectors indicating deposition contemporaneous with basement movements, while the upper sequence is dominated by reflectors that are typically more flat-lying and continuous.

Basement: Basement reflections are obscured beneath the Labuan Basin due to faulting and block rotation. The brute-stack section indicates a series of dipping basement reflectors beneath the flank of the plateau, which may be interpreted as a plateau derived from the build-up of volcanic flows.

Initial UNCLOS parameters: The FoS/EoAP was recorded at about SP 2500, with the 2500 m isobath intersected further to the west. The identification of these points more outboard and inboard of the previously interpolated positions, respectively, narrows the potentially claimable gap between the Hedberg Line and the maximum allowable isobath cut-off position.

Line 180/04 - Hedberg Line to maximum claim position (Fig. 2d)

Source: 1500 in^3 sleeve guns (see Narrative)
Streamer: 3000 m, 240 channels
Record: 16 seconds, 2 ms sample
Orientation: ESE

Objective: As for line 180/03.

Actual configuration: As noted above, this is the continuation of the planned line KP-J, which was restarted to measure the sediment thickness between the proposed Hedberg Line and the maximum possible claim at the 2500 m isobath plus 100 n mile cut-off. An iceberg at the proposed EOL caused a slight course alteration and the line being extended beyond the original EOL.

Sediment: Again, this section is characterised by at least two megasequences. The lower megasequence is comprised of some 600-800 ms TWT of strata. The upper megasequence averages about 600 ms TWT in thickness and is characterised by mostly flat-lying and continuous reflectors.

Basement: Basement is readily identified as a strong event along the line. Several normal faults could indicate some minor extension.

Initial UNCLOS parameters: The Labuan Basin at the revised Hedberg Line and beyond, contains about 1300 ms TWT of sediment. This is expected to correspond to a sediment thickness greater than 1100 metres, which appears to support an Australian claim beyond the Hedberg Line. The maximum cut-off is probably inboard of the EOL.

Line 180/05 - CS maximum cut-off to Kerguelen Plateau margin (Fig. 2e)

Source: 1500 in^3 sleeve guns (see Narrative)
Streamer: 3000 m, 240 channels
Record: 16 seconds, 4 ms sample
Orientation: ENE then ESE

Objective: Line KP-K was designed to determine the position of the 2500 m isobath and the sediment thickness beyond the proposed Hedberg Line out to the associated maximum possible claim. It was positioned 60 n mile to the north of line KP-J, commencing at the proposed 2500 m isobath plus 100 n mile cut-off boundary position.

Actual configuration: An iceberg at the proposed SOL required both a modification in the line configuration so as to commence further to the south, and a small dogleg midway along the line. The revised line was within 60 n mile of both 180/04 to the south and a *Marion Dufresne* multichannel seismic line to the north.

Sediment: In this region, the Labuan Basin contains up to 1800 ms TWT of sediment above basement. A lower megasequence of chaotic reflectors averages 400 ms TWT in thickness, while an upper sequence averages 1400 ms TWT and is characterised by reflectors of more continuous and flat-lying character. The boundary between the two sequences is an angular unconformity with clear truncation of the lower sequence in places. Sediments onlap and thin onto the shallowing plateau basement in the vicinity of the FoS/EoAP. A moat-like feature, near the base of the margin, has formed through erosion of strata at the seafloor, indicating that the elevated plateau has focussed deep ocean currents around its base. Little sediment cover is evident on the Kerguelen Plateau margin.

Basement: Basement is rugged and faulted beneath the Labuan Basin. Some faulting has also affected the overlying sediment. To the east, the brute stack provides some evidence of deeper reflection events below basement.

Initial UNCLOS parameters: The FoS was found at about SP 4500, with the 2500 m isobath intersected further to the west. Both of these picks are inboard from their respective predictions. The Labuan Basin at the proposed Hedberg Line and beyond contains some 1800 ms TWT of sediment. This is expected to correspond to a sediment thickness of the order of 2000 m, indicating support in this vicinity for pushing Australia's claim beyond the Hedberg Line to the maximum isobath cut-off position.

Line 180/06 - CS maximum cut-off to Kerguelen Plateau margin (Fig. 2f)

Source: 3000/1500 in^3 sleeve guns
Streamer: 1600 m, 128 channels (see Narrative)
Record: 16 seconds, 4 ms sample
Orientation: E

Objective: Line KP-L was designed to determine the sediment thickness between the Hedberg Line and maximum cut-off boundary. It will enhance definition of the FoS and 2500 m isobath on the eastern margin of the Kerguelen Plateau.

Actual configuration: The original line was extended to the east to form a complete transect of the Labuan Basin. This extension was based on interpretation of satellite-altimetry gravity data, which indicated a clear northwest-striking lineation northeast of the end of the proposed line. Furthermore, the line was continued past the end of seismic acquisition, with bathymetry, in order to capture the 2500 m isobath. The actual SOL was relocated south of the intended position due to an iceberg. A minor deviation of about 1 km was implemented towards the EOL to avoid another iceberg.

Sediment: Sediment onlaps a steep boundary with the Australian-Antarctic oceanic crust at the eastern end of the line. The Labuan Basin sedimentary section is split into two sub-basins about a basement high at about SP 4000. The sedimentary section, to the east of this high, is dominated by mostly flat-lying and continuous reflectors. Sediment mounding corresponds with basement topography and reactivated faulting. Sediment thickness averages 1000-1200 ms TWT, and is a maximum of some 2000 ms TWT at the eastern end of the line. In the western sub-basin the sedimentary thickness averages 600-800 ms TWT, but is more variable than that to the east, with reflectors less continuous in character. Two megasequences are identified, with the lower being a syn-rift section. Sediment thins towards the flank of the plateau over a basement arch at about SP 6000. On the Kerguelen Plateau itself, some 800 ms TWT of sedimentary section is found, and is made up mostly of flat-lying and continuous reflectors. The base of the plateau's flank is again characterised by a moat-like feature (SP 7000).

Basement: Basement is readily identified along most of the line. Below the Labuan Basin it is strongly faulted and forms a series of rotated fault-blocks in the western sub-basin. Basement faulting is less apparent on the Kerguelen Plateau.

Initial UNCLOS parameters: The 2500 m isobath was located. Two candidate locations for the FoS were identified. The more inboard pick at about SP 7000, which is close to the predicted position, places the Hedberg Line in the Labuan Basin at about SP 4800, where the sediment cover in the western sub-basin thins over uplifted basement towards the mid-basin

basement high. The sediment thickness here, which is of some 600-700 ms TWT, is unlikely to support any further extension of CS. The more distal FoS at about SP 6700, however, appears to place the Hedberg Line beyond the 2500 m isobath plus 100 n mile cut-off boundary, therefore obviating the need to use the sediment thickness criterion.

Line 180/07 - Kerguelen Plateau margin to CS maximum cut-off (Fig. 2g)

Source: 3000/1500 in^3 sleeve guns
Streamer: 3000 m, 240 channels
Record: 16 seconds, 4 ms sample
Orientation: NE

Objective: Line KP-M was intended to establish the position of the FoS and the sediment thickness distribution beyond the Hedberg Line out to the maximum cut-off boundary. The line is positioned to cross the maximum allowable claim boundary slightly less than 60 n mile southeast of the equivalent position on line KP-N.

Actual configuration: Line 180/07 was extended at both ends of the proposed line KP-M: to the southwest to intersect the 2500 m isobath on the plateau margin, and to the northeast to complete another transect across the Labuan Basin.

Sediment: Some 600 ms TWT of sediment covers Kerguelen Plateau basement as it deepens into the Labuan Basin. The sediment pinches out at the base of the slope, where a strong FoS pick can be made. The Labuan Basin is characterised by western and eastern sub-basins about a major basement high (SP 5200). Sediment in the western sub-basin averages 1200-1400 ms TWT in thickness and is comprised mostly of continuous and horizontal reflectors. A mound-like feature dominates the sedimentary section at about SP 3700 and probably represents a contourite. The eastern sub-basin contains up to 2000 ms TWT of sedimentary section and onlaps onto shallowing basement at the eastern end of the line. At least two megasequences are present with the lower sequence having syn-rift characteristics.

Basement: Basement on the Kerguelen Plateau margin is generally well defined and continuous with some truncation evident towards the base (SP 2300). Down-to-basin dipping reflectors are evident below the basement and indicate likely volcanic flows. Basement is strongly faulted in the western Labuan Basin with tilted fault-blocks dominant adjacent to the plateau. Basement morphology is more difficult to discern in the eastern sub-basin because of the thicker sediment cover. Sediment mounding in both sub-basins indicates episodes of reactivation along the basement faults.

Initial UNCLOS parameters: The 2500 m isobath was intersected with the FoS crossed further to the east, close to the predicted position. Sediments at the Hedberg Line (about SP 4600) are 900-1000 ms TWT thick and thin gradually as they onlap outcropping basement of the mid-Labuan Basin basement high. This sediment thickness would not appear to support an extension of the CS claim beyond the Hedberg Line.

Line 180/08 - northern Labuan Basin (Fig. 2h)

Source: 1500 in^3 sleeve guns (see Narrative)
Streamer: 3000 m, 240 channels

Record: 16 seconds, 4 ms sample
Orientation: ENE

Objective: Line KP-T was planned during the survey to tie to seismic line 47/17 and continue as a transect across the northern Labuan Basin at the base of William's Ridge. The line is situated completely outside the preliminary arc defining the maximum allowable claim position so that there are no LOS implications.

Actual configuration: The line began with two small doglegs to tie to previously acquired seismic line 47/17.

Sediment: The Labuan Basin is again separated into two distinct sub-basins by an outcropping basement high (SP 2000). This basement high, which was also noted on seismic lines 180/01, 180/06 and 180/07, indicates that the Labuan Basin is probably split into two sub-basins throughout its length. The western sub-basin contains a maximum thickness of 1800-2000 ms TWT of sediment. The western flank of this sub-basin is characterised by basement downfaulted to the east. Reflectors here are generally continuous and flat-lying with at least two megasequences recognisable – the lower sequence is affected by basement tectonics. The eastern sub-basin contains a maximum of 2200 ms TWT of sediment. Reflectors here are generally continuous, but a series of diffractions in the sediment column, near the mid-basin high, may point to the presence of interbedded volcanics (SP 2200-2500). A flat seafloor that truncates the underlying section may indicate that compaction and basement movements have ended. The entire sedimentary section appears to be conformable with no sequence boundaries visible.

Basement: The basement is strongly faulted across the basin. Its highly diffractive nature indicates a rugged form and so, probable oceanic composition. A deeper, dipping event is possible at SP 1500.

Initial UNCLOS parameters: The line was not acquired for LOS purposes.

Line 180/09 - bathymetric line across William's Ridge (Fig. 2i)

Source: None - bathymetry
Streamer: None
Record: None
Orientation: S then SE

Objective: Line KP-O was intended to establish the FoS pick on both sides of the William's Ridge and to pick the position of the 2500 m isobath.

Actual configuration: The line was shortened at its northern end from the intended FoS position, as this was sampled in the vicinity by seismic line KP-H on the previous Kerguelen Plateau LOS survey (Ramsay et al., 1998).

Initial UNCLOS parameters: The southern FoS/EoAP was located. The slope then shallowed and the 2500 m isobath was located. This isobath was sampled a further seven times over the rugged profile of the William's Ridge.

