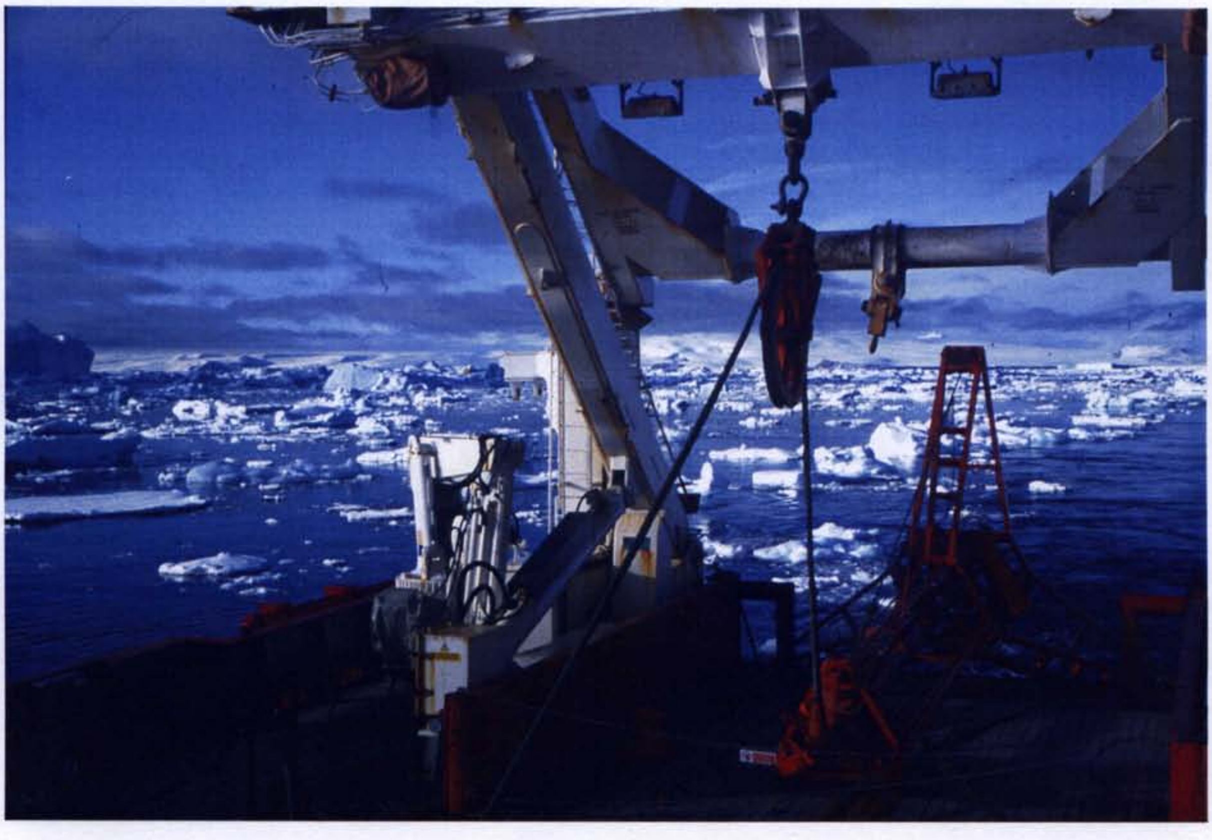
RRS James Clark Ross

JR71 Cruise Report



Marine geology and geophysics on the continental shelf and slope of the Antarctic Peninsula and in the NW Weddell Sea

British Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

Cruise Report

RRS *James Clark Ross*

Cruise JR71

February to March 2002

Swath bathymetry, TOPAS sub-bottom profiling, seismic profiling, coring and CTD's

Continental shelf and slope of the Antarctic Peninsula, including former ice shelf areas, and NW Weddell Sea

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with contributions from Claire Allen, Julian Dowdeswell, Jeff Evans, Pete Lens, Peter Morris, Keith Nicholls, Colm O'Cofaigh, Jenny Pike, Mark Preston and Ali Skinner

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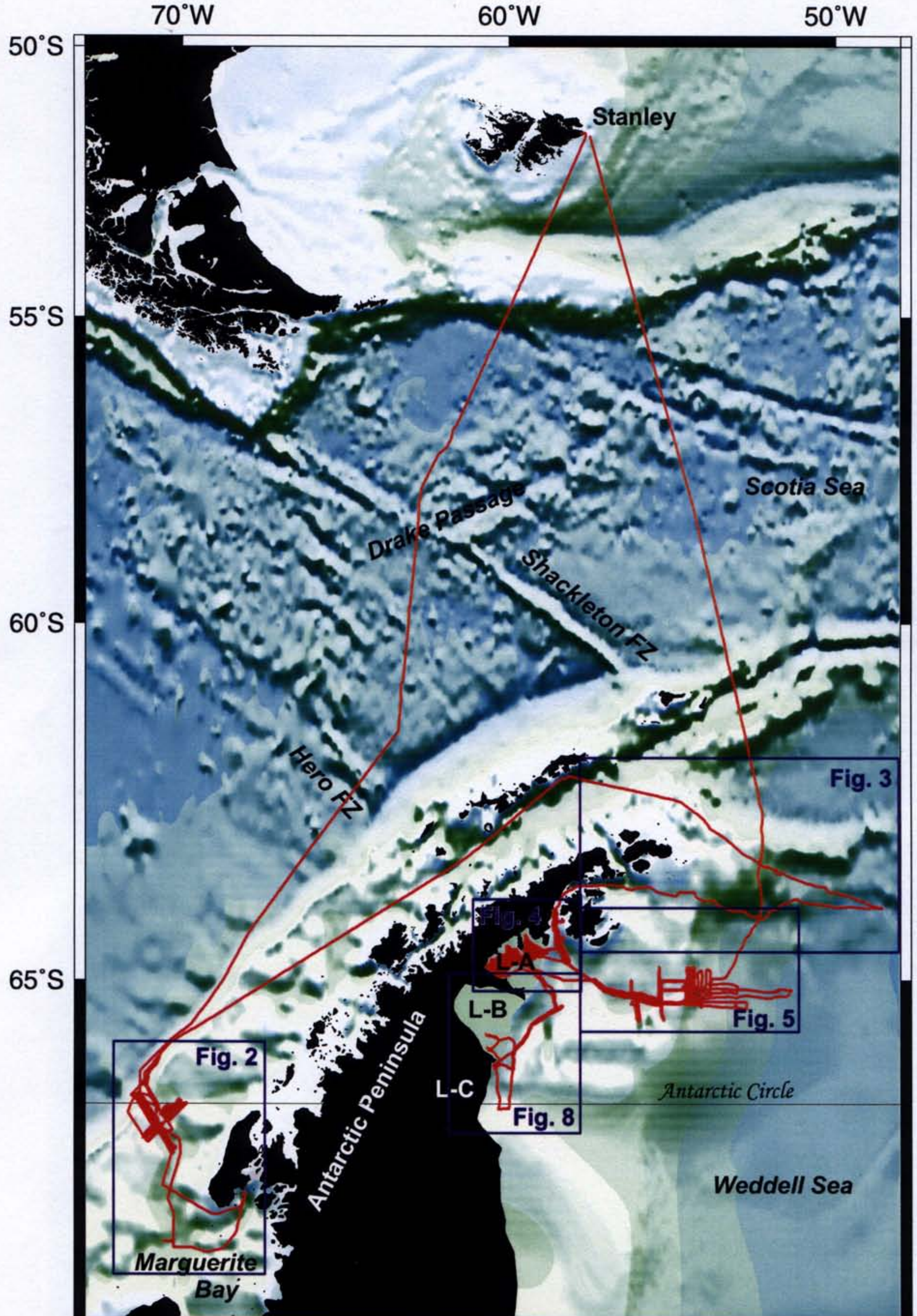
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1. SUMMARY (CJP)

Cruise JR71 had four main objectives:

i) Survey and coring on the continental shelf and slope east of the northern Antarctic Peninsula, within and offshore from the areas formerly covered by the ice shelves in Prince Gustav Channel, Larsen-A and Larsen-B (SAGES core programme, led by Dr C J Pudsey)

ii) Survey and coring on the continental shelf and slope offshore Marguerite Bay (AFI project 48/02, led by Prof J A Dowdeswell)

iii) Surface water sampling for diatom assemblages (AFI-CGI project 99/02, led by Dr J Pike)

iv) A CTD transect across the northern limb of the Weddell Gyre, to measure the outflow of Weddell Sea Bottom Water (opportunistic project led by Dr K Nicholls).

Underway measurements included swath bathymetric, TOPAS and magnetic survey, plus the routine collection of ocean-logger and acoustic doppler current profiler data.

The cruise occupied 34.5 days (Feb 12th to March 19th, Stanley to Stanley) plus three days of mobilisation and one day of demobilisation. The ship's track is ahown in Fig. 1. The weather was generally very good and no time was spent hove-to, though it was often necessary to slow down because of ice conditions combined with poor visibility. A small amount of time was lost on account of equipment failure (the BGS vibrocorer and the ship's Seametrix system). 21 hours were spent on passage to/from Rothera and alongside transferring passengers and cargo.

All the objectives were achieved except for survey of Larsen-B, which was prevented by a major collapse of the ice shelf which filled the sea with fragments of ice (see frontispiece and back cover). The total area of swath survey was some 40,000 sq. km. Cores totalling 158.6 m were recovered from 56 sites. As well as the main transect of 11 full-depth CTD stations, 11 more were occupied on the continental shelf, and 66 XBT casts were made. 240 surface water samples and 26 samples from CTD's were filtered for diatoms.

Fig. 1. Summary track chart for JR71. Background is a shaded-relief image of bathymetry. On this cruise we crossed the Antarctic Circle both west and east of the Antarctic Peninsula.

Introduction and objectives (all)

Cruise JR71 was planned to include geophysical surveying and sediment coring on the continental margins both east and west of the northern Antarctic Peninsula. The sedimentary record of this region contains a history of Late Quaternary glaciation and Antarctic Peninsula ice sheet dynamics. Areas of fast flowing ice within ice sheets and their signature within the sedimentary record are a particular focus, as these palaeo-ice streams can have a major influence on ice sheet stability during glacial maxima. The cruise provides material for the BAS core programme SAGES and two AFI/CGI projects. As a late addition to the programme some oceanographic work was also undertaken.

Larsen area - NW Weddell Sea

Swath bathymetric survey and TOPAS sub-bottom profiling were undertaken in the area exposed following the 1995 breakup of the northern Larsen Ice Shelf. This was a follow-up to BAS cruise JR48, which undertook conventional bathymetric survey and vibrocoring in the same area in Feb-March 2000. Results from JR48 demonstrated that the ice shelf in Prince Gustav Channel had disappeared and re-formed during an earlier warm period in the mid-Holocene (Pudsey & Evans 2001). We also characterised glacial-interglacial sedimentation on the inner continental shelf (Pudsey et al. 2001, Evans & Pudsey 2002). The new high-resolution shaded-relief maps of the seafloor reveal the pattern of past ice flow: ice streams and inter-stream areas with subglacial bedforms on the shelf, mass flow processes on the continental slope, trough-mouth fans or contourite drifts on the continental rise in the NW Weddell Sea. The extent of glaciation and ice dynamics on the shelf will influence the mode and style of sedimentation on the adjacent continental slope. Additional vibrocores, box cores and piston cores were taken on the continental shelf, slope and rise. The cores will reveal the glacial history of this part of Antarctica, in particular the details of the most recent deglaciation and climate fluctuations within the last 10,000 years.

One of the interesting results from the JR48 cores in the former Larsen-A area is that clast composition changes dramatically downcore. Holocene glacial-marine sediments contain ice-rafted debris corresponding to known rock types seen on the Antarctic Peninsula. Glacial diamicts (sub-ice shelf and subglacial tills) contain mainly pebbles of Mesozoic sedimentary rocks, which have only small outcrops on land. A few published seismic profiles on the outer continental shelf (Anderson ref) suggest it is underlain by east-dipping Mesozoic to Cenozoic strata of the Larsen Basin. It is likely that these sedimentary rocks supplied the material for a deforming till layer which facilitated offshore flow of the ice sheet. We planned to acquire seismic lines in Larsen-A to confirm the existence of Larsen Basin sediments on the inner shelf. Seismic profiles were also acquired to investigate the style of deposition on the slope.

The main objectives of the Larsen work were:

1. Characterise glacial sedimentation across the Larsen-A continental shelf and slope.
2. Relate the sedimentation patterns and processes to ice shelf and ice sheet dynamics (notably fast flowing ice) and ice extent during Late Quaternary glacial-interglacial oscillations.
3. Investigate the existence of Mesozoic strata on the inner continental shelf.
3. Compare and contrast ice shelf and Antarctic Peninsula ice sheet dynamics between west and east Antarctic Peninsula (*cf.* Marguerite Bay work).

Marguerite Bay

The Marguerite Bay leg of the cruise was an AFI project involving geophysical and geological investigations of a large palaeo-ice stream which drained through Marguerite Bay to the continental shelf edge at 71°W during the last glacial maximum (LGM). We aim to reconstruct the Late Quaternary dynamics of the western margin of the Antarctic Peninsula ice sheet, with particular emphasis on the role of fast glacier flow and the controls thereon. This part of the cruise builds on the swath and TOPAS survey undertaken on JR59 last season (Ó Cofaigh et al. in press). The aims of the Marguerite Bay leg of JR71 were threefold:

1. To accurately reconstruct the dimensions of the Marguerite Trough ice stream using swath bathymetric and TOPAS data and coring. This will allow quantitative estimates of ice volume and flux from this region of the Antarctic Peninsula ice sheet during the LGM.
2. To investigate conditions at the former ice-stream bed in order to understand the physical mechanism(s) of fast flow and the controls thereon, particularly the role of subglacial deformation. TOPAS data collected during JR59 revealed a till unit up to 15 m thick in the outer shelf trough. Investigation of the sedimentological and geotechnical properties of this till, and determining its spatial distribution, were key targets during JR71.
3. To investigate continental slope sedimentation in front of Marguerite Trough. Although much research on palaeo-ice streams and continental slope sedimentation has been carried out in the northern hemisphere, primarily from the Norwegian-Greenland Sea, there has been relatively little comparable work on the Antarctic Peninsula margin. We planned to investigate spatial variation in sedimentation style on the slope, both directly in front of the trough and adjacent to it.

Collection of phytoplankton samples

This project involves the identification of (i) diatom communities across the Scotia Sea and the northern Antarctic Peninsula in order to assess their distribution and (ii) the relationship between the live diatom assemblage in the water column and that preserved in sediments.

Marine diatom assemblages are widely used as a proxy tool in palaeoceanographic reconstructions. Their distribution is controlled by environmental factors including water temperature, salinity and water column stability as well as light, nutrient availability and sea ice. In addition, the sedimentary assemblage is influenced by physical degradation (i.e. taphonomic) processes during transport to, and at the sea floor. These processes, which include grazing, aggregation, dissolution, advection and bioturbation, alter the assemblage preserved in the sediments. Analysing the associations between the surface water and sediment surface diatom assemblages is fundamental to any modern analogue technique (MAT) for reconstructing ocean and climate conditions.

The Antarctic Peninsula and Scotia Sea are recognised as having a highly dynamic oceanographic and climatic setting, resulting in the presence of unique diatom assemblages. Thus it is inappropriate to apply MATs derived from other regions. The purpose of this project was to collect surface water diatom assemblages together with sea surface temperature and salinity measurements from this complicated biogeographic/oceanographic region. These assemblage data will then (i) be compared with sediment core top diatom assemblages to assess the impact of taphonomic processes on the fossil assemblage and also (ii) provide data to verify MAT environmental reconstructions.

Objectives:

1. To collect surface water samples and continuous temperature, salinity and fluorescence measurements along a transect from the Falkland Plateau to the northern Antarctic Peninsula
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2. To document quantitatively the modern diatom floral assemblages across all the major water masses traversed, and at core sites where an undisturbed sediment surface was recovered.

3. To compare modern water column assemblages with core-top fossil assemblages.

Conductivity-Temperature-Depth (CTD) profiling work

During the final stages of planning for JR71, it was clear that conditions in the Weddell Sea were very unusual this season. Firstly the Weddell pack ice had not drifted west and north along the Antarctic Peninsula as it normally does, so that the Larsen area north of 67°S was ice-free while the southern area (including the vicinity of Halley base) was still infested with dense pack. Secondly, during November 2001, the SOC team undertaking the annual Drake Passage CTD transect on cruise JR67 found a virtual absence of cold deep water south of the Polar Front. While not unusual during a year with a Polar Front located well to the south, the front this year was relatively far north. The combination of a front well to the north and a strong depletion in cold deep water to the south was unprecedented.

To monitor bottom water in a key location in the Weddell Sea, we therefore planned to reoccupy a CTD section that had been established during the 1990's by the Alfred-Wegener Institute. The section extends along 108° from the continental shelf east of Joinville Island, down the continental slope and out into the northern Weddell Sea. It thus includes the core of Weddell Sea Deep Water (WSDW) that is confined to the NW Weddell continental slope as a northerly flowing bottom current, and ultimately escapes the Weddell Basin via multiple routes across the South Scotia Ridge. The most recent repeat of the AWI CTD section was a Brazilian cruise in 2000. A strong warming was observed in the WSDW, unprecedented in the time series of sections and mooring data obtained during the previous decade. Repeating the same CTD section on JR71 would determine whether the properties of the WSDW in the northward flow had changed since the year 2000, and whether any light could be cast on the absence of cold deep water during the early-season Drake Passage section.

Time was also found during the cruise to occupy two CTD stations in the former Larsen-A ice shelf and nine adjacent to the northern Larsen C Ice Shelf. These were the first ever measurements of Larsen ice Shelf Water close to source.

Additional underway measurements

Navigation data (differential GPS), Ocean Logger data (sea surface temperature, salinity, and meteorological data), and Acoustic Doppler Current Profiler data were logged throughout the cruise.

BAS's Shipborne Three-Component Magnetometer (STCM) is now being routinely used but comparison with data from a towed magnetometer is still desirable. The BGS magnetometer was deployed on long passages. Ship tracks were mainly selected to optimise swath bathymetry coverage, but the return leg across Drake Passage was offset from the direct line to enable collection of new magnetic data.

3. NARRATIVE (CJP)

The scientific party for JR71 arrived at Stanley in several instalments, dictated by the availability of flights. Mark Preston was already on board from the previous cruise. The advance party of John Derrick and Graham Tulloch (BGS) and Tim Moffat arrived on Feb 6th, a couple of days ahead of the ship; this meant that mobilisation of the BGS equipment could begin as soon as space became available on deck on Feb 9th. Most of the rest of us arrived at 1730 on Feb 9th, after a very long commercial flight and one or two nights' stay in Santiago de Chile. Mobilisation of the BGS vibrocoring and seismic equipment, the UKORS piston corer and the BAS laboratory equipment was essentially complete by the evening of Feb 11th, when the ship gave a reception for our many friends and supporters in the Falklands. The RAF Tristar bringing our two VIP's Crispin Tickell and Director BAS was delayed by 24 hours, arriving in the afternoon of Feb. 12th. That morning the opportunity was taken to test-fire the airguns in the harbour. Full details of the BGS mobilisation are given in Skinner (2002).

The ship sailed from FIPASS at 1620 (local) on day 043 (Feb 12th) straight into a force 7 west-southwesterly wind. Luckily all necessary safety training and lifeboat familiarisation had taken place before we sailed, so those affected could retire to their bunks. The uncontaminated seawater supply and ocean-logger were turned on shortly after we passed Cape Pembroke, and water sampling for diatoms was started (see section 4.4). The magnetometer was streamed just before 2000, though it produced very noisy data except when the ship's cathodic protection system was switched off for an hour. The EM120 swath bathymetry system was started after some difficulty (see section 5.2) and we commenced logging the first survey (JR71_12) at 2040.

Our course was initially SSW, parallel to and offset to the east from our Drake Passage tracks from JR59 (see track chart). We had been given permission to steam at full power for the long passages during this cruise, to make extra time for insertion of the oceanographic work into the itinerary. In the prevailing sea conditions (the wind stayed westerly force 6-7 for the next two days) we made 14-15 knots and the quality of the swath data was remarkably good with a beam angle of 55°. In widening the swath coverage of this part of Drake Passage we mapped an interesting small seamount at 56° 31'S, 61° 28'W. From 1100 on day 044 we launched XBT's at 6-hourly intervals; it was necessary to slow the ship to 10 knots and come head to wind for each XBT, to allow safe working on the after deck. The Polar Front was located between 57° and 58°S.

At the Shackleton Fracture Zone we altered course to the south, to rejoin another JR59/JR67 swath at 61° 35'S. The TOPAS sub-bottom profiler was started in the afternoon of day 045, approaching the sedimented area southwest of the Hero Fracture Zone; surprisingly, TOPAS also produced acceptable data at 15 knots. That night we slowed to 10 knots for the hours of darkness. The track continued along the base of the continental slope.

Marguerite Bay

We reached the Marguerite Bay survey area (65° 50'S) in the early afternoon of day 046, just under three days out from Stanley, in steadily improving weather. Six days plus the Rothera port call were allocated to the AFI part of the cruise. Pack ice still covered George VI Sound and the southern part of Marguerite Bay, but fortunately it had already been decided to concentrate on the outer shelf. A number of core sites had been picked by Colm O'Cofaigh and Julian Dowdeswell on the basis of the TOPAS lines from JR59, designed to sample the different acoustic units. We began by running a SSE line on the outer shelf (new survey JR71_16)

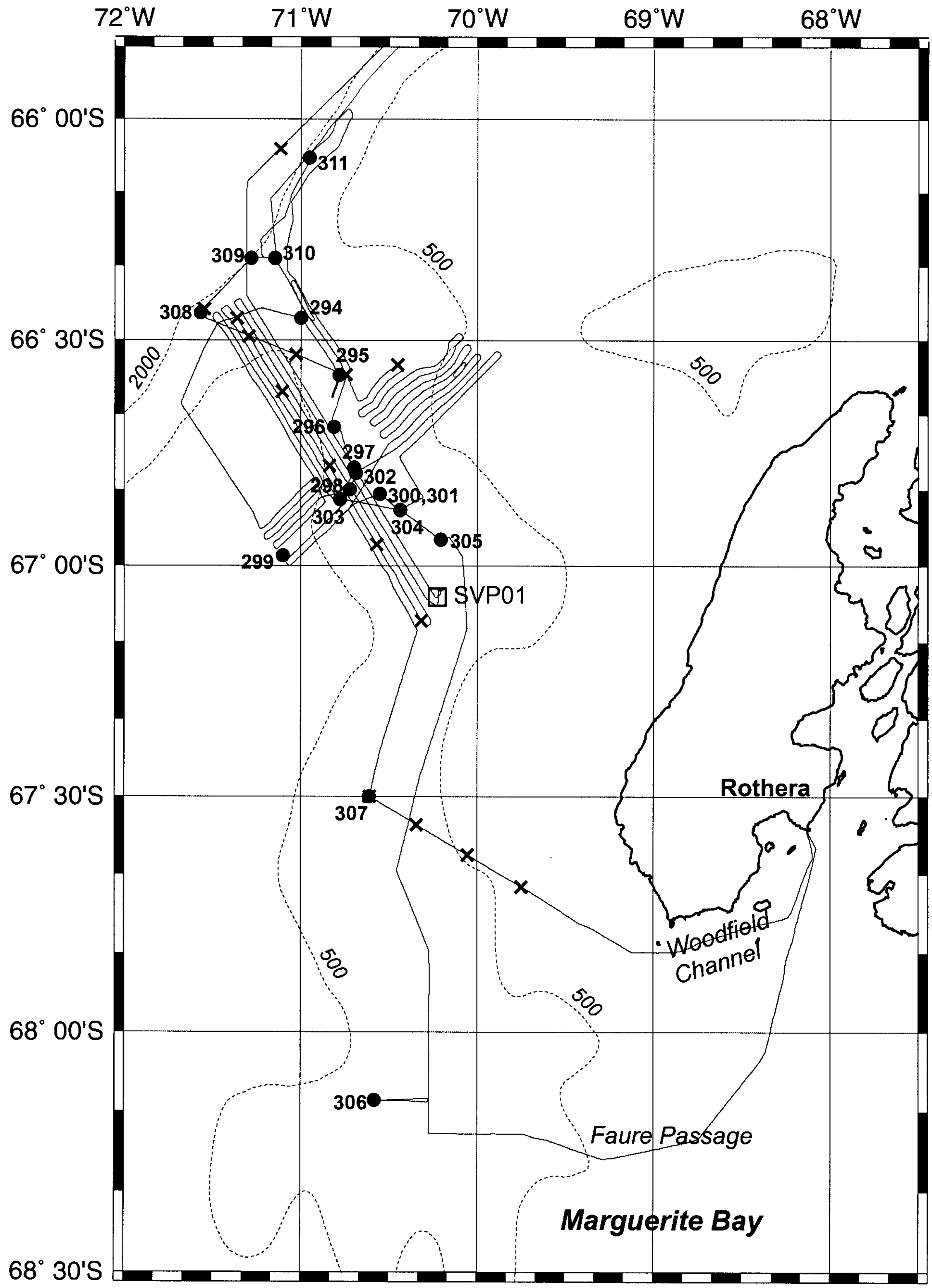


Fig. 2. Ship tracks, core sites 294-311 and XBT positions on the continental shelf off Marguerite Bay. XBT station numbers are shown on the main track chart (foldout). 500 m and 2000 m contours shown.

parallel to and west of the JR59 swath. At the end of this line (midnight day 046-7) the magnetometer was recovered, the Sound Velocity Probe deployed and an STCM calibration turn carried out. A fault with the SVP, manifested as incorrect depth values, rendered the data unusable; for the rest of the cruise we continued using XBT-derived sound velocities for the EM120.

