RRS James Clark Ross

JR 59 Cruise Report

Swath bathymetry and TOPAS profiling
on the Antarctic Peninsula margin
and in Drake Passage

British
Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Cruise Report

RRS *James Clark Ross*

Cruise JR59

February to March 2001

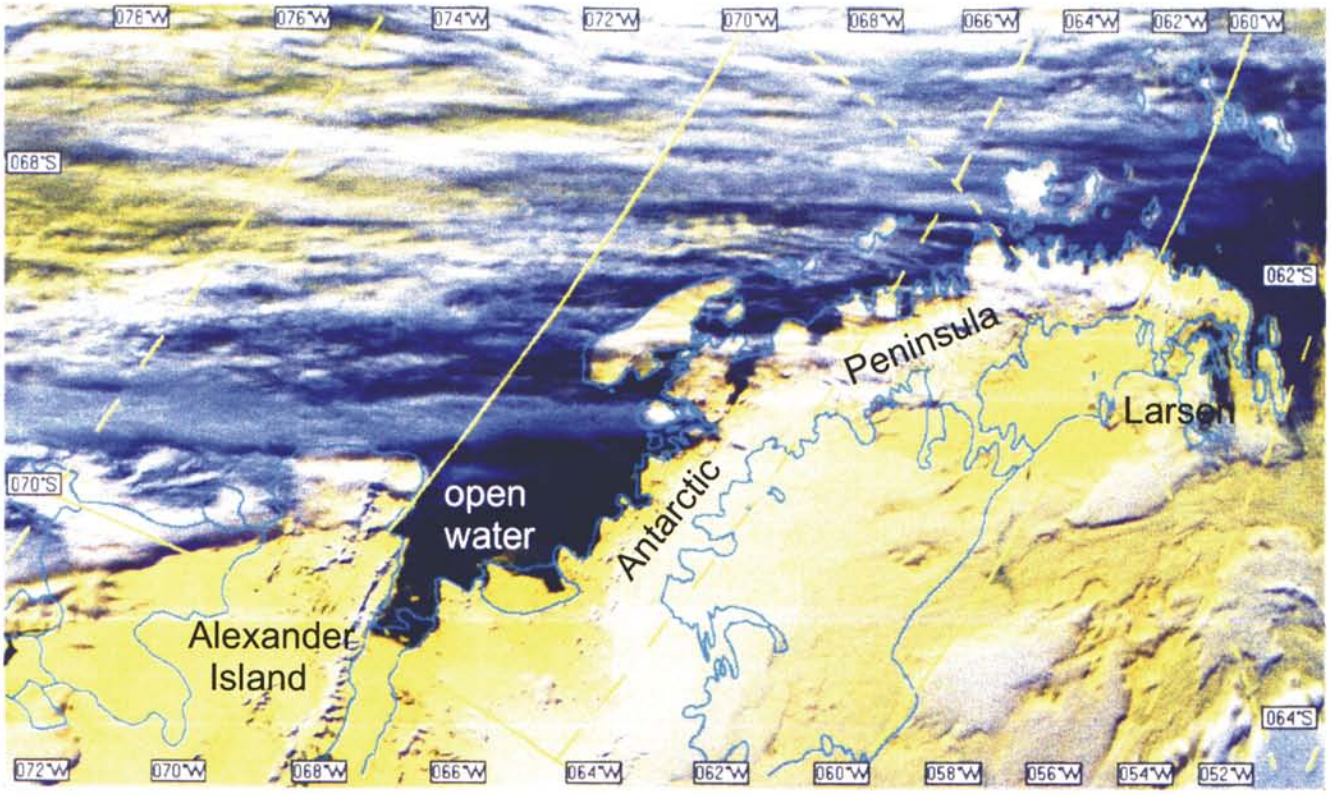
Swath Bathymetry
and
TOPAS sub-bottom profiling

Antarctic Peninsula Pacific Margin
and Drake Passage

Carol J Pudsey and Peter Morris
with contributions from Mark Preston, Chris Drew and Simon Wright

BAS Reference No. ES6/1/2001/1 **April 2001**

Copy no. ....

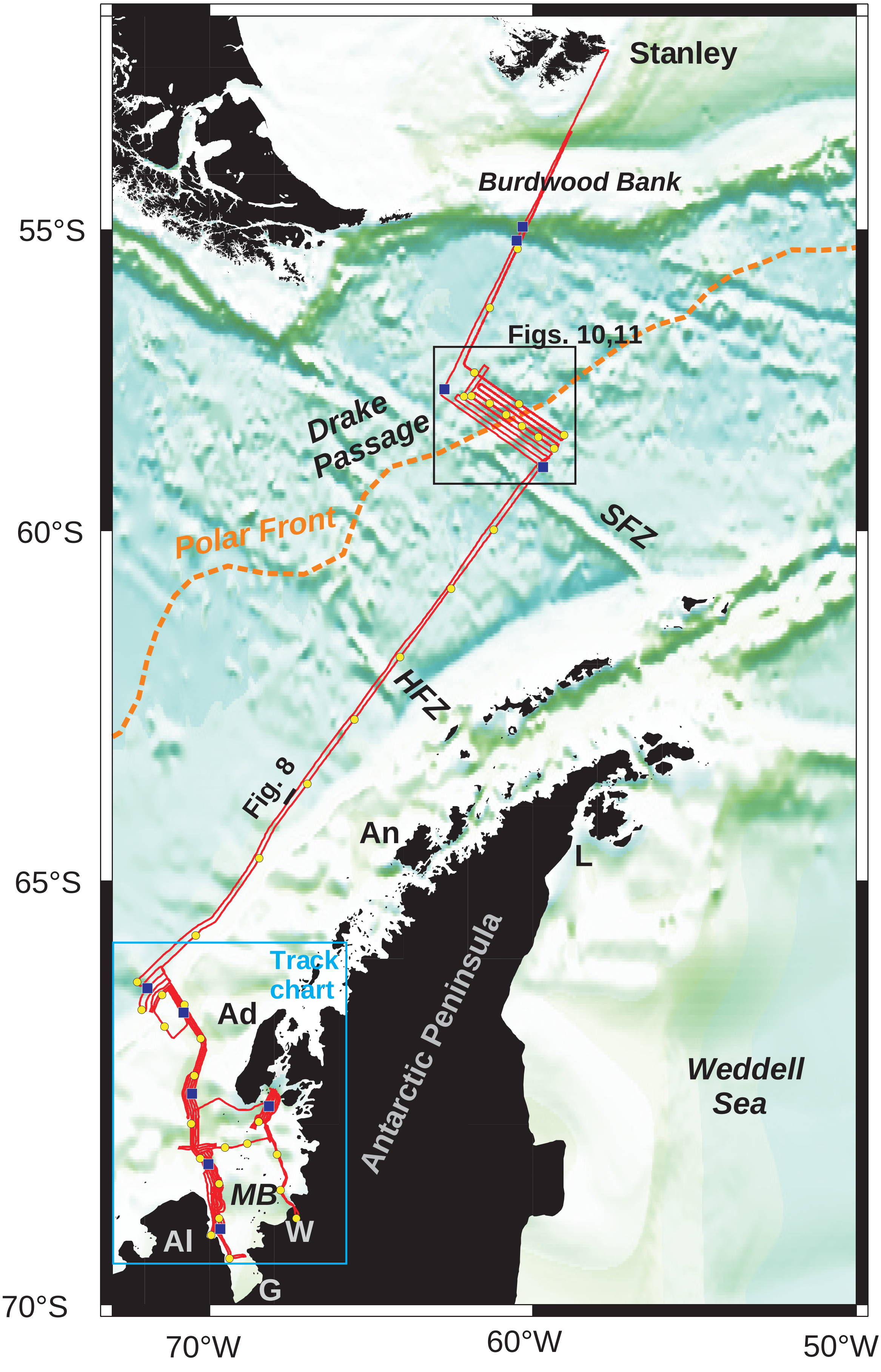


Frontispiece: DARTCOM HRPT image of the northern Antarctic Peninsula, 19 Feb 2001. Sea appears dark, land and floating ice appear yellow, clouds appear blue and white. Superimposed coastline coloured light blue, lat/long grid in light yellow.

Front cover photograph: RRS *James Clark Ross* alongside Biscoe Wharf. Taken from the workboat during echo sounder trials.

Back cover: JR59 swath coverage in Marguerite Bay.