Line 180/10 - bathymetric line across William's Ridge (Fig. 2i)

Source: None - bathymetry
Streamer: None
Record: None
Orientation: E

Objective: Line KP-P was planned to determine the position of the FoS and 2500 m isobath on the eastern end of the William's Ridge.

Actual configuration: The line was run with bathymetry and did not deviate from that proposed.

Initial UNCLOS parameters: The FoS/EoAP was located at the base of the ridge, while the intersection with the 2500 m isobath was located further to the west. Other intersections of the 2500 m isobath were made, but may be side reflections.

Line 187/01 - seismic transect of southern Naturaliste Plateau (Fig. 2j)

Source: 3000 in^3 sleeve guns
Streamer: 4000 m, 320 channels
Record: 16 seconds, 4 ms sample
Orientation: S then SSE

Objective: Line NP-1 was designed during the survey to acquire a deep-seismic transect of the southern margin of the Naturaliste Plateau. Data were acquired both for LOS purposes and to aid interpretation of the local and regional tectonics.

Actual configuration: Towards the northern end of the line, an extension of 50 km was made so as to tie to existing seismic.

Sediment: For SPs 1000-7300, the seafloor is very rugged, being dominated by basement ridging and intervening basins. This complex morphology may reflect the forces that came to shape the Diamantina Zone. The highly diffractive nature of the seafloor masks sediment characteristics in many parts. However, strata are clearly evident in several depressions (eg. SPs 3050-3700 and 4600-4850), where the sedimentary sections are characterised by mostly continuous reflectors showing signs of slight differential compaction effects and erosion at the seafloor. Between SPs 6500-7300 a shallow sedimentary section is located and is characterised by mostly continuous reflectors that are broken in parts by basement faulting. From about SP 7900 to EOL there is continuous sedimentary cover overlying the plateau. Its thickness varies from 500 to 800 ms TWT. Here, the reflectors are mostly flat-lying and continuous. An unconformity is present at the base of this section and shows truncation of steeply dipping strata. This indicates erosion of an older sequence and may suggest a continental origin for the Naturaliste Plateau.

Basement: The basement form is very rugged along the line. Its strongly diffractive appearance to the south of SP 7400 indicates probable oceanic composition. It is a clear event on the plateau and does not appear to represent crystalline basement, but the eroded top of a much older and deformed sedimentary section.

Initial UNCLOS parameters: A strong candidate for the FoS was located at about SP 7400 with the 2500 m isobath intersected further to the north.

Narrative for cruise 180 and line 187/01

The following is a brief overview of both weather and equipment conditions for the survey. More detailed information may be gleaned from the seismic and navigation line logs as well as the electronic equipment and System Quality Control reports. Concise daily weather details as noted by the ship's bridge officers are to be found in Appendix 8. Sonobuoy deployment details and Law of the Sea CS parameters can be found in Appendices 6 and 7, respectively.

Friday 28 February.
Left Fremantle Harbour at 12.00 pm. Conditions calm and shifts started. Recording gravity and bathymetry using the 3.5 and 12 kHz echosounders. Magnetometer head getting some last minute repairs. Course set for way point 57° 30.0' S, 95° 0.0' E, then for 61° 0.0' S, 85° 0.0' E where the streamer will be deployed to commence seismic on KP-J.

Saturday 1 March.
Moderate to rough seas during night, calming by day. Averaging some 10 knots.

Sunday 2 March.
Slight to moderate swell. Averaging about 9 - 9.5 knots.

Monday 3 March.
Averaging 9.5 knots.

Tuesday 4 March.
Swell and seas picking up slightly in anticipation of approaching front but averaging 9 knots. Capacitors blown on Uninterruptible Power Supply (UPS) board meaning it will no longer be of use on this cruise – instrument room equipment now operating directly off ship's power supply. Hope is that instrumentation power supply units will smooth out irregular waveform of ship's AC supply.

Wednesday 5 March.
Continuing problems with DGPS system saw us navigating mostly off dead reckoning. Seas have increased resulting in an average speed of 5 knots.

Thursday 6 March.
Speed maintaining 7 - 8 knots.

Friday 7 March.
Averaging 8 knots in slight - moderate seas. Problems continuing with the satcom fax and phone connections back to Canberra. Sighting of 2 large icebergs within the space of an hour at 6.00 pm local time. This is of concern as we are only at 52° 30.0' S and aim to head for 61° 0' S to complete 2 southerly lines. Icebergs in blue sky with setting sun make for some spectacular photos.

Saturday 8 March.
Averaging 7 - 8 knots speed. Sighting of more icebergs.

Sunday 9 March.
Averaging 7 knots during daylight; down to 2 knots at night in case of icebergs. Bergy bits and growlers are the major concern as they are not detected by radar and are large enough to cause structural damage to the ship. At this stage there is major concern as to the state of the seas in the southern reaches of the survey area – are we heading into a minefield of ice bits?

Monday 10 March.
Many iceberg, bergy bit and growler sightings in the morning. Concerns with the ice situation by the bridge have forced us to alter course and head for approximately 55° 0' S, 84° 0' E where a decision will be made on shooting KP-O, KP-M or KP-N depending on prevailing conditions. If substantial ice not encountered, idea is to steam down KP-N with a 3000 m streamer and in so doing ascertain probable ice accumulations on the plateau itself and to the south.

Tuesday 11 March.
On new course setting have had a minimal sighting of icebergs and no associated bits. Averaging 7 - 8 knots during day, down to 4 knots later as seas roughen. Have informed Canberra (ie. Doug Ramsay) regarding our intentions of trying KP-N from the northeast to the southwest.

Wednesday 12 March.
Little progress today – hove-to in force 9 -10 seas.

Thursday 13 March.
Seas have abated during day. Deployment of 3000 m streamer began at about 9.30 pm local time in slight seas with some 60 km to go before SOL KP-N.

Friday 14 March.
Streamer deployed by 3.00 am local time – 4 litres of cable fluid was added to each section to increase buoyancy as recommended by findings on previous cruise (ie. Kerguelen Plateau 1). Seismic acquisition began on KP-N as 180/01 at approximately 8.39 am local time. First sonobuoy stopped transmitting after 1/2 hour; the second worked fine. The starboard array was retrieved at 6.30 pm local time for minor maintenance. Overall cruise time constraints and basic LOS requirements do not necessitate dual gun strings.

Saturday 15 March.
Woken up at 2.15 am local time to change line course as large iceberg (about 4 miles across) sighted on desired course. Two close doglegs were implemented to bring the course around further to the north. Unfortunately, these small doglegs caused some seismic shot re-synchronisation. Line now heads due west and altered to capture foot-of-slope. Course alteration took place well past the crucial LOS area between the proposed Hedberg Line and 2500 m isobath + 100 n mile cut-off. Starboard array redeployed at 4.15 am local time. Line ended at 7.30 pm local time. Cable retrieved at 11.00 pm.

Sunday 16 March.
Transit to ODP KIP-13A site line. 3000 m streamer deployed at 11.53 pm.

Monday 17 March.
Commenced line ODP KIP-13A as 180/0201 at 4.00 am. Gun deployment problems forced us to miss first 5 km of already shortened line – originally 50 km either side of ODP site, previously shortened to 40 km each side. Decided to record seismic data on this line at 2 ms sample rate, rather than 4 ms as previously used. Four sonobuoys were deployed for this line, of which, unfortunately, only one lasted to the end. Cross-course error (CCE) at proposed site was ~ 5m. Sighted 2 icebergs to E of EOL in heavy fog conditions. Left streamer out and commenced transit to KP-J. Concern about visibility of growlers in fog forced us to consider vulnerability of magnetometer so it was brought in. Began deployment of mag and both gun strings at 11.40 pm as come on to line.

Tuesday 18 March.
Commenced seismic on KP-J as 180/0301 at 1.50 am in calm to moderate seas. Large iceberg short of proposed dogleg on line forced modification of course via a series of doglegs to its north and then back on to line to run through the required line for recording beyond the Hedberg Line. However, the cold water conditions were causing the gun air lines to freeze up, and so both strings were retrieved and seismic ended at 1.45 pm. The ship came back onto the original line at 61° 50.925' S, 88° 17.465' E in moderate - rough seas as 180/0401. This is about 40 km from the proposed EOL at the 2500 m + 100 n mile cut-off. It was decided to recommence with only the starboard gun string as the other could be used as a back-up should the cold waters take their toll again. At approximately 20 km from EOL, a new way point was set up 1 km south of the EOL to give greater clearance around several icebergs which were in its vicinity.

Wednesday 19 March.
180/0401 ended at 3.04 am at 61° 57.793' S, 89° 8.197' E, which was several kilometres beyond the proposed EOL, since it was worth continuing to acquire seismic as the bridge aimed for a wider berth to the icebergs near EOL. Headed north to commence recording KP-K at its eastern end. Another large iceberg sighted at proposed KP-K SOL forced its repositioning some 7 km further to the south. This in turn increased the original dogleg angle. The dogleg was altered by splicing in a 10 km section to smooth out the turn. KP-K was commenced as 180/0501 at 1.39 pm in calm conditions at 61° 14.632' S, 89° 23.671' E. Only one gun string was deployed to maintain a spare on board in consideration of our earlier problems with the cold sea state.

Thursday 20 March.
Line 180/05 being shot in mostly calm conditions. Line ended at 12.17 pm at 61° 12.638' S, 85° 27.308' E. Cable retrieved by 3.30 pm in preparation for major transit to eastern end of KP-L. Although direct transit to western end was shorter, calculations of overall line and transit lengths showed that this route provided the shortest option to the northern lines.

Friday 21 March.
Conditions worsening in morning – force 9 -10 with 70 knot gusts. Transit speed down to 1-2 knots as we maintain a heading of 320° to make a course 035°. Cable deployment unlikely today.

Saturday 22 March.
Conditions deteriorated considerably during the early morning – we are experiencing force 12 -13 with gusts well beyond 80 knots. If this weather forces us to lose several days, we may be forced to shorten KP-L over Labuan Basin beyond the LOS requirements to make up projected time – we will no doubt encounter more days of lost production. Most of day spent hove-to to southwest. Weather began to abate late afternoon so steamed to SOL. Plan to deploy only 1600 m cable as expecting another front during the acquisition of this line (ie. 350 km), and we are not confident as to the life expectancy of the cable in seas like those we have just had.

Sunday 23 March.
1600 m streamer deployed at 6.15 am. KP-L SOL moved south of original to 58° 10.217' S, 89° 22.162' E to avoid iceberg, and began at 9.18 am as 180/0601. Both gun strings deployed, but problems with port array sausage buoy resulted in its retrieval. Port array redeployed at 11.02 am. At 12.00 pm, course was altered slightly to run at CCE of 900 m for greater clearance around a bergy bit – back on line at 1.27 pm.

Monday 24 March.
Calm conditions and excellent data being recorded – this and two gun strings make up a bit for the lower fold cable configuration. At 11.10 am, starboard array retrieved because of leaking sausage buoy; redeployed at 1.28 pm. Seismic EOL at 9.23 pm at 58° 41.005' S, 83° 21.736' E but continued on course to record 2500 m isobath at 10.13 pm at 58° 41.632' S, 83° 13.156' E, then transit to KP-M.