The first 1 ½ days were spent running parallel swath tracks on the outer shelf, in a fresh NW wind and overcast conditions with snow showers. Fig. 2 shows the tracks and core sites. Survey speed was 10-11 knots. Having widened the NNW-SSE swath to 20 km and defined the edge of the lineated area within the outer shelf trough, we ran some cross lines at the southern end then looped around the western side of the JR59 survey before attempting to start coring just before noon on day 048. Our early attempts were plagued by mechanical and electrical problems. The penetrometer on the BGS vibrocorer did not work properly for several days, so a guess had to be made at the length of vibration time required to collect a core. On the first deployment of the vibrocorer the rig came back on deck empty but with inverted core catchers; the pin which holds the core barrel at the top of the rig until vibration starts had not released. The second deployment was successful and VC294 recovered 2.6 m.

We had intended to take duplicate vibrocores and gravity cores at several sites, gravity cores being considered more reliable for microfabric studies of glacial diamicts. We tried to deploy a one-barrel (3 m) gravity core at this first site, but first the coring wire escaped from a sheave, then the Seametrix winch monitoring system failed, refusing to measure amything except the biological winch. It is not safe to deploy equipment without a record of outboard tension, so the corer was secured again. Mark Preston and Doug Trevett immediately started diagnostic tests on Seametrix, which required considerable effort as the documentation is inadequate and many items were very difficult to access (see section 5.8).

Meanwhile the ship proceeded ~9 miles south to the next site where VC295 went smoothly and recovered 4.4 m. The next site was approached just after 1800, but had to be aborted because there was no power to the BGS deck equipment. After 1h:20 min diagnostics the ship re-started swath and TOPAS survey while various power supplies were tested and rebuilt. We ran NNW to the shelf edge then surveyed some 40 km of the upper slope to the NE, before returning to a revised site VC296 just after 6 am on day 049. An EM120 crash necessitated looping round and repeating part of the line. The following three vibrocores went reasonably smoothly and recovered 2.9-4.2 m mainly of normally consolidated diamict, though there was some damage to the rig at VC298 which had to be repaired after recovery. We waited on station at the next intended site for two hours for the repairs to be completed; the deployment was unsuccessful, so the rig was lifted inboard so that work could continue on it while the ship added another cross-line to the swath and TOPAS survey. Meanwhile, after 24 hours' intensive work, the Seametrix system had been fixed.

VC299 was a site on the southwestern bank of the trough, and recovered stiff diamict interpreted as subglacial. Now that we were able to use the coring wire again, the next site back in the centre of the trough was duplicated by GC300 and VC301. Two hours later at midnight (day 049-50) the vibrocorer was again recovered empty. This time extensive work was required on the relay cases, so the ship surveyed the first two cross-lines on the NE side of the trough overnight, before returning to site VC302. A malfunction of the ship's DP system meant it took over an hour to get on station, but at least the vibrocorer worked this time and recovered 4.7 m. After a day or so of lighter winds and good visibility (but still a swell from a distant depression farther to the NW) we again had a fresh northerly and mank for the last three sites on the outer shelf. We were unlucky in probably hitting a rock with the corer at VC305, which was sited in an area of thick drape but only recovered a bag sample.

We then had a long steam to the southernmost core site, VC306 at 68° 09'S near the western end of Fauré Passage. This route to Rothera had been suggested by the Master to minimise the time spent in rock-infested waters in the dark. Full core recovery was achieved in thick draped sediment, and we headed for Rothera at full speed at 0400 on day 051.

The ship tied up just after 0900 and spent nine hours alongside Biscoe Wharf. Five personnel disembarked (Dowdeswell, Kaiser, Moffatt, Rapley and Tickell), Nicholls embarked and we reverted to single-cabin occupancy. Twelve containers were discharged to the base, including a temporary dive facility to replace part of what was lost in the Bonner lab fire last year, and 11 containers of Bonner lab wreckage were loaded on board. There was time for a number of base personnel to visit the ship and a party from the JCR to have a guided walk round Rothera Point. We sailed in the evening via Woodfield Channel. Back in open water, the big northerly swell was still there; after one final core on the shelf (VC307) we continued northwards, rolling heavily in the wee small hours, before resuming the set of cross-lines on the NE side of the trough. By 1830 on day 052 we had mapped part of the NE margin of the trough and the adjacent bank, and it was time to head for the slope so that we could core four sites there before leaving Marguerite Bay.

From a large-scale contour swath map of the slope we had selected sites at about 1500 m depth in the bottoms of three large gullies, one in front of the trough and one to either side, plus one site at ~850 m in front of the trough. We had intended to piston core at least one of the deep sites, anticipating mud-rich debris flows in the gullies, but after we had vibrocored the first and recovered less than half a metre of gravel with a rock jammed in the core catcher, we dared not risk the piston corer in such a difficult coring environment. The bonus at VC308 was that the penetrometer was now functioning, though on the slope it indicated considerably more penetration than the amount of sediment we actually recovered. At the other two deep sites we found similar gravel, but the upper-slope site (VC310) recovered 3.8 m of mud.
We were able to fill in a gap in the swath coverage of the slope before taking our departure (i.e. increasing to full speed) at noon on day 053. Despite losing some 12 hours in equipment failure of various kinds, the AFI part of the cruise had been very successful.

During the passage along the continental shelf past Anvers Island and the South Shetland Is we continued to run the EM120 and TOPAS (swath survey JR71_18). In addition to the known palaeo-ice stream east of Smith I (Canals et al. 2000) we crossed at least four other troughs with a linear, probably subglacial, seafloor fabric. We had clear (if not exactly sunny) views of the South Shetland Is, and the islands provided a very welcome lee from the persistent swell. The ship made a small detour to the south side of King George I to run a swath line off Admiralty Bay, to aid interpretation of cores recovered on cruise JR29 (Evans, submitted).

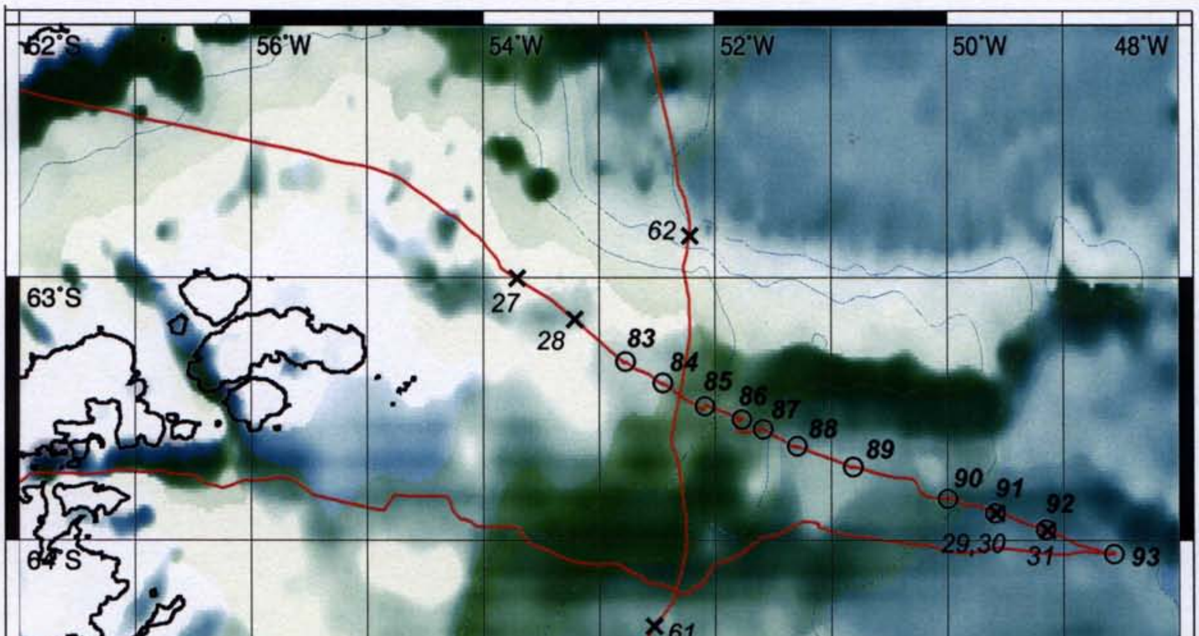
Weddell Sea Oceanography

The next project for JR71 was a transect of full-depth CTD casts in the NW Weddell Sea, to monitor Weddell Sea Deep Water (WSDW) outflow from the Weddell Gyre. This was considered too important by BAS Directorate to leave till the end of the cruise, so rather than breaking off from the Larsen survey at some stage we decided to do the CTD’s on the way to the Larsen. We planned to repeat 12 of the CTD stations occupied by *Polarstern* in 1998 (cruise ANT XV/4, stations 4-16; Fahrbach 1999). Although Mark Preston was the only one of the scientific party who had recent experience of the Seabird CTD, he was able to train the three new operators (Pudsey, Nicholls and Lens) during the first few stations so that 24-hour working could be maintained.

to be nowhere safe to stop the ship amidst the ice (the bridge was suffering from wave clutter on the radar as the wind was force 6-7 from the north). The instrument package was lowered to within 10 m of the bottom, measured using the altimeter (which worked very well with its new component). All the stations went smoothly except for minor problems with the ship's DP, and the sensors freezing up between some of the deployments (see section 5.7). Up to six water bottle samples were taken at each station for salinity calibration, oxygen isotope measurements, and filtering for suspended sediment or diatoms (Table 4). The EM120 and TOPAS were run during the short passages between CTD stations, though the swath data quality was locally rather poor in deep water (EM120 survey JR71_19). TOPAS imaged sediment waves at about 49° 15'W.

The last CTD in 3800 m of water was completed at 3 pm on day 056 and we turned west for James Ross I. The magnetometer was streamed for a few hours but had to be brought in at night. It was still blowing quite hard from the north, and overnight we were forced well south of the direct course by ice. That the ship was able to keep going at 6-8 knots most of the time was a tribute to the skill of the navigating officers. In the morning of day 057 conditions eased somewhat, and by the forenoon we were thrashing along at 14 knots in the lee of a 5-mile long tabular berg. Dundee I and Paulet I loomed through the murk to starboard, and what we could see of James Ross I was covered in snow.

Fig. 3. CTD stations 83 to 93 (open circles) in the NW Weddell Sea. Ship track in red, XBT stations shown as crosses.



Prince Gustav Channel, Larsen Inlet and Larsen-A

On JR48 we had acquired a good collection of vibrocores and a reasonable idea of the bathymetry of this area, but nothing was known of the detailed morphology of the seabed apart from the small amount of Seabeam data kindly made available by Dr E W Domack (Domack *et al*. 2000, 2001). It was expected that high-resolution swath mapping would reveal (i) subglacial bedforms and (ii) possibly other linear features on the shelf, related to stillstands of the ice sheet grounding line or stable, long-term positions of the ice shelf front. We also required cores with an undisturbed sediment-water interface so that the radiocarbon age of true surface sediment could be determined. Seven existing vibrocore sites in Prince Gustav Channel had been selected for box coring.

Because of the rather slow passage overnight we arrived in Prince Gustav Channel later than planned, and despite the by now very calm conditions our progress was impeded by ice. The new swath survey JR71_20 was along the deepest part of the channel north and west of James Ross I. Subglacial bedforms showed the expected palaeo-ice flow direction eastwards along the north coast, with a glacial trough emanating from Croft Bay. Past the constriction of Carlson I (water depth ~300 m) ice flow was to the south. From about 64° 10' S southwards we encountered abundant small bergs, growlers and stringers of old pack ice, reducing our speed to 5-6 knots, so the first box core site was not reached until 7 pm on day 057. The box corer was deployed with the coring wire through the midships gantry. Deployment was very straightforward and we recovered 0.8 m at the first attempt. The procedure for subsampling the mud using offcuts of vibrocore liner was rather messy to start with, but became better organised at subsequent sites under the able direction of Graham Tulloch.

We nosed slowly into Rohss Bay at dusk for BC313, and back out for BC314. This site required three attempts because the box corer spades got jammed open by rocks on the seabed, fortunately without doing any damage. Local concentration of ice farther south meant that the ship would only survey the northern part of Prince Gustav Channel overnight, but two useful swath lines were obtained (fig. 4). As on JR59, we gridded the data promptly using Neptune and printed chartlets with soundings for the bridge, as an aid to confident navigation along tracks offset from earlier swaths. Come daylight we made better progress south to box cores 315 (which had to be over 1 km away from the intended site of VC244, and required 2 attempts), 316 and 317. At this stage the Master decided to set double watches on the bridge, with himself and the Chief Officer doing 12-hour watches and the Second and Third Officers working 6 on, 6 off. This was greatly appreciated by the scientific party as it meant we could get very much more work done during the cruise.

Near Cape Longing we at last ran into more open water. Since most of the ice appeared to have coagulated against James Ross I., we decided to leave the rest of Prince Gustav Channel for later. We proceeded west round the cape and into Larsen Inlet at 8-10 knots in beautiful calm weather. Near the top end we encountered some brash at about 6pm, so turned and ran a parallel swath southeastwards. Gridding these first two tracks in Neptune, we could already see morphological evidence for southeastward flow of grounded ice, but surprisingly little sign of the mass-flow deposits interpreted from the JR48 cores. We took the opportunity to fill a gap in vibrocore coverage with VC318 near Cape Longing, encouraged by the 2-3 m sub-bottom penetration we were seeing on TOPAS (the 3.5 kHz showed an opaque seabed in this area).

Two more parallel swaths overnight covered most of the deep part of Larsen Inlet, and after breakfast on day 059 we took box core 319 at the site of VC247 before continuing west towards Larsen-A, starting a new EM120 survey JR71_21. South of Sobral Peninsula we had to divert northwards around a large cluster of bergs congregated around a 5-mile tabular berg.

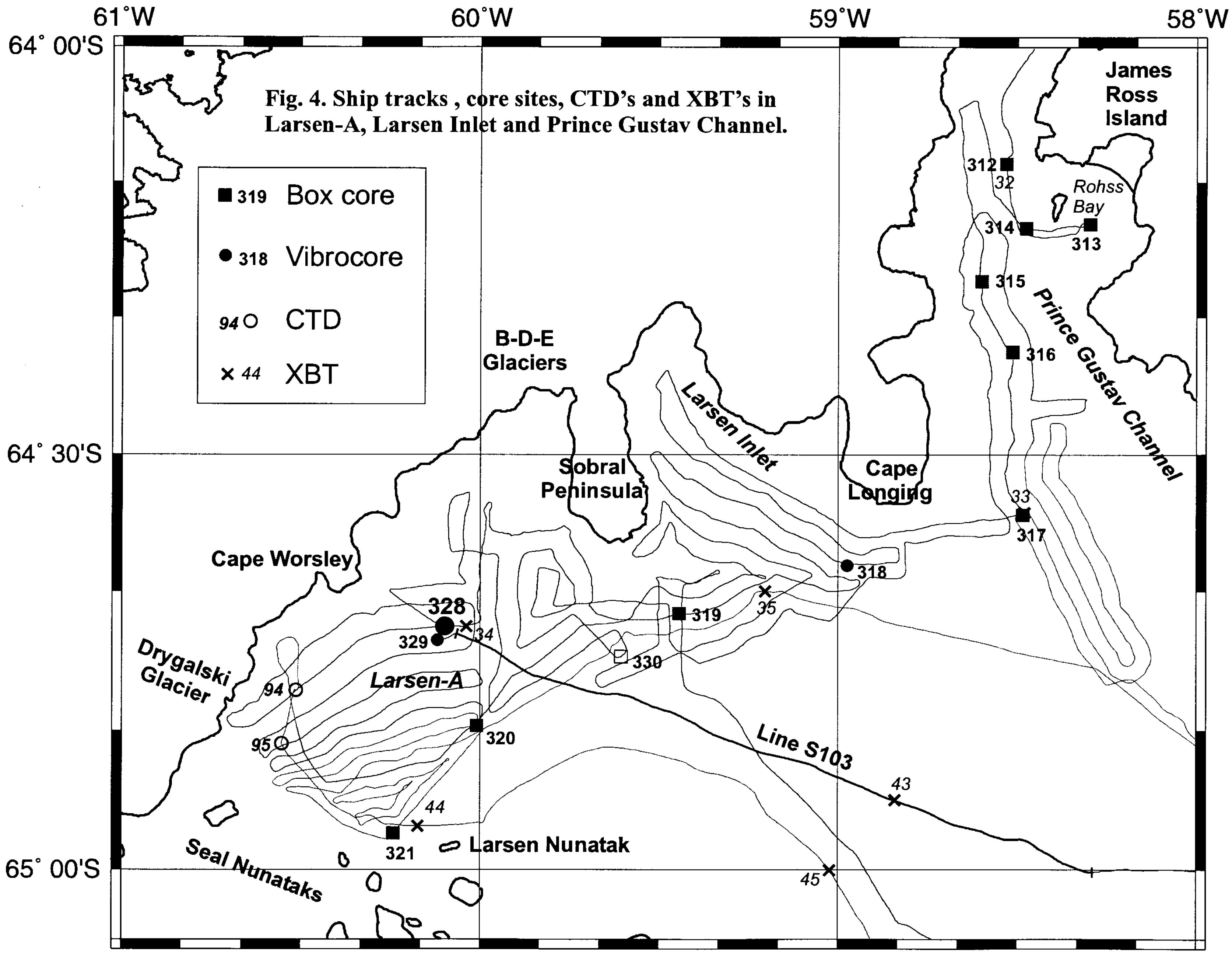


Fig. 4. Ship tracks , core sites, CTD's and XBT's in Larsen-A, Larsen Inlet and Prince Gustav Channel.

The bases of large icebergs close to the ship were clearly visible on the outer swath beams. We were able to work up the west side of Sobral at 5-7 knots, accompanied by small flocks of snow petrels and passing a few crabeater seals on the floes. As on JR48, the northern end of the bay west of Sobral was completely jammed up with bergs and old pack, and it took a couple of hours of squeezing through fairly dense ice before we entered a lead on the western side of the bay and could make progress to the south. The EM120 produced remarkably good data despite continual ice noise, though the TOPAS records suffered a bit. For the first time we were able to image the glacial trough carved by the Bombardier-Dinsmoor-Edgeworth glacier system.

We regained the intended line in the deepest part of the Larsen-A trough in mid-afternoon and proceeded west and southwest nearly to the ice front near Drygalski Glacier. Three small minke whales kept us company for some 20 minutes, apparently completely unperturbed by our echo sounder transmissions. It was so calm and clear we could see them swimming several metres underwater alongside the ship. The calm overcast conditions were also ideal for seeing ice-blink and water-sky to the south of us, indicating the strip of ice shelf still connecting Seal Nunataks and the open water beyond it. Only one more swath was required to the north of the first line, so we did that in daylight and continued running parallel swaths to the south overnight in largely ice-free conditions. We collected two more box cores (320 and 321), which were rather short as the soft Holocene mud is thin in this area. A live brittle star on the surface of BC321 meant we were amost certainly collecting the real sediment-water interface. The freeboard of the ice shelf was estimated at 18-19 m just west of BC321.

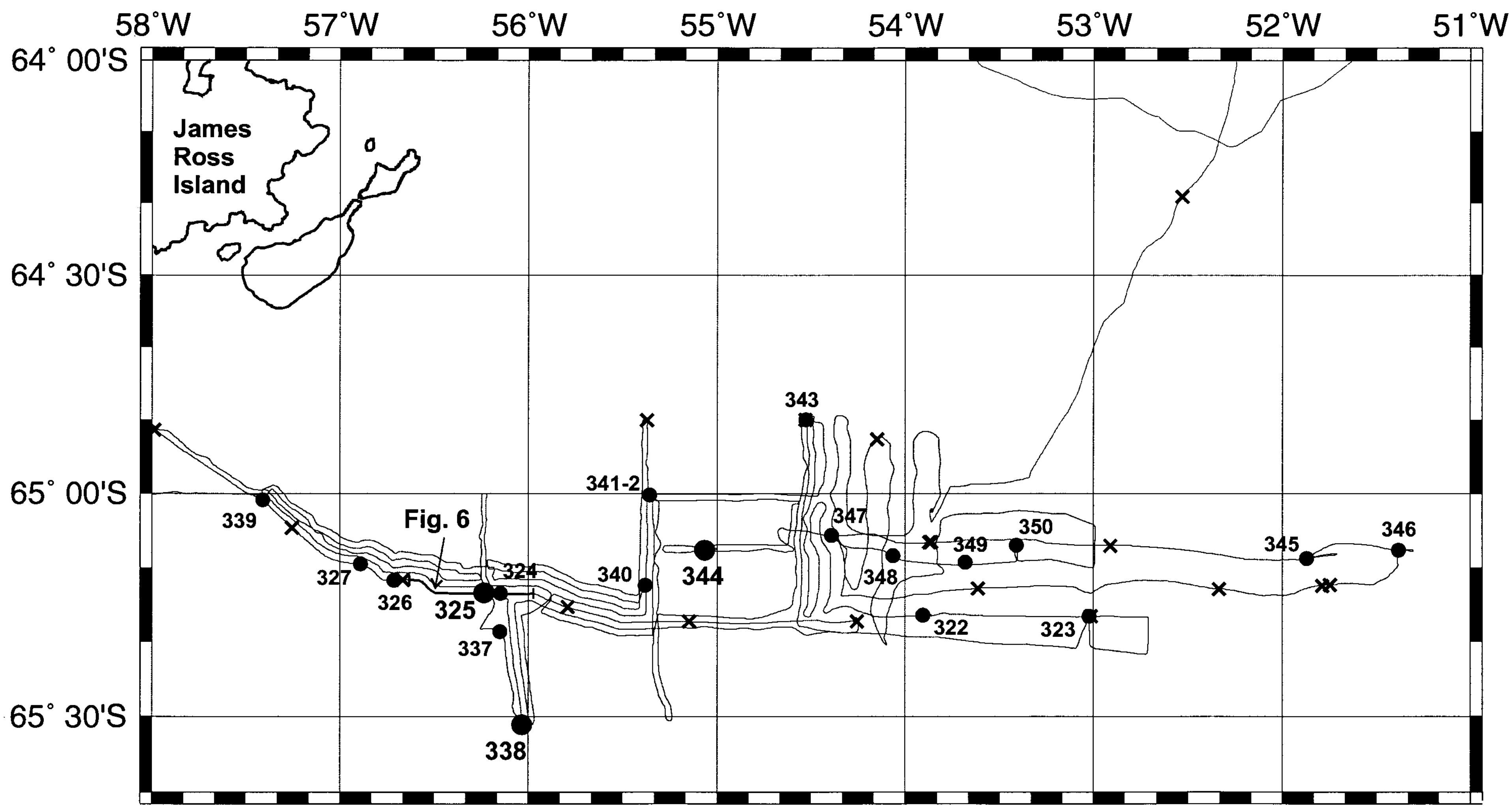
The gridded swath data revealed spectacular subglacial bedforms, not only in the deep trough as expected, but also very prominent troughs coming from the SW between Seal Nunataks (see section 4.2). Evidently the flow direction of grounded ice was very different from the offshore-directed flow of the floating ice shelf. After 24 hours of survey we had covered nearly all the area imaged during cruise NBP 00-03. It was time to start tracing the ice palaeoflow across the continental shelf, so we sailed eastwards to the southern end of Larsen Inlet and then ESE across the shelf.

Outer continental shelf and slope (1)

We were aiming for the axis of a 500 m deep trough which had been contoured by Peter Morris from existing soundings, but had to stay slightly north of the planned track to avoid some very large icebergs (the biggest some 40 x 30 nm). The overnight speed was only 4-6 knots despite calm conditions and good visibility. Although we found the trough it was at once apparent this had been a different subglacial environment from the palaeo-ice stream in Marguerite Bay. Linear features were not continuous and there was no thick till sheet. We reached the shelf edge in the morning of day 061, and continued east downslope to 1000 m depth where we stopped for an STCM calibration. We then returned to the shelf break and ran northwards along it for 30 miles, asking the bridge for small course alterations so that we followed the shelf break exactly. The most prominent bathymetric features were large iceberg plough marks, mainly oriented north-south. Three more parallel swaths on the uppermost slope became rather wavy because of deviations for ice, and were interrupted by a sudden failure of the forward propulsion motor, which necessitated stopping in DP mode for 20 minutes.

There seemed to be somewhat less ice farther east, so at dusk we headed downslope again looking for possible core sites. TOPAS showed rather little penetration, but a vibrocore site was identified at 1500 m depth and we recovered 4.35 m. The slope is gentle (2° at the top decreasing to 0.5° at 3000 m) and by 5 am we were still only in 2350 m of water. We continued to 2500 m

Fig. 5. Ship tracks, vibrocore sites and XBT's on the outer shelf and slope off Larsen-A. XBT numbers are shown on the foldout Larsen track chart.



data. PC323 was the first piston corer deployment and problems were experienced with the auxiliary winch during recovery. The auxiliary wire had to be led aft to one of the mooring winches, as on JR19. After the corer was recovered a large amount of surplus wire was removed from the winch drum and coiled on deck, and no further problems occurred.

As the slope appeared to be covered in rather uniform mass-flow sediments it was decided to leave the rest of the slope mapping until the end of the cruise, and to return to the shelf trough for some more survey and cores. The rest of day 062 was spent swathing parallel to and south of our earlier line and running a cross-line 30 km long at 56°W (fig. 5). Overnight we collected four vibrocores in various acoustic facies within the trough (VC324-327; fig. 6). At VC326 the corer became firmly stuck in the seabed, refused to retract, and was only pulled free an hour later by a combination of holding the main cable on the winch brake and moving the stern gantry outboard. The attempts at retraction had pulled the rig into the seabed, rather than pulling the barrel out. The lower 0.5 m of the core apparently consisted of cohesive concrete, so this core was set aside for splitting on shore, rather than attempting to cheese-wire it on board.