CONTENTS



Stanley
Burdwood Bank
Figs. 10,11
Drake Passage
Polar Front
SFZ
HFZ
Fig. 8
An
L
Track chart
Ad
Antarctic Peninsula
Weddell Sea
MB
W
Al
G
55°S
60°S
65°S
70°S
70°W
60°W
50°W

1. INTRODUCTION AND OBJECTIVES (CJP)

Cruise JR59 was originally planned as a follow-up to the highly successful cruise JR48 in the 1999-2000 season. We had intended to conduct swath bathymetric survey and TOPAS profiling in the area of the former Larsen Ice Shelf. About a month before departure it became clear that the pack ice in the northwestern Weddell Sea was not going to recede sufficiently to allow ship access to that area. Accordingly we decided to work on the west side of the Antarctic Peninsula, from southernmost Marguerite Bay out to the continental shelf edge at 71˚W.

This cruise forms part of the BAS SAGES programme (Signals in Antarctica of Global changES) and the AFI bid "Ice-rafted debris on the Antarctic continental margin and the dynamics of the Antarctic ice sheet" led by Julian Dowdeswell and Carol Pudsey. Continental shelf sediments contain a record of the last deglaciation and the palaeoclimate of the Holocene interglacial. The recession history of the Wordie and George VI Ice Shelves will provide an interesting comparison with that of the northern Larsen and Prince Gustav Ice Shelves. The latter has recently been shown to have retreated at least once before, during the mid-Holocene warm period (Pudsey & Evans in press).

Prior to cruise JR59, the trough on the continental shelf extending north from Marguerite Bay had been interpreted as deepened by an ice stream, on the basis of seismic and (rather sparse) bathymetric data (Bart & Anderson 1995, Rebesco *et al.* 1998). A mid-shelf grounding zone had been postulated to explain certain features on seismic profiles, and this was an important target for swath survey. We planned to survey selected areas from overdeepened glacial basins on the inner shelf, along Marguerite Trough to the shelf edge, slope and upper continental rise. This would be the first high-resolution survey of a complete glacial pathway on any Antarctic margin. The southern part of Marguerite Bay is largely unsurveyed (it was perennially ice-covered until the late 1980's), but the Hydrographic Office provided collector sheets for the area. Lines of *Endurance* soundings extending south towards George VI Ice Shelf were particularly useful.

The AFI bid called for all the Marguerite Bay work to be undertaken in the 2001-02 season. By obtaining site survey data this year, core selection for next season can be more carefully considered and the Marguerite Bay component of next year's cruise can be shorter. Additional time will, however, be required in the Larsen area next year.

Figure 1. Summary track chart of cruise JR59, superimposed on a shaded-relief bathymetric map. Ad, Adelaide Island; Al, Alexander Island; An, Anvers Island; HFZ, Hero Fracture Zone; L, former Larsen Ice Shelf; MB, Marguerite Bay; SFZ, Shackleton Fracture Zone. Blue squares mark Sound velocity Profile stations, yellow dots mark XBT casts. The blue rectangle is the area of the fold-out track chart at the back of this report.

Swath bathymetric survey was also undertaken in central Drake Passage. During the 1997-98 season an area of seafloor adjacent to the Shackleton Fracture Zone was mapped by BIO *Hesperides*. This included the southwestern part of segment W1 of the West Scotia Ridge. This part of the cruise, originally designated JR56, completed the mapping of W1 and its offset transform to the northeast, to establish the sequence of events related to Drake Passage opening. STCM magnetic data were acquired throughout the cruise and were particularly useful in this area to define the sequence of magnetic anomalies near the ridge crest.

The swath system had been installed on RRS *James Clark Ross* in the summer of 2000 and cruise JR59 was to be its first use in the Antarctic. Although the complete system had been accepted after the trials cruise (JR50) and successfully used on an Arctic cruise (JR51), on the southward Atlantic transect problems had been reported with the Simrad Synchronization Unit (SSU). As these could not be resolved by BAS ETS/ITS staff during the first part of the season, it was decided to send an engineer from Kongsberg Simrad on the first part of JR59 to fix the SSU. This would also provide an excellent training opportunity for the scientific party, only two of whom had been on the trials cruise. A brief call at Rothera was inserted in the itinerary to disembark the KS engineer, and we were then also asked to undertake some cargo work at the base.

JR59 was a minimalist cruise with only two scientific and two technical staff. We collected 25.9 GB of data which represents nearly 300 MB per person, per day.

2. NARRATIVE (CJP)

RRS *James Clark Ross* sailed from FIPASS, Port Stanley at 1110 on the morning of Saturday Feb 17th (day 048), 2001. Three scientific personnel (Carol Pudsey, Peter Morris and Kjetil Aasekjar) had arrived from the UK the previous afternoon; the technical support staff (Mark Preston and Chris Drew) remained on board from the previous cruise. Because we were using entirely ship-fitted equipment, no mobilisation time was required, though a safety brief took place on the afternoon of sailing.

The ship headed SSW across the Falkland Plateau, Falkland Trough and Burdwood Bank towards the northern end of the first survey area in Drake Passage (fig. 1). The EM120 swath bathymetry system and TOPAS sub-bottom profiler were turned on. Much **cognitive interaction in a technologically enriched learning environment** ensued, as we climbed up the steep learning curve of data acquisition with the aid of Kjetil and the manuals. Only PM and MOP had been on the trials cruise with the new equipment; it was entirely new to CJP and CJD. We were not helped by the weather, the southwesterly wind increasing to force 7-8 by the first evening and reducing ship speed to 7 knots. All the echo sounders on the ship, including the EA500 on the bridge and the EK500, suffered badly from dropouts resulting from aeration under the hull.

During the following day the wind eased and we started to obtain reasonable records. Kjetil fixed the SSU so that in shallow water over Burdwood Bank (~100 m depth) the EM120, EK500, EA500 and TOPAS could all be made to transmit and receive in sequence. The first deployment of the Sound Velocity Probe (SVP) was made on the south side of Burdwood Bank, but no data were recorded because of low battery power. A second attempt 3 hours later was successful, and with a realistic sound velocity profile the EM120 data looked considerably better (i.e. a flat seabed looked flat).

We proceeded SSW in deep water, with the EK500 turned off, the EM120 and EA500 controlled by the SSU but with TOPAS on manual triggering at a 2-second ping rate. A compromise has to be chosen between quality and quantity of acoustic data in deep water. With all three echo sounders pinging in sequence, the ping interval for each is about 25 seconds. This is very much less than the 1-second ping interval of the old 10 kHz PES and 3.5 kHz profiler. At 10 knots the ship travels 128 m in 25 seconds, and this is insufficient horizontal resolution for many of the features we wish to image with TOPAS. We considered it preferable to acquire many more traces using manual triggering, and put up with a percentage of noisy traces.

The Drake Passage survey area was approached in the morning of day 050. We carried out another SVP drop and an STCM calibration, and started the first NW-SE survey line just after 11 am. Survey speed was 10 knots. For the first few hours we experienced problems with the EM120 losing the seabed, repeated manual corrections being required (force depth). We turned off TOPAS after 4 ½ hours, and the bridge EA500 off after a further 1 ½ hours. Despite minimum acoustic interference and good weather, the EM120 still required continual adjustment of its settings to keep track of the seabed over steep gradients.

At the end of the first line we stopped for a further SVP deployment. The survey area straddles the Polar Front (fig. 1), so there is likely to be variation in temperature and hence sound velocity along the lines from NW to SE. The second long line was completed in