Tuesday 25 March.
At 3.45 am, reconfigured streamer for 3000 m operation. KP-M commenced at 7.12 am as 180/0701 on SOL with both gun strings. Increasing swell from behind forced us to run cable at 14 m depth. Cable noise is averaging some 30 - 40 microbars. The onboard seismic processing Quality Control Officer ran some F-K tests on the shot gathers and found that most coherent noise was both removable and did not greatly degrade the signal. Swell began to lessen at 8.00 pm and so cable was set to 12 m. Line was lengthened by approximately 60 km beyond LOS requirements to complete a Labuan Basin transect. Strong currents were pushing feather angle to 18° at times.

Wednesday 26 March.
Swell started to increase again at 8.00 am with noise levels back up to 30 - 40 microbars. Starboard array retrieved at 8.35 am. LSP of 180/0701 at 12.16 pm at 56° 29.776' S, 86° 12.785' E. Transiting to northeast of KP-T with worsening conditions and cable set to 20 m. Slowing down to 1.5 - 2 knots due to rough conditions.

Thursday 27 March.
Constant force 8 - 9 all day, though strengthening at night, forced us to hove-to till conditions improve.

Friday 28 March.
Transiting to southwestern end of KP-T on a parallel course awaiting calmer conditions. Started KP-T at 7.33 pm as 180/0801 at 55° 49.766' S, 83° 19.481' E with cable at 14 m. Seas have calmed only slightly but with weather faxes for southern Indian Ocean not coming

through and time slipping away, a start was made. Noise levels were moderate at 20 microbars with a 4 Hz filter at SOL, so decided to begin with starboard array. The ship's heading with respect to course made precludes deployment of the port array with the tow leader running directly out to port – feather angle reasonable at 10°. High 60 knot wind gusts do not seem to have whipped up the seas yet, with noise levels still around 20 microbars through the night.

Saturday 29 March.
Conditions on 180/0801 begin to deteriorate at 3.00 am with noise levels going beyond the 50 microbar level. Cable came near surface at 6.40 am with 14 km left to EOL – decide to continue line with reshoot option later for at least last 20 km. EOL reached at 8.22 am. Decide to leave cable in the water and transit slowly to southern end of KP-O. Weather begins to deteriorate considerably to consistently force 11. Decision is made that given the time we are likely to lose in these conditions and the need to complete the northerly lines, the reshoot for the end of KP-T will be abandoned. Concerns mount as to the condition of the cable – retrieval not an option! Several ground fault interrupts culminated in the tension meter no longer registering the load on the cable – counting on bird information as the only means to cable condition and existence. Worst day not over yet as Ross Bodger stumbles while closing a door and almost shears off the top of his wedding-ring finger – immediate medical attention given with his condition to be examined in several days time.

Sunday 30 March.
No respite from atrocious weather – we have been hit by two consecutive fronts being driven by deep low pressure systems to the south. Gusts consistently beyond 80 knots registered in the morning. We are hove-to awaiting a window of opportunity to retrieve the cable. Another two crew down: Brian Dickinson hurting his back and Mark Davis falling down a stairwell; thankfully, neither serious. Continual pounding and lurching of vessel taking its toll on general dispositions. Last half of cable variable in its depth position, an indication that the tailbuoy is no longer with us.

Monday 31 March.
At 12.20 am weather proves calm enough to retrieve streamer. With great relief, cable on board at 5.59 am, minus tailbuoy. KP-O, as 180/0901, SOL at 11.14 am recording only bathymetry and magnetics. Seas are moderate but are beginning to pick up again as the barometer falls. Line could have been done with seismic but bathymetry meets LOS requirements, and lack of weather faxes makes us wary as to next storm...

Tuesday 1 April.
Seas moderate – very good bathymetry and magnetic data being acquired on 180/0901. KP-O EOL reached at 12.48 pm at 53° 30.554' S, 82° 48.013' E. Commence transit to eastern end of KP-P. KP-P, as 180/1001, SOL at 5.40 pm at 53° 45.042' S, 83° 57.190' E, acquiring only bathymetry. Plan is to deploy 1200 m streamer - a length it may be able to sacrifice in very rough weather - for KP-Q and KP-R so as to get at least some seismic coverage down northern margin of William's Ridge.

Wednesday 2 April.
Completed bathymetry on 180/1001 at 1.57 am at 53° 48.096' S, 82° 15.126' E. At 8.05 am, commenced cable work to transfer 1800 m of cable from the starboard reel to the port reel in order to deploy remaining 1200 m from starboard. At 10.14 am during retrieval, cable got

caught in propeller and last 800 m left in water was cut off. At 12.00 pm the Norwegian tailbuoy was retrieved along with the rest of the cable. The broken active section was examined and found to have about 50 m missing. It was soon verified, by Rod Willis as diver, to be wrapped around the propeller guard. At 3.08 pm began transiting to Fremantle at a low 4.5 knots in order to be closer to home should the prop fail. Later examination via a submersible video camera showed the section still to be there. We plan to continue sailing north till we reach warmer waters whereby Rod can attempt a more substantial dive to free it. Unfortunately, this means that all the objectives for cruise 180 have not been met, though the major ones have.

Thursday 3 April.
Maintaining an average of 5 knots on our course for Fremantle. It is obvious now that we will not return to the survey area to complete lines KP-Q and KP-R. Once the section is clear we will steam at top speed by which we may be able to reach the Naturaliste Plateau with some days to spare. Given this scenario, I have telexed Canberra requesting requirements for a seismic line there should it still be an option.

Friday 4 April.
Meteorological buoy deployed at 4.00 pm local time at 49° 55.550' S, 88° 26.872' E. At same time, vessel prop was declutched and examined via video for traces of cable – it remains, but is gradually being chopped away. Meanwhile we continue to transit home at 6 -7 knots via two intermediary way points at 47° 43.0' S, 92° 30.0' E and 37° 46.7' S, 107° 30.0' E that I have set up to fill in some coverage between previous ship tracks from Fremantle to the Kerguelen Plateau area.

Saturday 5 April.
Continuing transit to Fremantle in force 8 - 9 conditions. Speed down to 3 - 4 knots. Echo sounders finding it difficult to track and mag data noisy; magnetometer retrieved to check cabling.

Sunday 6 April.
Calmer conditions see us transiting at about 8 - 9 knots. A day of continuous sunshine – the first for 4 weeks! The Inmarsat fax and phone came to life about 1.00 pm giving us back ready communication with Canberra.

Monday 7 April.
Conditions roughen slightly but our speed maintains 8 - 9 knots. Spoke to Canberra stating our position and likely availability for a Naturaliste Plateau seismic transect.

Tuesday 8 April.
Camera went over side at about 1.00 pm to inspect propeller – active is still wrapped around the guard.

Wednesday 9 April.
Transiting at about 9 knots in calm conditions. Magnetometer causing some problems; periods of very noisy records.

Thursday 10 April.
Have received confirmation of the northerly line across the Naturaliste Plateau this morning. Vessel has changed course for SOL to east to deploy cable – 4000 m intended.

Friday 11 April.
Cable deployed by 11.30 am local time to commence on seismic line 187/0101. Canberra informed us that survey number 187 was the next available number able to be used. Seismic acquisition began at UTC 101.0628 (2.28 pm local) at 38° 0.000' S, 110° 52.997' E.

Saturday 12 April.
Heading north along line 187/0101. Slight to moderate swell but recording data - albeit deep - of good quality. Was notified by Canberra to extend line by about 50 km to enable a tie to an existing seismic line.

Sunday 13 April.
EOL for 187/0101 at UTC 103.0540 at 34° 7.614' S, 110° 13.852' E. The streamer was retrieved at 103.0940 after some cable configurations. This part of the line was shot in excellent conditions. Steaming at 9 knots for Fremantle where we will anchor till a berth is made available at about 9.30 am Wednesday morning.

Monday 14 April.
Good news – a berth has been found for docking on Tuesday morning. Still acquiring good magnetic and bathymetric data. Magnetometer brought in at 6.00 pm local time.

Tuesday 15 April.
The end. Docked in Fremantle port at about 8.30 am local time.

Conclusion

Despite the difficult weather conditions that AGSO LOS Survey 180 had to operate in, the main survey objectives were successfully completed. In summary, the data acquired over the Labuan Basin provides an indication that sediment thickness may be used to enhance Australia's claim to 'legal' Continental Shelf along the eastern and south-eastern margin of the Kerguelen Plateau. Furthermore, on the return to Fremantle at the end of Survey 180, a long deep-seismic line was shot across the Naturaliste Plateau as LOS Survey 187. This seismic profile has provided some LOS parameters for the plateau, as well as a new view of its geological characteristics.

Acknowledgments

Thanks are owed to, on behalf of the Law of the Sea project, Trevor Walters and his AMSA crew for all facets of ship operations, and the AGSO scientific staff for their professionalism in obtaining the required data – the sea and ice states made the conditions quite trying at times. A list of the full crew appears in Appendix 4.

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Appendices

Appendix 1

United Nations Convention on the Law of the Sea

Article 76 : Definition of the legal continental shelf

1. The continental shelf of a coastal State comprises the seabed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured where the outer edge of the continental margin does not extend up to that distance.

2. The continental shelf of a coastal State shall not extend beyond the limits provided for in paragraphs 4 to 6.

3. The continental margin comprises the submerged prolongation of the land mass of the coastal State, and consists of the seabed and subsoil of the shelf, the slope and the rise. It does not include the deep ocean floor with its oceanic ridges or the subsoil thereof.

4. (a) For the purposes of this Convention, the coastal State shall establish the outer edge of the continental margin wherever the margin extends beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured, by either:

(i) a line delineated in accordance with paragraph 7 by reference to the outermost fixed points at each of which the thickness of sedimentary rocks is at least 1 per cent of the shortest distance from such point to the foot of the continental slope; or

(ii) a line delineated in accordance with paragraph 7 by reference to fixed points not more than 60 nautical miles from the foot of the continental slope.

(b) In the absence of evidence to the contrary, the foot of the continental slope shall be determined as the point of maximum change in the gradient at its base.

5. The fixed points comprising the line of the outer limits of the continental shelf on the seabed, drawn in accordance with paragraph 4 (a) (i) and (ii), either shall not exceed 350 nautical miles from the baselines from which the breadth of the territorial sea is measured or shall not exceed 100 nautical miles from the 2,500 metre isobath, which is a line connecting the depths of 2,500 metres.

6. Notwithstanding the provisions of paragraph 5, on submarine ridges, the outer limit of the continental shelf shall not exceed 350 nautical miles from the baselines from which the

breadth of the territorial sea is measured. This paragraph does not apply to submarine elevations that are natural components of the continental margin, such as its plateaux, rises, caps, banks and spurs.

7. The coastal State shall delineate the outer limits of its continental shelf, where that shelf extends beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured, by straight lines not exceeding 60 nautical miles in length, connecting fixed points, defined by coordinates of latitude and longitude.

8. Information on the limits of the continental shelf beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured shall be submitted by the coastal State to the Commission on the Limits of the Continental Shelf set up under Annex II on the basis of equitable geographical representation. The Commission shall make recommendations to coastal States on matters related to the establishment of the outer limits of their continental shelf. the limits of the shelf established by a coastal State on the basis of these recommendations shall be final and binding.