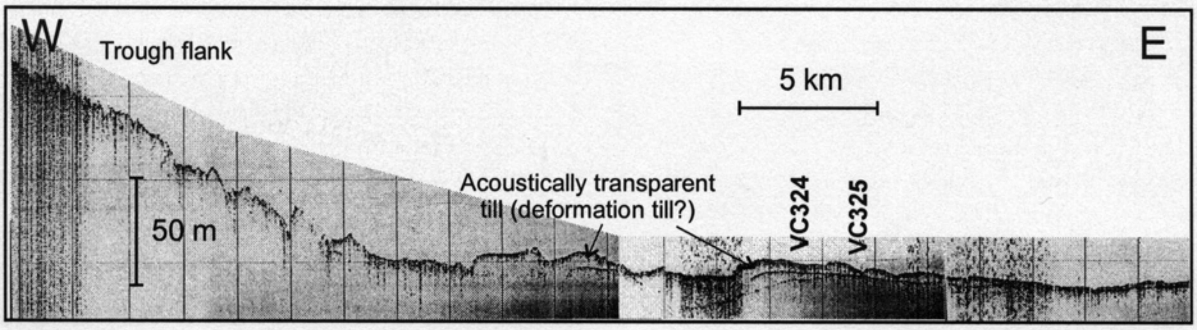


Fig. 6. TOPAS record from outer Larsen-A shelf trough. Location on fig. 5.

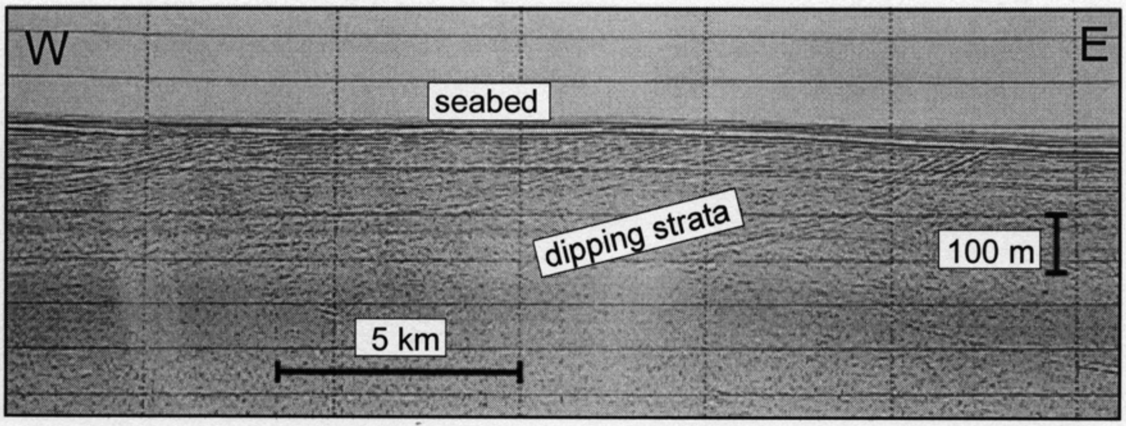


Fig. 7. Part of single-channel seismic line S103 showing dipping strata of the Larsen Basin very near the seabed

Larsen-A (2)

Day 063 was allocated to a single-channel seismic line across the inner shelf, to see if dipping strata of the Larsen Basin occurred near the seabed. We now knew there was sufficient open water to be able to steer in a fairly straight line and without having to recover the seismic gear in a hurry. The line ran from 65°S, 58° 20'W along 290° towards Cape Worsley (fig. 4). After several calm days we had to contend with a force 5 southwesterly, but this was still acceptable for seismic work and we would be running into shelter. The deployment of umbilical, airgun hoses and frame, test-firing the guns, and hydrophone took only 3/4 hour. We came up to survey speed of 4.5-5 knots at 11.30 am for SCS line JR71-103. The data suffered considerably from interference from the ship's cathodic protection system, which generates electrical noise at 100 Hz, right in the middle of "geological" frequencies. A notch filter of 95-105 Hz got rid of the noise but also wiped out a good part of the desired signal. Nevertheless the western two-thirds of the line showed clear dipping reflectors folded into gentle anticlines and synclines with a wavelength of several km. Even from the shipboard monitor record it appeared the dipping beds came to within less than 10 m of the seabed (fig. 7); they may even outcrop, as TOPAS showed no penetration along the line.

The line was terminated and the seismic gear recovered as it got dark just after 9 pm, and we proceeded to two nearby vibrocore sites, VC328 in a flat area and VC329 on top of a drumlin next to it (fig. 4). The new swath data enable very smart, precise targeting of cores to sample morphological features. For the rest of the night and the following day we filled in swath survey between Larsen-A and Larsen Inlet. We also attempted a box core on the site of VC249, but three attempts recovered only rocks jammed in the spades, so we gave up. The big tabular berg that had bothered us on day 059 had moved a few miles west, so we ended up with only a small gap in swath coverage south of Cape Sobral. In the early evening of day 064 we nosed into a tremendous ice embayment just offshore Sobral among tabular bergs as high as the mast. What an aerial photo opportunity we had to miss. Fine, clear weather enabled us to receive a good HRPT Dartcom image of Larsen-B; the southwesterly wind had pushed the debris from the recent calving events into the northern two-thirds of the embayment, but it looked as though the southern end was still accessible to a ship.

Having extricated ourselves from the ice, we returned to western Larsen-A to to fill in the small remaining gap in swath coverage NW of Larsen Nunatak. We also made two CTD casts in the deepest part of the trough off Drygalski Glacier, to detect any Ice Shelf Water flowing northeastwards along the coast from the Larsen-B ice shelf. In the forenoon of day 065 we headed east past Matienza base on Larsen Nunatak, but were then slowed to 5-7 knots by numerous small pieces of ice. It was more efficient to make a loop out to the north round Lindenberg Island, so that we could maintain 11 knots to the east and southeast. Meanwhile we received comms from Cambridge informing us of a new ARIES satellite image that showed the remaining northern portion of Larsen-B had collapsed. In due course we obtained the image and another Dartcom of our own (see back cover of this report). It was clear the opportunities for ship access were decreasing and that airborne survey would be more valuable; however it was not possible to divert BAS' Twin Otters (which had already left Rothera) or *Endurance*'s helicopters to the area at short notice.

Larsen-B and C

Our somewhat sinuous course towards southern Larsen-B (fig. 8) was dictated by the gaps between abundant tabular bergs. At times these seemed to be wall-to-wall, but we always found a way through. This area was completely unsurveyed; we were getting depths of 400-500 m and not much in the way of coreable seabed sediment. Just after dinner we came to the outermost of a line of four large tabular bergs extending ENE from Jason Peninsula. Preferring to keep in open sea as darkness approached, we turned slightly to the south and found clear water for miles ahead. We closed the coast near Cape Framnes at 10 knots at midnight in nearly 400 m of water. Overnight we did five short CTD stations, spaced about 8 nm apart and 2-3 nm off the ice front. This took us across the Antarctic Circle for the second time on this cruise.

The morning of day 066 was bright and clear with an air temperature of -14°C, and sea smoke drifting in a light southwesterly breeze. Conditions were judged suitable for a visit to what remained of Larsen-B. Returning northwards about 10 miles off the ice front, we collected one vibrocore in a small patch of sediment in a 500 m deep trough (VC331, recovery 4.6 m). David Vaughan at BAS sent us a high-resolution MODIS image of Larsen-B, and when Peter Morris had plotted a lat/long grid and coastline on it, the bridge could use it in conjunction with Microplot to select a course. We sailed between the 3rd and 4th bergs out from the coast and turned west towards the ice shelf debris. At 4 pm we stopped, pointing south, to receive a new Dartcom image. The area of debris was expanding quite rapidly southwards and the four large bergs were moving slowly north; not a good place to break down. However, in the slot we had there was enough sea-room between bergs, and weather conditions were excellent, so we continued westwards at 8-10 knots until we came to the edge of the ice shelf debris. It was abundantly clear we could not make any further progress as the sea between bergs was filled with a chaotic mass of ice of all shapes and sizes - the marine equivalent of a volcanic eruption (fig. 9).

Although we had not been able to reach the deepest part of the former ice shelf area (inferred from gravity data; Renner 1980) we did stop for an hour to collect VC332, then made our escape through the gap between the 2nd and 3rd bergs. The 1st berg was now touching the remnant ice shelf at its NW end; we snuck up the triangular gap between them briefly, but the seabed was rather featureless and TOPAS showed a hard bottom with no sediment. VC333 (recovery 4.4 m) was taken in a small sedimented area just off Cape Framnes. Just after it came on deck the power supply to the bridge failed. It took only 10 minutes to fix, and four more CTD casts were then made on a line east from the cape.

At 7 am on day 067 we began the return track parallel to and east of our earlier swath. As there was no further scope for surveying Larsen-B we had more time for the continental shelf. We spent the rest of the day thickening up the swath in the outer part of the trough emanating from Larsen-B, in rather dense ice conditions (hence the wiggly tracks; fig. 8). Two vibrocores were also collected. The first site (VC334-5) suffered from positioning problems, because again there was no feedback from the bow thruster to the DP. After three hours and two attempts we recovered 1.8 m. VC336 went smoothly and cored nearly 4 m, but by then it was dark and there was ice everywhere. In very poor visibility (a snowstorm) the ship was stopped for about an hour, then conditions improved slightly and we were able to proceed at 3-4 knots, though it was not possible to achieve swath overlap with our earlier track.

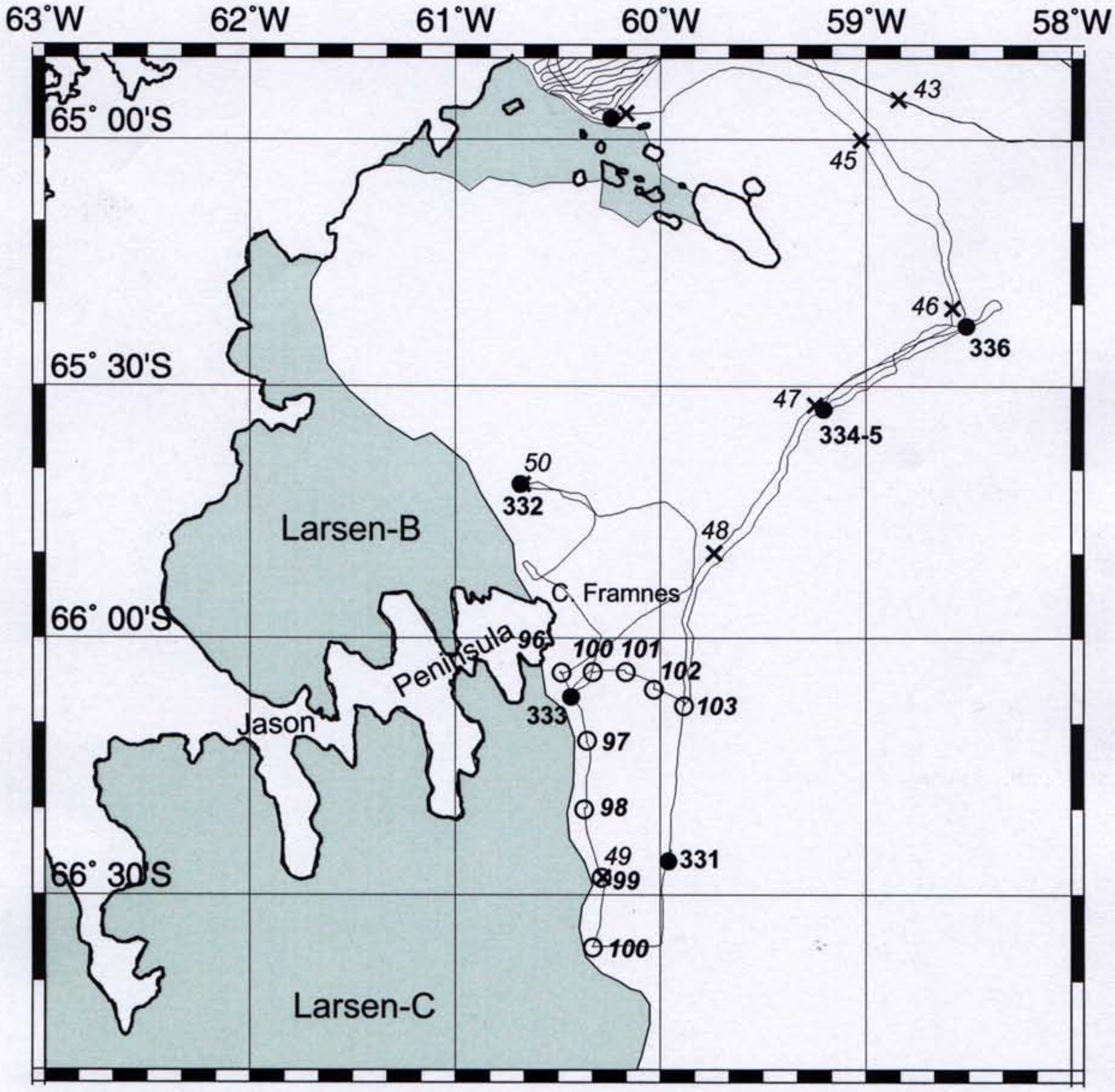


Fig. 8. Ship tracks and stations in the Larsen-B and Larsen-C areas. Position of ice front from MODIS image of 06 March (day 065).

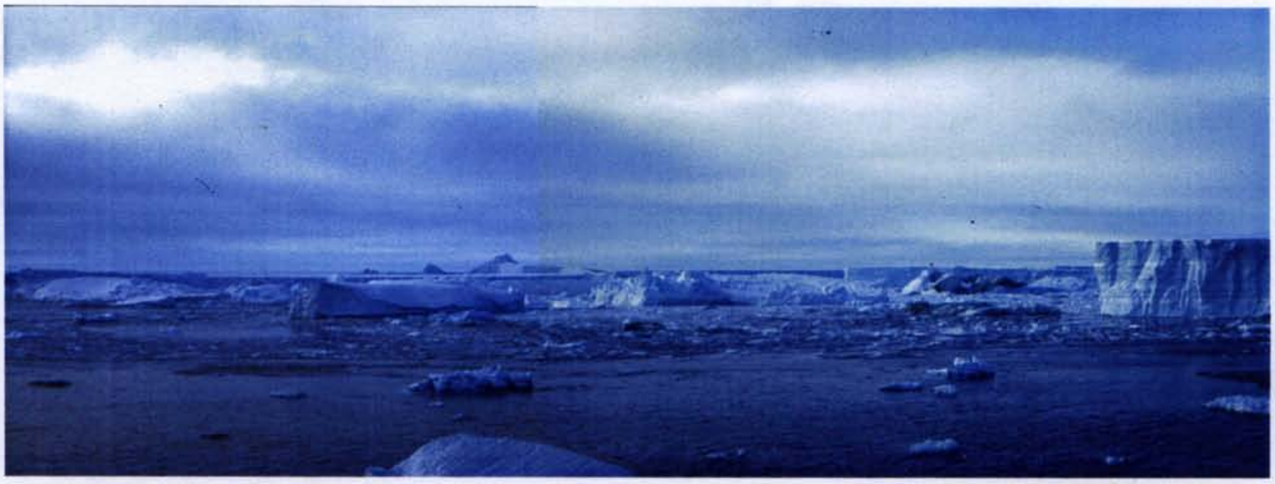


Fig. 9. Photograph of Larsen-B Ice shelf debris.

Prince Gustav Channel and continental shelf (2)

The next day was spent swathing along the south side of our Larsen Inlet survey and in the southern part of Prince Gustav Channel. The wind was light WSW and the visibility genearlly poor, so yet again we had no views of James Ross Island. Prince Gustav Channel was still quite full of ice and we could only make 6-8 knots, but we covered enough of it to delineate the main ice flow directions. In the evening we tried to collect the last of the planned box cores, at the site of VC276, but a serious problem developed with the winch. As the corer was being deployed the winch refused to veer and would only haul. This happened to us on JR19 and was cured then by a complete shutdown and restart of the winch. On this occasion this procedure had no effect, and it was necessary to bring the box corer as far inboard as possible on the gantry and transfer it to the deck using the after crane. It was decided to abandon the box core site rather than wait for the winch to be fixed.

Three days (am 069-am 072) were then devoted to swath and TOPAS survey of the continental shelf, with a few vibrocores. In the first morning we added to the swath SW of James Ross I, in search of any transverse features of the seabed which might represent former ice sheet grounding lines or stable, long-term positions of the ice front. None was found, all the seabed fetures being parallel to southeastward ice flow. That evening the weather was quite foul for no good reason that we could see from the weather maps; luckily the giant tabular bergs to the south of our position provided a lee from a force 7 southwesterly. The bergs were gradually moving north, so our additional tracks were of necessity to the north of the original lines. The tracks came out remarkably straight considering the amount of ice around. We surveyed two cross lines to define the north side of the 500 m deep trough (fig. 5 and section 4.2). Four more vibrocores (VC337-340) recovered 1.4-4.1 m of trough and trough-marginal diamicts. The liner of VC338 froze in to the barrel and took nearly an hour to extract. On the bank to the north of the trough, VC341-2 only obtained 0.3 and 0.8 m of stiff diamict and another mangled core catcher. At some of the stations we again suffered from delays in positioning, because of the bow thruster or DGPS satellites not communicating with the DP system.

Quite an extensive grid of N-S and E-W lines showed that in contrast to the shelf west of the Antarctic Peninsula, the 500 m deep trough did not extend to the shelf edge and that linear subglacial fabric was present only in patches. VC343 was taken in a large iceberg furrow near the shelf edge and VC344 on the easternmost patch of sediment seen on the shelf. At the latter site we broke a retractor wire and bent the bottom plate on the vibrocorer.

site we broke a retractor wire and bent the bottom plate on the vibrocorer.

Continental slope (2)

The final three days were spent on the continental slope. The slopes east and west of the Antarctic Peninsula have completely different morphologies and depositional styles; the eastern slope is much more gentle (0.5-2°, compared with 13-18° on the west side). We shot two single-channel seismic lines, a dip line from the shelf edge down to 2500 m, and a strike line at 1300 m water depth. The dip line (S104) was shot in the afternoon and evening of day 072. This time we had permission for the ship's cathodic protection system to be turned off, and in a light westerly wind we acquired excellent data. At the very end of the line the cathodic protection was turned back on; the dramatic effect on data quality is shown in section 4.4. After finishing the line we continued downslope, being able to keep going at 9 knots at night because there was very little ice about.

Both the SCS and TOPAS data showed the slope consists of mass flow deposits (debris flows and turbidites) with no evidence for current-controlled deposition. On day 073 we collected two long piston cores at 2900-3100 m. The stations were delayed by continuing problems with the DP and the main winch. We then turned for the long run back to the upper slope, in increasingly pleasant weather (the southerly wind dropped, the clouds lifted and there was a spectacular sunset). Overnight three vibrocores and one more piston core were obtained in water depths of 800-2000 m, recovering some 4 m each. After PC350 we continued to 53°W then ran another swath to the north before looping round to start the slope-parallel SCS line (S105) at 65° 20'S, again with the cathodic protection turned off. It was a beautiful day with spectacular icebergs everywhere, they did nothing for the straightness of our track but were nice to look at. Line S105 imaged an impressive series of lenticular, stacked debris flows. It was terminated at 9 pm. In the remaining 15 hours of science time we continued the swath survey of the upper slope and carried out one more STCM calibration in the form of a yin-yang symbol. The vibrocorer was lifted inboard while we were head to wind on one of the turns, so that the work of stripping it down could begin. The stern bulwark had frozen in its lowered position so we could not get under way again until it had been worked loose and raised.

Return passage and demobilisation

Science time officially finished at noon on day 075. It was an overcast day with a force 6 southerly and frequent snow showers reducing the visibility to half a mile or less: a good day to be going home. As soon as the ship tried to increase speed for the passage home, the forward propulsion motor failed again and it was 3/4 hour before we could speed up to 12 knots. We saw the contourite sediments on the lower slope (2500 m depth) only about 5 miles north of our slope survey, so the boundary between mass-flow and current-controlled deposition is now quite well constrained.

We had the worst weather of the whole trip on the passage back to Stanley. We spent day 076 (Sunday March 17th, St Patrick's Day) surfing in a big following sea with a force 9 southerly behind us, and occasional gusts of 50 knots. The magnetometer was streamed in the early morning. The bridge went back on to normal sea watches now that we were largely clear of ice. We kept the EM120 and TOPAS running with a beam angle of 52-55° (survey JR71_25), though both systems struggled to find the seabed through the yawing and the aeration under the hull. This part of the South Scotia Ridge is not very well charted and has very abrupt topography. The next day the wind moderated to force 6 and we obtained better swath records, and it was safe to go out on deck again to do XBT's. TOPAS was turned off in the morning at about 57°S, approximately the end of the sedimented area of the western Scotia Sea. The Polar Front was an obvious temperature gradient at 56°S. The magnetometer was recovered at 3.30 pm (over Burdwood Bank). EM120 survey and water sampling continued until the early morning of day 078 on the southern Falkland Plateau. We secured to FIPASS at 9 am on day 078 (Tuesday March 19th).

Much of the scientific equipment had already been stripped down and packed into boxes, and at the end of the day's demobilisation all the containers were packed and evrything was lined up on the quay awaiting stowage in the hold. This was completed the following day. Meanwhile the story about Larsen-B had created unprecedented interest, and six radio interviews were given by Carol Pudsey (PSO) via the BAS Press Office. On March 20th a group of science sixth form students from Stanley High School visited the ship and were shown the UIC room and some of the JR71 results.

The scientific party left the ship on March 21st, some to fly straight home on the airbridge that day and others to await the LanChile flight on the 23rd.

4. PRELIMINARY RESULTS

4.1. Marguerite Bay (COC. JAD, JE)

Continental Shelf

Swath bathymetric data from the outer part of the trough that extends across the continental shelf from inner Marguerite Bay to the shelf edge (Fig. 10) reveal a detailed picture of the morphology of the sea-floor in this region. The floor of the trough is characterised by mega-scale glacial lineations (Fig. 11) that record flow of a grounded ice stream to the shelf edge during the last glacial maximum. The swath bathymetric data collected during JR71 have allowed us to accurately reconstruct the dimensions of this ice stream for the first time. They indicate that the ice stream was about 75-80 km wide and about 370 km long.

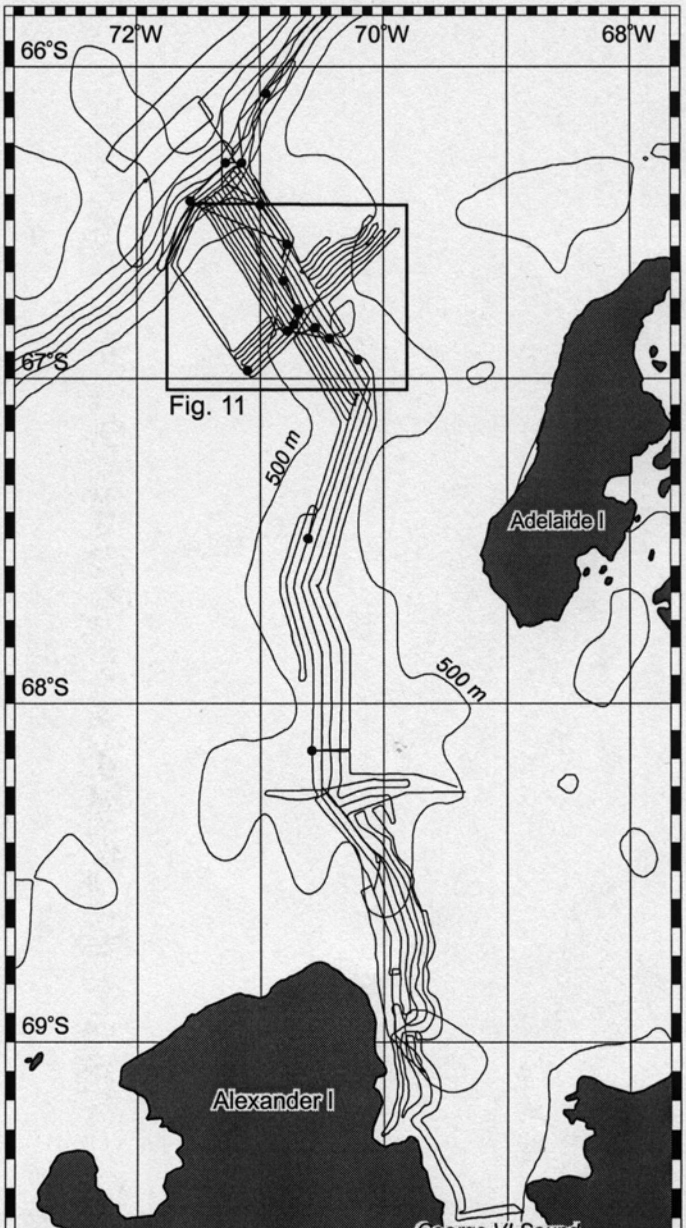


Fig. 10. Location map of Marguerite Bay showing ship tracks (combined JR59 and JR71), core sites and bathymetry (500 m contour interval).

TOPAS acoustic data from the uppermost few 10's of metres of the sea floor indicate that the floor of the trough on the outer shelf is underlain by a thick sediment layer in which mega-scale glacial lineations are formed. Vibrocores, up to about 5.7 m long, penetrated this sediment layer and demonstrate that it comprises a massive, matrix-supported, grey diamict facies that is relatively soft (shear strengths generally <0.4 kg cm^{-3}) and water-rich. This soft diamict overlies a much stiffer (shear strengths >1 kg cm^{-3}) massive, matrix-supported diamict facies. Both diamict units contain striated clasts. The soft diamict facies is interpreted as a subglacial deformation till, formed, at least in part, by subglacial erosion of the underlying stiff diamict facies. The micromorphology of the deformation till will be investigated using samples obtained from a gravity core in order to assess the magnitude and style of deformation in the unit.

Using the TOPAS and core data, the extent and thickness of the deforming till layer has been mapped throughout Marguerite Trough. The till unit is confined to the trough on the outer continental shelf and disappears south of about 67° 20'S. Along most of the outer shelf-trough (north of about 66° 50'S) the thickness of the till layer is less than about 15 m. This indicates that the zone of fastest flow within the ice stream (based on the elongation of subglacial bedforms imaged on the swath bathymetric records) occurred over the area of the trough floored by deformation till.