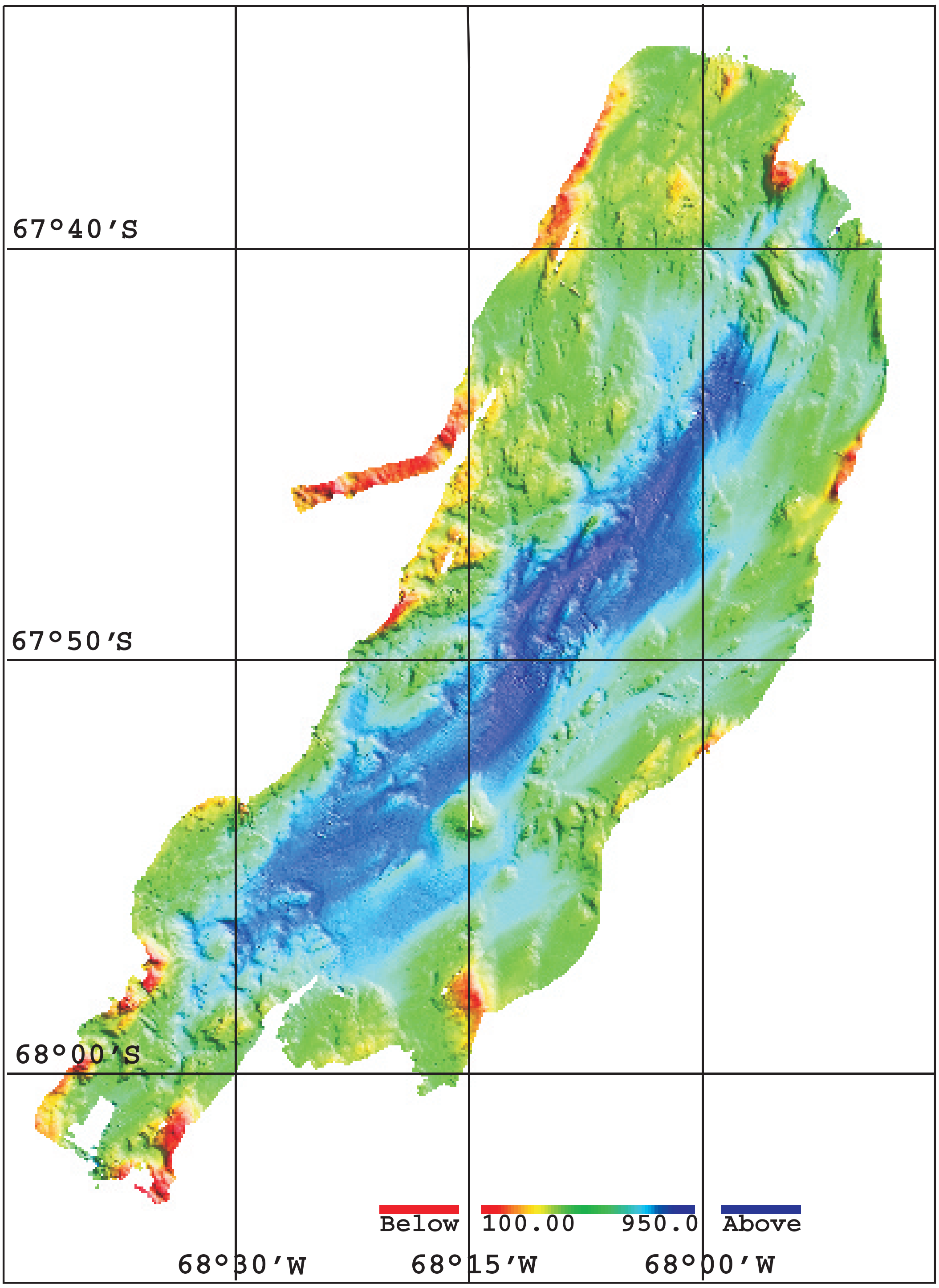


Fig. 2. Swath bathymetric map of southern Laubeuf Fjord

deteriorating weather, with the wind NE force 7 and poor visibility. At the start of the third line the ship rolled so much that the data were almost useless, so it was decided to try NE-SW lines instead, up- and down-wind. When the sea state eased a little we launched the first XBT and ran another SE line (overnight days 051-052). This completed nearly two days out of four planned for this survey. In view of the continuing northeasterly wind, we decided to run for Marguerite Bay and finish the Drake Passage survey on the way home.

TOPAS was re-started in the morning of day 052 and we ran southwest at 12 knots, doing XBT casts every six hours. With increasing practice we were all getting the hang of running the EM120 and TOPAS. In a big following sea (wind NE veering SE, force 7-8) the data quality suffered, and we used a swath beam angle of only 50-55° for the first part of the passage. TOPAS at last began to show some sub-bottom penetration in the sedimented area between the Shackleton and Hero Fracture Zones. The weather improved during day 053 and we obtained good swath and TOPAS records over the sediment drifts nothwest of Anvers Island. From 64° 30'S our track was along the base of the continental slope, as far as 66° 08'S, 71° 30'W where we turned southeast early on day 054 to run upslope and across the continental shelf.

In relatively shallow water (~500 m) we needed a different mode for the SSU. EM120 and TOPAS data were both required, and the bridge needed to know depth under the ship. Kjetil had the bright idea of starting the EA500 and EM120 cycle at the same time, and setting the EA500 in passive mode so that it did not transmit, but listened for the return echo from the centre beam of the EM120. This allowed the same data to be acquired during a shorter ping interval than with the EA500, EM120 and TOPAS each pinging in sequence. The Principal Scientist’s birthday was spent running a long line south along Marguerite Trough to the NE end of Alexander Island. We imaged glacial flutes clearly showing the northward flow of grounded ice, also a spectacular sediment lens interpreted as a till sheet on the outer 25 miles of the shelf.

Waypoints had been picked along the line of the deepest of the *Endurance* soundings, southwards in George VI Sound. At about 3 a.m. on day 055 the concentration of icebergs and bergy bits made it unwise to continue south in the dark, so the ship turned back and ran a parallel swath about 1 ½ miles to the west. Turning south again we imaged a deep glacial trough only some two miles off the coast of Alexander Island. In the forenoon this was followed southwards to 69°S. Seeking the deepest water, we reached 69°05'S, 69° 40'W before increasing amounts of ice, fog, snow and a freshening northerly wind made it prudent to retreat. We ran another parallel swath north to 68° 16'S, stopping once for an SVP. Turning south again, it was clear the weather was getting the better of us: dropouts on all three echo sounders, and the non-toxic seawater pump tripped because of aeration at the intake. Finally when the SSU crashed, leaving the bridge without any depth readings for the third time that evening, we decided to cease data collection and head slowly north back up our inbound track, until the weather improved.

In the forenoon of day 056 it was still blowing hard from the north and forecast to continue. The only place on this coast with any shelter from the north and likely to be fairly ice-free is Laubeuf Fjord, so as we had to be at Rothera the following day we headed east a day early. The SSU was re-programmed to allow the bridge EA500 to operate independently of our equipment. The new “safe” mode normally provides for the EA500, EM120 and TOPAS each to ping in sequence. If either the EM120 or the SSU itself fails, the EA500 will