9. The coastal State shall deposit with the Secretary-General of the United Nations charts and relevant information, including geodetic data, permanently describing the outer limits of its continental shelf. The Secretary-General shall give due publicity thereto.

10. The provisions of this article are without prejudice to the question of delimitation of the continental shelf between States with opposite or adjacent coasts.

Appendix 2

Informal Terms relating to Article 76

Application of Article 76 of United Nations Convention on the Law of the Sea (UNCLOS) raises several concepts and terms which will be referred to frequently in interpretations of seismic/bathymetric survey lines for the purposes of 'legal' Continental Shelf (CS) definition. Following are simplified definitions of the more important terms that we commonly use. Some aspects of the application of Article 76 remain unclear, and will only be resolved following further deliberation by the Commission on the Limits of the Continental Shelf.

Firstly, a *Hedberg arc* may be drawn, with a radius of 60 n miles, from an interpreted foot-of-slope (FoS) position. The location at which this arc intersects the seaward extension of the survey line is called the *Hedberg point.* With a series of FoS positions established around a continental margin, at a spacing of less than 120 n miles, a series of intersecting Hedberg arcs may then be constructed. Clearly, as the spacing between survey lines (and therefore, the FoS positions) decreases, the envelope of the intersecting Hedberg arcs approaches a 60 n mile buffered locus of the FoS, except in some cases where the latter contains embayments. This is part of the reason for AGSO's 'safe minimum' approach, where we aim to space survey lines ~30 n mile apart, where logistically possible. The final outcome, the true *Hedberg Line* (the informal name for the line that defines the outer edge of the 'legal' continental margin, as contained in Article 76, paragraph 4(a)(ii), of UNCLOS), is constructed by joining selected points on the Hedberg arcs by straight lines, not more than 60 n mile long. This would normally be done in a manner so as to maximise the size of the enclosed 'legal' continental margin. This true Hedberg Line will normally only intersect the survey line at the Hedberg point where the locus of the FoS points is a straight line. Such situations are unusual in the context of CS beyond 200 n mile, since it is normally associated with irregularly shaped marginal plateaus.

Secondly, a *Sediment Thickness point* may be determined, by interpretation of a seismic survey line (or possibly by drilling), where the 1% sediment thickness criterion is satisfied. That is, the point at which the thickness of sedimentary rocks is at least 1% of the shortest distance from such point to the FoS. In contrast to the Hedberg arc, this is strictly a single point, which may be joined to adjacent Sediment Thickness points to form the *Sediment Thickness Line* (the informal name for the line that defines the outer edge of the 'legal' continental margin, as contained in Article 76, paragraph 4(a)(i), of UNCLOS), or to selected points on Hedberg arcs, again by straight lines, not more than 60 n mile in length.

Finally, the fixed points (not more than 60 n mile apart) comprising the line which defines the outer limits of the CS, may not lie beyond one or other of two cut-offs. The first cut-off is 350 n mile from the baseline (informally called the *350 n mile cut-off line*), and the second is 100 n mile beyond the 2500 m isobath (informally called the *isobath cut-off line*). The former is purely a geometrical construction from the Territorial Sea baselines, whereas the latter depends on definition of the 2500 m isobath.

Appendix 3

Description of RV *Rig Seismic*

The research vessel RV *Rig Seismic* was chartered and equipped by the Australian Geological Survey Organisation (AGSO) of the Australian Commonwealth Government. Its mission was to support the primary geoscientific requirements of acquiring data for Australia's Law of the Sea claims and the Australian Ocean Territory Mapping Program. It was constructed in Norway in 1982 and later commissioned by AGSO in 1984. The vessel is registered in Newcastle, New South Wales, and is operated for AGSO by the Australian Maritime Safety Authority (AMSA).

Gross tonnage:	1545 tonnes
Length:	72.5 metres
Breadth:	13.8 metres
Draft:	6.0 metres
Engines:	
Main:	Bergen KVMB-12 2640 H.P./825 r.p.m.
Auxiliary:	3 x Caterpillar 564 H.P./482 kVA 1 x Mercedes 78 H.P./56 kVA
Shaft Generator:	AVK 1000 kVA; 440 V/60 Hz
Side Thrusters:	2 forward, 1 aft; each 600 HP
Helicopter Deck:	20 metres diameter
Accommodation:	3 double-berth cabins 38 single-berth cabins

Appendix 4

Crew List

AMSA CREW

Master	Trevor Walters
1st Mate	Mike Gusterson
2nd Mate	John Weeks
Chief Engineer	John Scott
1st Engineer	Gerard Patton
2nd Engineer	John Vinter
Electrician	Ian McCulloch
Chief IR	Rod Willis
IR	John Fraser
IR	Tony Dale
IR	Merve Hagner
Chief Cook	Ken Beu
Cook	Ted Strange
Catering Attendant	Steve Stavely
Catering Attendant	Bob Lansdowne

AGSO CREW

Ship Manager	Drew Murray
Client Representative	George Bernardel
Quality Control Officer	Greg Atkinson
Quality Control Officer	Tim Viser
Seismic Processor	Bill Plumridge
Science Technician	Tony Hunter
Science Technician	Linda Philippa
Science Technician	Shaun Hazell
Science Technician	Dave Warren-Smith
Science Technician	Paul Attenborough
Science Technician	Duncan Palmer
Chief Electronics Technician	Joe Mangion
Electronics Technician	Phil Doolan
Electronics Technician	Mark Davis
Electronics Technician	Paul Conroy
Chief Gun Mechanic	Simon Milnes
Gun Mechanic	Brian Dickinson
Gun Mechanic	Ross Bodger
Gun Mechanic	Nick Boylan
Gun Mechanic	Garth Doblinger

Appendix 5

Proposed Survey Way Points

Proposed Kerguelen Plateau 2 way points in Borissova (1997).
FoS and Sed refer to the foot-of-slope and sediment thickness criteria, respectively.

Line Name	Comments	Latitude DD MM SS	Longitude DDD MM SS	LOS Purpose
KP-J	SOL	61 56 27.1S	89 01 39.9E	FoS, Sed
	Turn	61 40 34.5S	86 54 14.2E	
	EOL	61 15 24.6S	85 32 36.6E	
KP-K	SOL	61 12 20.9S	85 33 31.0E	FoS, Sed
	EOL	61 01 16.1S	89 11 31.7E	
KP-L	SOL	58 23 14.8S	87 26 39.6E	FoS, Sed
	EOL	58 36 53.7S	83 21 12.8E	
KP-M	SOL	58 01 50.0S	83 07 58.1E	FoS, Sed
	EOL	56 59 52.3S	85 13 13.3E	
KP-N	SOL	56 15 06.0S	84 03 43.6E	FoS, Sed
	EOL	57 21 33.8S	82 09 38.8E	
KP-O	SOL	54 44 36.7S	83 31 08.0E	2 FoSs, 2500 m
	Turn	54 17 24.3S	82 41 32.0E	
	EOL	53 10 36.5S	82 50 44.7E	
KP-P	SOL	53 47 46.9S	82 25 43.3E	FoS, 2500 m
	EOL	53 45 16.7S	83 48 08.3E	
KP-Q	SOL	52 49 39.8S	82 39 24.5E	FoS, 2500 m
	EOL	53 19 31.9S	80 47 27.2E	
KP-R	SOL	52 13 47.8S	81 13 40.2E	FoS, 2500 m
	EOL	53 19 31.9S	80 47 27.2E	
KP-S	SOL	51 13 31.0S	77 20 33.2E	FoS
	EOL	51 50 11.8S	76 45 07.5E	

Appendix 6

Sonobuoy Deployments

Sonobuoys launched for Kerguelen Plateau 2 - includes seismic line 187/01 over Naturaliste Plateau.

UTC	Line No.	Name	SP	Latitude	Longitude	Comment
73.0310	180/0101	KP-N	1490	55 46.987	84 50.996	
73.0332			1560	55 48.368	84 48.679	stopped recording
73.0356	180/0101	KP-N	1640	55 49.902	84 46.116	
73.0611			2085	55 58.661	84 31.433	
73.1446	180/0101	KP-N	3720	56 30.823	83 37.047	
73.1740			6350	56 39.849	83 21.001	
74.0426	180/0101	KP-N	14050	56 40.382	82 05.690	
74.0630			14460	56 40.242	81 45.557	
75.1810	180/0201	KIP-13A	1052	59 29.881	84 01.657	not recorded
75.2113	180/0201	KIP-13A	1624	59 43.003	84 17.576	
75.2121			1650	59 43.598	84 18.307	stopped recording
75.2133	180/0201	KIP-13A	1689	59 44.451	84 19.352	no signal received
75.2142	180/0201	KIP-13A	1715	59 45.093	84 20.109	
75.2349			2110	59 54.151	84 31.184	
77.0419	180/0301	KP-J	1219	61 36.217	87 03.050	
77.0545			3205	61 38.220	87 17.723	end-of-line
77.1409	180/0401	KP-J	1135	61 51.876	88 24.827	
77.1422			1168	61 52.123	88 26.843	stopped recording
77.1500	180/0401	KP-J	1270	61 52.865	88 32.780	
77.1521			1335	61 53.254	88 35.934	stopped recording
77.1627	180/0401	KP-J	1515	61 54.846	88 45.633	
77.1904			1925	61 57.793	89 08.197	
78.0734	180/0501	KP-K	1347	61 12.959	89 04.578	
78.0955			1775	61 10.894	88 41.235	
78.1459	180/0501	KP-K	2705	61 06.466	87 50.264	8 deg dogleg at UTC 78.1558
78.1715			3135	61 06.937	87 26.148	

79.0155	180/0501	KP-K	4820	61 11.437	85 52.692	
79.0415			5280	61 12.637	85 27.855	end-of-line
82.0449	180/0601	KP-L	1667	58 13.558	88 48.766	
82.0730			2195	58 16.984	88 22.309	
82.1437	180/0601	KP-L	3566	58 24.195	87 13.710	
82.1714			4100	58 26.168	86 46.556	
83.0310	180/0601	KP-L	6076	58 33.475	85 05.858	
83.0529			6538	58 35.179	84 42.262	
84.0729	180/0701	KP-M	2591	57 44.517	83 43.353	
84.0945			3040	57 36.344	83 59.969	
84.1915	180/0701	KP-M	4940	57 01.692	85 09.586	no signal received
84.1924	180/0701	KP-M	4971	57 01.120	85 10.719	
84.2152			5470	56 52.023	85 28.827	
87.1349	180/0801	KP-T	1400	55 47.531	83 38.285	
87.1628			1878	55 44.515	84 00.360	
101.0839	187/0101	NP-1	1415	37 48.810	110 53.001	
101.1103			1864	37 36.728	110 52.998	
102.0314	187/0101	NP-1	4913	36 14.323	110 51.873	
102.0401			5062	36 10.442	110 50.697	stopped recording
102.0408	187/0101	NP-1	5083	36 09.867	110 50.535	
102.0409			5083	36 09.867	110 50.535	sank
102.0418	187/0101	NP-1	5116	36 08.992	110 50.267	
102.0642			5561	35 57.308	110 46.734	
102.1857	187/0101	NP-1	7744	34 59.998	110 29.454	
102.2202			8300	34 45.397	110 25.102	
103.0159	187/0101	NP-1	9046	34 25.809	110 19.263	
103.0413			9525	34 13.229	110 15.539	

Appendix 7

Preliminary Law of the Sea Parameter List

Note that the given parameters are subject to modification following final data processing and interpretation.