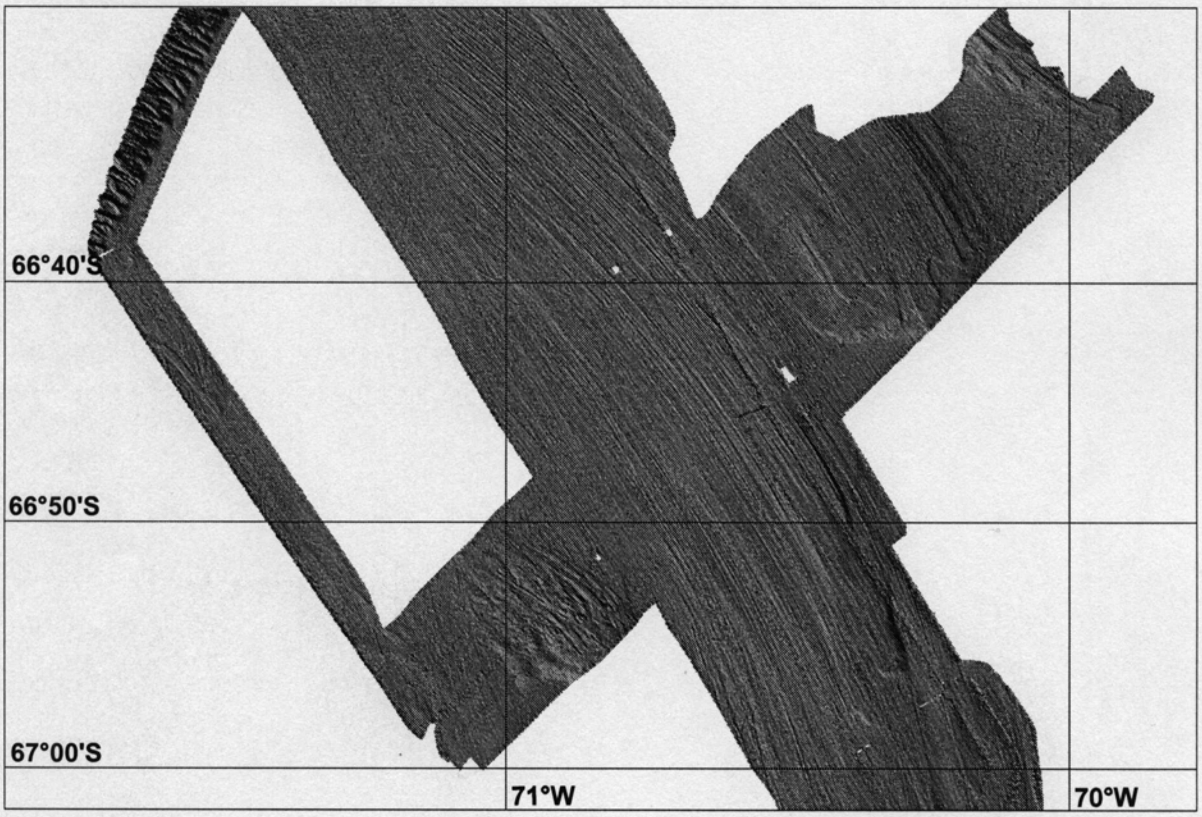


Fig. 11. EM120 sun illumination image of mega-scale glacial lineations in the outer part of Marguerite Trough. Grid cell size 50 m X 50 m.

The soft, grey diamict facies is generally overlain by massive silty-clayey muds. In some cores these units may contain zones of coarser, sandier mud, but generally they appear to be relatively fine grained and coarse sand and gravel units are absent. Smear slides indicate that diatoms are usually absent or minor within these sediments. These muddy facies formed during deglaciation and record the transition from a subglacial environment to a glacimarine, probably ice shelf, depositional setting. The absence of gravely or sandy subaqueous outwash suggests that deglaciation was rapid. This is also supported by the well-preserved nature of the mega-scale glacial lineations in the trough, and the absence of recessional moraines or zones of cross-cutting bedforms on the swath bathymetry data. The cores are capped by olive grey (5Y5/2), massive, diatomaceous mud that records the development of open marine conditions.

Continental Slope

Swath bathymetric data and vibrocores were also obtained from the continental slope offshore of Marguerite Trough in order to investigate the sedimentary architecture and processes that characterise this environment. The swath bathymetric data show that the continental slope in this region is incised by a series of gullies, which are most prominent away from the former ice-stream terminus. Vibrocores from these gullied areas recovered massive pebbly gravel. By contrast, the slope directly in front of the ice-stream terminus is gentler and smoother in appearance (Fig. 12). A core from 850 m water depth in this area recovered about 3.7 m of massive, matrix-supported diamict overlain by a thin (5 cm) unit of massive olive-grey (5Y 4/2) clayey mud. No stratification or bedding was observed within the diamict facies and it appears to comprise a single sedimentary unit. It is similar in terms of both its colour and macro-sedimentology to the grey deformation till recovered in vibrocores from the outer shelf trough (see above).

The slope diamict facies is interpreted as a glacigenic debris flow(s) sourced from till delivered to the shelf break by subglacial sediment advection under the ice stream in Marguerite Trough. The cores and geophysical data thus indicate that slope progradation has occurred in front of the ice-stream terminus. By contrast, sediment delivery to adjacent areas of the slope was lower and this is reflected in the well-developed gullies and steeper slope. The record of sedimentation preserved in cores from the continental rise offshore of Marguerite Trough shows elevated sedimentation rates during glacial periods back to oxygen isotope stage 6 (Ó Cofaigh et al., 2000). This provides indirect support for the presence of an ice stream in Marguerite Trough on more than one occasion.

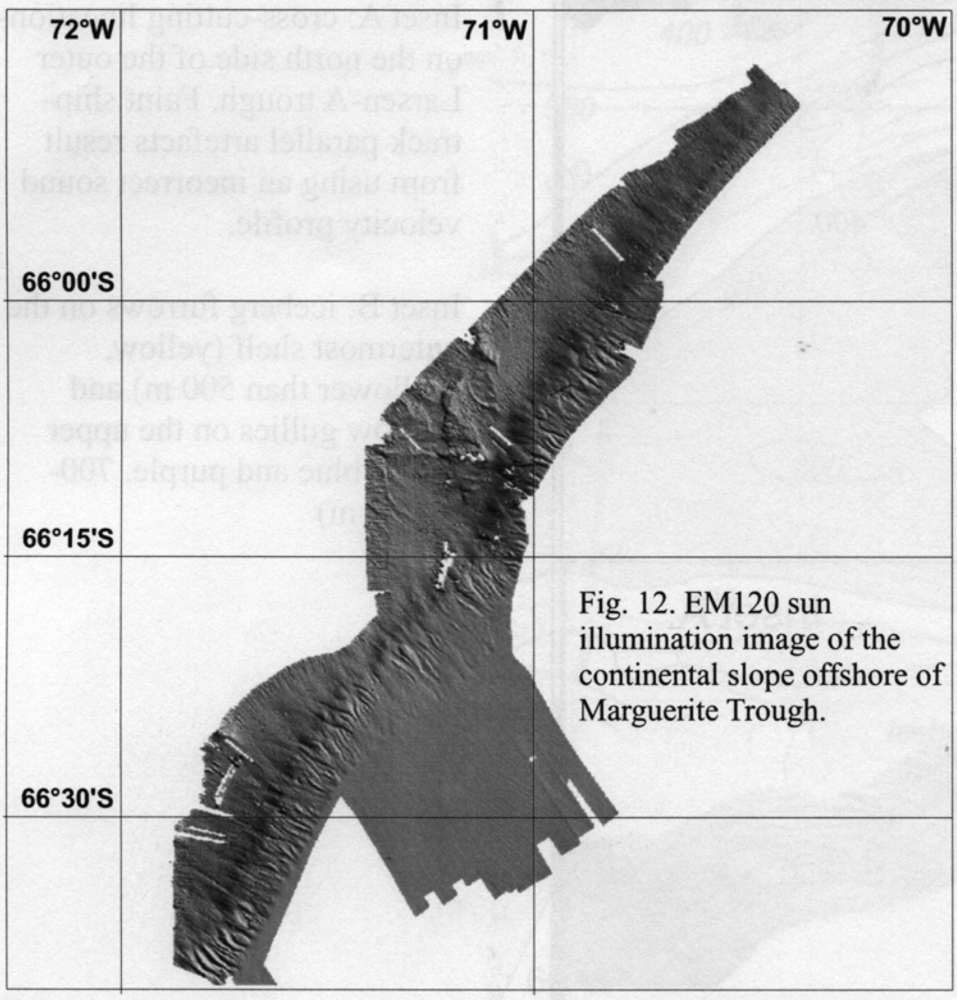


Fig. 12. EM120 sun illumination image of the continental slope offshore of Marguerite Trough.

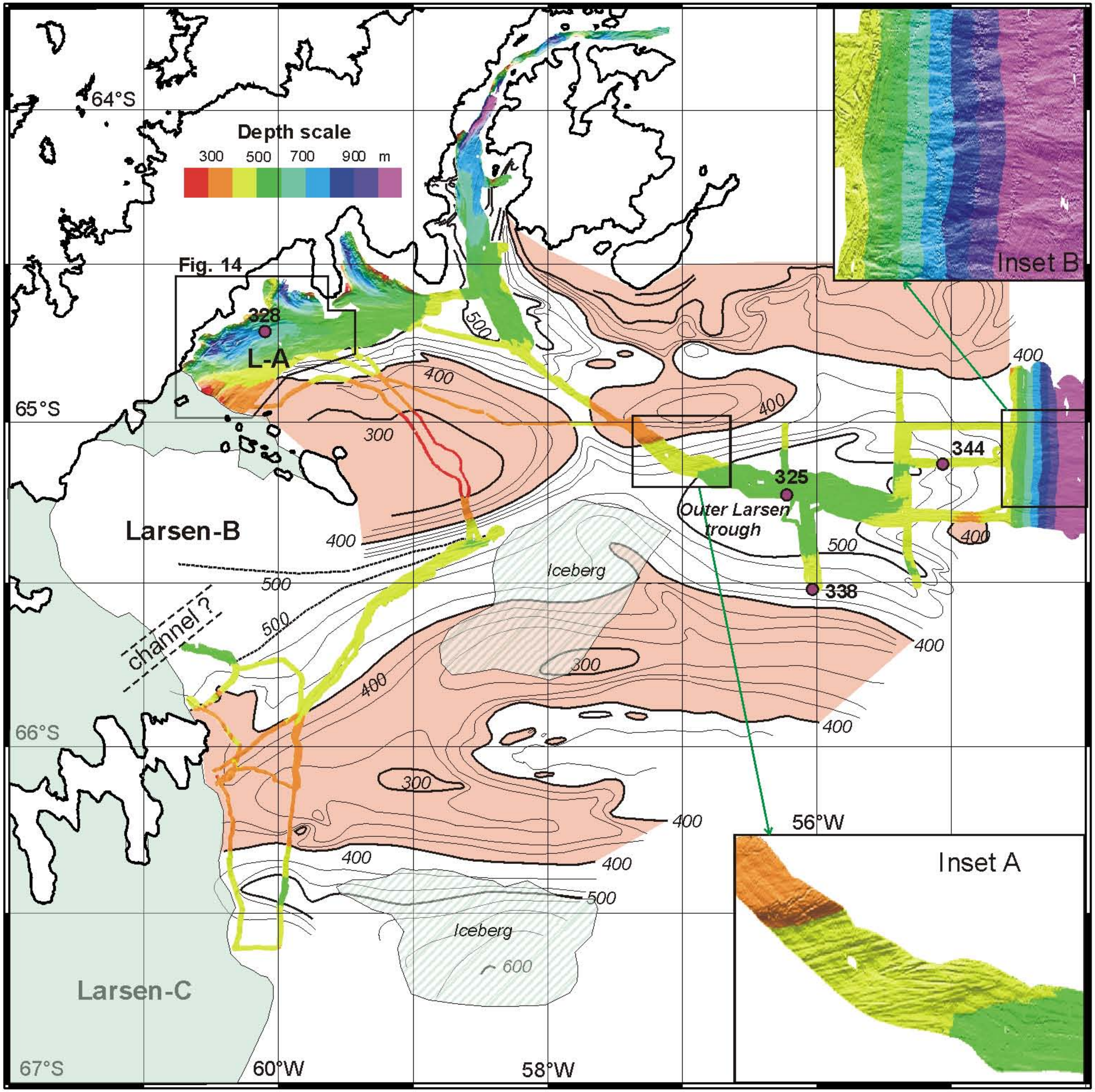


Fig. 13. Bathymetry of the continental shelf in the Larsen area. Colour changes every 100 m. Shaded-relief illumination is from NW. Channel in Larsen-B is inferred from four lines of oversnow gravity data (Renner, 1980)

Positions of ice fronts and large icebergs from MODIS image of day 064.

Cores 328, 325, 338 and 344 are illustrated in fig. 15.

Inset A: cross-cutting lineations on the north side of the outer Larsen-A trough. Faint ship-track parallel artefacts result from using an incorrect sound velocity profile.

Inset B: iceberg furrows on the outermost shelf (yellow, shallower than 500 m) and shallow gullies on the upper slope (blue and purple, 700->1000 m)

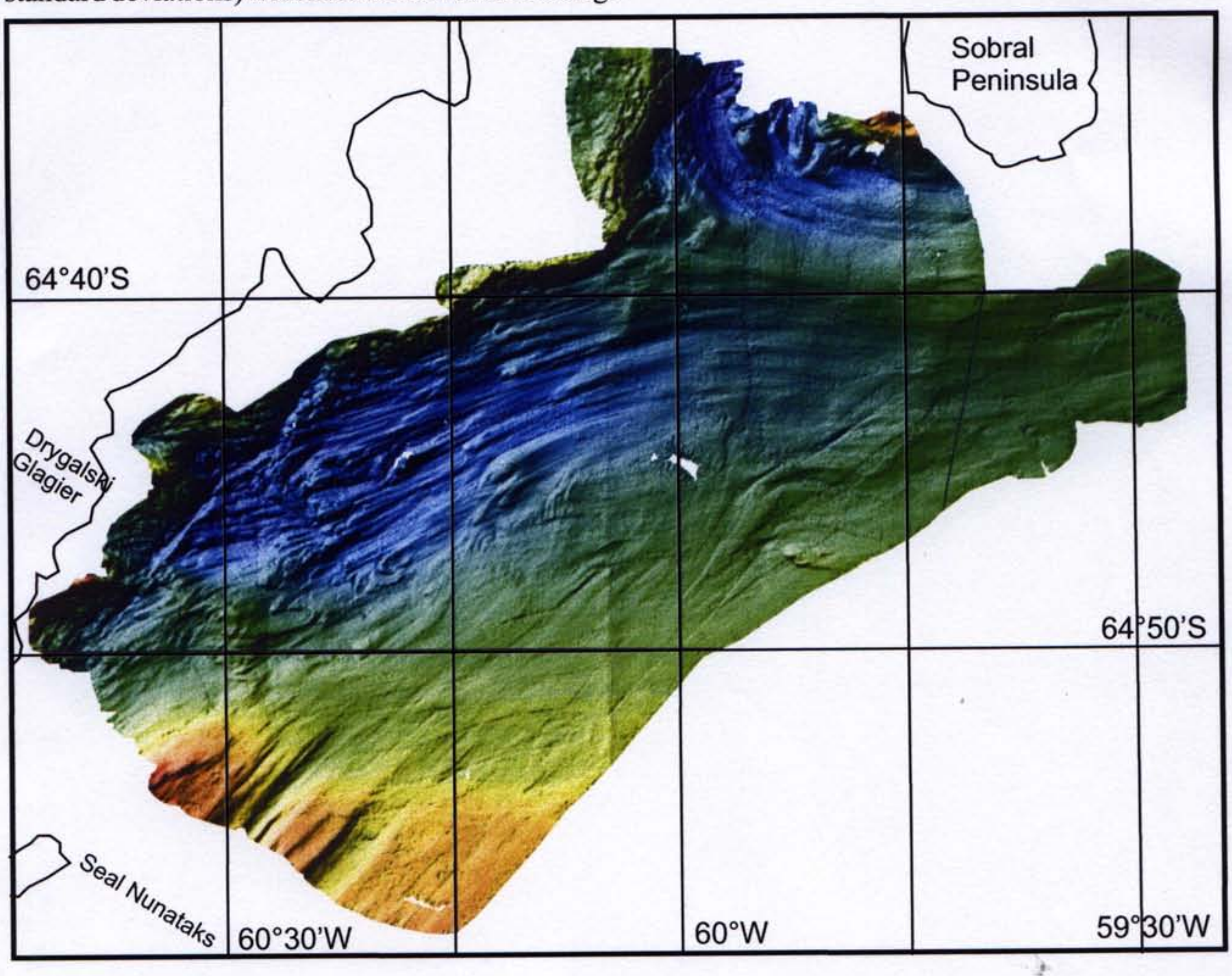
4.2. Larsen-A, B, C and adjacent shelf and slope

The eastern margin of the northrn Antarctic Peninsula includes deep glaciated inshore basins, a shelf 100-200 km wide with east-west troughs and banks, and a gentle continental slope. Fig. 13 shows bathymetric contours derived from all available soundings (GEODAS database) and the new swath data from JR71. The inner shelf areas contain drumlins clearly showing the direction of ice flow: to the ENE in Larsen-A (fig. 14), to the SE (Larsen Inlet) and to the south (Prince Gustav Channel). Ice also entered Larsen-A from the southwest through Seal Nunataks (fig. 14).

Farther offshore, elongated bedforms become indistinct. Banks shallower than 400 m (pink in fig. 13) generally have smooth surfaces with no acoustic penetration. Troughs deeper than 500 m have some areas of linear bedforms, particularly at their margins (fig. 13 inset A), but other areas are smooth. Ice sheet flow was probably faster through bathymetric troughs than across adjacent banks. However, there is no single glacial cross-shelf trough or well-developed, mega-scale subglacial lineations comparable with the Marguerite Bay-shelf system to suggest the existence of a major ice stream. The TOPAS acoustic records show that soft subglacial till (acoustically homogeneous sediment) corresponding to the bedforms is thin and discontinuous across the region, in support of this interpretation.

The 500 m deep troughs do not reach the shelf edge, which is generally shallower than 430 m. The outermost part of the shelf is incised by abundant iceberg furrows (fig. 13, inset B). Our reconnaissance swath lines farther south confirmed the existence of the trough in Larsen-B inferred from gravity data (Renner, 1980). Its offshore extension just reached 500 m depth at 65° 20;S, 58° 30'W, again with a patchy cover of till. Palaeo-ice flow was to the ENE along the trough.

Fig. 14. Shaded-relief image of Larsen-A; grid 50 x 50 m. Data cleaned using BINSTAT (2 standard deviations) with additional manual editing.



Distinct sediment facies associations were identified within the vibrocores from the shelf (fig. 15). The lowermost facies comprise extremely stiff (very high shear strength), massive, very dark grey muddy diamicton with rafts of stiff diamicton or mud. These characteristics indicate deposition and compaction of basal till beneath an ice sheet. This facies is overlain by waterlain (very low shear strength), dark grey massive, matrix-supported muddy diamicton corresponding to the thin discontinuous, acoustically homogeneous till deposit in TOPAS records (see fig. 6). The preliminary interpretation of this facies is a subglacially deformed till, possibly derived from the underlying stiffer basal till. This is further supported by its recovery from the subglacial bedforms and lineations in inner Larsen-A, Larsen Inlet and the outer Larsen trough. Collectively these sediments provide evidence for the advance of a grounded ice sheet across the shelf, and changes in ice sheet dynamics through time. The waterlain till is either absent or very thin in cores away from the outer cross-shelf trough indicating that subglacial deformation across shallower shelf regions is less marked or absent in response to relatively slower ice sheet flow.

Massive olive grey/grey, silty sandy mud, muddy diamicton, gravelly mud, pelletised mud facies and muddy gravel immediately overlie the subglacial lithofacies. These facies indicate rain out of debris and mass-flow deposition associated with an ice shelf, proximal to the grounding line following the decoupling of grounded ice from the sea floor during deglaciation. The transition up into massive, commonly bioturbated olive grey to grey, clay-rich mud is consistent with the recession of the grounding line towards the coast and development of distal ice shelf conditions. These sediments further suggest that the subsequent retreat of the ice margin towards the present coastline was relatively slow. This contrasts with the deglacial record in Marguerite Bay where glacier retreat appears to have been relatively rapid. Surface sediments comprise thin massive olive silt- to clay-rich diatom-bearing mud representing open marine to distal ice shelf conditions. However, the thinness of the diatom-bearing muds will make it difficult to date deglaciation on the outer shelf.

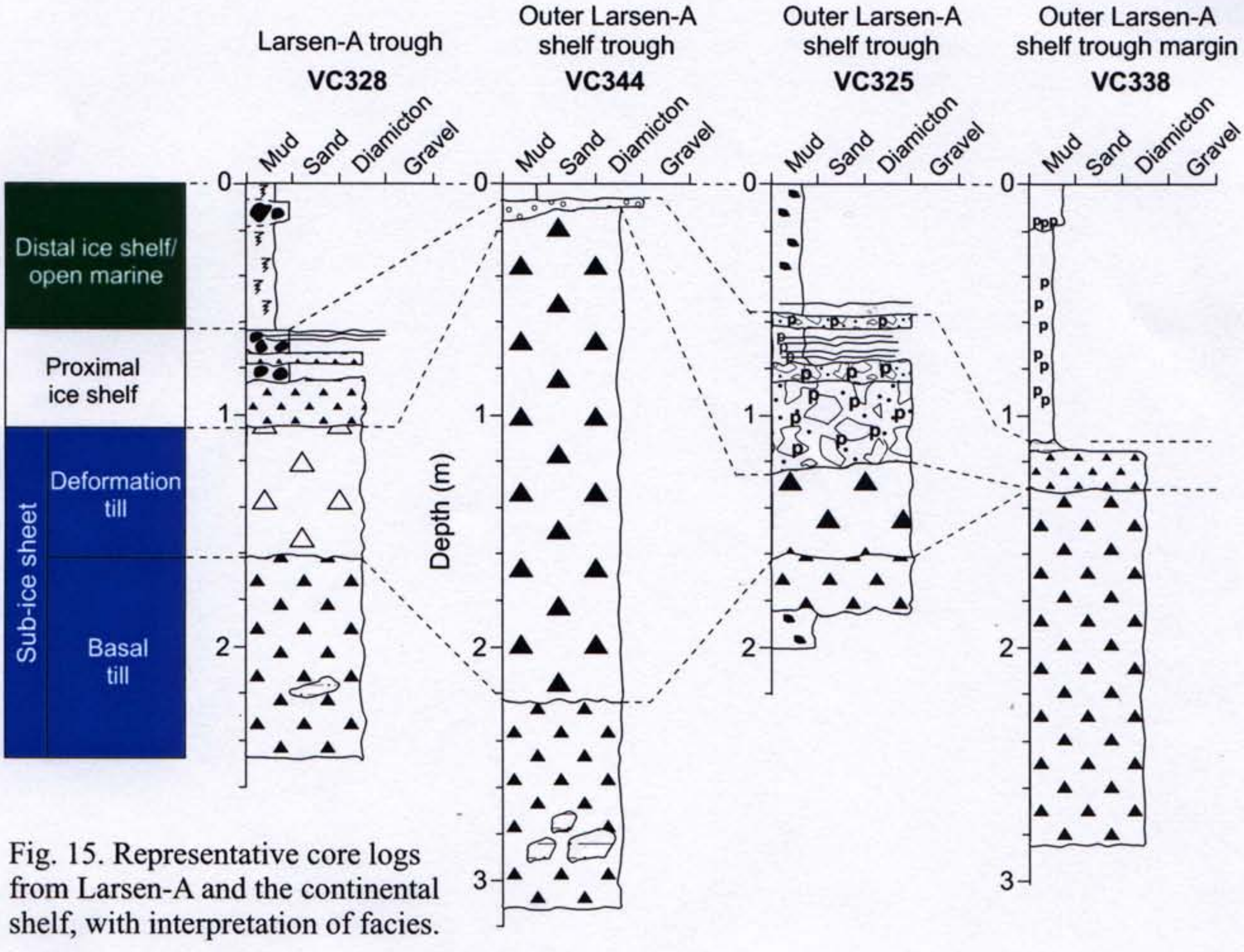
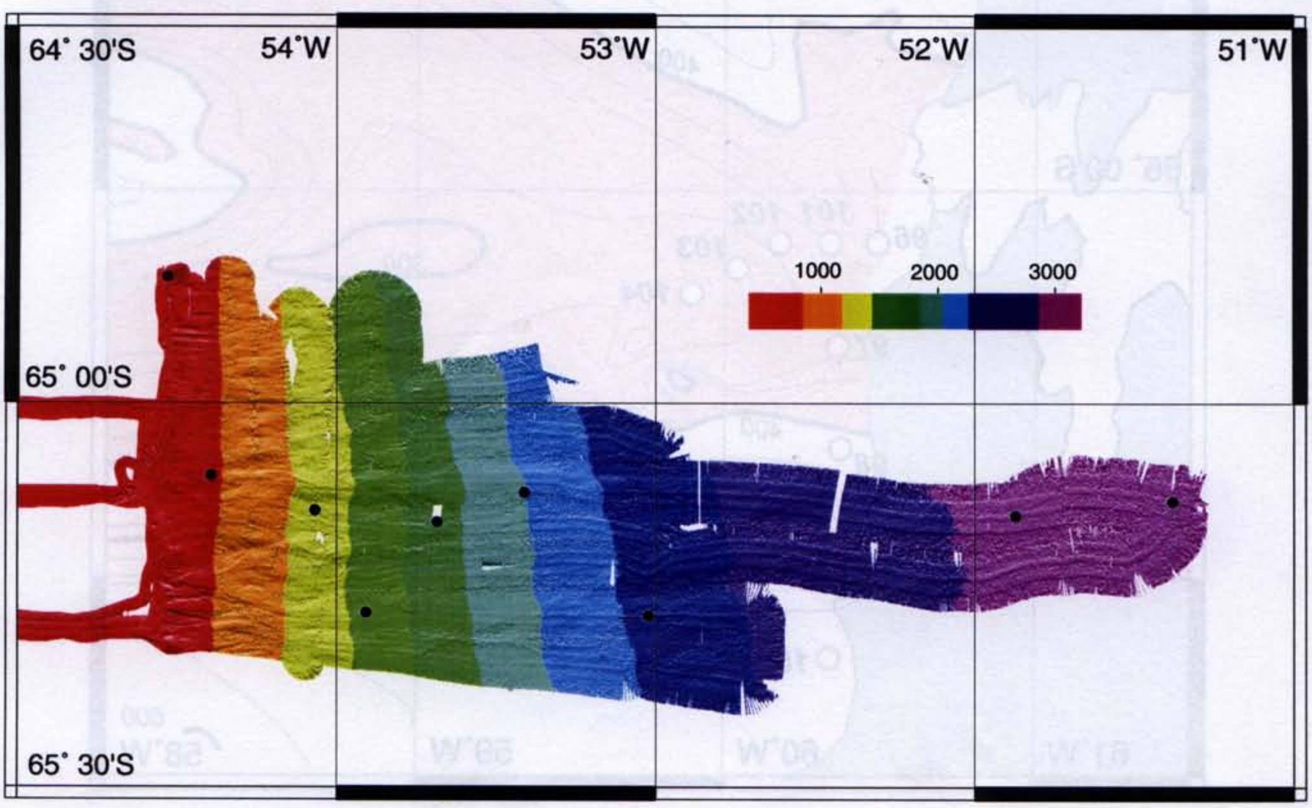


Fig. 15. Representative core logs from Larsen-A and the continental shelf, with interpretation of facies.