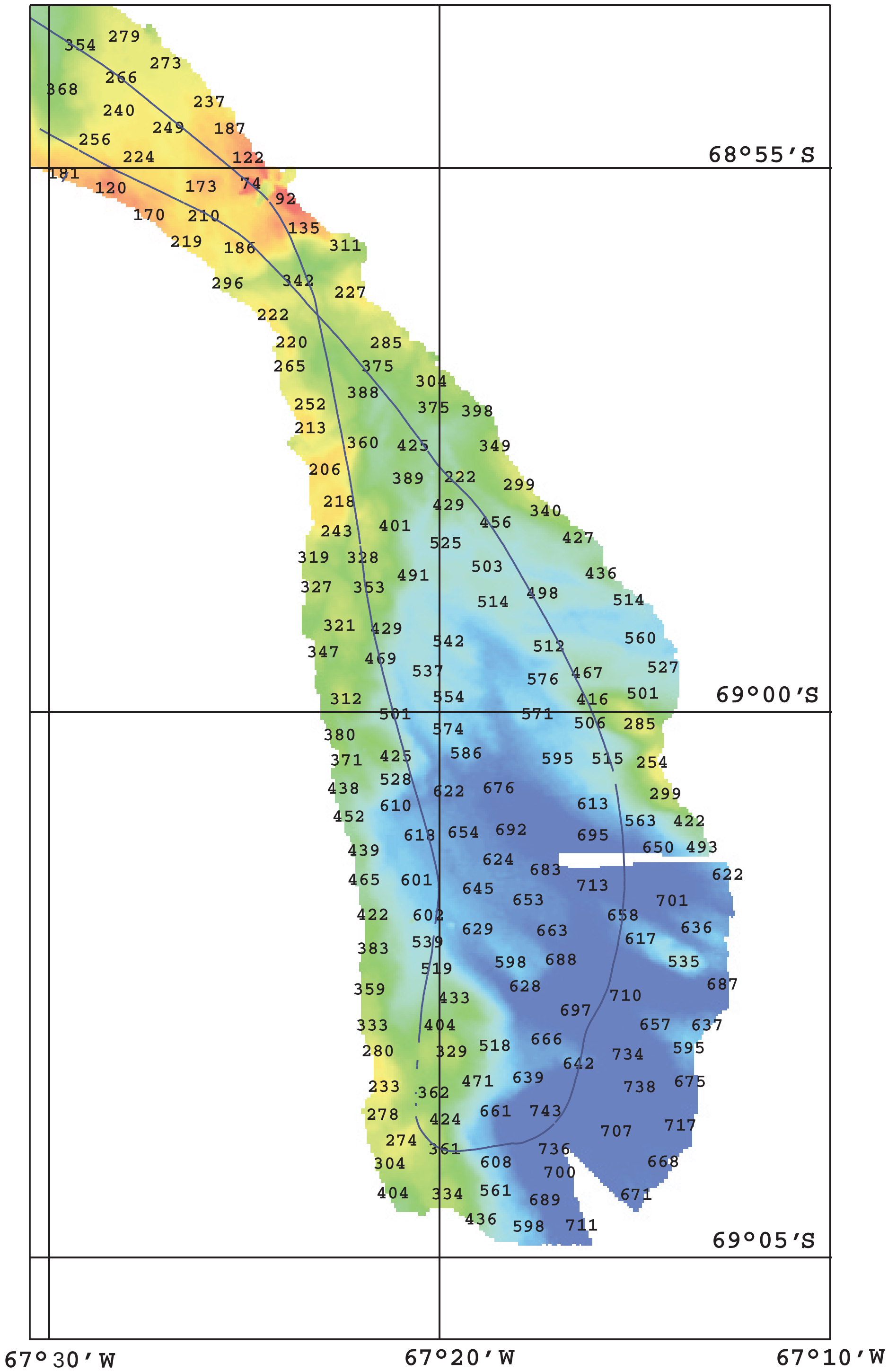


Fig. 3. Swath bathymetric map of small area NW of Wordie Ice Shelf. Ship track shown in dark blue. Soundings in metres.

revert to its normal mode of operation after a maximum of 30 seconds. Such safeguards are essential when working in unsurveyed waters.

The vessel took the normal route towards Rothera south of Adelaide Island, the EM120 and TOPAS records improving as we entered the lee of the island. The TOPAS recording window is only 400 ms long, and this necessitates very frequent delay changes when traversing the rough topography of the inner shelf. The survey of southern Laubeuf Fjord began at 4 p.m., and by breakfast the following morning we had completed four long lines and were ready to head for Rothera base. The ship spent 6 hours at Biscoe Wharf. Kjetil disembarked, 3 containers and some general cargo were off loaded and 13 containers and 2 waste skips taken on. We were honoured by a visit from Admiral Ian Forbes R.N., Flag Officer Surface Flotilla, who was on a tour of Antarctic Peninsula bases. The opportunity was also taken to launch the workboat and try out its echo sounder, which had been reconditioned by the Electrical Engineer. There was a possibility we might use the workboat to go ahead of the ship in particularly shallow, unsurveyed waters.

We left Rothera at 1440 and spent the rest of the day and night finishing the survey of Laubeuf Fjord (fig. 2). It is essentially a rock basin with very little sediment except for a few patches on the east side. Southwestward ice flow can be inferred from seabed topography, but the basin has no obvious outlet at the southwest end. In the early morning of day 058 we started south towards the Wordie Ice Shelf. This was the start of 6 days' calm weather. As far as 68° 48'S we were near an existing line of soundings, but the area south of Cape Berteaux was completely unsurveyed, so we proceeded with caution at 4-6 knots. Luckily the visibility was excellent and we had stunning views of the mountains and glaciers of Trinity Peninsula.

The bridge was using the Furuno sonar directed forwards to warn of any impending dangers. We passed over three small shoals with soundings as shallow as 90-100 m, and as expected found deep water (550-600 m) just off the ice shelf front. By then we had found out how to grid the recently-acquired swath data and print it rapidly on A4 sheets as coloured charts with soundings in metres. The supply of these to the bridge approximately every half hour did a great deal to inspire confidence. Unfortunately, in contrast to the Larsen, deep-water areas suitable for coring were extremely restricted. A dense mass of large tabular bergs just to the southwest of our track were thought to be aground in shallow water, and the HRPT image of 19 Feb showed fast ice south of 69° 06'S (see Frontispiece). It was fairly clear that one double swath would be enough for the Wordie (fig. 3) and that it would be more rewarding to spend time on the west side of George VI Sound. Fine views of the Peninsula continued all evening as we returned northwards.

At first light on day 059 the ship proceeded west through Fauré Passage to rejoin the survey northeast of Alexander Island. The strong northerly wind a few days earlier had blown most of the ice a long way south, and despite poor visibility we were able to sail right into Schokalsky Bay at 69° 16' S. Using the real-time display on the EM120 it was possible to guide the ship along the axis of a deep glacial channel for some 15 miles, asking the bridge for small course changes each time we veered off to one side. Again, the deepest water (nearly 800 m) was within about two miles of the snout of Hampton Glacier. There was too much ice about to be able to work this far south overnight, so the hours of darkness were spent adding two more lines to the survey between 68° 20' and 69°S. Post-processing of the swath data (gridding and Binstat quality control) could be done on earlier survey data on the processing workstation while data acquisition was still going on, so we started to produce

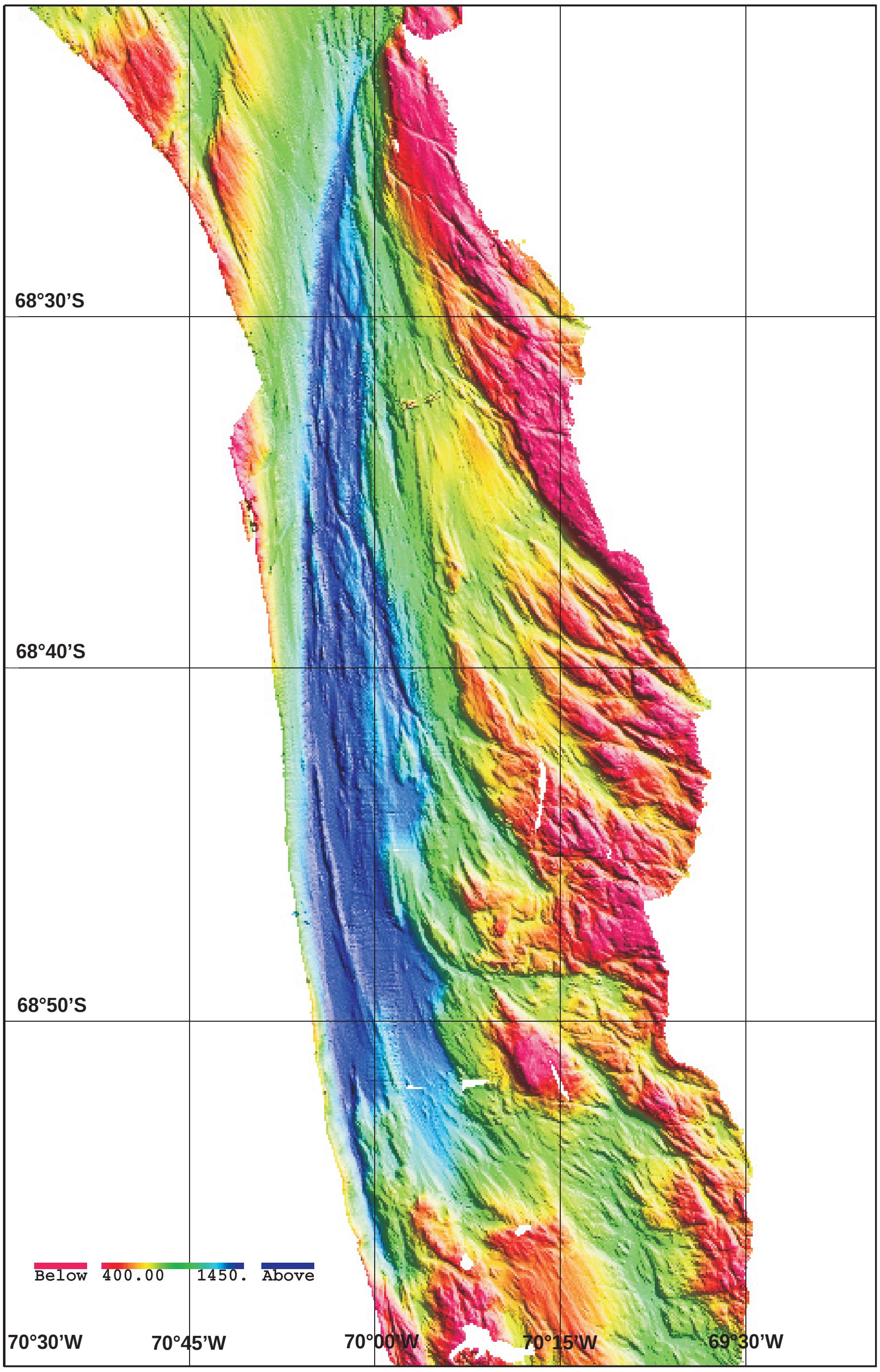


Fig. 4. Swath survey of part of the inner shelf NE of Alexander Island.

colourful shaded-relief maps of the survey areas.