Sediment column refers to sediment thickness in ms TWT while UTC represents the Universal Time Constant. Latitude is for the southern hemisphere, and longitudes are east. Depths are given in metres.

For the feature column:

SOL - start of line;
EOL - end of line;
FoS - foot of slope;
EoAP - edge of abyssal plain;
dogleg - a change in direction of the line; and
2500m - 2500 metre isobath.

Line No.	Name	Feature	Depth	Sediment	Latitude	Longitude	UTC	Comments
180/0101	KP-N	SOL	3811	?	55 37.690	85 06.489	73.0040	minimal sediment cover
		dogleg	4697	400	56 39.435	83 22.358	73.1727	avoid iceberg - alter course
		dogleg	4657	500	56 41.040	83 17.538	73.1815	increase safety margin
		FoS?	4483	1000	56 39.942	81 06.083	74.1040	FoS mounding
		FoS?	4339	300	56 39.927	81 02.428	74.1105	greater change of gradient
		EOL	3751	?	56 39.881	80 57.236	74.1141	
180/0201	KIP-13A	SOL	1729	400	59 28.618	84 00.098	75.1750	non-LOS seismic line for ODP
		EOL	2198	600	60 04.359	84 43.701	76.0214	planning purposes.
180/0301	KP-J	SOL	2416	200	61 13.952	85 27.914	76.1750	
		2500m		400	61 17.428	85 39.106	76.1924	
		FoS?	2969	500	61 25.220	86 04.263	76.2215	
		FoS?	3676	500	61 32.798	86 36.561	77.0100	
		dogleg	3751	800?	61 35.097	86 36.396	77.0149	avoid iceberg dead-ahead
		FoS?	3753	800	61 35.137	86 36.561	77.0150	
		FoS/EoAP	3882	800	61 35.256	86 39.707	77.0207	best FoS candidate
		dogleg	3882	800	61 35.283	86 40.942	77.0214	continue avoiding iceberg
		dogleg	3874	1000	61 35.049	86 53.220	77.0322	head back to original line
		dogleg	3873	1000	61 37.574	87 14.853	77.0527	next section to original line
		EOL	3872	1000	61 38.220	87 17.723	77.0545	EOL - gun problems
180/0401	KP-J	SOL	3940	1400	61 50.974	88 17.513	77.1320	restart seismic KP-J over Hedberg
		dogleg	3915	1400	61 53.561	88 38.341	77.1537	alter course to avoid berg at EOL
		dogleg	3916	1300	61 55.413	88 48.882	77.1651	back to ‖ original course
		EOL	3923	1400	61 57.778	89 08.082	77.1903	
180/0501	KP-K	SOL	4278	1500	61 14.632	89 23.671	78.0540	iceberg at proposed SOL
		dogleg	4200	1600 ?	61 06.491	87 51.091	78.1454	
		dogleg	4200	1600 ?	61 06.275	87 40.031	78.1558	
		FoS/EoAP	4283	50	61 10.686	86 08.285	79.0030	
		2500m		100	61 12.366	85 33.048	79.0346	
		EOL	2445	100	61 12.639	85 27.486	79.0417	
transit	KP-K to L	FoS/EoAP	3584	?	60 57.198	85 35.582	79.0915	
180/0601	KP-L	SOL	4525	?	58 10.217	89 22.162	82.0118	
		FoS/EoAP	3988	400	58 36.915	84 18.394	83.0751	
		EOL	2585	400	58 41.005	83 21.736	83.1323	end of seismic
		2500m		?	58 41.632	83 13.156	83.1413	
transit	KP-L to M	2500m		?	58 37.284	83 05.616	83.1515	

		2500m		?	58 27.004	82 52.572	83.1719	
180/0701	KP-M	SOL	2389	600	58 13.499	82 43.978	83.2312	
		2500m		600	58 11.000	82 49.128	83.2357	
		FoS/EoAP	4359	100	57 50.015	83 32.123	84.0555	
		EOL	4674	?	56 29.776	86 12.785	85.0416	
180/0801	KP-T	SOL	4775	1000	55 49.766	83 19.481	87.1133	non-LOS line
		EOL		0	55 34.793	85 11.477	88.0022	
180/0901	KP-O	SOL	4774	?	54 52.752	83 46.086	90.0314	bathymetry only
		FoS/EoAP	4754	?	54 36.630	83 16.535	90.1145	
		2500m		?	54 25.526	82 56.356	90.1904	ascending
		dogleg		?	54 21.817	82 49.560		
		dogleg		?	54 18.344	82 45.567		
		dogleg		?	54 15.107	82 43.483		
		2500m		?	54 13.103	82 42.947	90.2324	descending
		dogleg		?	54 10.943	82 42.452		
		2500m		?	53 56.319	82 44.481	91.0135	ascending
		2500m		?	53 53.565	82 44.848	91.0156	descending
		2500m		?	53 44.672	82 46.088	91.0304	ascending
		2500m		?	53 40.613	82 46.652	91.0334	descending
		2500m		?	53 34.931	82 47.384	91.0416	ascending
		2500m		?	53 34.099	82 47.506	91.0422	descending
		EOL	3905	?	53 30.554	82 48.013	91.0448	
transit	KP-O to P	FoS/EoAP	4130	?	53 31.328	82 59.252	91.0540	
180/1001	KP-P	SOL	4726	?	53 45.042	83 57.190	91.0941	bathymetry only
		FoS/EoAP	4748	?	53 45.767	83 32.119	91.1155	depth monitor very confused
		2500m ?		?	53 46.918	82 54.279	91.1500	peak above 2500 off-side ???
		2500m		?	53 47.626	82 30.738	91.1647	
		2500m ?		?	53 47.740	82 27.230	91.1703	minor trough below 2500m
		EOL	2406	?	53 48.096	82 15.126	91.1757	
transit	KP-P to Q	2500m		?	53 40.477	82 17.531	91.1854	
		FoS/EoAP	4475	?	53 14.970	82 28.009	91.2200	
187/0101	NP-1	SOL	4307	100	37 59.940	110 53.001	101.0629	seismic transect of southwestern
		dogleg	5726	300	36 20.713	110 53.016	102.0157	margin of plateau
		dogleg	5529	0	36 15.372	110 52.197	102.0300	
		FoS/EoAP	3891	0	35 04.095	110 30.683	102.1800	
		2500m		600	34 52.430	110 27.200	102.2034	
		EOL	2242	800	34 07.660	110 13.865	103.0540	
transit	NP-1 to Fremantle	FoS/EoAP	3837	?	33 21.242	111 46.921	103.2215	on way back to port
		FoS/EoAP	4066	?	32 27.337	113 59.404	104.1215	
		FoS	3800	?	32 23.517	114 08.722	104.1320	

Appendix 8

Weather Diary

Weather observations by the Bridge RV *Rig Seismic.*

Date	Time	Position		Temperature			Wind		Waves		Pressure
		Lat	Long	Dry	Wet	Sea	Dir.	Vel.	Sea	Swell	
	UTC	°S	°E	°C	°C	°C		knt	m	m	hPa
2-Mar	0:00	37.7	111.5	15.4	12.6	15.8	013	12	1.0	2.0	1021.8
	6:00	38.5	111.0	15.8	11.5	17.2	018	14	1.0	2.0	1023.4
	12:00	39.4	110.4	13.7	10.5	15.4	019	10	1.0	3.0	1026.1
	18:00	40.2	109.8	13.0	9.2	14.5	017	12	1.0		1028.7
3-Mar	0:00	41.0	109.2	12.3	8.8	13.8	160	4	0.5	3.5	1029.9
	6:00	41.8	108.6	12.6	9.1	12.9	250	10	0.5	3.0	1028.4
	12:00	42.7	107.9	13.1	11.0	13.4	310	20	1.0	3.0	1025.2
	18:00	43.5	107.3	12.2	10.2	12.0	290	20	1.0		1019.8
4-Mar	0:00	44.3	106.7	12.4	11.4	12.2	320	32	1.5	3.5	1015.2
	6:00	45.1	106.1	9.4	6.4	11.8	210	32	1.5	3.5	1012.7
	12:00	45.8	105.6	8.9	6.7	11.1	270	33	1.5	3.5	1011.5
	18:00	46.3	105.1	8.3	6.5	11.0	270	33			1006.4
5-Mar	0:00	46.9	104.7	6.7	4.5	9.2	250	32	1.5	3.0	1003.1
	6:00	47.4	104.2	6.0	4.5	8.2	240	40	1.5	3.5	997.1
	12:00	47.8	103.9	5.0	3.5	7.1	230	38	2.0	6.5	997.4
	18:00	48.1	103.6	4.3	3.1	6.4	220	40			999.9
6-Mar	0:00	48.5	103.4	5.0	3.3	6.9	210	42	2.0	10.0	1004.1
	6:00	48.6	103.1	5.6	3.5	7.2	220	30	1.5	4.5	1007.1
	12:00	49.3	102.6	6.0	4.5	6.9	240	25	1.0	4.5	1006.5
	18:00	50.0	102.0	6.0	5.5	6.8	240	20			1003.0
7-Mar	0:00	50.8	101.3	7.6	7.1	6.5	310	30	1.0	2.5	996.0
	6:00	51.6	100.7	4.8	4.0	6.8	210	38	1.0	3.0	995.3
	12:00	52.3	100.1	4.5	3.3	4.9	250	30	1.0	5.5	1000.0
	18:00	53.0	99.6	4.0	3.0	4.4	240	25			1001.2
8-Mar	0:00	53.6	98.8	4.1	3.5	4.8	280	40	1.5	5.0	1000.5
	6:00	54.3	98.2	3.8	3.5	3.9	260	20	1.5	5.0	998.8
	12:00	55.0	97.5	3.7	3.4	4.1	290	32	1.5	5.0	994.6
	18:00	55.8	96.7	3.5	3.2	3.8	270	30			986.0
9-Mar	0:00	56.5	96.0	2.0	1.8	2.4	290	31	1.5	5.0	978.7
	6:00	57.2	95.2	2.0	1.0	2.8	220	36	2.0	4.5	977.0
	12:00	57.7	94.5	1.0	0.0	2.4	240	32	2.0	4.5	981.8
10-Mar	0:00	57.8	93.9	0.5	0.6	2.4	230	32	2.0	5.0	990.9
	6:00	57.5	92.6	2.5	1.1	2.6	270	10	2.0	5.0	993.8
	12:00	57.1	91.2	3.4	3.4	3.1	360	25	1.0	5.0	988.2
	18:00	56.8	90.3	4.5	4.5	3.8	320	30			982.9
11-Mar	0:00	56.8	90.1	4.6	4.5	3.0	300	33	1.5	6.0	979.7
	6:00	56.5	89.0	3.0	2.2	1.0	280	33	1.5	6.0	989.9
	12:00	56.3	88.4	2.5	2.3	2.9	290	41	1.5	9.0	993.7
	18:00	56.2	88.1	3.5	2.5	1.8	270	40			999.6