The continental slope has a gradient of 2° at the top, flattening gradually to 0.5° by 3000 m. It is much smoother than the western Antarctic Peninsula slope, bearing shallow gullies only in the upper 1500 m. TOPAS and seismic profiles reveal that the slope is dominated by mass-flow deposits, notably debris flows (acoustically transparent lenses; fig. 16) and turbidites (parallel, discontinuous reflectors). There is no evidence for current-controlled sedimentation and this part of the slope is tentatively interpreted as a trough=mouth fan, though additional mapping of the slope farther north and south will be required to confirm fan morphology.

Vibrocores from shallower than 2000 m on the slope comprise grey, massive, matrix-supported muddy diamicton that grade towards the top of the facies supporting deposition by debris flow. Below 3000 m, acoustically stratified sediment is more common with some large muddy debris flows. This suggests interplay of turbidity current and hemipelagic deposition and rare debris flows more distal to the ice front with increased water depth. The grey colour and relatively compacted nature of the diamicton indicates that sediment is sourced directly from subglacial debris deposited at the shelf break in front of the outer shelf trough from the faster flowing part of the former ice sheet. Preliminary investigations suggest that the slope regions away from the shelf trough are more gullied, with the stratified sediment below 3,000 m influenced less by downslope remobilisation, reflecting lower sediment supply to the slope in response to slower ice sheet flow to the shelf break.

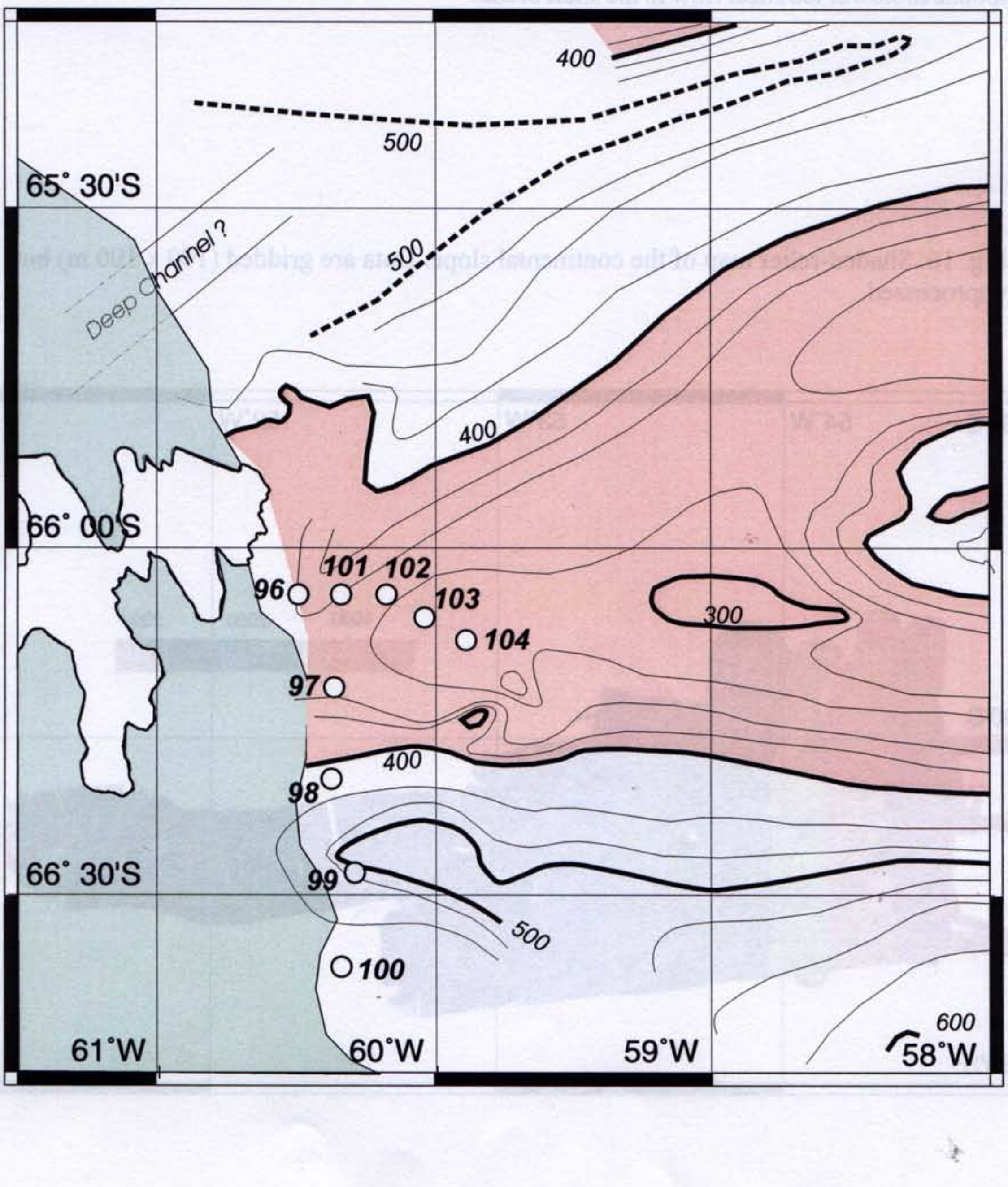
Fig. 16. Shaded-relief map of the continental slope. Data are gridded (100 x 100 m) but unprocessed.



4.3. Conductivity-Temperature Depth (CTD) (KWN)

Stations 71CTD083 to 093 lie along the 108° section from Joinville Island, cutting down the continental slope (fig. 3, Table 3). Stations 71CTD094 and 095 were designed to detect any Ice Shelf Water (ISW) originating from beneath Larsen B Ice Shelf that might be flowing northwards between Seal Nunataks and the coast (fig. 4). Stations 71CTD096 to 104 investigated the oceanographic regime of the northern extreme of Larsen C Ice Shelf (fig. 8). Figure 17 is a larger scale map showing the bathymetry in the region of the Larsen-area CTD stations. The SBE911Plus CTD with twelve 10-litre water sample bottles was used. Water samples were obtained from each station (Table 4), including salinity samples which were measured on the ship's Autosal during cruise JR72. Samples for $\delta^{18}O$ analysis were drawn into 30 ml plastic sample bottles and stored in cool stow for later analysis in the UK. Five-litre near-bottom samples were filtered for suspended sediment, for comparison with the transmissometer dataset. Additional 500 ml samples were filtered for diatoms.

Fig. 17. Bathymetric contour map showing the locations of the CTD stations occupied in the vicinity of the northern end of Larsen C Ice Shelf.



Joinville Island section

Contour plots of potential temperature and salinity for the Joinville Island section are shown in Figure 18. These data use the pre-cruise instrument calibrations, and are therefore provisional. The diagrams show the deepest 400 m of the casts, and are shown in terms of depth above the sea floor. The plots are therefore highly distorted, as the section lies over the continental slope. Weddell Sea Bottom Water is defined as having a temperature below –0.7°C, and this contour is highlighted in the figure. The structure of the northward-flowing plume of deep and bottom waters is almost identical to that observed during the Polarstern occupation of the section in 1998. It has therefore cooled again from the high temperatures observed during the Brazilian cruise of 2000. Analysis of the $\delta^{18}O$ samples taken along the section will help in determining the particular mechanism responsible for the deep and bottom waters observed on the slope.

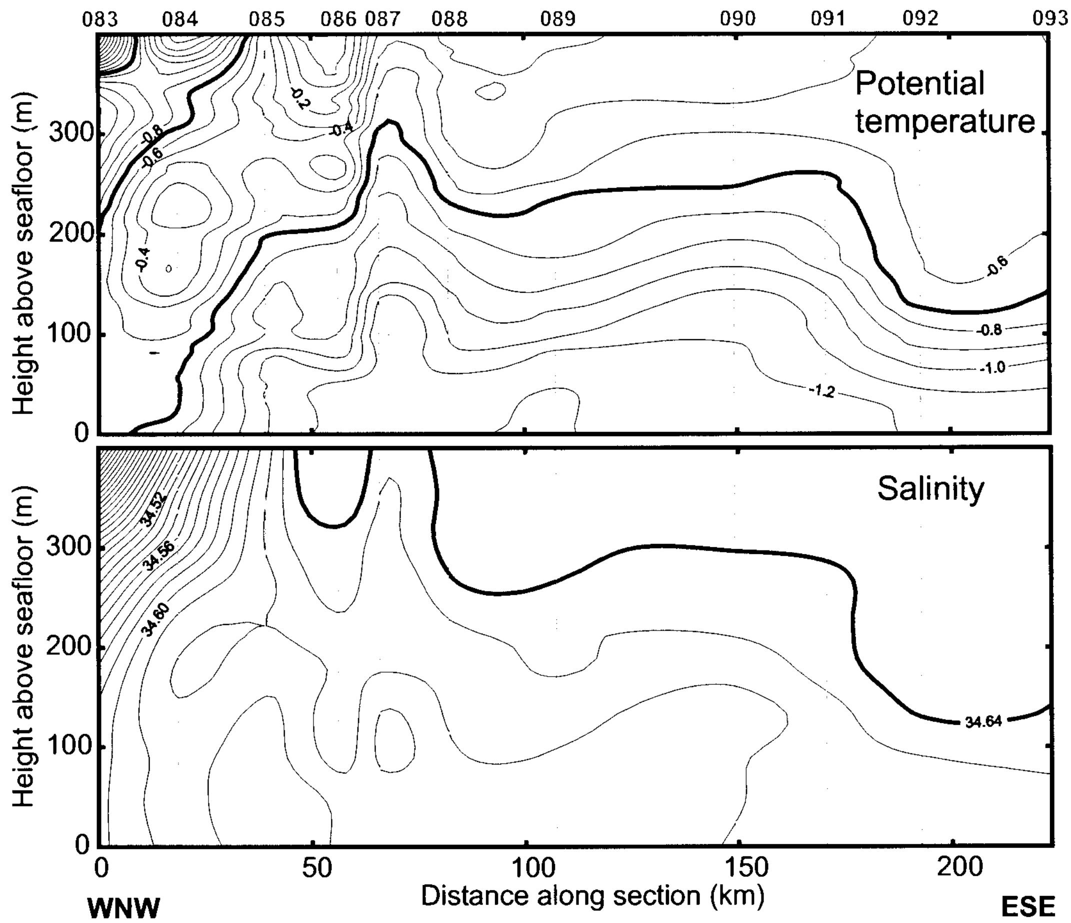


Fig. 18. Contour maps of potential temperature and salinity in the deepest 400 m of the water column along the Joinville Island section. Joinville Island continental shelf is to the left. Vertical grey lines indicate station locations.

Larsen area

The stations occupied west of Seal Nunataks showed no evidence for a strong northward ISW flow from beneath Larsen B Ice Shelf. It transpires that at this time the northern portion of Larsen B had already disintegrated; it is not clear how this would have affected production of ISW.

A significant ISW signal was observed at the northern extreme of the Larsen C Ice Shelf (station 71CTD096). The potential temperature profile is plotted in Figure 19, along with the surface-pressure freezing profile, illustrating the degree of supercooling with respect to surface pressure. Further south along the ice front the ISW signal was subdued, or non-existent, being replaced by a rather warm water mass. The warm water has some of the characteristics of Modified Weddell Deep Water, a water type often observed intruding onto the southern Weddell Sea continental shelf. Another short line of stations was occupied east from station 71CTD096, up onto a shallow topographic high (see Figure 17). Again, no ISW was observed and we conclude that the ISW outflow takes a northward course, confined to the coast. Figure 20 is a potential temperature-salinity plot showing example profiles from stations in the north Larsen area. Data from the off-shelf station 71CTD094 are included to place the shelf water masses in a broader context.

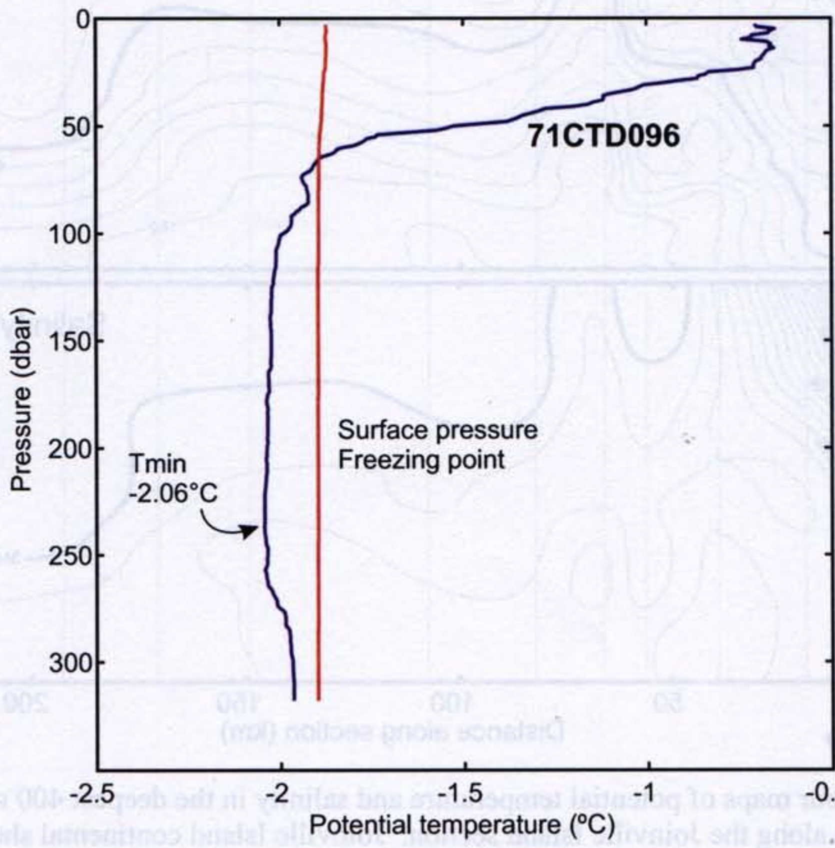
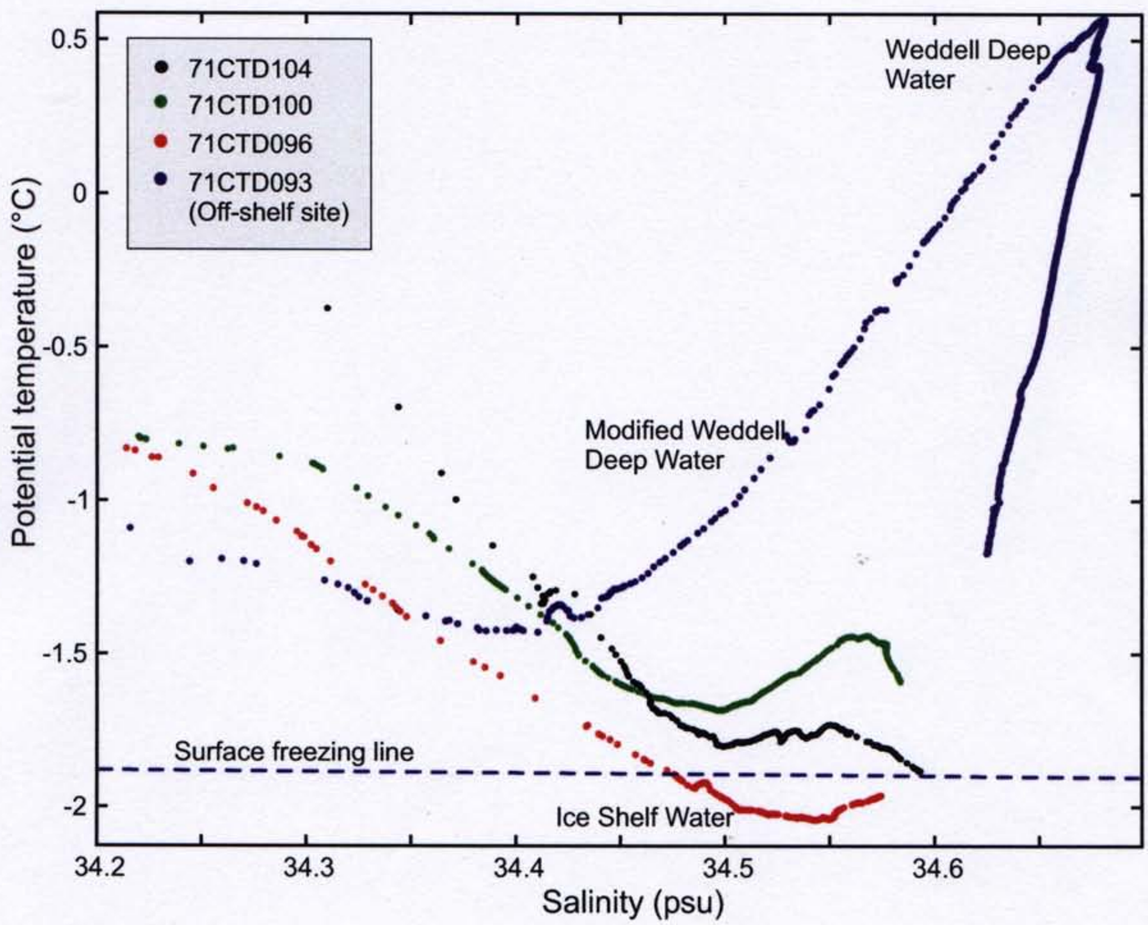


Figure 19. Potential temperature and surface pressure freezing point profiles for station 71CTD096, located at the northern tip of the Larsen C ice front.

Fig. 20. Potential temperature-salinity plots for sample stations from the northern Larsen C ice front regions, and one off-shelf station (71CTD093).



4.4. Diatom Assemblages (JP, CSA)

Sampling Strategy and Water Filtering Method

A sampling strategy for the long transects (Drake Passage South, Northern Antarctic Peninsula, Drake Passage North) was devised that would give a surface water sample approximately every 0.5º of latitude, at a ship speed of ~15 knots, but also permit much closer sampling as oceanographic features were traversed. Samples (~ 1 litre) from the ship's uncontaminated seawater system were taken every 20 minutes during long transects and concurrent SST, SSS and fluorescence values were noted, as well as latitude and longitude. One sample was filtered every two hours (to provide 0.5º latitude spacing) unless an oceanographic feature was crossed (identified from Ocean Logger data), when the intermediate 20-minute samples were filtered as necessary. Sampling every 20 minutes ensured that no oceanographic features were passed over and missed before they were identified. Unfiltered samples were discarded.

For the shelf areas (Marguerite Bay and NW Weddell Sea), the sampling strategy was dictated more closely by the Ocean Logger data and observed changes in SST, SSS and fluorescence (hence chlorophyll concentration), and the positions of sediment cores and CTD casts. Samples for filtering were targeted at monitoring changes in surface water diatom assemblages across the shelf, as related to oceanographic parameters (particularly fluorescence). At CTD sites, samples were taken down the water column from the surface ocean mixed layer to the sea floor, and within the chlorophyll maximum.

The intake for the ship's uncontaminated seawater supply (USS) is under the hull at ~6.5 m water depth (full load draft of ship, 6.511 m), and water is pre-filtered with a 2 mm screen to remove macro-particles such as krill. Water samples for diatoms were taken from the tap in the prep. lab connected to the Ocean Logger temperature, salinity and fluorescence probes. Water flow rate through the probes was maintained at ~0.6 litres/minute.

Each sample of 100 - 600 ml was filtered through 47 mm diameter Whatman Anodisc 0.02 μm filter membranes. A filtering manifold with three 37 mm internal diameter filter funnels was used with a vacuum pump to draw the water through and deposit a thin layer of material on the filter paper, ~ 1 diatom valve in thickness. The filter membrane was then rinsed with ~ 250 ml of de-ionised water to remove the salt. Dried filter membranes were stored in 50-mm diameter, numbered petri dishes. Surface water samples taken at core sites were filtered onto pre-weighed membranes to facilitate comparison of quantitative water column and sediment sample data.

All filter membranes were examined with a petrological light microscope at 200x magnification. This permitted qualitative identification of the diatom floral assemblage, biased towards the larger taxa present. This qualitative data enabled assemblages to be mapped onto the transects and shelf areas, and preliminary correlation of assemblages with oceanographic conditions and water masses

Below, results are outlined for five regions, including three transects and two areas of the continental shelf. The transects are Drake Passage South, Drake Passage North, and the Northern Antarctic Peninsula. The continental shelf regions are Marguerite Bay and the NW Weddell Sea (figure 21). These preliminary observations are biased towards the larger taxa in the assemblages.

Drake Passage South Transect

This transect extends from the Falkland Plateau, across the Scotia Sea and along the west Antarctic Peninsula shelf edge to Marguerite Bay. A number of changes were noted in the diatom assemblage along the transect, with one major change coinciding with a change in the surface ocean mixed layer depth.

Across the Falkland Trough, an assemblage dominated by *Corethron criophilum* was noted, which passed southwards into an assemblage notable for large *Rhizosolenia* spp. cells, and then southwards again into an assemblage notable for smaller *Rhizosolenia* spp. cells (fig. 21A). As the Antarctic Convergence (AC) was crossed there was a change in diatom assemblage and an increase in abundance, also associated with the shallowing of the mixed layer depth (see XBT data). South of the AC the assemblage was dominated by *Proboscia* spp., phaeoceros *Chaetoceros* spp., *C. criophilum* and *Fragilariopsis* spp. Southward along the transect, *Fragilariopsis* spp. and phaeoceros *Chaetoceros* spp. dominate until approximately 64°S, to the west of the Antarctic Peninsula, where *Fragilariopsis* spp., large *C. criophilum* cells and phaeoceros *Chaetoceros* spp. become the dominant taxa of this predominantly continental slope - shelf break assemblage.

Marguerite Bay

The samples taken in this region define different diatom assemblages from the continental slope and shelf break, extending across the shelf to the inner shelf. Distinct assemblages were identified with different water masses. Vibrocore sediment surface samples also were taken from VC294, VC296 and VC298.

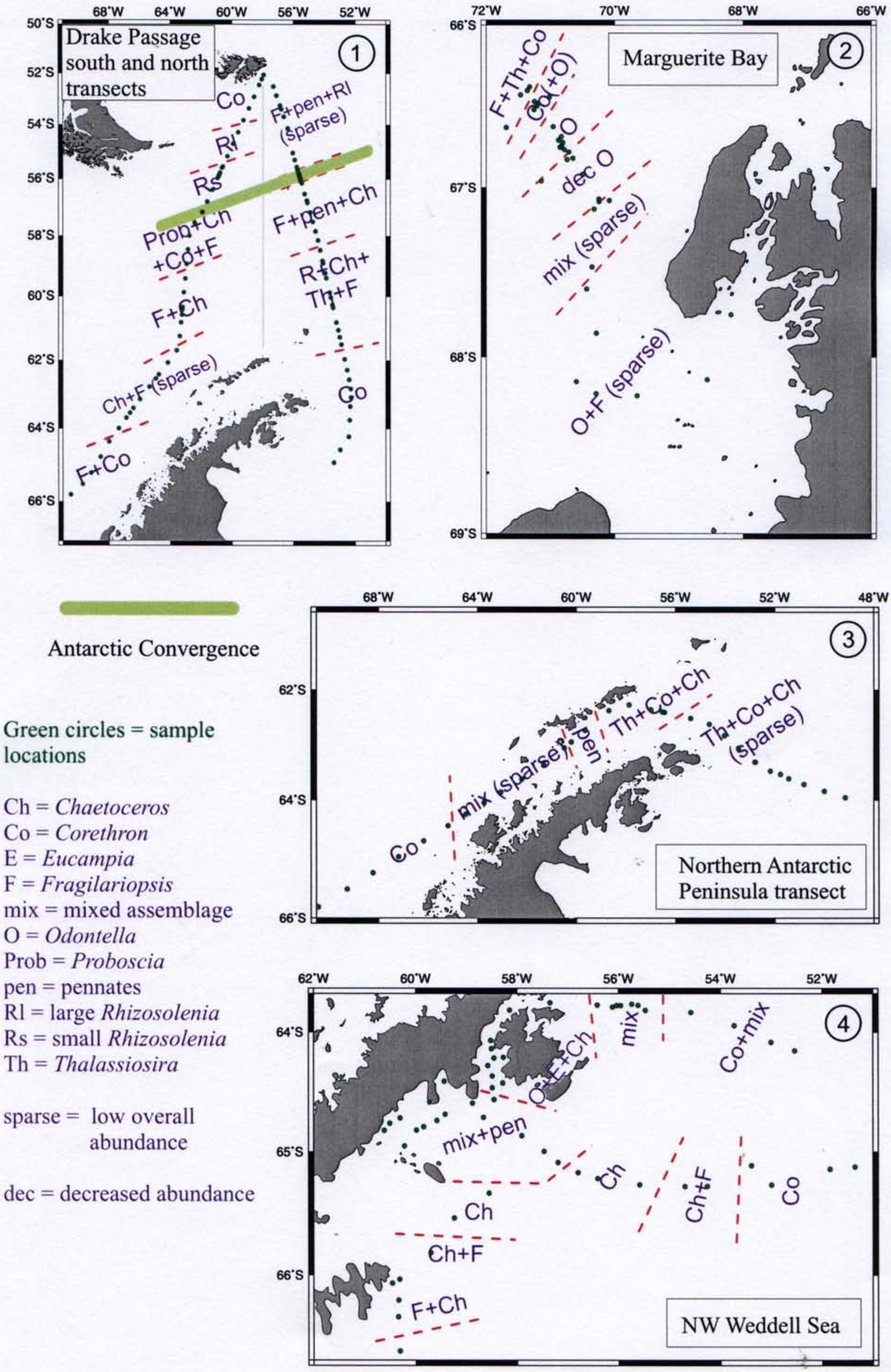
Over the continental slope, an essentially open ocean diatom assemblage typified by *Fragilariopsis* spp. and *Thalassiosira* spp. was collected (fig. 21B). Over the shelf break an assemblage dominated by large *C. criophilum, Fragilariopsis* spp. and *Odontella weissflogi* (*O. weissflogi* more common shelfward of the shelf break) was marked by decreased SST and SSS, most likely associated with upwelling Circumpolar Deep Water (CDW). Assemblages over the outer continental shelf were dominated by a much increased abundance of *O. weissflogi* and decreased abundance of *C. criophilum* compared to the shelf break, whereas the inner shelf diatom assemblage was typified by a very sparse assemblage of *O. weissflogi*, *Fragilariopsis* spp. and other, mixed taxa.