Day 60 saw our Farthest South. We extended the swath survey east from Alexander Island and did an SVP station off Cape Brown. While on station we attempted to correct a clock error of 40 seconds; this resulted in an SCS crash which took 3/4 hour to fix. The ship then headed south to Toynbee Glacier in patches of brash ice, poor visibility and snow. Luckily the weather cleared and the ice thinned out enough for us to take a run across George VI Sound at 69° 30'S. A deep (900-1100 m) glacial trough in the middle of the sound remains to be mapped during next year's cruise. Tempting as it was on a fine evening to continue south to the ice margin, we had work to do on the outer shelf, so ran one final swath up the eastern edge of our existing survey (fig. 4),

The next two days were spent mapping the middle and outer continental shelf. In relatively shallow water (450-600 m) the swath is quite narrow and we were unable to survey the whole width of Marguerite Trough. Nonetheless we defined the main trends of glacial flutes directed northwards off Adelaide Island, becoming more subdued and swinging to NNW on the outer shelf (fig. 5). TOPAS imaged a transparent sediment drape from about 68° 20'S to 67° 00'S, thickest in the south as had been found on earlier 3.5 kHz surveys (Pudsey et al. 1994). We also saw the till sheet near the shelf edge on all five lines (fig. 6). In the afternoon of day 063 we ran a 25-mile line along the shelf edge then headed southeast along a track well away from Marguerite Trough. The till sheet was absent but the same NNW seabed fabric was observed.

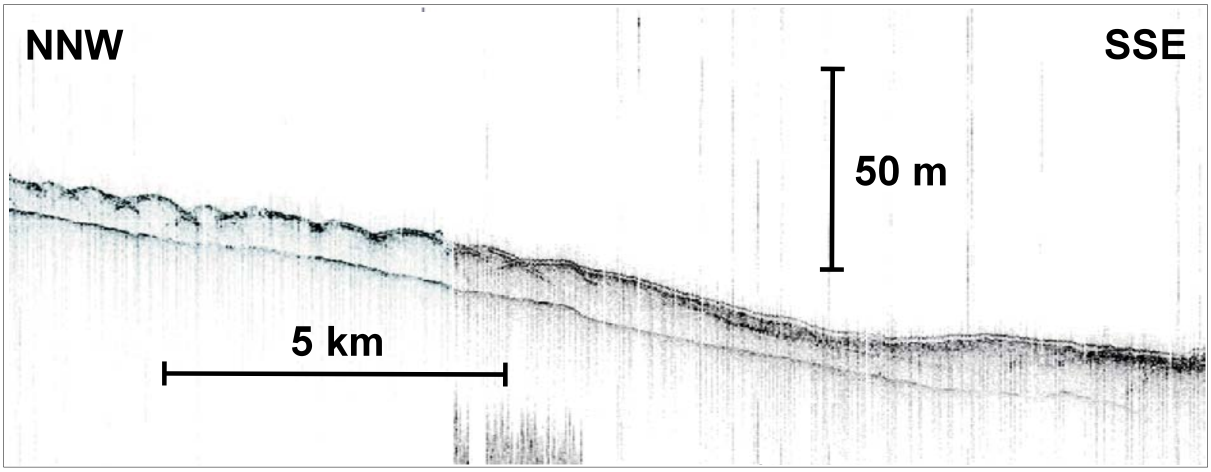


Figure 6. TOPAS profile near shelf edge. Thin transparent drape overlies another transparent layer some 8-12 m thick, which has a hummocky/furrowed top surface in the shallower (NNW) part and is interpreted as a till sheet. The base of the till sheet is much smoother..

Day 064 was devoted to the slope and upper continental rise. Three curving swaths parallel to the shelf edge line revealed numerous small gullies on the upper slope, fading out downwards (fig. 7). Three more lines provided a beautiful map of the southeastern part of

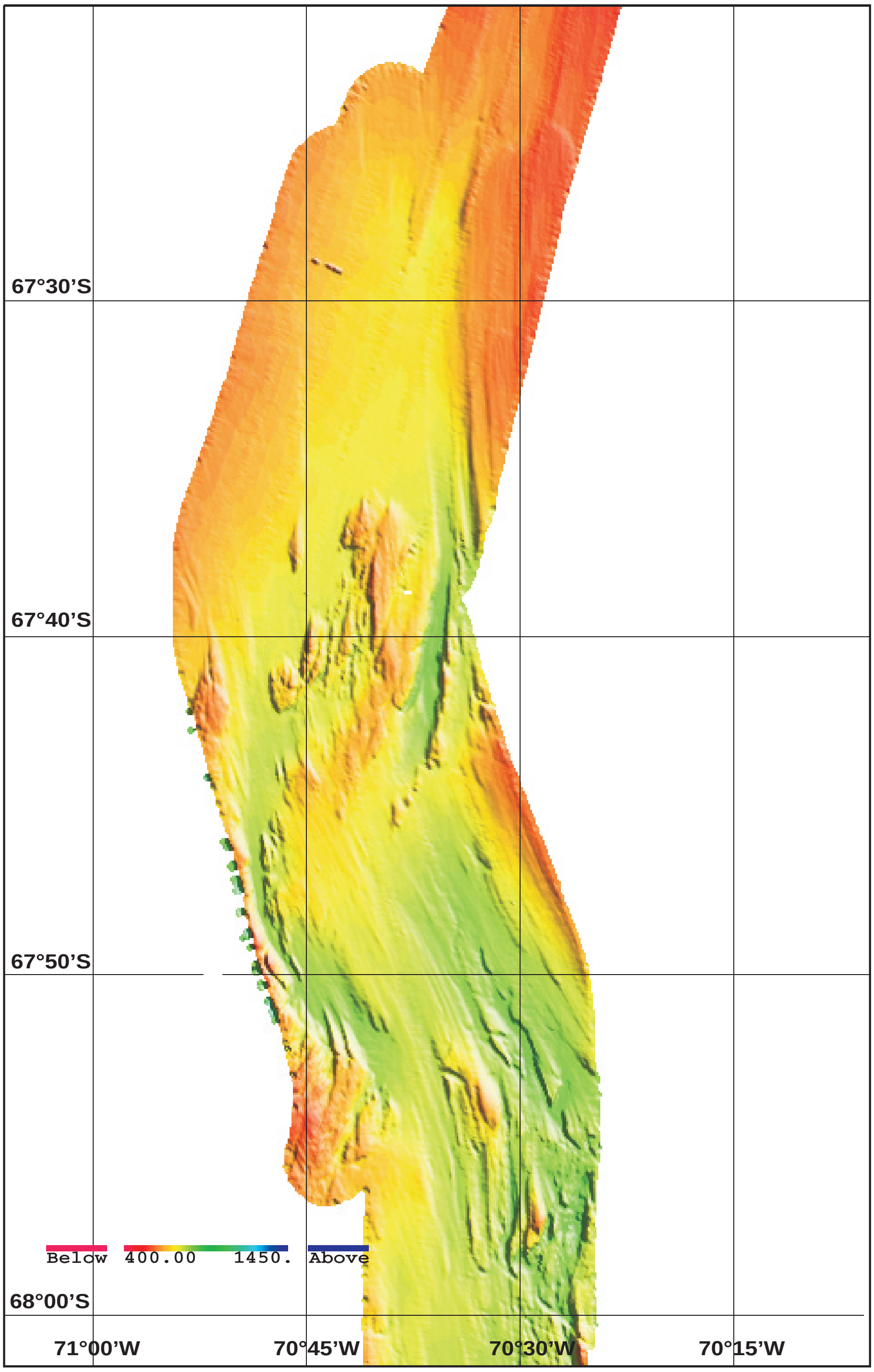


Fig. 5. Swath survey of the middle shelf east of Adelaide Island.