12-Mar	0:00	56.2	87.9	4.0	3.6	3.3	300	38	2.0	10.0	999.8
	6:00	56.2	87.7	4.5	4.0	1.7	290	50	2.5	10.0	989.3
	12:00	56.0	87.7	5.0	5.0	3.1	300	44	2.5	11.5	987.6
	18:00	56.0	87.5	5.0	4.5	1.8	280	42			981.8
13-Mar	0:00	55.8	87.3	2.6	2.0	3.3	260	42	2.0	12.0	985.9
	6:00	55.8	86.9	3.8	2.5	3.8	230	32	1.5	6.0	993.3
	12:00	55.8	86.4	3.0	2.0	4.1	260	22	1.5	5.0	995.7
	18:00	55.7	85.9	2.8	1.8	2.5	210	20	1.0	4.5	997.6
14-Mar	0:00	55.6	85.2	2.4	1.8	2.8	220	15	1.0	4.0	1000.5
	6:00	55.9	84.5	3.0	2.4	3.5	240	25	1.5	4.0	1000.7
	12:00	56.3	83.9	3.3	3.1	4.0	310	40	2.0	5.5	997.1
	18:00	56.7	83.3	3.2	3.0	2.0	260	20			995.5
15-Mar	0:00	56.7	82.7	3.8	3.8	3.3	300	24	3.0	4.0	992.8
	6:00	56.7	81.9	3.2	3.2	3.2	270	18	3.0	4.0	990.6
	12:00	56.7	80.9	3.0	2.9	3.0	320	26	3.0	3.5	987.0
	18:00	57.0	81.2	2.6	2.4	2.2	320	18			983.3
16-Mar	0:00	57.4	81.7	2.3	2.2	1.9	310	21	1.5	3.5	981.1
	6:00	58.2	82.6	4.7	2.1	3.0	320	18	1.5	3.0	979.7
	12:00	59.1	83.5	1.5	1.4	1.9	330	20	1.5	3.0	976.9
	18:00	59.5	84.0	0.5	0.5	0.8	005	20			967.7
17-Mar	0:00	59.9	84.5	0.6	0.4	1.5	100	30	1.5	3.5	955.0
	6:00	60.3	84.6	1.8	1.6	1.8	020	12	1.5	2.0	948.3
	12:00	60.9	84.8	1.5	1.0	1.4	360	8	1.0	2.0	945.7
	18:00	61.2	85.5	0.0	0.0	0.5	230	12			947.3
18-Mar	0:00	61.5	86.8	0.7	0.6	1.0	300	30	1.5	4.0	949.0
	6:00	61.6	87.2	0.2	0.3	1.0	300	30	1.5	5.0	958.1
	12:00	61.8	88.0	0.0	0.2	0.4	290	38	2.0	6.0	964.8
	18:00	61.9	88.9	0.2	0.6	0.8	320	36			970.9
19-Mar	0:00	61.6	89.4	0.5	0.0	1.0	300	20	1.0	6.0	975.6
	6:00	61.2	89.4	1.8	1.2	1.8	330	16	1.0	6.0	977.9
	12:00	61.1	88.4	1.0	0.8	1.3	030	18	1.0	3.0	977.5
	18:00	61.1	87.4	0.8	0.6	1.0	320	26			977.1
20-Mar	0:00	61.2	86.3	-0.5	-0.7	0.6	220	24	1.0	3.5	980.3
	12:00	60.6	86.0	0.0	-0.5	0.6	270	27	1.5	4.0	988.6
	18:00	60.0	87.4	0.0	-0.5	0.5	300	26	1.0	3.5	988.5
21-Mar	0:00	59.6	87.4	0.5	0.5	2.0	040	45	2.0	4.5	975.9
	6:00	59.4	87.8	2.8	2.5	0.5	280	73	3.0	8.0	961.8
	12:00	59.2	88.0	2.2	1.8	2.9	300	43	3.0	10.0	960.3
	18:00	59.0	88.1	1.3	0.0	1.8	230	58	3.0	10.0	964.7
22-Mar	0:00	58.9	88.1	0.6	-0.1	2.2	230	55	3.5	11.5	984.3
	6:00	59.0	88.1	1.6	0.2	1.0	230	35	5.5	11.5	997.4
	12:00	59.0	88.2	1.1	0.7	2.4	230	35	5.0	10.0	1003.2
	18:00	58.3	89.1	1.2	1.0	1.5	290	22	2.0	6.0	1006.3
23-Mar	0:00	58.1	89.6	2.0	1.0	2.3	270	27	1.5	5.0	1005.8
	6:00	58.2	88.7	2.1	1.4	2.1	260	23	1.0	4.0	1003.4
	12:00	58.4	87.7	1.8	1.0	2.9	220	6	0.5	3.0	1000.7
	18:00	58.4	86.7	1.2	0.5	2.0	230	15	0.5		1000.4
24-Mar	0:00	58.5	85.7	0.5	0.1	1.6	250	12	0.5	2.5	1001.4
	6:00	58.6	84.7	1.4	0.4	1.8	240	20	1.5	2.0	1004.7

	12:00	58.7	83.6	1.9	1.0	1.6	290	13	1.0	2.0	1004.8
	18:00	58.5	82.8	1.8	1.6	2.0	350	40	2.0	3.0	994.5
25-Mar	0:00	58.2	82.8	2.8	2.6	1.9	300	32	2.0	4.0	987.1
	6:00	57.8	83.5	3.0	2.8	2.0	300	35	2.5	5.0	984.8
	12:00	57.5	84.3	2.9	2.7	3.1	310	26	2.0	4.0	981.7
	18:00	57.1	85.0	2.3	2.0	2.5	220	18	1.0	3.0	978.1
26-Mar	0:00	56.7	85.7	2.0	0.6	3.0	230	32	2.0	3.5	984.4
	6:00	56.4	86.2	3.2	1.2	2.0	250	48	2.5	5.0	991.8
	12:00	56.1	85.9	3.5	2.1	5.5	280	50	3.0	8.0	997.0
	18:00	56.0	85.6	4.0	3.0	4.0	270	45	3.0	6.0	999.7
27-Mar	0:00	55.8	85.4	4.0	3.4	5.1	270	39	3.0	8.0	998.7
	6:00	55.7	85.3	4.5	3.8	4.8	310	38	3.0	8.0	992.7
	12:00	55.7	84.9	5.1	4.8	5.4	320	50	3.0	9.0	976.8
	18:00	55.7	84.7	4.0	2.5	3.0	300	45	3.5	9.0	988.2
28-Mar	0:00	55.5	84.2	4.0	3.0	4.6	290	30	2.5	10.0	991.6
	6:00	55.8	83.4	3.0	2.8	2.5	340	33	2.0	6.0	984.4
	12:00	55.8	83.3	3.5	3.0	3.9	360	42	2.5	7.5	973.1
	18:00	55.7	84.2	3.8	3.0	3.9	300	38	2.5	6.0	967.7
29-Mar	0:00	55.6	85.1	3.5	2.5	4.2	320	50	3.0	7.5	965.5
	6:00	55.7	85.0	3.8	2.4	3.0	300	55	3.5	11.0	968.4
	12:00	55.5	84.9	2.5	1.4	3.0	310	55	3.5	13.0	969.3
	18:00	55.5	84.8	2.0	1.1	2.8	290	60	3.5	14.0	969.6
30-Mar	0:00	55.4	84.6	1.8	1.5	2.5	260	58	3.5	14.0	975.4
	6:00	55.5	84.3	2.4	1.0	4.0	260	58	3.5	15.0	983.0
	12:00	55.5	84.0	2.0	0.9	1.8	260	58	3.5	16.0	991.7
	18:00	55.5	83.7	2.0	1.2	2.5	260	40		11.0	997.8
31-Mar	0:00	55.3	83.6	2.3	2.0	2.0	320	32	2.0	8.0	991.5
	6:00	54.8	83.6	4.3	4.0	2.6	290	40	2.0	7.0	990.4
	12:00	54.6	83.3	4.8	4.5	2.0	300	42	2.5	7.5	989.3
	18:00	54.5	83.0	5.0	4.8	2.5	310	45			984.2
1-Apr	0:00	54.2	82.7	3.1	3.0	2.3	240	42	2.5	7.5	985.4
	6:00	53.5	83.0	3.7	1.2	4.3	220	20	2.0	6.0	997.7
	12:00	53.8	83.5	2.6	2.1	2.8	260	25	2.0	7.0	1000.7
	18:00	53.8	82.3	2.5	2.0	2.5	270	25			1001.6
2-Apr	0:00	53.0	82.6	2.3	2.0	3.0	320	22	1.0	6.0	1002.0
	12:00	52.7	83.4	1.8	1.5	2.9	160	18	1.0	5.0	999.0
	18:00	52.4	83.9	3.2	2.6	3.5	090	20			999.9
3-Apr	0:00	52.1	84.6	3.6	2.9	5.6	130	26	1.5	4.5	998.9
	6:00	51.8	85.1	5.0	4.7	3.0	090	32	2.0	5.0	994.1
	12:00	51.4	85.7	4.6	4.5	5.1	150	32	2.0	5.0	989.9
	18:00	51.0	86.5	4.2	3.7	3.5	180	22			995.2
4-Apr	0:00	50.5	87.3	4.7	3.9	5.7	220	20	1.5	4.5	999.4
	6:00	50.1	88.2	6.5	5.0	4.5	230	15	1.0	4.0	1002.9
	12:00	49.6	89.1	6.1	4.1	7.8	140	12	1.0	4.0	1007.3
	18:00	49.0	90.1	7.5	6.0	5.5	090	25			1007.2
5-Apr	0:00	48.6	90.8	9.1	8.9	9.4	060	42	2.5	7.0	997.6
	6:00	48.4	91.3	10.5	10.5	5.8	340	35	2.5	6.0	994.6
	12:00	48.0	91.9	10.9	10.8	9.1	360	45	2.5	7.5	993.2
	18:00	47.8	92.4	10.2	9.6	6.0	340	45			992.0