Northern Antarctic Peninsula Transect

This transect extends from Marguerite Bay around the northern Antarctic Peninsula, out into the NW Weddell Sea and includes surface water and deeper water samples from the NW Weddell Sea CTD transect.

The diatom assemblage at the Marguerite Bay end of this transect is dominated by large *C. criophilum* cells and is similar to the Marguerite Bay assemblages associated with the continental shelf break (fig 21B, C). Farther east in Bransfield Strait, the diatom assemblage becomes more mixed and abundance decreases (fig. 21C). In the region of Deception Island, the assemblage is characterised by the occurrence of pennate diatoms. Around the northern tip of the Antarctic Peninsula, the assemblage is dominated by *Thalassiosira* spp., *C. criophilum* and hyalochaete *Chaetoceros* spp. In the NW Weddell sea, and along the CTD transect (diatom assemblage samples from 71CTD83, 71CTD86, 71CTD89 and 71CTD90), the assemblage is the same but abundance decreases significantly.

Fig. 21. Surface water diatom assemblages from the three transects and two shelf regions



NW Weddell Sea

Samples taken in this region include two transects from the continental slope, across the outer and inner shelf, to the continent or ice shelf edge, plus a roughly north-south transect along the eastern margin of the northern Antarctic Peninsula (fig. 21D). Box core (BC312, BC313, BC314, BC315, BC316, BC317, BC319, BC320, BC321), vibrocore (VC322, VC331), piston core (trigger core, TC323, TC345, TC346, TC350) sediment surface samples and CTD (71CTD94, 71CTD97) samples were also taken.

The diatom assemblage along the northerly transect (~ 64ºS) across the continental shelf in the NW Weddell Sea was similar to that along the CTD transect at the end of the Northern Antarctic Peninsula Transect (fig. 21C), namely large *C. criophilum* cells and a relatively sparse, mixed taxa assemblage. Prince Gustav Channel and the coastal sea around James Ross I was dominated by hyalochaete *Chaetoceros* spp., *O. weissflogi*, *Eucampia antarctica* and minor *Thalassiosira* spp. In the region of Cape Longing, Larsen Inlet and Cape Sobral the diatom assemblage was mixed with a large contribution from pennate diatoms, plus *Fragilariopsis* spp. and *Asteromphalus* spp. Hyalochaete *Chaetoceros* spp. decrease in abundance compared with Prince Gustav Channel to the north. Along the southerly transect (~65ºS), hyalochaete *Chaetoceros* spp. dominate the inner shelf region, joined by *Fragilariopsis* spp. on the outer shelf (fig. 21D). The shelf break region is typified by large *C. criophilum* cells with a minor contribution from pennate diatoms. The diatom assemblage along the north-south transect in front of the Larsen B and Larsen C ice shelves is dominated by hyalochaete *Chaetoceros* spp. and *Fragilariopsis* spp., the *Chaetoceros* decreasing in abundance further south with an associated increase in *Fragilariopsis*).

Drake Passage North Transect

This transect extends from the NW Weddell Sea, across the Scotia Sea to just north of the Falkland Trough (fig. 21A). It is essentially a repeat of the Drake Passage South Transect, however, the ship track was at a higher angle to the AC and frontal systems associated with it. There was approximately 5 weeks between Drake Passage South and Drake Passage North Transects which, in part, accounts for the lack of similarity between the two transects.

The most southerly assemblage (~65˚S) is dominated by *C. criophilum* and mixed taxa, typical for this region of the NW Weddell Sea. Farther out into the Scotia Sea, the assemblage changes to become more mixed with *Rhizosolenia* spp., hyalochaete *Chaetoceros* spp., *Fragilariopsis* spp. and *Thalassiosira* spp. (Figure 1 & 2). At 61ºS, pennate diatoms become more important, and *Fragilariopsis* spp. increase in abundance at ~ 59ºS. At the AC, hyalochaete *Chaetoceros* spp. disappear and phaeoceros *Chaetoceros* spp. dominate with *Fragilariopsis* spp., pennate diatoms and large *Rhizosolenia* spp. North of the AC, there is a significant decrease in abundance of diatoms with the assemblage typified by *Fragilariopsis* spp., pennate diatoms and large *Rhizosolenia* spp.

Future Work

All observations to date are dominated by the identification of large diatom taxa only, and are purely qualitative. All filtered samples will be analysed using a scanning electron microscope at 1000x magnification to provide a quantitative measure of the *number of diatom valves per litre*. This will permit quantitative comparisons of assemblages and individual species both along, within and between transects and regions. It is hoped to provide a very precise picture of the surface water diatom assemblages, with associated SST and SSS, that occur during the late Summer/Autumn across the Scotia Sea and around the northern Antarctic Peninsula.

Surface water assemblages will be compared to quantitatively analysed sediment surface assemblages. It is appreciated that we only have samples from one season, and perhaps not the most productive season at that, but preliminary observations suggest that very little of the late Summer/Autumn surface water diatom assemblage is preserved in the surface sediments. Further analysis, combining our late Summer/Autumn assemblages with Spring assemblages from literature, will reveal preservational biases and the magnitude of the taphonomic processes active in these regions.

Some remarkable assemblages consisting of the diatom *Corethron criophilum* were observed. The individual cells were at least at their maximum known dimensions (80 μm diameter; 240 μm length) and may have exceeded them, so must have undergone recent sexual reproduction. These very large *C. criophilum* cells were recorded from all around the northern Antarctic Peninsula, perhaps suggesting that sexual reproduction may be a more common occurrence than previously thought. Further morphometric work and abundance comparisons will be carried out on this genus, with a view to reassessing the suggested role of sexual reproduction in concentrating *Corethron* valves in monospecific sediment layers.

5. EQUIPMENT REPORT

5.1. Navigation, including dynamic positioning (PM, CJP)

Scientific underway navigation was by means of differential GPS. The principal navigation set was the Trimble receiver on the bridge, though position data from the Ashtec 3D and Glonas units were also logged. The Simrad EM120 uses its own Seapath system, whilst the ship's navigation and Dynamic Positioning (DP) depends on a separate Leica GPS unit. Position data derived from the data stream logged on to the SCS were displayed on a UNIX terminal in the UIC lab. The same screen can be used to display other values from the SCS, such as ocean-logger data.

The Doppler Log was not operational during the cruise.

Persistent problems were experienced with the DP system because the bow thruster was not supplying correct feedback to it. This was an intermittent and unpredictable fault. For CTD stations or deep piston core stations it was acceptable to keep station manually, but for shallow vibrocore stations where the ship had to be in the same place (within 2-3 m) for as much as 30 minutes, DP was essential. The ship's staff worked on this problem continually during the cruise but were unable to fix it completely.

We lost the signal from the Falklands DGPS repeater station for about 20 minutes on day 070.

5.2. EM120 data acquisition and processing (PM, PCDL, CJP, COC)

The Simrad EM120 worked well throughout the cruise. There were of course the inevitable system crashes from time to time, some due to operator error but most for reasons best known to the instrument itself. The more experienced operators were noticeably more confident in using the system this year, having now seen it in action in a variety of different conditions and having had the opportunity to recover from a good range of disasters.

For an unknown reason, the em120, topas and neptune machines will sometimes start in OpenWindows rather than the recommended CDE (Common Desktop Environment).

To change this back:

1. logout
2. login as root
3. `cd  /export/home/user` (ie neptune, topas or em120)
4. `cd .dt/sessions`
5. `vi lastsession`
6. edit the line which says `/usr/dt/config/Xsession.ow`
   to read /usr/dt/bin/Xsession
7. save the file and logout of root

<u>Sound velocity profiles</u>

We only used the sound velocity probe once, at the end of the first shelf survey line in Marguerite Bay. Its output file appeared to have depth values too low by a factor of about 25. In view of the much greater convenience of obtaining sound velocity from the XBT (not necessary to stop the ship, and data transfer is much simpler) we used XBT's for the rest of the cruise. With practice, we only needed to stop logging the EM120 for two minutes while the profile was collected from the processing machine and edited. The default profile file name is a long string of year/month/day/time. We found it much easier to change this to the XBT number, eg. XBT035.asvp.

One problem encountered in the swath data was "arching" of the outer beams so that the individual lines have artificial "ridges" at their outermost edges and where they overlap. There are several reasons why this can occur, including ship roll and use of an incorrect sound velocity profile during data collection. The latter is probably the most significant. It is in theory possible to input the correct sound velocity profile in the "Depth Processing" module in Neptune at post-processing stage. It should be noted, however, that extreme difficulty was found in trying to remedy this problem during JR71. Numerous sound velocity profiles collected during the cruiseand also profiles from JR59 were tried via the "Depth Processing" module, and new profiles were also constructed using the Neptune SVP Editor function, with only limited success. It is therefore recommended that considerable emphasis is placed on ensuring that the correct sound velocity profile is used *when the survey data are being acquired* as it appears that correction of this problem may not necessarily be straightforward during post-processing.

5.3. TOPAS and Simrad Synchronisation Unit (CJP)

We used the original version of the TOPAS software throughout the cruise. A partially new version was supplied only days before we left the UK, and there was not time to try it out at BAS. Subsequently we did not wish to interrupt data collection to install and test the new software (and possibly have to revert to the old version if it didn't work). The system worked well, within the same limitations as listed in the JR59 cruise report (notably being unable to record more than 400 ms of data at a sampling rate of 10 kHz). The following information is largely reproduced from the JR59 report.

Throughout: sampling rate 10 kHz, trace length 400 ms, file size 10 MB (actually 10,485,760 which includes 640 pings and ranged from 30 to 100 minutes of acquisition depending on the ping rate); in the processing menu, swell OFF, dereverb OFF, stacking OFF.

Deep water (>1000 m)
Chirp source, 15 ms pulse length, 1.5-5 kHz, level 85%; bandpass filter settings 1400-1600/4900-5100 Hz
Manual triggering, generally 2000 msec (note you must type in a value 20 ms more than required!). Move to 1800 msec when passing through 1500, 3000 or 4500 m depth to avoid the transmission pulse interfering with the bottom echo.
Gain 20-25 dB depending on water depth, seabed type and weather.
Processing: filter ON, deconv ON (1 ppm), TVG ON (manual start about 200 ms above the seabed, slope 60-100 dB/s depending on seabed type), scale 3000%.

Shallow water (<1000 m)
Burst source, period 2, level 100%, secondary frequency 2800 Hz
SSU triggering, ping interval set to 0 (varies from approx. 2 to 6 sec depending on water depth)
Gain 10-20 dB depending on water depth, seabed type and weather
Processing: filter ON, AVC ON, scale 2000%

The narrow beam of TOPAS tends to produce a very poor echo on steep slopes, e.g. on the continental slope west of the Peninsula and in glaciated inner shelf areas. We tried angling the beam by 5 degrees in towards the slope, but this produced only a small improvement.

The EPC chart recorder worked faultlessly. TOPAS input was on channel A. We used a 0.5 second sweep, 0 delay, threshold about 1/3 turn clockwise from minimum setting, trigger level 0, gain 10 (maximum), sweep direction left to right, print polarity +/- (centre setting). For the chart, we used takeup on, scale lines on (there are 8 divisions), mark/annotate off (centre setting), chart drive internal (centre setting), 100 LPI, contrast centre setting. A 10-minute time mark was supplied from the radiocode clock at the aft end of the UIC room.

Because the ship was generally operating in water deeper than 300 m, even in unsurveyed areas of the Larsen, it was acceptable to the bridge to have the EA500 echo sounder in passive mode and receiving the echo from the EM120 centre beam. The SSU was therefore left in the EM&EA&EK TO mode. On the few occasions we had an EM120 crash (usually while changing surveys), it was necessary to ask the bridge to put the EA500 in active mode for a few minutes while we sorted ourselves out.

5.4. BGS Underway Equipment: magnetometer, single-channel seismic system (partly from Skinner 2002)

The magnetometer was deployed (from the port quarter) on the long passages between Stanley and the Antarctic Peninsula, and for a short time in the NW Weddell Sea. Deployment and recovery were carried out manually at a ship speed of 2 knots, and the magnetometer was towed at a ship speed of 11-16 knots. The raw magnetometer data were generally very noisy because of interference from the ship's cathodic protection system. Nevertheless, after filtering, the data are acceptable for mapping long-period oceanic magnetic anomalies.

The BGS magnetometer requires a NMEA GPS stream input. The magnetometer output is logged on the SCS system. GPS stream is easy to establish by sending a serial SCS message (Trimble) and plumb through to a serial connection in the UIC room near the magnetometer.

The magnetometer data comes from a BCD to ASCII converter which gives RS232 data. The black box converter can be either polled with a "?" or can free run sending many readings a second. The SCS polled parent did not work, so the serial parent was chosen instead. The following settings were used:

Parent:	9600,8,N,1	Child:	Decode type : ASCII
	record size : 255		Units : nT
	termination char : Any		Start char : 1
	history : 30		End char : 5
	log rate : 2		
	lab file decimation : 30		

`/nerc/packages/rvs/home/scs2levc/scs2levc.xml` configuration file edited to accomodate the new data stream.

The single-channel seismic system was used for three lines: S103 in the former Larsen-A area, S104 from the continental shelf edge to 2400 m on the slope, and S105 along the slope at 1300 m depth (Table 1). Only one of the ship's four compressors was required for the array of three or four 40 cu.in. airguns (out of five on the frame), with another compressor on standby. Deployment and recovery of the airguns and streamer only took about 20 minutes with a ship speed of 2 knots; survey speed was 4.5 knots through the water (measured by the bridge using the EM log). The ship's cathodic protection system seriously degraded the seismic data on Line 103, so permission was obtained to switch it off for the duration of Lines 104 and 105. No other problems occurred with the equipment. A full report on the deleterious effects of the cathodic protection can be found in Skinner (2002).

Interference of the seismic source on the swath and TOPAS systems (with a firing interval of 3 seconds) was limited to artefacts at the ends of the EM120 beams every few traces, and the occasional noisy trace on TOPAS.

5.5 BGS Vibrocorer and Box Corer (partly from Skinner 2002)

This was the first time the vibrocorer alone had been used on the JCR; cruise JR48 used the combined vibrocorer/rock drill. The vibrocorer can collect up to 6 m of sediment in a steel core barrel with polycarbonate liner tube, stainless steel core catcher (s) and carbon steel cutting shoe. It was deployed from the stern gantry using the BGS umbilical winch. On several occasions core catchers were inverted while recovering diamicts with very hard pebbles. A number of retractor wires were broken during coring operations, and were replaced with the spares carried.

A number of problems occurred during the Marguerite Bay coring, resulting in some 8 hours of lost ship time and necessitating many more hours of repair work while the ship was underway for swath and TOPAS survey. Problems included a power supply failure to deck on day 048 (traced to an electrical fault on the core bench), and a broken transformer lead in a relay case on day 050. For all the shelf sites in Marguerite Bay (VC294 to VC307) it was not possible to obtain reliable readings from the penetrometer, so the corer was set to vibrate for 10-20 min. After various tests including changing the transducer, the gain inside the echo-sounder module was adjusted and an acceptable signal was obtained. From VC308 onwards a graph of penetration against time was obtained at each site (Skinner 2002).

Considerably fewer problems were experienced from the third week of the cruise onwards. At site VC326 on the Larsen shelf, the vibrocorer got stuck in the seabed. The retract mechanism had failed as a result of an electrical malfunction. Eventually by lifting with the stern gantry, with the winch brake on, the rig was eased out of the seabed.

The box corer was very successful, though up to three attempts were required to recover sediment at some stations where rocks at the seabed jammed in the spade arms. It was deployed on the coring wire (30 tonn winch) from the midships gantry. On recovery the complete 0.3-0.8 m of mud was subsampled using offcuts of vibrocore liner, and the uppermost 1 cm was sampled using a spatula (for diatoms) and a small scoop (for live benthic foraminifera).

5.6. UKORS Piston Corer (CJP)

The piston corer was used much less than anticipated: four times in piston coring mode and once as a gravity corer. It had been hoped to collect several gravity cores in Marguerite Bay, but the loss of the Seametrix system for 24 hours (see section 5.9), and delays arising from breakdowns of the vibrocorer, meant that very little time remained for gravity coring. Also, the slope off Marguerite Bay proved to be gravelly and completely unsuitable for piston coring.

Most of the piston coring system (corer, trigger mechnism, bucket, davits) worked faultlessly, and no damage was sustained to any of the equipment. The auxiliary winch failed to haul in the piston corer on the pennant during its first deployment at station PC323. To get the corer inboard, a jury rig was used with the pennant led aft along the deck to one of the mooring winches, as previously used on JR19. The winch had been supplied with a large amount of redundant wire coiled on the drum, increasing the effective radius of the drum. It was realised that the motor could not develop enough torque under these conditions to lift the ~1.2 ton weight of a full corer. The wire (some 1000 m?) was wound off the drum and coiled on deck. No further problems were experienced.

5.7. Core processing (JE)

Vibrocores and piston cores were cut into 1 m sections and labelled on the core bench on the aft deck. Core lengths were transferred to the wet laboratory where the end caps were sealed to the core liner with tape. To prevent water loss, the core ends up to a level above the tape were dipped in hot wax (wax bath supplied by BGS) and allowed to cool at room temperature sealing any voids. The cores were then stored in cardboard boxes in the scientific cold room. Core catcher samples were sealed in polythene bags and labelled, and stored with the cores.

A total of 38 vibrocores (from both Marguerite Bay and Larsen-A regions, and adjacent continental slopes) and one piston core were split on the aft deck using the BGS router system. Cores were split longitudinally, using a router to split the core liner and cheese wire to cut the sediment. The sediment surface of the archive half was cleaned with a microscope slide. The core was described visually, documenting characteristics such as lithology and grain size, sedimentary structures and contacts, sediment colour (using the Munsell colour chart), bioturbation and level of sediment compaction or consolidation. Smear slides were taken at selected points within the Holocene mud of the Marguerite Bay cores and their diatom content estimated.

The shear strength of sediment was measured using a shear vane (Torvane system). Only minimum shear strengths were determined on the stiffest sediments at the base of several cores, as shear strength exceeded the measurement capacity of the shear vane. In addition, shear strength could not be determined on all cores as the shear vane developed an irreparable fault. Samples of sediment from selected facies were taken for grain size analysis to be performed back in Cambridge. Each split core section was covered in cling-film and sealed inside lay-flat polythene tubing, and returned to the scientific cold storage.

5.8. Ocean Logger (MOP)

This version of the OceanLogger was new to the ship in the summer of 2001 and was designed, built and installed by the outgoing ETS engineer, Richard Bridgeman. As with any new equipment, especially home-grown, there were some problems, some easy solutions and some problems still to be investigated.

The machine was required to be measuring and logging for the maximum time possible; modifications to the software on the machine itself were viewed undesirable as this would produce considerable ‘holes’ in the data. The machine was stopped (while on station) for just long enough to take a copy of the program for investigation elsewhere.

<u>Time shown on the graph X axis gradually drifts compared to ‘real’ time</u>

Within LabView there are several ways of displaying a graph of data. One of the easiest is the use of a ‘stripchart’ display. Data are written to the chart as they are acquired, the strip chart being left responsible for displaying time. Although this works well in the short term, this type of display is not designed for the display of data over the long term. To counter this problem a standard X-Y graph must be used with both data and time being dealt with by the program. To do this two arrays of data are needed, one is the bundled Y values and the other an array of time values. Both of these arrays are plotted to the graph after each update.

To modify the program three arrays are generated, one for each of the graphs and the third – time. Each time a new data set is acquired (one point of each PAR, TIR, temperature, salinity etc. these values are appended to the arrays, a point is then trimmed off the other end of the array and this new array plotted to the graphs. This arrangement works well and ensures that the times displayed accurately reflect real time.

Inappropriate grouping of traces on a graph resulted in incorrect Y-axis scales

This was corrected by creating different 'Y' scales for each of the data plotted on the graphs, allowing each trace to 'autoscale' thereby providing much better display of information.

The Flow meter reading is different on the meter from the Ocean Logger reading.

Several things were wrong here. Firstly the NuDam module located in the PrepLab had developed a fault and transmitted incorrect data. The problem appeared to be that the module would 'forget' all its calibration information periodically. Attempts to re-calibrate the module would be successful for a time but would invariably be forgotten at some later time. The module was replaced and the fault never re-occurred.

The second fault with the flow is related to the physical installation. Sea water from the ship's uncontaminated supply is tapped off the main system through a series of valves, and its flow is reduced. On this cruise with only one tap in use the desired flow was only 0.6 litres/minute. To get this value some of the valves have to be shut down to almost closed. This means that the setting of the valves is really sensitive with tiny adjustments being made by tapping the valve handle with a screwdriver. The slightest change in the pressure of the main seawater supply, caused for example by the filters picking up debris, the pumps being changed over, or even sea water being drawn off somewhere else in the ship, cause the flow value to vary considerably. It would be desirable if the seawater supply to the Prep Lab instruments could be de-coupled from the pressure variations in the seawater supply. One way to do this would be for a header tank to be installed. The tank is continuously fed from the main supply, surplus water being overflowed to waste. This continuous but lower value of head could then be used to supply the instruments.

Calibration file selection was awkward

The calibration file does not need to be accessed frequently. Scientists might want to verify that the correct formula are entered however, and this can be done by clicking on the 'calibration' menu item. Apart from this the file will not need to be changed except when newly calibrated instruments are installed. With this in mind the calibration selection was removed and instead OceanLogger.cal was the default file. This can be edited by selecting the 'calibrate' option, and no other calibration option now exists.

Graphs were too small and therefore displayed insufficient information

As the system was, two graphs were displayed side by side limiting the displayed information to two small square areas. All the numerical information was rearranged to a neat group lower down on the screen, thereby allowing the graphs to be shown one above the other and occupying the full width of the screen. Three times the graphical display area was produced this way, making for a much more informative display.

Failure of TIR sensor

Right at the end of the cruise it appeared that one of the TIR sensors, or possibly the associated DAC NuDam module, failed. This resulted in a permanent reading of 10288. Power cycling the module corrected this ‘latch-up’ condition.

5.9. CTD (KWN)

The ship's SBE911Plus CTD was used with twelve 10-litre water sample bottles. The sensor package consisted of dual temperature and conductivity sensors, each pair with an independent pump; a Digiquartz pressure sensor; a transmissometer; a Chelsea fluorometer; and a PAR sensor. An altimeter provided an indication of depth above seabed, when within range (100 m). The package was the same as used during JR70, and details of the operation and deployment of the instrument package can be found in the JR70 cruise report.

The CTD instrument package performed well. Minor problems with the functioning of the altimeter that had been experienced during JR70 were corrected for JR71 with the installation of a replacement part that had been brought from the UK. The biggest problem encountered was freezing-up of the package when being operated at low air temperatures. The lowest temperature experienced during CTD work was -14°C. Because it was not possible to bring the roller shutter door of the water bottle annexe all the way to the deck between stations, the temperature at deck level, that is, at the level of the SBE911Plus instrument, remained around -3 to -5°C. This meant that the sensors and pumps needed to be warmed and defrosted prior to their deployment: even a five-minute soak at 10 m depth failed to defrost them adequately. Thereafter, care was always taken to ensure the sensor ducts were blown clear of the majority of water after each deployment. The water bottle annexe door cannot be completely closed unless the CTD cable is removed after each deployment, which is time-consuming. Another possible solution is to install a fan heater powerful enough to mix warm air to deck level.

5.10. Winch/Seametrix (MOP)

On day 048 the Seametrix cable metering system suffered a failure and would not acquire the selected winch. When rebooted, it would run slowly through the selection process for the 30T system but quickly through the selection process for the CTD and Bio winches.

An initial examination by Doug Trevett and Mark Preston was considerably hindered by the location of the components in the traction winch room, above the spooling gear for one of the drums. Next some of the circuit boards were swapped between the 30T and CTD systems, which are close to each other. The system was tested after each swap; on swapping the CPU cards, the CTD winch now exhibited the same fault. Restoring the boards back to their original positions, however, did not re-instate the CTD system as functional. At this point both the CTD and the 30T system were both faulty.

Further fault finding continued through to the morning of day 049 with spare cards being substituted, diagrams examined, and any idea being given a fair hearing. It was noted that on one of the drawings a fuse was present on the diagram that had not been obvious on the installation. Further examination of the system revealed the fuse securely hidden behind some wiring; this fuse was blown.