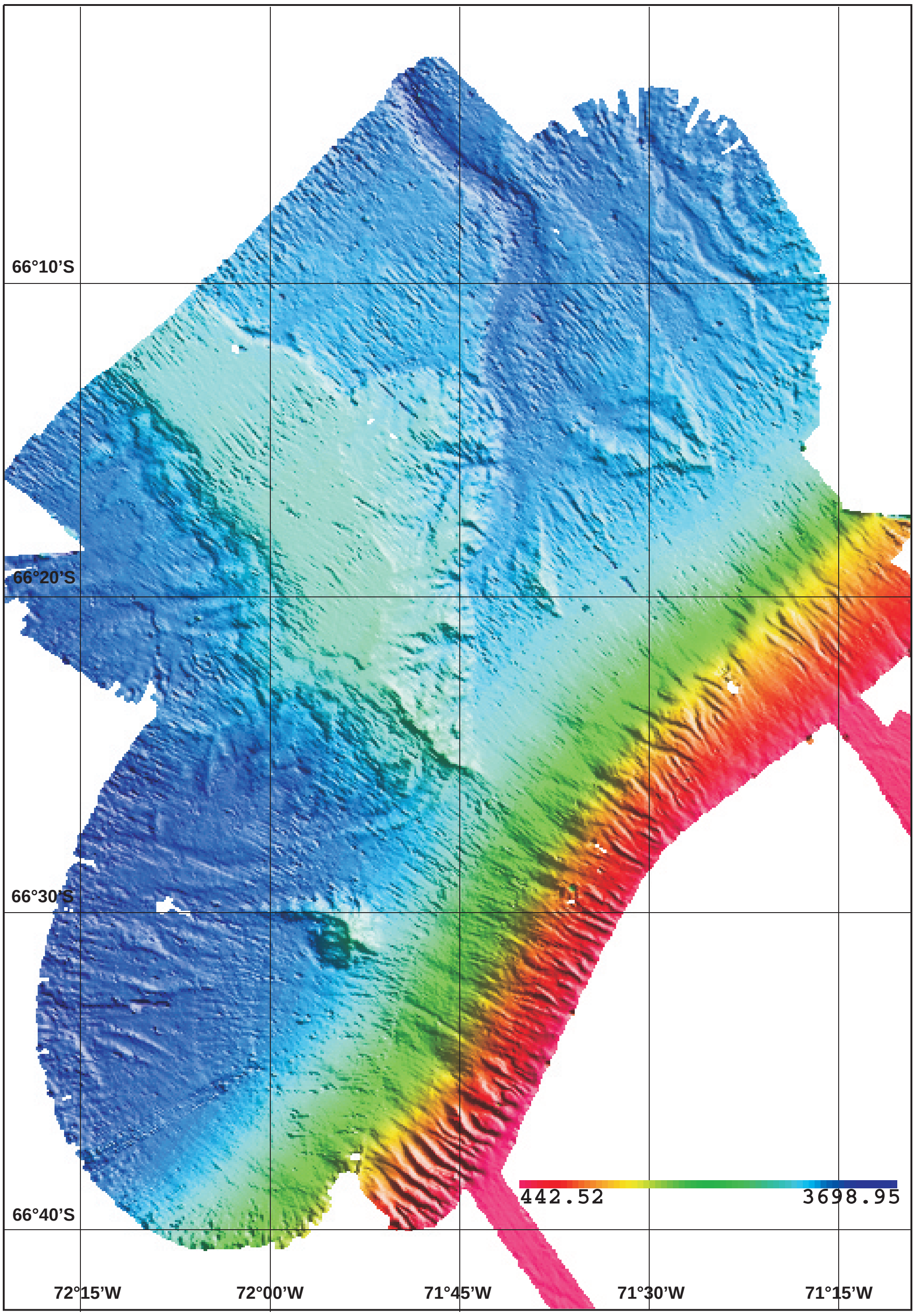


Fig. 7. Swath survey of the continental slope and rise including drift 5.

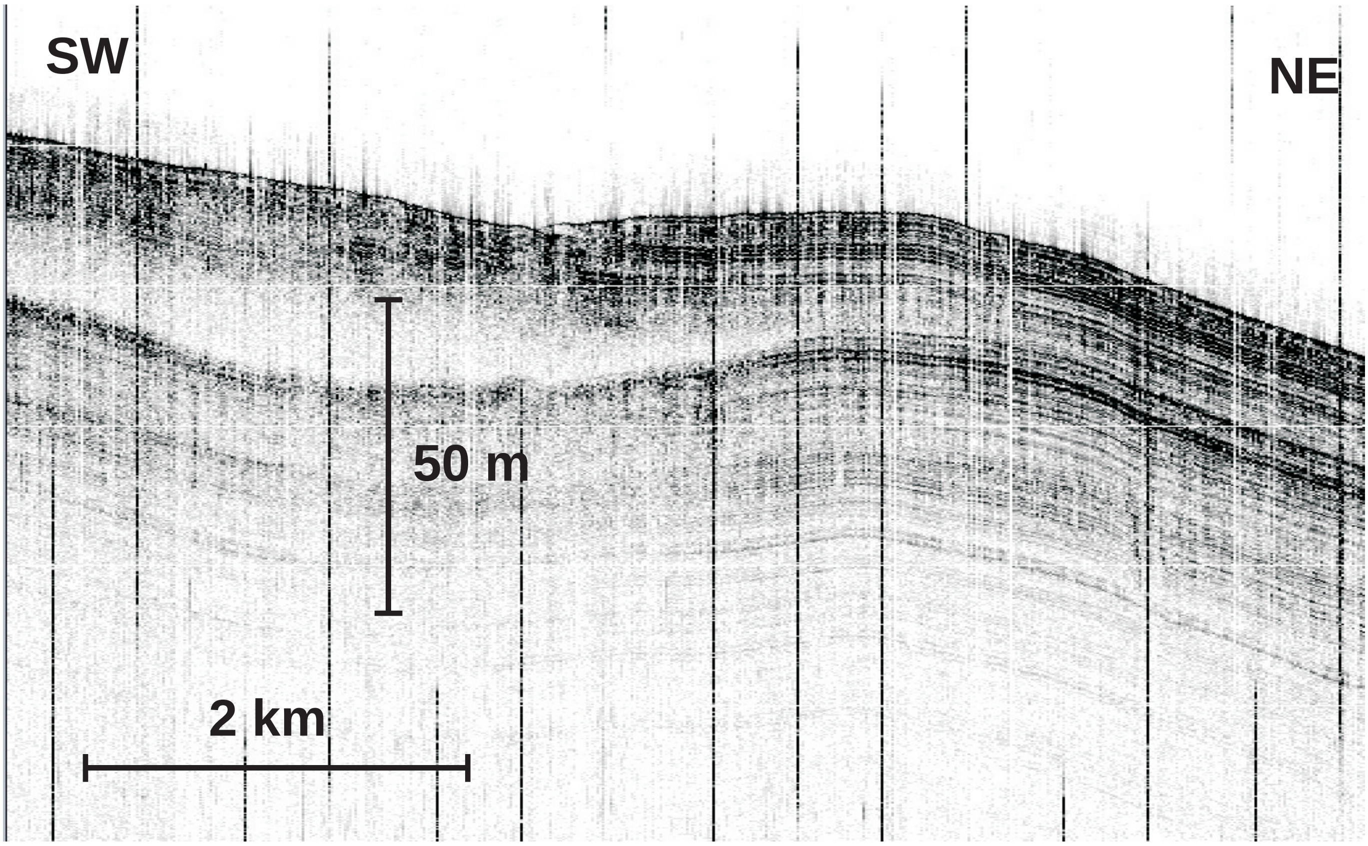


Figure 8. TOPAS profile over part of drift 3. Acoustically stratified sediments are muddy contourites and hemipelagites; transparent lens at left is a debris flow. Location on fig. 1. Black vertical lines result from interference from the EM120 transmission.

sediment drift 5 (Rebesco *et al.* 1998) and the channel systems to either side. We took our departure exactly on time at 8 pm after a very successful 10 ½ days in the main work area.

Our NE-bound track was a parallel swath to the west of the outward track, crossing the inner margins of sediment drifts 4A and 4 and the proximal parts of drifts 3, 2 and 1. TOPAS achieved some 80-100 m of penetration and better than 1 m of resolution over drift 3 (fig. 8), which is very promising for future studies of deep-sea sediments. The first part of the trip back to Drake Passage was slowed by head winds. Nevertheless we arrived back at the Shackleton Fracture Zone on schedule in the early afternoon of day 066. We found that in reasonably flat, sedimented areas, TOPAS interference on the EM120 could be much reduced by setting a rather narrow EM120 depth range, some 200 m either side of the actual depth.