6-Apr	0:00	47.6	92.8	9.4	8.4	8.9	300	45	3.0	9.0	998.3
	6:00	47.1	93.7	10.4	9.6	10.4	300	25	2.0		1008.1
	12:00	46.5	94.5	10.1	10.0	10.1	030	9	1.5	10.0	1011.1
	18:00	45.9	95.4	9.5	9.0	9.7	090	15			1010.3
7-Apr	0:00	45.3	96.4	9.5	9.0	10.5	130	17	1.5	5.0	1010.3
	6:00	44.7	97.3	9.1	8.9	10.3	100	40	1.5	5.5	1011.0
	12:00	44.2	98.1	13.5	13.5	12.2	060	16	1.5	4.0	1010.1
	18:00	43.6	99.0	13.6	13.6	13.0	020	30			1011.0
8-Apr	0:00	43.0	99.8	13.6	13.6	13.2	020	16	1.0	4.0	1011.5
	6:00	42.6	100.6	14.5	13.8	13.2	020	36	1.0	3.0	1010.8
	12:00	42.0	101.4	13.9	13.9	12.6	020	28	1.5	3.5	1010.1
	18:00	41.4	102.2	14.3	14.3	14.6	340	32			1006.7
9-Apr	0:00	40.9	103.0	14.9	14.9	14.4	350	30	2.0	3.5	1006.0
	6:00	40.3	103.9	15.1	15.0	14.5	320	18	1.0	3.0	1003.4
	12:00	39.7	104.7	14.9	14.5	15.1	300	23	1.5	3.0	1003.1
	18:00	39.1	105.6	15.0	14.2	15.5	300	18			1004.8
10-Apr	0:00	38.6	106.6	15.0	14.2	15.4	280	25	1.5	3.0	1007.4
	6:00	38.4	107.7	15.4	14.5	15.6	270	18	2.0	3.0	1007.9
	12:00	38.5	109.0	15.9	14.4	16.2	270	27	2.0	3.0	1008.9
	18:00	38.3	110.1	16.2	15.2	16.1	290	18	1.5	3.0	1007.8
11-Apr	0:00	38.1	110.7	14.5	13.5	14.9	290	30	2.0	3.5	1010.2
	6:00	38.0	110.9	14.8	13.8	15.0	280	22	2.0	3.0	1012.7
	12:00	37.5	110.9	14.5	13.5	14.9	210	22	2.0	3.0	1018.6
	18:00	37.0	110.9	14.5	12.0	16.6	200	12	1.0		1020.9
12-Apr	0:00	36.5	110.9	15.1	12.2	17.7	180	8	0.5	3.0	1021.6
	6:00	36.0	110.8	18.0	14.5	18.2	250	10	0.5	3.0	1022.4
	12:00	35.5	110.6	16.5	13.6	18.3	230	6	0.5	2.5	1024.2
	18:00	35.0	110.5	17.0	14.3	19.4	170	10			1025.2
13-Apr	0:00	34.6	110.4	17.4	14.5	18.6	110	6	0.5	2.5	1025.3
	12:00	34.0	110.3	18.4	16.5	19.6	130	12	1.0	2.5	1026.3

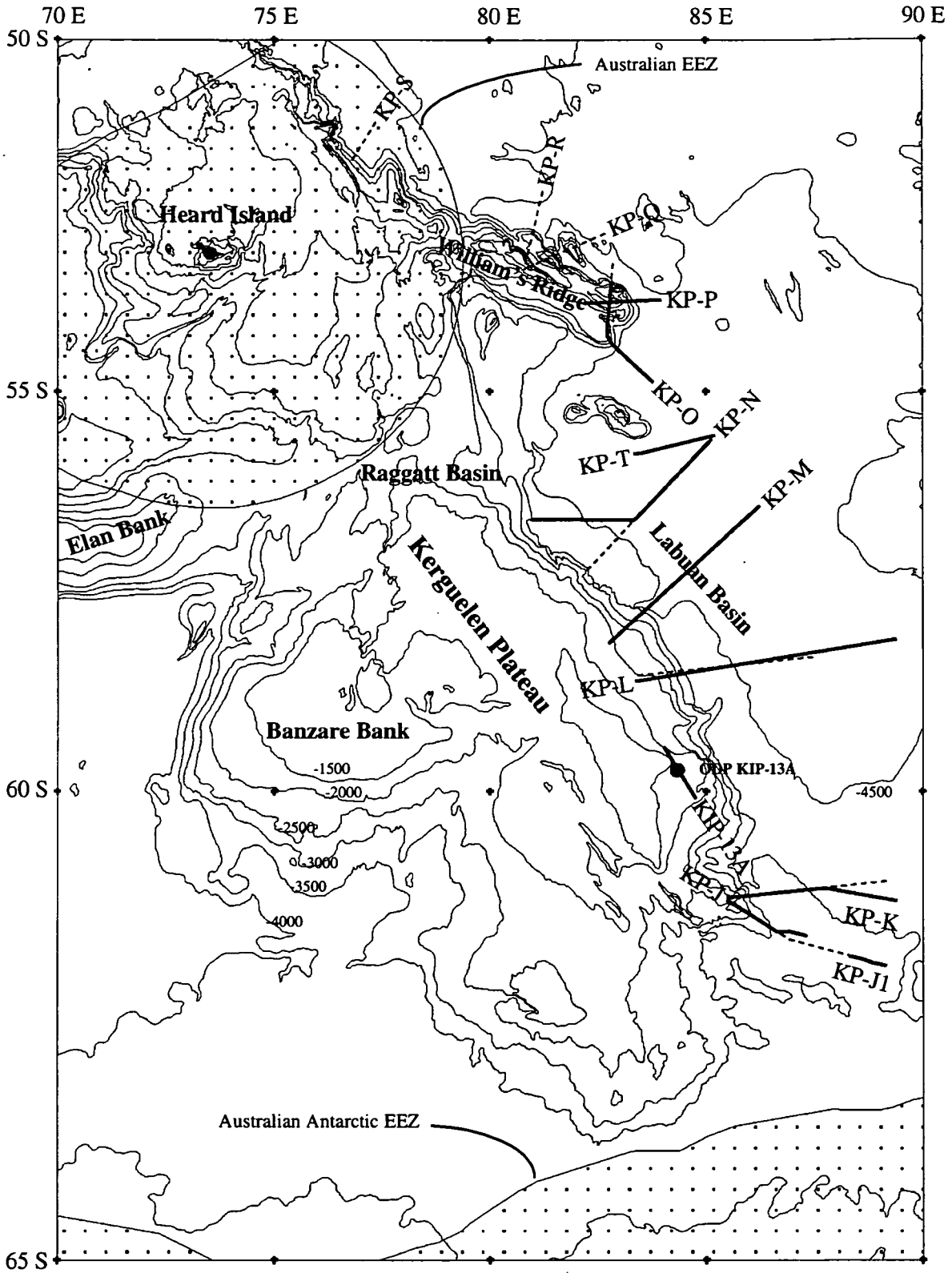
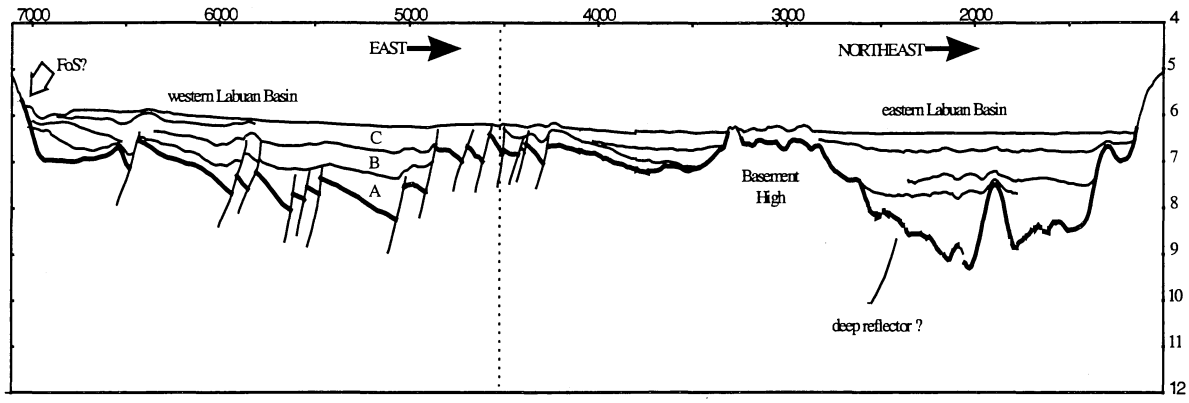
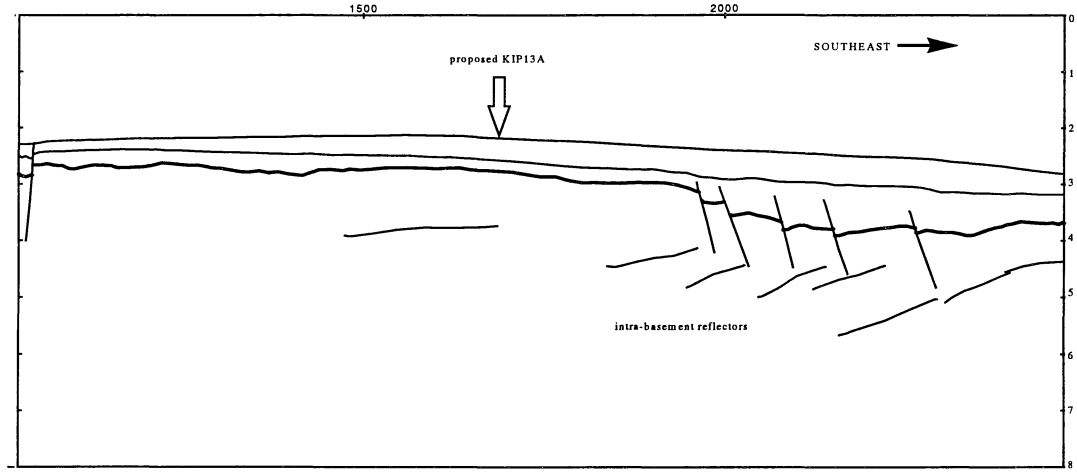


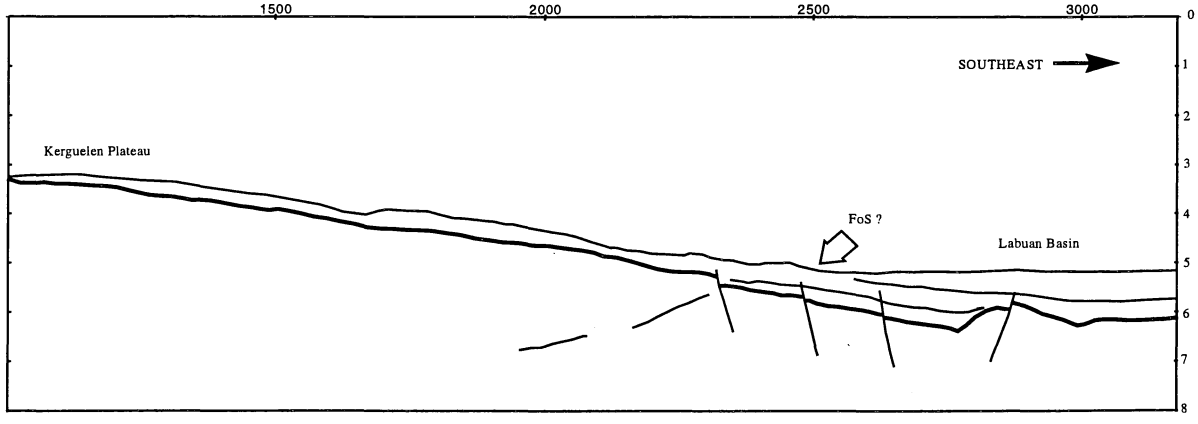
Figure 1. Map of LOS Kerguelen Plateau 2 survey area showing EEZs (stippled area), proposed (dashed) and actual (solid) lines and main morphological features.