Replacing the fuse did nothing for the functionality of the system however. Whilst there and holding a meter the power supply fuses were checked again out of desperation. The -12V fuses in both systems were found to be blown. Replacing these brought the CTD winch back to operation but the 30T was still dead, in fact the system blew the fuse as soon as power was restored. At this time the 30T system had the spare CPU card installed. Swapping this to the CTD system blew the fuse there too. Replacing the fuses once more and using the CPU card from the CTD winch brought the 30T system back to life.

At this point we had one working CPU card and two otherwise working systems. This was a better state than we had been in for quite some time and was viewed as ‘progress’ by all those involved. Either system could be made operational by swapping the CPU card. Just to check the logic of our deductions the original CPU card was re-introduced and (to our amazement) now also worked. All systems now worked fully.

What had happened? It seems that a rather unlikely series of events took place.

For some unknown reason the ‘hidden’ fuse in the 30T system blew, putting that system out of action. The most probable cause of this was a fault with the CPU card that somehow at the end of the day cleared itself. Later in the investigations the spare CPU card was inserted into each system and blew the –12v power supply fuse in both systems. Replacing the relevant cards in both systems now was ineffective as fuses were blown. When the blown fuses were replaced, the CTD system worked again but the 30T didn’t. This was because the spare card was still installed. On replacing the card with the original and replacing the fuse once more, all functioned correctly again.

Careful examination of this procedure produces few concrete conclusions. Why did the fuse blow in the first case? Why did the 30T CPU card blow fuses initially and not later on? The answers to these problems might well never be known, but there are lessons to be learned.

Always make fuses readily accessible and always provide supply lamps to indicate that state of fuses. If this had been done with the Seametrix system, the fault finding might have taken minutes and not days.

Spare cards need to be tested regularly, as in this case the spare CPU card caused more problems than it solved.

5.11. Other equipment: PES, ADCP, XBT’s, STCM, Honeywell Magnetometer (CJP, PM)

The PES was used only to monitor pinger-bottom separation while coring at stations GC300, PC323, PC345-6 and PC350. A rather weak echo was recorded at the first two stations. It was realised that the PES had been switched from 10 kHz (its normal setting) to 12 kHz. When this was fixed (necessary to remove one of the front panels to do this!) strong direct and bottom echoes were obtained. It is recommended to turn off the EM120 and TOPAS transmissions when the corer is near the seabed so that the PES gain can be turned up to see a clear pinger-bottom echo.

The ADCP was run throughout the cruise except while alongside at Rothera. Its clock drifts by about one minute in three days (ADCP clock becomes fast). It was reset approximately every six days so that ADCP time was always within one minute of scientific (GPS) time. Early on day 069 the machine stopped logging because its hard disk was full. Only 20 min worth of data were lost.

A total of 66 XBT casts were made, using T5 or T7 probes depending on the water depth (Table 5). The probes were launched from the port quarter or the starboard side of the ship according to sea conditions. The data were required mainly to input the correct sound velocity profile to the EM120, and also to identify oceanographic features such as the Polar Front and incursions of warm water near the edge of the continental shelf. Most of the casts on the shelf, when the ship was surveying at 10-11 knots or coming on or off station, went to full depth (300-600 m). Only one of the deep-water casts went to the full T5 depth of 1830 m; some failed at depths as shallow as 300-500 m (Table 5). In a few cases this could be related to high ship speed (15-16 knots) or bad weather, which tends to break thin copper wires. Unfortunately it was not possible to find a suitable XBT launching position while towing the seismic gear (airguns on the port quarter and streamer on the starboard quarter). Wherever we tried, the copper wire broke in the ship's wake or on some part of the towed equipment.

When using an XBT cast for sound velocity, the file is smoothed and re-exported at least several minutes after the time of the cast, sometimes considerably later. The original .edf file name is used, but the file receives a later time stamp. A note must therefore be made of the actual time of the cast. The lat/long typed in to the PC just before the cast are only approximate, and the true position of the cast must be obtained from the processed navigation data.

<u>Three-component Magnetometers</u>

The two fixed STCM's on the ship performed normally throughout the cruise. Three calibrations were carried out:

0427-0454/047	67° 03'S	70° 11.5'W
1314-1342/061	65°17.2'S	54°15.5'W
1226-1250/075	65° 02.3'S	53° 52'W

In addition a Honeywell HMR2300 Smart Digital Three-component magnetometer was run for testing and comparison with the existing STCM units. The sensor for this unit was mounted on a plastic pole (an offcut of core liner) above the port aft corner of the UIC room. A laptop with two serial ports was used (the rugged unit supplied for the Sound Velocity Probe) to connect to the magnetometer and the SCS.

A PowerBasic program was written to poll the magnetometer, read input data, convert and send an output string to the SCS. Program included as Appendix A in the ITS report for this cruise.

Output from magnetometer	:	`-xx,xxx  -yy,yyy  -zz,zzz`
Input to SCS	:	`$SDMAG,-xx.xxx,-yy.yyy,-zz.zzz,<CR/LF>`

The output was connected via a 9-pin D-type/RJ45 converter to the LAN cabling.

The magnetometer was added to SCS sensor.cfg file. The stream name is SDMagnet, has one NMEA parent and three children (units are mGauss). A Level C stream was created called "sdmag". Copied the format from previous magnetometer stream "magnet".

`/nerc/packages/rvs/home/scs2levc/scs2levc.xml` configuration file edited and `./scs2levc.pl` re-run to include the newly created instrument.

A slight problem persisted throughout the cruise. Every day at about 2000 GMT, data would stop arriving from the magnetometer. This was not the program or power management of the laptop. The conclusion was that the instrument that was at fault, but no further investigation was done. Initial comparisons suggest that the readings from the Honeywell instrument correlate well with those from the STCM, but a full evaluation awaits analysis in Cambridge.

5.11. Data logging/Scientific Computer System

The following instruments were logged to the SCS, with conversion to Level C streams also being made available:

trimble	position
glonass	position
ashtec.3du	position, attitude
tsshrp	attitude
gyro	heading
doppler log	velocity
emlog	velocity
anemometer	wind speed and direction
oceanlogger	sea temperature, salinity, fluorescence
bas stcm	magnetic field
new stcm	magnetic field
Honeywell HMR2300	magnetic field
magnetometer	magnetic field (towed proton magnetometer)
ea500	water depth (bridge echo sounder)
em120	water depth (swath centre beam)

The ADCP logs to its hard disk (with time stamp from the PC, which drifts) and subsequently to the Level C.

There has been a limitation on the number of serial connections to the SCS in the past. This is because of the number of scientific wiring RS232 connections between the UIC room and computer room. The LAN cabling can be used to overcome this, but care must be taken not to connect RS232 to the LAN equipment.

8. ACKNOWLEDGEMENTS

We thank all the officers and crew of the *James Clark Ross* for an enjoyable and scientifically productive cruise. The work in the Larsen area depended on the navigational skills of Captain Jerry, Graham, Dave and Paul. Their willingness to work double watches on the bridge was very much appreciated. We also thank Paul for compiling the web diaries. We thank the engineers for keeping the ship going, and particularly their efforts with the dynamic positioning and Seametrix. All the crew provided willing and competent help with mobilisation, demobilisation and corer and seismic deployments. John Summers, Dave Peck and Doug Trevett drove and maintained the ship's winches with their usual high level of skill, and Doug also looked after the non-toxic seawater supply. Steve Mee the Sparky kept us in touch with the outside world, including fielding the BAS Press Office at the end of the cruise. Last but not least of the ship's staff, Hamish and the galley crew kept us well-fed and entertained.

The BGS vibrocorer and seismic system were efficiently operated, thanks to the BGS technical team of six led by Ali Skinner. Graham Tulloch's attention to core curation was appreciated. We thank Richie Phipps for operating the RVS corer so successfully, if infrequently. Mark Preston (electronics) spent many hours sorting out the Ocean Logger, as well as mnding the Seametrix. Pete Lens and Roy Dodson kept the computer systems under control, and we are also grateful for their assistance with scientific watchkeeping. BAS Operations (Mike Dinn, Ian Collinge, Kath Nicholson and Caroline Lewis) got us and all our equipment to the ship eventually. Myriam Booth made sure things went smoothly in Stanley.

We also thank Mike Meredith who obtained the XBT's from the UK Hydrographic Office, Steve Colwell at BAS for sending the weather maps every day and David Vaughan for sending the satellite images of Larsen-B.

7. CREW LIST

Scientific Party and VIP's

Dr Carol J. Pudsey	BAS	Principal Scientist
Dr Jeff Evans	BAS	Marine geologist
Dr Peter Morris	BAS	Geophysics database manager
Miss Claire Allen	BAS	Diatom micropalaeontologist
Dr Keith W Nicholls+	BAS	Oceanographer
Prof Julian A Dowdeswell*	University of Cambridge	Glaciologist/AFI PI
Dr Colm O'Cofaigh	University of Cambridge	Glacial geologist
Dr Jenny Pike	University of Cardiff	Micropalaeontologist/AFI PI
Mr Ian J Hawkes	University of Lancaster	CASE student
Mr Mark Preston	BAS	Electronics engineer
Mr Pete Lens	BAS	Computer support
Mr Roy Dodson	BAS	Computer support
Mr Richie Phipps	UKORS	Mechanical engineer (coring)
Mr Ali Skinner	BGS	BGS Team Leader
Mr Colin Brett	BGS	Geophysicist
Mr Neil Campbell	BGS	Mechanical engineer
Mr John Derrick	BGS	Mechanical engineer
Mr Dave Smith	BGS	Electronics engineer
Mr Graham Tulloch	BGS	Survey technician
Dr Sarah Hortop	BASMU	Doctor
Prof Chris Rapley*	BAS	Director BAS
Sir Crispin Tickell*	FCO (ret'd)	Special Adviser to BAS
Dr Tim J Moffat*	BAS	BAS Directorate
Miss Jocelyn Kaiser*	Science	Scientific correspondent

BAS = British Antarctic Survey, BASMU = BAS Medical Unit, BGS = British Geological Survey, FCO = Foreign & Commonwealth Office, UKORS = United Kingdom Ocean Research Services.
* = disembarked at Rothera, + = embarked at Rothera.

Ship's Company

Jerry Burgan	Master	Colin Lang	Bosun
Graham Chapman	Chief Officer	Dave Peck	Bosun's Mate
Dave King	2nd Officer	Martin Bowen	Seaman
Paul Clarke	3rd Officer	Kelvin Chappell	Seaman
Steve Mee	Radio Officer	George Dale	Seaman
Duncan Anderson	Chief Engineer	Ian Raper	Seaman
Colin Smith	2nd Engineer	Luke Trussler	Seaman
Robert (Rag)Macaskill	3rd Engineer	Nick Greenwood	Motorman
Matt Noyes	4th Engineer	Angus Macaskill	Motorman
Keith Rowe	Electrician	Danny McManamy	Chief Cook
John Summers	Deck Officer	Tracey Macaskill	2nd Cook
Doug Trevett	Deck Engineer	Lee Jones	Senior Steward
Hamish Gibson	Catering Officer	Tony Dickson	Steward
		Simon Hadgraft	Steward
		Graham Raworth	Steward

8. CRUISE STATISTICS (CJP)

Total cruise time (2000/043-1100/078)		**34.6 days**
Vibrocoring and box coring	3.2 days	
Piston and gravity coring	0.7 day	
CTD stations	1.2 days	
Total station time		5.1 days
Rothera call		0.4 day
STCM calibrations and SVP cast		0.1 day
Mechanical failures and maintenance		0.6 day
Waiting on weather/ice etc.		Negligible
Underway data collection (Ocean logger, STCM, ADCP)		**28.4 days**

Of which:

EM120 swath bathymetry	28.0 days
TOPAS	25.7 days
Magnetometer	4.8 days
Seismic profiling	1.1 days

Data recorded 33.2 Gigabytes of which EM120 =	11.8 raw
	12.9 processed
TOPAS =	7.4

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Acronyms etc

AFI	Antarctic Funding Initiative
BAS	British Antarctic Survey
BGS	British Geological Survey
CGI	Collaborative Gearing Initiative (part of AFI)
CTD	Conductivity-Temperature-Depth
DGPS	Differential Global Positioning System
DP	Dynamic Positioning
FIPASS	Falklands Interim Port And Storage Services
GC	Gravity core
GEODAS	GEOphysical DAta System (National Geophysical Data Center, USA)
HRPT	High-Resolution Picture Transfer
LGM	Last Glacial Maximum
Microplot	JCR's bridge navigation software
MODIS	MODerate resolution Imaging Radiometer
Neptune	EM120 processing software
PC	Piston core
PES	Precision Echo Sounder
SAGES	Signals in Antarctica of Global changES (BAS core programme)
TOPAS	Topographic Parametric Sonar
UKORS	United Kingdom Ocean Research Services
VC	Vibrocore
XBT	Expendable bathythermograph

10. RECOMMENDATIONS

In the following list, items for BAS-only attention are in normal/bold type; items for BAS/Kongsberg Simrad attention are in italics.

1. Electrical noise at 100 Hz from the ship's cathodic protection system (ICCP) generates serious interference on a variety of geophysical data including seismic and magnetometer data. **Whether, and for how long, it is acceptable to turn off the ICCP during science cruises, needs to be clarified**.

2. *Kongsberg Simrad must be reminded that they have promised to provide an* ***upgrade to the TOPAS post-processing software which includes the capability to export processed data*** *to digital files.* ***(STILL an unresolved issue from the trials cruise)***

3. *In TOPAS acquisition, the maximum recorded trace length of 400 ms is insufficient in some situations, e.g in areas of rugged topography (where frequent delay changes are required). It would be advantageous to be able to use a relatively low sampling rate (10 kHz) and* ***longer trace length (1000 ms)****.*

4. *In TOPAS acquisition, the value for manual triggering always re-sets to a value 20 ms less than the value typed in.* ***This software error should be corrected****.*

5. For TOPAS and EM120 post-processing, it would be very helpful to have an additional workstation in the UIC room so that both types of data could be processed at once (i.e. **one EM120 and one TOPAS processing workstation**).

6.The dedicated XBT computer is a 486 and there are no equivalent "spare" machines. **The XBT software needs to be upgraded to run on a pentium**.

7. The dedicated ADCP computer is a 286 and there are no equivalent "spare" machines. **The ADCP software needs to be upgraded to run on a pentium**.

* * Note that recommendations 2 to 7 are carried forward from the JR59 cruise report one year ago.* *

Table 1 Single-channel seismic lines

Line no	Start time	Start lat S	Start long W	Start depth	End time	End lat S	End long W	End depth	Length	Remarks
S103	1430/063	65˚ 00.2'	58˚ 17.4'	310 m	0012/064	64˚ 43.1'	60˚ 04.5'	807 m	91 km	Inner shelf
S104	1515/072	65˚ 04.7'	54˚ 39.3'	428 m	0052/073	65˚ 07.0'	53˚ 00.6'	2392 m	78 km	Shelf edge to slope
S105	1823/074	65˚ 19.2'	54˚ 07.9'	1227 m	0000/075	64˚ 53.1'	54˚ 05.1	1316 m	50 km	Shelf edge

Table 2 Core stations

Station	Latitude S	Longitude W	Water depth m	Core length m	Time on station	Area	Notes
VC294	66° 27.0'	71° 00'	532	2.6	1440-1645/048	Marguerite Bay	2 attempts
VC295	66° 34.6'	70° 46.7'	543	4.42	1920-2046/048	Marguerite Bay	
VC296	66° 41.6'	70° 48.7'	533	4.19	0915-1042/049	Marguerite Bay	
VC297	66° 47.0'	70° 41.9'	542	3.6	1125-1237/049	Marguerite Bay	
VC298	66° 49.9'	70° 43.4'	523	2.87	1256-1425/049	Marguerite Bay	
VC299	66° 58.6'	71° 06.2'	473	2.54	2000-2135/049	Marguerite Bay	
GC300	66° 50.5'	70° 33.2'	570	1.66	2310/049-0018/050	Marguerite Bay	
VC301	66° 50.5'	70° 33.2'	570	5.84	0018-0143/050	Marguerite Bay	Same as GC300
VC302	66° 47.7'	70° 41.2'	544	4.71	1130-1347/050	Marguerite Bay	problem with DP
VC303	66° 51.2'	70° 46.7'	504	1.93	1424-1533/050	Marguerite Bay	
VC304	66° 52.6'	70° 26.3'	618	4.53	1635-1800/050	Marguerite Bay	
VC305	66° 56.5'	70° 12.4'	595	0.1 (bag)	1845-2012/050	Marguerite Bay	
VC306	68° 08.6'	70° 34.9'	772	5.94	0306-0434/051	Marguerite Bay	
VC307	67° 30.0'	70° 36.7'	747	5.31	0253-0445/051	Marguerite Bay	
VC308	66° 26.3'	71° 34.1'	1531	0.35	0025-0310/053	Marguerite Bay slope	
VC309	66° 18.9'	71° 16.9'	1494	0.1 (bag)	0440-0640/053	Marguerite Bay slope	
VC310	66° 18.9'	71° 08.8'	845	3.79	0720-0845/053	Marguerite Bay slope	
VC311	66° 05.3	70° 57.2'	1515	0.39	1030-1255/053	Marguerite Bay slope	

Station	Latitude S	Longitude W	Water depth m	Core length m	Time on station	Area	Notes
BC312	64° 08.7'	58° 31.9'	856	0.8	2203-2328/057	Prince Gustav Channel	VC 239
BC313	64° 13.1'	58° 17.8'	654	0.68	0100-0155/058	Rohss Bay	VC 243
BC314	64° 13.4'	58° 28.6'	811	0.6	0320-0630/058	Prince Gustav Channel	VC 237; 3 attempts
BC315	64° 17.3'	58° 36.0'	740	0.52	1150-1330/058	Prince Gustav Channel	near VC244; 2 attempts
BC316	64° 22.5'	58° 30.8'	757	0.64	1425-1520/058	Prince Gustav Channel	VC 242
BC317	64° 34.4'	58° 29.1'	594	0.64	1655-1810/058	Prince Gustav Channel	VC 277
VC318	64° 38.1'	58° 58.5'	542	2.78	0110-0230/059	southern Larsen Inlet	
BC319	64° 41.6'	59° 26.6'	568	0.52	1120-1250/059	S of Cape Sobral	VC 247; 2 attempts
BC320	64° 49.6'	60° 00.5'	449	0.45	0930-1030/060	Larsen-A	VC 263
BC321	64° 57.4'	60° 14.5'	314	0.28	1510-1550/060	Larsen-A	VC 262
VC322	65° 16.4'	53° 54.4'	1492	4.35	0200-0412/062	slope	
PC323	65° 16.6'	53° 01.4'	2320	4.85 + 1.0 TC	1020-1357/062	slope	
VC324	65° 13.5'	56° 08.9'	512	2.94	0045-0142/063	Larsen-A shelf	
VC325	65° 13.4'	56° 14.2'	513	1.92	0210-0306/063	Larsen-A shelf	
VC326	65° 11.7'	56° 42.9'	524	3.36	0540-0800/063	Larsen-A shelf	Corer got stuck
VC327	65° 09.5'	56° 53.5'	499	3.77	0920-1013/063	Larsen-A shelf	
VC328	64° 43.5'	60° 07.1'	826	2.53	0044-0215/064	Larsen-A	next to drumlin
VC329	64° 42.5'	60° 05.9'	775	2.0	0230-0400/064	Larsen-A	on drumlin
BC330	64° 44.7'	59° 36.3'	554	0	1120-1254/064	S of Cape Sobral	3 attempts; rocks only

Station	Latitude S	Longitude W	Water depth m	Core length m	Time on station	Area	Notes
VC331	66˚ 26.1'	59˚ 57.6'	525	4.6	1322-1415/066	Larsen-C	
VC332	65˚ 41.8'	60˚ 41.0'	573	1.47	2100-2200/066	Larsen-B	
VC333	66˚ 06.9'	60˚ 26.1'	340	4.4	0305-0430/067	Cape Framnes	
VC334	65˚ 32.6'	59˚ 12.4'	449	0	1954-2145/067	Offshore Larsen-B	No recovery
VC335	65˚ 32.8'	59˚ 12.4'	450	1.82	2145-2250/067	Offshore Larsen-B	repeat of VC334
VC336	65˚ 22.7'	58˚ 30.7	501	3.9	0120-0240/068	Offshore Larsen-B	
VC337	65˚ 18.6'	56˚ 09.0	515	4.1	0100-0217/070	Larsen-A shelf (trough)	
VC338	65˚ 31.1'	56˚ 02.1	452	2.6	0418-0559/070	Larsen-A shelf (bank)	liner got stuck
VC339	65˚ 00.9'	57˚ 24.7	344	1.37	1926-2031/070	Larsen-A shelf (bank)	problem with DP/GPS
VC340	65˚ 12.4'	55˚ 22.9'	496	2.4	0320-0434/071	Larsen-A shelf (trough)	
VC341	65˚ 00.2'	55˚ 21.61'	454	0.3	1340-1432/071	Larsen-A shelf (bank)	
VC342	65˚ 00.2'	55˚ 21.57'	451	0.8	1432-1523/071	Larsen-A shelf (bank)	repeat of VC341
VC343	64˚ 50.0	54˚ 31.8'	426	1.84	0030-0135/072	Larsen-A shelf edge (furrow)	
VC344	65˚ 07.7'	55˚ 03.9'	466	3.0	1155-1323/072	Larsen-A shelf (lineated)	broken retractor wire
PC345	65˚ 08.8'	51˚ 52.4	2933	7.68 + 1.0 TC	0536-0938/073	Lower slope, Larsen-A	
PC346	65˚ 07.7	51˚ 22.9'	3112	10.3 + 0.1 (bag)	1135-1552/073	Lower slope, Larsen-A	
VC347	65˚ 05.7'	54˚ 23.5'	789	3.7	0006-0133/074	Upper slope, Larsen-A	
VC348	65˚ 08.4'	54˚ 04.0'	1298	4.2	0247-0434/074	Upper slope, Larsen-A	
VC349	65˚ 09.3'	53˚ 41.0'	1770	4.5	0554-0809/074	Mid slope, Larsen-A	
PC350	65˚ 07.0'	53˚ 24.7'	2040	4.36 + 0.7 TC	0909-1232/074	Mid slope, Larsen-A	

Table 3 CTD stations.

Station	Latitude S	Longitude W	Water depth m	Time on station	Location
71CTD83	63° 19.6'	52° 46.7'	448	0815-0910/055	NW Weddell
71CTD84	63° 24.5'	52° 27.1'	536	1005-1050/055	NW Weddell
71CTD85	63° 29.6'	52° 04.9'	960	1150-1310/055	NW Weddell
71CTD86	63° 32.7'	51° 45.9'	1416	1355-1520/055	NW Weddell
71CTD87	63° 34.8'	51° 35.1'	1872	1615-1830/055	NW Weddell
71CTD88	63° 38.8'	51° 17.7'	2211	1915-2112/055	NW Weddell
71CTD89	63° 43.3'	50° 48.7	2511	2225/055-0029/056	NW Weddell
71CTD90	63° 50.6'	50° 03.5'	2885	0340-0600/056	NW Weddell
71CTD91	63° 54.0'	49° 35.2'	3272	0735-1000/056	NW Weddell
71CTD92	63° 57.5'	49° 09.0'	3508	1120-1355/056	NW Weddell
71CTD93	64° 03.0'	48° 34.0'	3796	1510-1810/056	NW Weddell
71CTD94	64° 46.4'	60° 32.1'	953	0342-0444/065	Larsen-A
71CTD95	64° 47.1'	60° 30.9'	914	0556-0703/065	Larsen-A
71CTD96	66° 04.0'	60° 29.4'	328	0250-0347/066	Larsen-C
71CTD97	66° 12.1'	60° 21.5'	350	0457-0536/066	Larsen-C
71CTD98	66° 20.0'	60° 22.0'	420	0646-0721/066	Larsen-C
71CTD99	66° 27.9'	60° 17.0'	455	0823-0922/066	Larsen-C
71CTD100	66° 36.0'	60° 20.0'	440	1030-1110/066	Larsen-C
71CTD101	66° 04.0'	60° 20.0'	389	0514-0607/067	Larsen-C
71CTD102	66° 04.0'	60° 10.2'	344	0645-0720/067	Larsen-C
71CTD103	66° 06.0'	60° 02.0'	318	0805-0840/067	Larsen-C
71CTD104	66° 08.0'	59° 53.0'	314	0920-1000/067	Larsen-C

Table 4. CTD water bottle samples

Station No	Bottle	P(dbar)	Samples	Station No	Bottle	P (dbar)	Samples
71CTD083	1	446	D1/S1/B		2	2545	D48
	2	250	D2/B		3	1529	D49/B
	3	100	D3/B		4	452	D50
	4	50	S2/B		5	127	D51/B
71CTD084	1	533	D4/L		6	30	B
	2	475	D5/S3	71CTD093	1	3848	D52/S20/L
	3	334	D6		2	3067	D53
	4	138	D7/S4		3	1529	D54
71CTD085	1	963	D8/S5/L		4	613	D55/S21
	2	874	D9		5	440	D56
	3	461	D10		6	96	D57
	4	231	D11/S6	71CTD094	1	966	D58/S22/L/B
71CTD086	1	1425	D12/S7/L/B		2	800	B
	2	1271	D13		3	375	D59
	3	1148	D14		4	203	D60/B
	4	585	D15/B		5	82	B
	5	155	D16/B		6	42	D61/B
	6	34	S8/B	71CTD095	1	918	D62/S23/L
71CTD087	1	1883	D17/S9/L		2	505	D63
	2	1802	D18		3	204	D64
	3	1526	D19		4	37	
	4	609	D20/S10		5	22	D65
	5	173	D21	71CTD096	1	318	D66/S24/L
71CTD088	1	2226	D22/S11/L		2	244	D67
	2	1883	D23		3	102	D68
	3	1527	D24		4	41	D69
	4	558	D25	71CTD097	1	345	D70/S25/B
	5	185	D26/S12		2	274	D71
71CTD089	1	2533	D27/S13/L/B		3	223	D72/B
	2	2334	D28		4	163	D73/B
	3	2038	D29		5	82	D74/B
	4	1527	B		6	22	B
	5	488	D30/S14	71CTD098	1	416	D75/S26
	6	125	D31/B		2	228	D76
	7	24	B		3	193	D77
71CTD090	1	2916	D32/S15/L		4	92	D78
	2	2797	D33	71CTD099	1	451	D79/S27
	3	2550	D34		2	375	D80
	4	2038	D35		3	203	D81
	5	1528	D36	71CTD100	1	436	D82/L
	6	1017	D37		2	356	D83/S28
	7	507	D38		3	305	
	8	415	D39		4	203	D84
	9	115	D40		5	62	D85
	10	35	S16	71CTD101	1	385	D86
71CTD091	1	3312	D41/S17/L		2	324	
	2	3066	D42		3	152	D87/S29
	3	2450	D43	71CTD102	1	338	D88/S30
	4	1734	D44	71CTD103	1	312	D89/S31
	5	452	D45/S18		2	205	D90/S32
	6*	107	D46		3	103	D91
71CTD092	1	3544	D47/S19/B/L	71CTD104	1	310	S33/L

B = Biological; Dnn = Oxygen isotope; Snn = Salinity; L = Suspended sediment load

* Bottle 6 on 71CTD091: Lower end cap had not seated properly.