TOPAS was again turned off and the EA500 switched to passive mode for the mid-ocean ridge survey. We completed five more NW-SE lines during the next two days, in reasonably good weather with westerly to northwesterly winds. A transect of six XBT's was done along one of the central lines and three more along the northeasternmost line. This was an attempt to quantify the variation in sound velocity across the survey area, without having to stop the ship every two hours for an SVP (fig. 9). With only the EM120 running and performing well (i.e. few crashes), scientific watchkeeping was quiet enough that a start could be made on replaying TOPAS data. We also created a poster describing the main results of the continental shelf survey.

For the last three lines, the ship was being set strongly to the east. This resulted in swath beams which, although at right angles to the ship, were some 5° away from a right angle to the course made good. Despite being very noticeable in the bridge display of swath coverage, this should not affect the gridded datasets.

Rain and sleet showers on day 068 gave way to fine, breezy weather for the last survey line, which was completed just after midnight. A shaded-relief image of the mid-ocean ridge survey is shown in fig. 10. We then made a fast passage home in a strong SW breeze, again running a swath parallel to our outward track. TOPAS was turned on briefly but it interfered badly with the EM120 (in a quartering sea and at a ship speed of 12 knots, the bottom echo from the side beams was frequently less strong than the TOPAS echo), so was turned off until we reached Burdwood Bank.

On the southern slopes of Burdwood Bank the vessel took several heavy rolls (usual combination of the oceanic swell running into shallow water, and a squall), but the motion eased overnight. In shallow water (~ 100 m) we took the opportunity to calibrate the EM120 centre-beam depth against the bridge EA500. The EM120 measured depth is shallower by 5 m (fig. 11, page 20). This is because (1) the EM120 measures depth from the transducer, while the EA500 is corrected for transducer depth so it effectively measures depth from the sea surface; this should make the EM120 depth about 7 m <u>less</u>. (2) the EM120 assumes a sound velocity of 1470 m/s and the EA500 uses 1500 m/s; this would make the EM120 depth 2 m <u>more</u> in 100 m of water. And 7 - 5 = 2. ☺

Data collection continued across the western end of the Falkland Trough. The EM120 and TOPAS were switched off when we reached 500 m depth on the south side of the Falkland Plateau. The ADCP and Ocean Logger were turned off as we entered Port William in the forenoon of day 070 (March 11th). The ship secured to FIPASS just before 11 a.m.

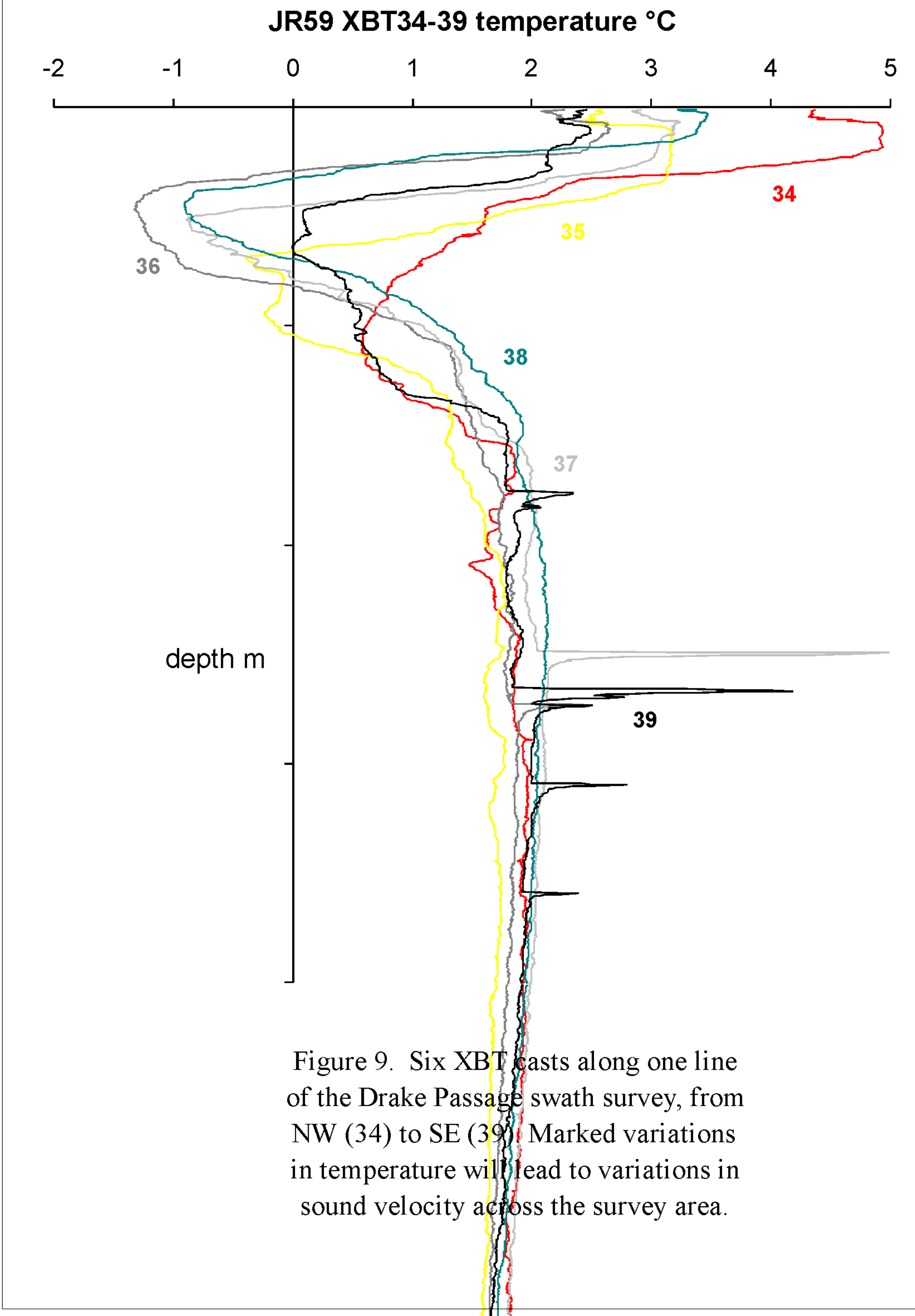


Figure 9. Six XBT casts along one line of the Drake Passage swath survey, from NW (34) to SE (39). Marked variations in temperature will lead to variations in sound velocity across the survey area.