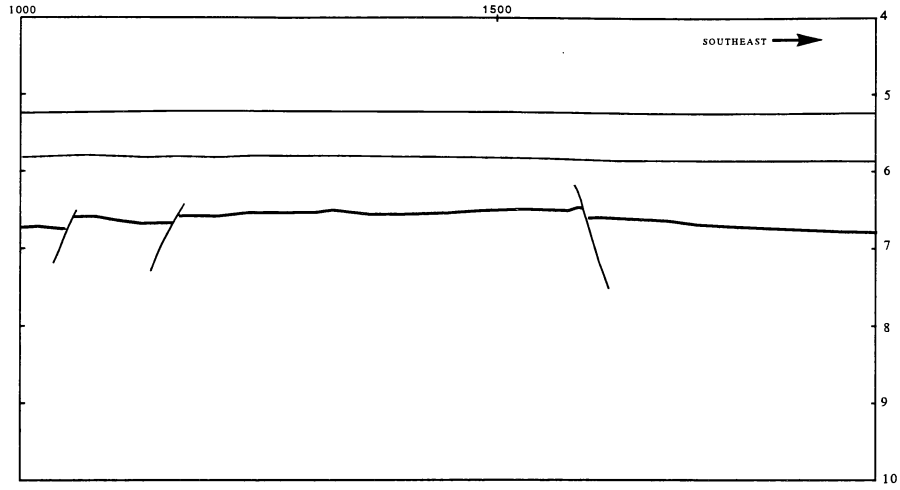
(a) Seismic line 180/01.



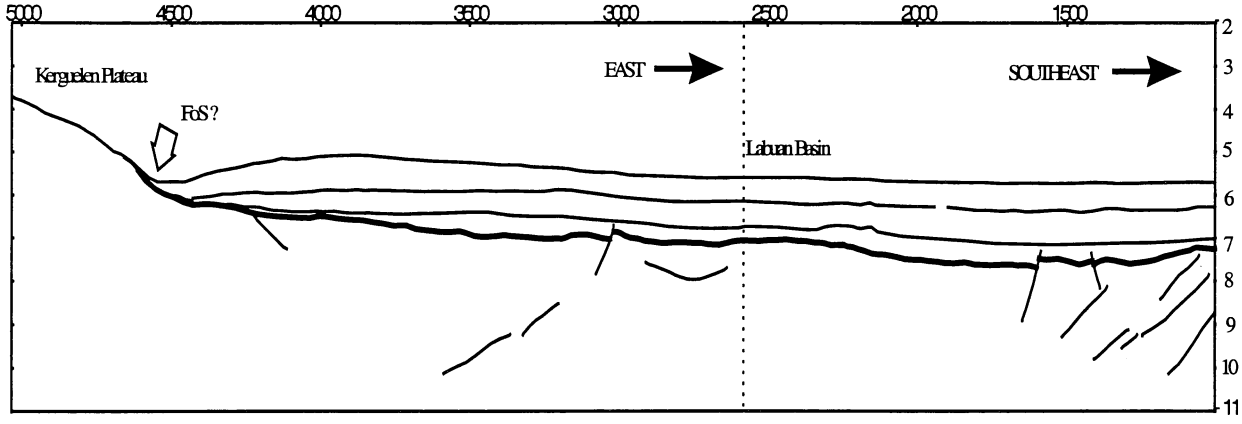
(b) Seismic line 180/02.



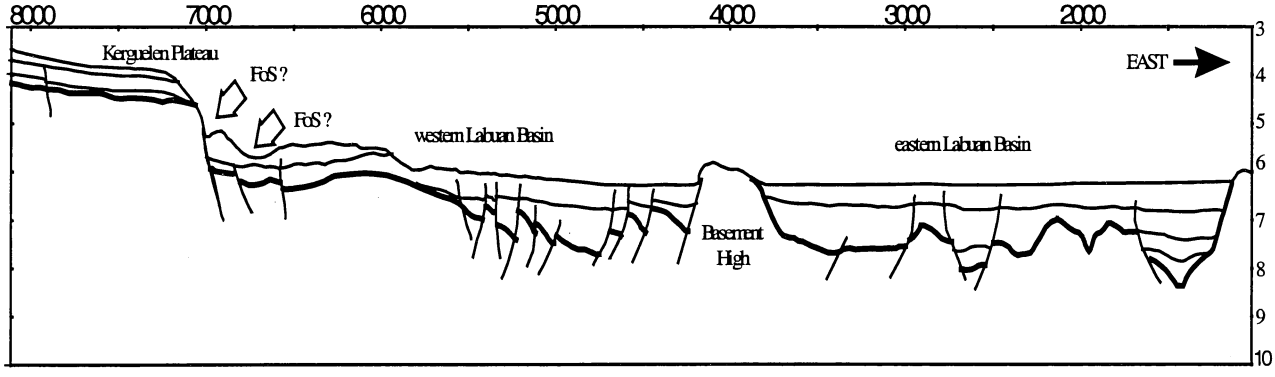
(c) Seismic line 180/03.



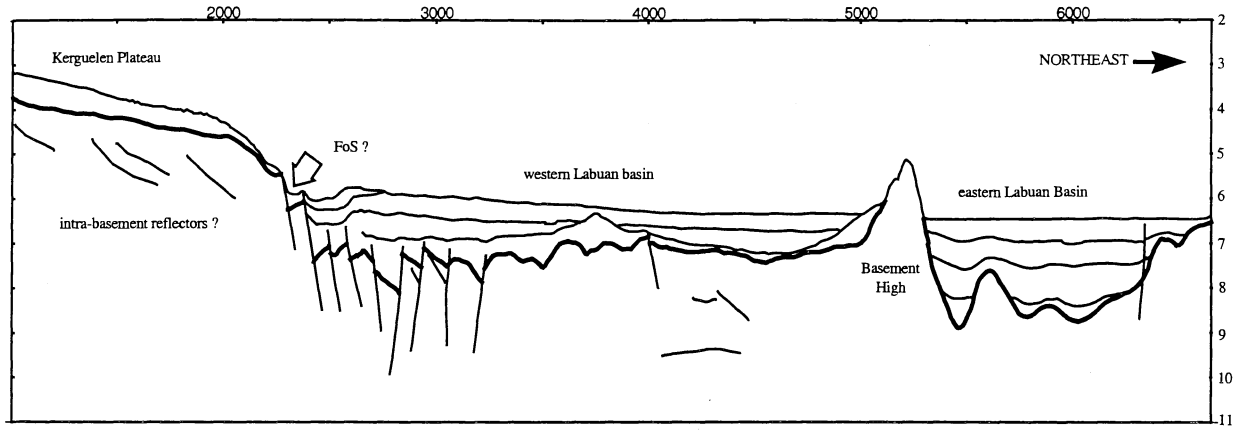
(d) Seismic line 180/04.



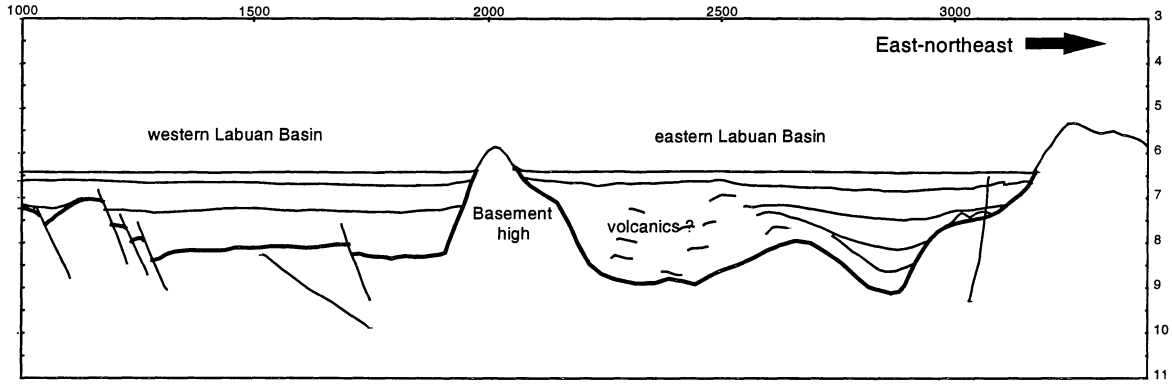
(e) Seismic line 180/05.



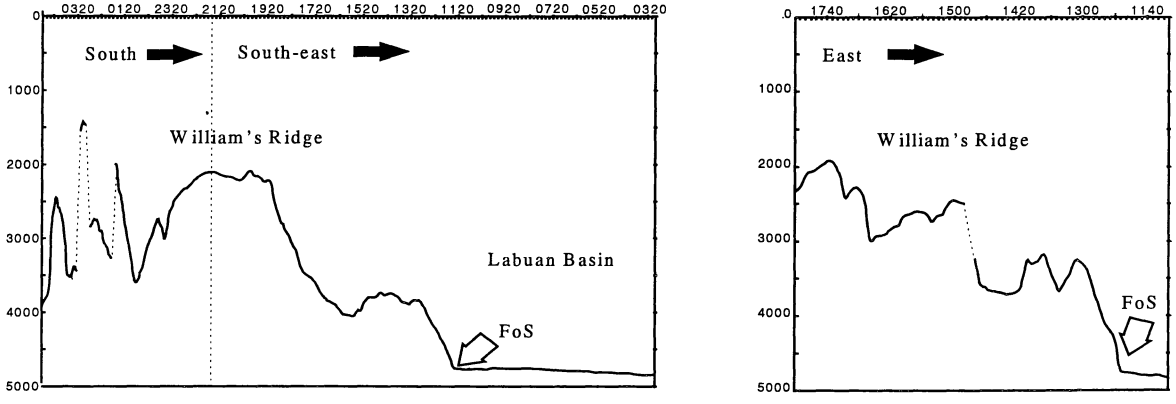
(f) Seismic line 180/06.



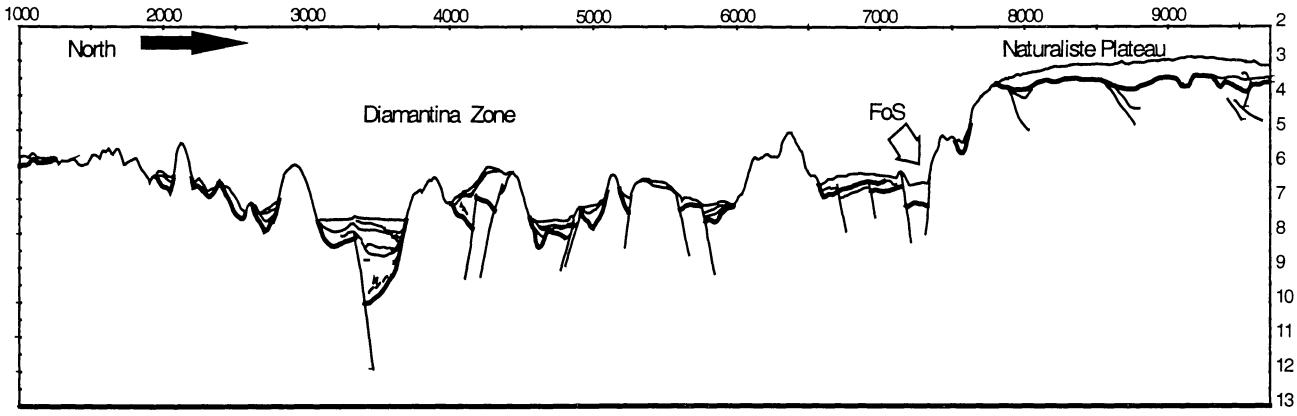
(g) Seismic line 180/07.



(h) Seismic line 180/08.



(i) Bathymetry lines 180/09 and 180/10. Days are Julian days 90 then 91.



(j) Seismic line 187/01.

Figure 2. Line diagrams for seismic and bathymetry acquired. Seismic lines given in terms of shot points (1000 SPs = 50 km) and TWT in seconds, while bathymetry is given in terms of UTC time and depth in metres.