Table 5 XBT Stations

Cast no.	Probe_edf file	Time/date	Lat S	Long W	Water depth m	Cast length m
1	t5_00053	1459/044	55° 44.3'	60° 41.2'	4354	1296
2	t5_00054	2035/044	56° 51.9'	61° 37.3'	4126	403
3	t5_00055	0229/045	58° 02.7'	62° 43.2'	3937	1482
4	t5_00056	0930/045	59° 42.9'	63° 01.6'	3945	609
5	t5_00057	1430/045	60° 52.5'	63° 15.9'	3695	470
6	t5_00058	1435/045	60° 53.0'	63° 16.7'	3702	434
7	t5_00059	2030/045	62° 06.1'	64° 12.2'	3896	1419
8	t5_00061	0235/046	63° 11.0'	65° 58.9'	3165	294
9	t5_00062	0240/046	63° 11.6'	66° 00.1'	3170	296
10	t5_00063	0930/046	64° 13.3'	67° 41.9'	2633	1226
11	t5_00064	1500/046	65° 21.2'	69° 29.5'	2164	1496
12	t5_00065	2031/046	66° 04.0'	71° 07.0'	2773	556
13	t7_00066	1506/047	67° 07.2'	70° 19.2'	612	610
14	t7_00068	1615/047	66° 57.1'	70° 34.3'	525	519
15	t5_00069	1729/047	66° 46.8'	70° 50.4'	507	506
16	t7_00070	1840/047	66° 36.9'	71° 06.3'	502	499
17	t7_00071	1950/047	66° 27.0'	71° 21.8'	498	498
18	t7_00072	0109/052	67° 41.5'	69° 45.0'	333	333
19	t7_00073	0147/052	67° 37.5'	70° 03.4'	590	590
20	t7_00074	0222/047	67° 33.6'	70° 20.7'	641	630
21	t7_00075	0420/052	67° 30.0'	70° 36.7'	613	613
22	t7_00076	2059/052	66° 33.3'	70° 27.3'	600	600
23	t7_00077	2202/052	66° 34.6'	70° 45.0'	544	415
24	t7_00078	2241/052	66° 31.9'	71° 01.8'	520	457
25	t7_00079	2315/052	66° 29.4'	71° 17.7'	499	499
26	t5_00080	0014/053	66° 25.8'	71° 32.7'	1500	1396
27	t7_00081	0523/055	63° 00.3'	53° 42.7'	293	293

28	t7_00082	0654/055	63° 09.7'	53° 12.6'	415	415
Cast no.	Probe_edf file	Time/date	Lat S	Long W	Water depth m	Cast length m
29	t5_00083	1005/056	63° 54.0'	49° 35.2'	537	537 (noisy)
30	t5_00084	1011/056	63° 53.7'	49° 34.8'	536	536 (noisy)
31	t5_00085	1358/056	63° 57.4'	49° 08.8'	3506	1053
32	t7_00086	2252/057	64° 08.7'	58° 31.9'	857	760
33	t7_00087	1728/058	64° 34.4'	58° 29.1'	594	594
34	t7_00088	1826/059	64° 42.5'	60° 02.3'	792	760
35	t7_00089	2044/060	64° 40.0'	59° 12.3'	535	535
36	t7_00090	2357/060	64° 51.3'	57° 59.4'	455	395
37	t5_00091	0357/061	65° 04.6'	57° 15.3'	420	420
38	t5_00092	0704/061	65° 11.6'	56° 40.2'	520	520
39	t5_00093	0932/061	65° 15.3'	55° 52.9'	510	510
40	t5_00094	1114/061	65° 17.3'	55° 08.9'	440	440
41	t7_00095	1316/061	65° 17.2'	54° 15.5'	1042	1042
42	t5_00096	1016/062	65° 16.6'	53° 01.4'	499	499
43	t7_00097	1745/063	64° 55.0'	58° 50.5'	322	322
44	t7_00098	1340/065	64° 56.8'	60° 10.4'	330	330
45	t7_00099	1719/065	65° 00.1'	59° 01.4'	281	281
46	t7_00100	2009/065	65° 20.4'	58° 34.8'	485	485
47	t7_00101	2207/065	65° 32.3'	59° 14.8'	457	457
48	t7_00102	0013/066	65° 49.9'	59° 44.3'	430	430
49	t7_00103	0920/066	66° 27.9'	60° 17.0'	454	452
50	t7_00104	2202/066	65° 41.8'	60° 40.5'	466	466
51	t7_00105	1233/071	64° 50.0'	55° 22.4'	406	406
52	t7_00106	0136/072	64° 50.0'	54° 32.0'	421	437
53	t5_00107	1936/072	65° 06.6'	53° 52.5'	1523	154 (short)
54	t5_00108	1939/072	65° 06.6'	53° 52.0'	1540	162 (short)
55	t5_00109	0109/073	65° 07.0'	52° 54.8'	2307	1830
56	t5_00110	1702/073	65° 12.3'	51° 45.0'	2961	485 (noisy)

57	t5_00111	1708/073	65° 12.4'	51° 47.5'	2945	1234
Cast no.	Probe_edf file	Time/date	Lat S	Long W	Water depth m	Cast length m
58	t5_00112	1826/073	65° 12.8'	52° 20.4'	2725	1238
59	t5_00113	2127/073	65° 12.8'	53° 37.2'	1831	1266
60	t5_00114	0020/075	64° 52.6'	54° 08.8	1256	1256
61	t5_00115	1839/075	64° 19.0'	52° 32.1'	2529	496
62	t5_00116	0317/076	62° 49.9'	52° 13.2'	3027	1641
63	t5_00117	1250/077	56° 08.8'	55° 24.4'	4269	1007
64	t5_00118	1425/077	55° 45.0'	55° 37.3'	3989	904
65	t5_00119	1645/077	55° 08.8'	55° 56.2'	2392	917
66	t5_00120	0004/078	53° 29.1'	56° 41.0'	2845	1056

Table 6. Surface water samples.

Filter no.s 1-45 were pre-weighed and used for core sites.
Samples from CTD's are labelled as "CTD xxx".

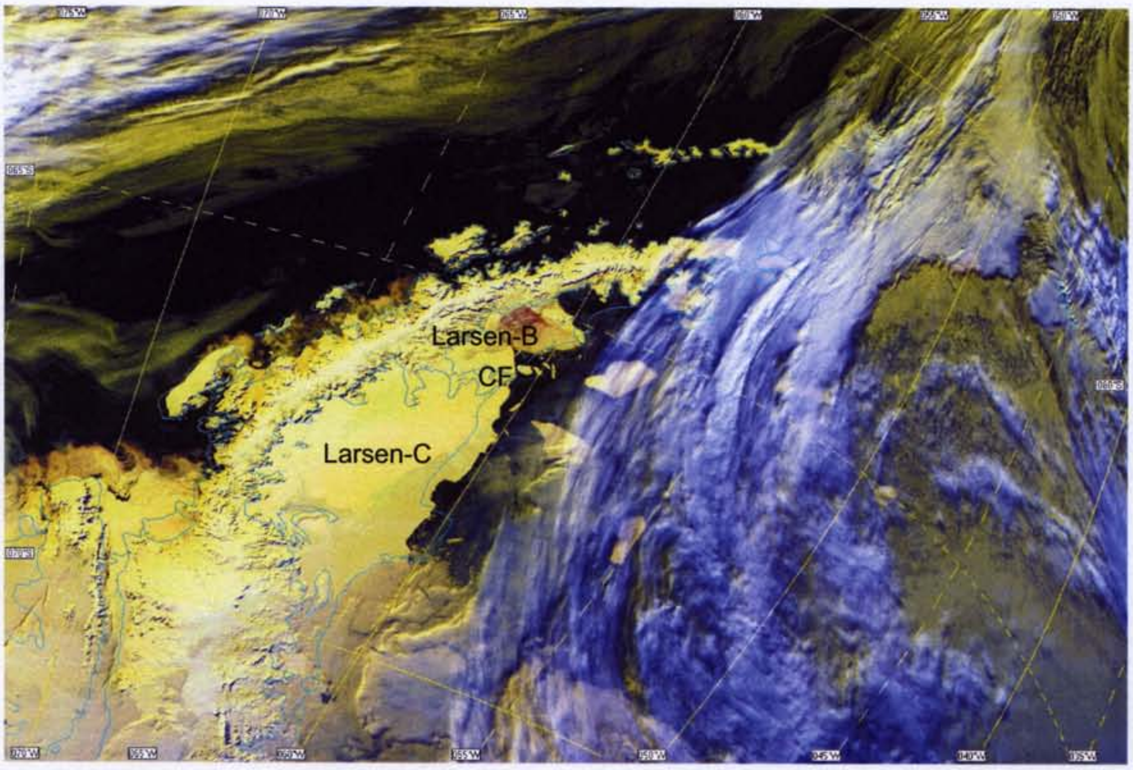
Julian day	Time (GMT)	Sample No.	Latitude S		Longitude W	
43	22.10	46	52	3.8	57	52.7
43	23.10	47	52	14.2	57	59.9
44	0.10	48	52	27.8	58	10.0
44	2.10	49	52	55.3	58	29.9
44	4.10	50	53	22.7	58	50.3
44	6.10	51	53	50.0	59	11.1
44	8.10	52	54	16.8	59	31.9
44	10.10	53	54	42.7	59	52.1
44	12.10	54	55	10.0	60	13.7
44	13.50	55	55	33.1	60	32.1
44	14.10	56	55	35.1	60	35.5
44	15.10	57	55	46.0	60	42.4
44	15.30	58	55	50.1	60	45.7
44	15.50	59	55	54.0	60	48.9
44	16.10	60	55	57.9	60	52.3
44	18.10	61	56	23.0	61	12.7
44	20.10	62	56	47.5	61	33.0
44	22.10	63	57	9.8	61	51.4
45	0.10	64	57	32.1	62	21.4
45	2.10	65	57	58.5	62	42.0
45	4.10	66	58	26.2	62	47.1
45	6.10	67	58	55.4	62	52.6
45	8.10	68	59	23.8	62	58.1
45	10.10	69	59	51.1	63	4.3
45	12.10	70	60	19.3	63	8.7
45	12.30	71	60	24.0	63	9.6
45	13.10	72	60	33.6	63	11.5
45	14.10	74	60	48.1	63	14.3
45	16.10	75	61	14.2	63	19.6
45	18.10	76	61	40.7	63	31.4
45	18.10	77	61	40.7	63	31.4
45	20.10	78	62	2.4	64	6.3
45	22.10	79	62	23.9	64	40.6
45	22.50	80	62	31.3	64	52.7
46	0.10	81	62	46.1	65	17.3
46	2.10	82	63	8.3	65	54.0
46	4.10	83	63	23.7	66	19.7
46	5.10	84	63	32.0	66	33.3
46	6.10	85	63	40.4	66	47.3
46	8.10	86	63	58.2	67	16.7
46	10.10	87	64	20.7	67	54.4
46	12.10	88	64	46.3	68	27.8
46	14.14	89	65	12.1	69	5.6
46	16.09	90	65	30.2	69	38.3
46	18.10	91	65	46.9	70	24.5
46	20.10	92	66	1.4	71	0.6
46	22.10	93	66	19.7	71	18.5
46	22.30	94	66	23.1	71	18.5
46	23.10	95	66	29.2	71	10.3
47	0.10	97	66	37.9	70	56.4
47	0.50	98	66	43.7	70	47.3

Julian day	Time (GMT)	Sample No.	Latitude S		Longitude W	
47	1.14	99	66	47.1	70	41.8
47	1.30	100	66	49.5	70	38.0
47	2.10	101	66	55.2	70	28.7
47	5.10	102	67	5.1	70	13.7
47	3.11	103	67	4.2	70	13.9
47	7.35	104	66	46.3	70	45.9
47	7.46	105	66	44.8	70	48.3
47	8.00	106	66	42.8	70	51.5
47	9.30	107	66	30.2	71	11.5
47	9.42	108	66	28.6	71	14.1
47	10.12	109	66	24.5	71	20.7
47	12.40	110	66	45.4	70	50.0
47	15.02	111	67	7.8	70	18.3
47	19.17	112	66	31.7	71	14.4
47	20.11	113	66	26.1	71	27.0
48	5.50	114	66	57.7	71	7.6
48	12.29	115	66	38.2	71	40.5
48	14.41	1	66	27.0	71	0.1
49	10.36	2	66	41.6	70	48.7
49	13.29	3	66	49.9	70	43.4
50	21.10	116	67	4.7	70	4.1
50	23.10	117	67	28.4	70	20.1
50	23.50	118	67	36.2	70	25.2
51	1.10	119	67	51.6	70	16.3
51	3.46	120	68	8.6	70	34.9
51	5.50	121	68	12.7	70	16.3
51	7.10	122	68	13.5	69	38.1
51	9.10	123	68	7.9	68	32.8
51	10.54	124	67	45.1	68	10.6
53	14.50	125	65	49.1	70	24.8
53	17.10	126	65	31.3	69	15.6
53	19.10	127	65	14.9	68	12.8
53	21.10	128	64	58.6	67	10.9
53	23.10	129	64	42.4	66	9.9
54	1.10	130	64	26.6	65	10.8
54	3.10	131	64	14.9	64	27.7
54	5.15	132	64	2.8	63	43.3
54	7.10	133	63	51.7	63	2.5
54	9.10	134	63	37.7	62	12.0
54	11.10	135	63	22.3	61	18.4
54	13.10	136	63	4.2	60	28.7
54	13.50	137	62	57.8	60	11.8
54	15.10	138	62	45.0	59	38.1
54	17.30	139	62	23.0	58	40.6
54	19.30	140	62	16.6	57	51.6
54	21.10	141	62	21.9	56	58.8
54	22.00	142	62	24.5	56	31.6
54	22.10	143	62	25.0	56	26.1
55	0.12	144	62	31.6	55	23.0
55	2.10	145	62	38.1	54	38.1
55	4.10	146	62	50.7	54	1.6
55	6.10	147	63	4.4	53	27.5
55	8.10	148	63	19.5	52	47.8
55	8.26	CTD 149	63	19.6	52	46.7

Julian day	Time (GMT)	Sample No.	Latitude S		Longitude W	
55	"	CTD 150	"	"	"	"
55	"	CTD 151	"	"	"	"
55	"	CTD 152	"	"	"	"
55	"	CTD 153	"	"	"	"
55	11.35	CTD 154	63	29.3	52	10.4
55	15.16	CTD 155	63	32.7	51	45.9
55	"	CTD 156	"	"	"	"
55	"	CTD 157	"	"	"	"
55	"	CTD 158	"	"	"	"
55	"	CTD 159	"	"	"	"
55	18.55	CTD 160	63	37.2	51	25.7
55	23.23	CTD 161	63	43.3	50	48.7
55	"	CTD 162	"	"	"	"
55	"	CTD 163	"	"	"	"
55	"	CTD 164	"	"	"	"
55	"	CTD 165	"	"	"	"
56	5.57	CTD 166	63	50.7	49	59.6
56	12.48	CTD 167	63	57.5	49	9.0
56	"	CTD 168	"	"	"	"
56	"	CTD 169	"	"	"	"
56	"	CTD 170	"	"	"	"
56	"	CTD 171	"	"	"	"
57	5.10	172	64	9.8	52	33.8
57	7.10	173	64	5.5	53	1.9
57	9.10	174	63	57.0	53	45.4
57	11.13	175	63	50.1	54	36.4
57	13.10	176	63	49.1	55	30.1
57	13.30	177	63	46.5	55	38.4
57	13.46	178	63	45.9	55	46.0
57	14.10	179	63	46.5	55	58.9
57	14.20	180	63	46.6	56	3.9
57	14.30	181	63	47.4	56	8.7
57	15.10	182	63	46.4	56	26.6
57	17.10	183	63	45.1	57	22.4
57	19.10	184	63	49.0	58	10.0
57	21.11	185	64	4.5	58	32.8
57	22.07	186	64	8.7	58	31.9
57	22.07	4	64	8.7	58	31.9
58	1.13	5	64	13.1	58	17.8
58	4.49	6	64	13.5	58	28.8
58	12.08	7	64	17.3	58	36.0
58	15.00	8	64	22.5	58	30.8
58	16.10	187	64	28.4	58	30.8
58	17.06	9	64	34.3	58	28.8
58	19.10	188	64	36.0	58	54.3
58	21.10	189	64	25.2	59	27.4
59	11.30	10	64	41.6	59	26.6
59	14.42	190	64	35.5	59	45.0
59	19.16	191	64	43.5	60	19.9
59	20.00	192	64	49.7	60	38.5
60	10.01	11	64	49.6	60	0.5
60	15.30	12	64	57.4	60	14.5
60	18.40	193	64	48.0	59	51.8
60	22.12	194	64	43.2	58	41.1

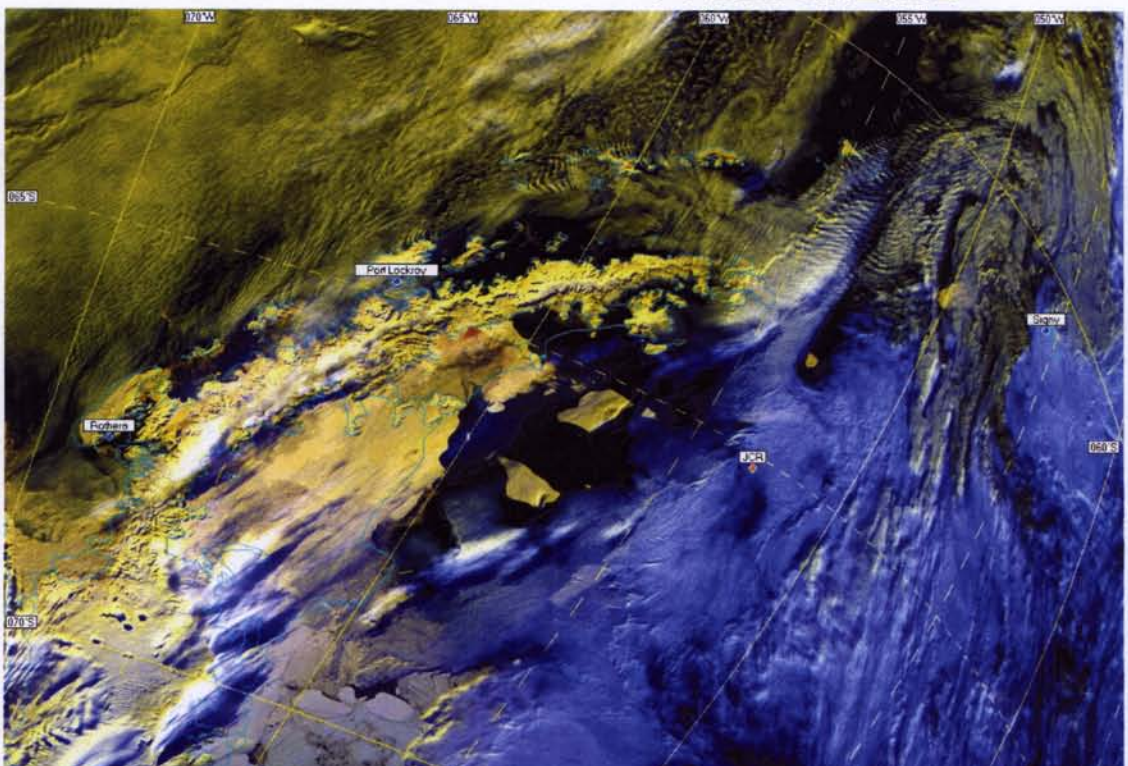
Julian day	Time (GMT)	Sample No.	Latitude S		Longitude W	
61	0.10	195	64	52.4	57	56.0
61	2.10	196	65	0.0	57	29.4
61	4.14	197	65	5.5	57	13.0
61	6.10	198	65	10.5	56	49.4
61	8.10	199	65	13.4	56	26.4
61	10.10	200	65	16.5	55	36.9
61	12.10	201	65	17.4	54	43.5
61	13.10	202	65	17.2	54	17.3
62	11.17	14	65	16.6	53	1.4
64	11.13	13	64	44.7	59	36.3
65	4.32	CTD 203	64	46.2	60	32.1
65	"	CTD 204	"	"	"	"
65	"	CTD 205	"	"	"	"
65	"	CTD 206	"	"	"	"
65	"	CTD 207	"	"	"	"
65	"	CTD 208	"	"	"	"
65	20.10	209	65	20.6	58	34.9
65	22.12	210	65	32.6	59	15.9
66	0.10	211	65	49.6	59	43.5
66	2.10	212	66	2.2	60	20.5
66	2.50	219	66	4.1	60	29.2
66	5.31	213	66	12.1	60	21.5
66	7.07	CTD 214	66	20.0	60	22.3
66	"	CTD 215	"	"	"	"
66	"	CTD 216	"	"	"	"
66	"	CTD 217	"	"	"	"
66	"	CTD 218	"	"	"	"
66	11.03	220	66	36.0	60	20.0
68	23.30	15	64	26.0	58	18.5
73	6.56	16	65	8.8	51	52.4
73	6.56	221	65	8.8	51	52.4
73	11.38	17	65	7.6	51	22.9
74	12.02	18	65	7.0	53	25.1
75	15.10	222	64	56.7	53	19.7
75	17.10	223	64	35.7	52	55.1
75	19.10	224	64	13.5	52	21.7
75	21.10	225	63	45.2	52	18.1
75	23.10	226	63	21.7	52	15.9
76	1.10	227	63	6.0	52	13.2
76	3.10	228	62	50.8	52	13.6
76	5.10	229	62	33.9	52	19.7
76	7.10	230	62	16.7	52	27.4
76	9.11	231	61	57.3	52	37.8
76	11.10	232	61	30.3	52	49.9
76	12.10	234	61	16.4	52	56.3
76	13.10	233	61	3.4	53	2.1
76	14.10	235	60	48.8	53	9.5
76	16.10	236	60	20.7	53	22.5
76	16.32	237	60	15.2	53	24.9
76	17.30	238	60	1.3	53	31.5
76	18.10	239	59	51.9	53	35.6
76	20.10	240	59	23.3	53	48.8
76	20.50	241	59	13.3	53	53.4
76	22.11	242	58	53.8	54	1.6

Julian day	Time (GMT)	Sample No.	Latitude S		Longitude W	
76	22.30	243	58	49.3	54	3.6
77	0.15	244	58	28.2	54	12.6
77	2.10	245	58	8.3	54	21.3
77	4.10	246	57	49.4	54	30.8
77	6.10	247	57	30.1	54	41.4
77	8.10	248	57	10.5	54	51.8
77	9.50	249	56	50.2	55	2.6
77	10.10	250	56	45.5	55	4.8
77	11.10	251	56	31.7	55	12.6
77	12.50	254	56	8.8	55	24.4
77	13.10	252	56	4.0	55	27.0
77	13.30	253	55	58.9	55	29.7
77	13.50	255	55	53.9	55	32.5
77	14.00	256	55	51.4	55	33.9
77	14.20	257	55	46.3	55	36.6
77	14.50	258	55	38.6	55	40.7
77	15.11	259	55	33.1	55	43.4
77	14.10	260	55	17.9	55	51.5
77	17.10	261	55	2.6	55	59.4
77	21.11	262	54	7.8	56	19.0
77	23.06	263	53	41.0	56	34.3
78	0.30	264	53	23.7	56	44.0
78	1.12	265	53	15.0	56	48.8
78	3.10	266	52	51.7	57	2.5
78	4.55	267	52	30.1	57	14.7



05 March 2002

14 March 2002




Cruise JR71
Track chart of Larsen area, continental shelf and slope
Colour code for days
057
058
059
060
061
062
063
064
065
066
067
068
069
070
071
072
073
074
075
313 Box core
344 Vibrocore or piston core
102 CTD
60 XBT
64°S
65°S
66°S
60°W
58°W
56°W
54°W
52°W
James Ross Island
Prince Gustav Channel
Cape Longing
Sobral Peninsula
Cape Worsley
Seal Nunataks
Line S103
Line S104
Line S105
Larsen-B
Cape Framnes
Larsen-C iceshelf
500
2000


Cruise JR71
Track chart
Track with normal data (EM120, TOPAS,STCM ocean logger, ADCP)
Track without TOPAS data
Track with towed magnetometer data
CTD
Core
XBT
(Omitted for clarity in Larsen-A and outer Marguerite Bay)
Inset:
Marguerite Bay
(same scale as JR59 track chart)
Colour code for days
046
047
048
049
050
052
053
Core
XBT
Larsen area track chart
50°W
60°W
70°W
71°W
55°S
60°S
65°S
66°S
67°S
Stanley
Burdwood Bank
Scotia Sea
Drake Passage
JR59 survey
Shackleton Fracture Zone
Hero Fracture Zone
South Scotia Ridge
South Shetland Is
King George I
Smith I
Dundee I
Paulet I
Carlson
Croft Bay
James Ross I
Prince Gustav Channel
Peninsula
Antarctic
Anvers I
Seal Nunataks
Larsen-B
Jason Peninsula
Weddell Sea
Larsen-C Ice Shelf
Rothera
Marguerite Bay
2000 m