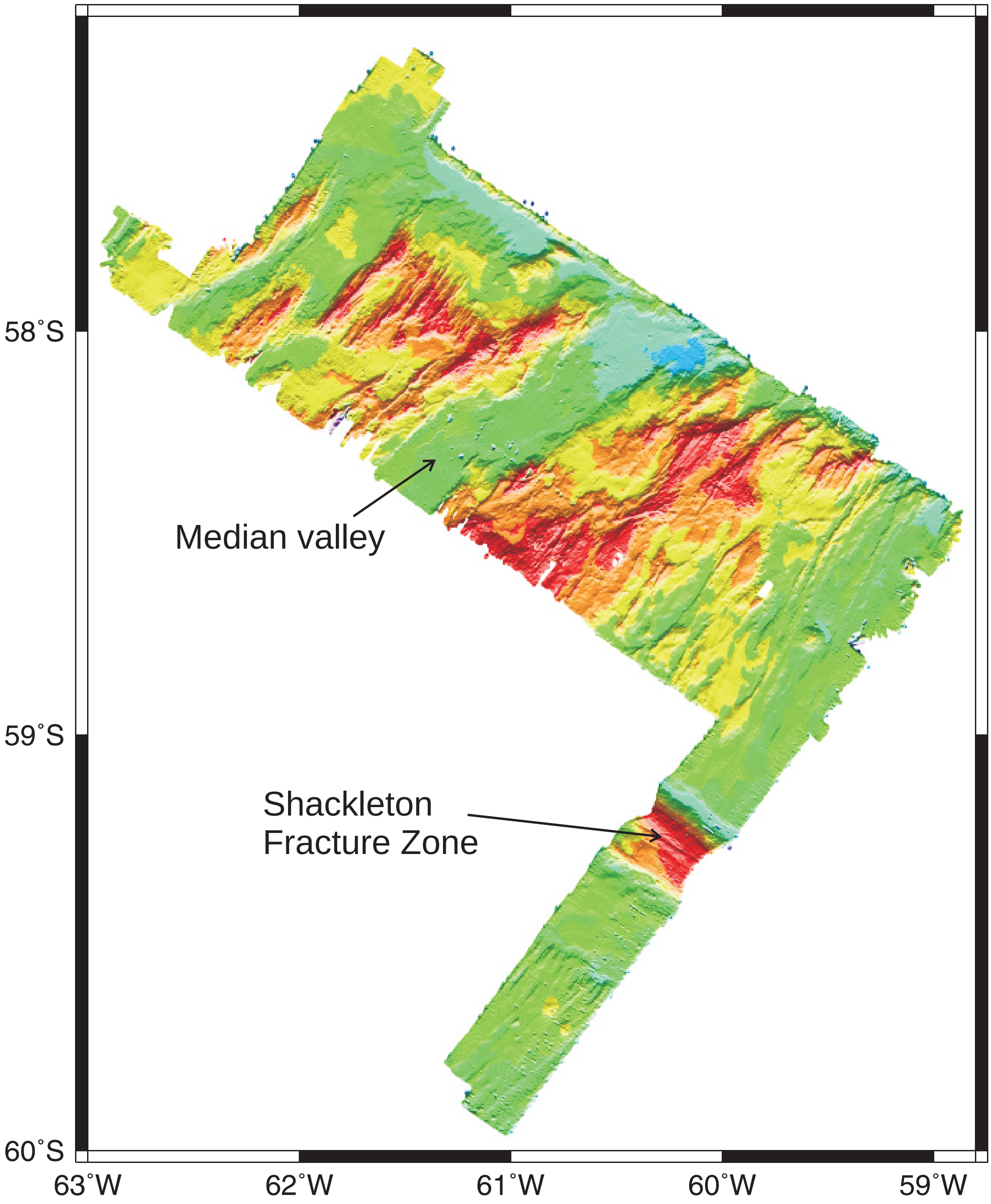


Figure 10. Shaded-relief map of the mid-ocean ridge survey in Drake Passage (JR56).

3. EM120 SWATH BATHYMETRY SYSTEM (PM)

The EM120 was run throughout almost the entire cruise. The nature, operations, and some of the problems of the instrument have been considered in earlier cruise reports. This, however, was the first time that the system had been used in Antarctic waters and most of the scientific staff initially had minimal experience of operating the unit or knowing what sort of results to expect from it. It was thus fortunate that a Simrad engineer was aboard during the first part of the voyage as he was able to provide reassurance as to what exactly was going on and what strategies to adopt when things started to go wrong. By the end of the cruise the operators' confidence had increased significantly and this appears to be reflected in the quality of the data collected (though this may also be weather related!).

There is little doubt that in good weather conditions the EM120 is capable of acquiring superb data. The quality of this drops as the sea conditions deteriorate, but reasonable results were still being obtained in force 5 or 6 seas provided the ship motion was not too excessive. The attitude compensation system seems to correct for a pure pitch or roll far better than a corkscrew motion. The worst sea conditions were those which produced significant aeration under the hull.

The transmit / receive hardware appeared to function well throughout. During the cruise the Seapath motion unit also appeared to be working well and gave rise to no obvious serious problems. Once set up the SSU too seemed to perform adequately, apart from a couple of unexplained crashes which brought the whole logging system to a halt.

The weak part of the system is undoubtedly the Merlin control software. This is very prone to locking up and the need for frequent reboots of the system must be anticipated. These may range in severity from simply restarting the operator interface to complete shut down and reboot of the computer and possibly the acquisition hardware. Reports on previous cruises have identified some of the conditions which can cause it to stop responding. On JR59 problems occurred while using the Planning module, when changing survey, when the SSU failed, and on a number of occasions for no obvious reason whatsoever.

On a typical BAS cruise which involves a series of long transits followed by work in discrete areas, it is desirable to split the EM120 acquisition up into a series of separate surveys. If the size of any single survey becomes too unwieldy this causes severe delays when reloading the survey (after a crash for example) and makes subsequent processing more tiresome. Although it is of course possible to switch data between surveys at any time using the import-export controls, the present acquisition would have been far more efficient had we been able to devise a clear plan of separate surveys beforehand rather than working in reconnaissance mode.

As the weather conditions deteriorate, an increasing amount of operator intervention will be required to keep the EM120 working adequately. In poor conditions the instrument loses track of the bottom with some or all of the beams and may fail, or take an extremely long time, to recover lock. A number of strategies need to be employed such as :

a) Restricting the maximum and minimum depth limits allowed to a tight range about the true seabed depths;

b) Reducing the beam angles to produce a very narrow swath, and when lock is established steadily increasing the beam angle to rebuild the swath;

c) Using the 'Force Depth' command with a depth somewhat less than the true seabed depth;

d) Changing filter settings; though the effect of this is often difficult to quantify.

The width of the swath is controlled by adjusting the beam angle on either side of the ship. The choice of angle is somewhat empirical dependent on the quality of the data being acquired. On the present survey the range used was mostly between 55 and 65°. It is also useful sometimes to extend the beam somewhat to fill in areas poorly imaged on a previous parallel swath, even though the data obtained on the outer beams are of variable quality.

Two modes of survey were used. The JR56 part of the programme consisted of a series of straight parallel lines, some 10 km apart. The overlap between swaths varied along these tracks depending on the water depth. The Simrad Helmsman's display on the bridge can be set up so that the officer on the bridge has an indication of deviation from the track on the screen. This however was very jittery, and it was found to be preferable to set the waypoints on the ship's navigation system and sail using this instead.

For the rest of the programme, successive tracks were sailed with the bridge adjusting the course to maintain a constant overlap between the beams. This results in a sinuous track, as in areas where the water is deep the swath is wider than where it is shallow. There may be a reduction in data quality due to the ship turning but this was not obvious, providing the yaw compensation was switched off. The advantage of this approach is that it maximises the area covered in a given time.

TOPAS and the EM120 do not always coexist happily together. In shallow water it is possible to coordinate them using the SSU so as not to interfere with each other, but in deep water the rate of Topas pinging is insufficient. In this case it is possible to operate TOPAS in manual triggering mode, but this will affect every few swath traces. The disturbance occurs in the central part of the beam in which the depths are determined using amplitude detection. There is no real cure for this, though the effects on the EM120 may be reduced by establishing very tight depth limits for the EM120 bottom detection.

The captain and bridge officers much appreciated being able to obtain depth displays with depth values overprinted on them. These are easily obtained by choosing to display 'cell depth with OVR text' on the 'show/hide' menu when plotting a map. Such instant displays were particularly useful when exploring in unsurveyed waters as they gave a picture of regional trends and showed where deep water was more likely to be found.

One of the more useful features of the system is the interactive grid display in which a grid of the total survey builds up in real time. To set this up initially it is necessary to stop logging and create a grid. If restarting from a crash with a big survey, this can take some time, resulting in significant loss of new data, and if there is a corrupt file present the system will hang indefinitely. Corrupt files seem to include those with too few pings; some care needs to be taken not to generate a lot of empty new files by repeatedly clicking the 'Logging' button. Corrupt line files should be deleted from the system, if necessary by opening a normal unix terminal window and removing them from the raw and processed file directories.

Some discussion has arisen as to what the water depths recorded by the EM120 actually represent. Comparisons between the bridge EA500 and the EM120 over an area of known water depth (Burdwood Bank) show that the EM120 reads consistently about 5 m shallower than the EA500. From the available manuals, it appears that the EM120 reference point is at the transducers whereas the EA500 reference has been corrected to sea level. Thus it appears that water depths recorded by the swath system also need a correction to sea level of the order of 5-6 m (fig. 12).

Data Processing

The EM120 files generated on the logging machine (em120-101) are automatically copied every minute onto the processing machine (em120-102) where it is possible to work on them using Simrad's Neptune swath bathymetry processing package. This is a useful arrangement but occasionally frustrating in that unwanted, possibly corrupt files deleted from the processing machine will be replaced a minute later by new copies from the logging machine.

Not a great amount of processing was carried out during the cruise. Given the good weather conditions encountered during much of the cruise, the raw depth displays were of quite reasonable quality. Using the global rule to remove depths in a grid cell greater than 2 standard deviations from the mean combined with a minor amount of manual editing in Binstat generally removed the worst anomalies. The 2 standard deviation rule actually seems to remove a lot of quite valid data, which is a somewhat worrying feature. A variety of artefacts remain however including significant crenellation of the grid along the beam edges which could be removed or reduced by more detailed editing work. This however is very time and labour intensive work and if it is intended to carry this out during a cruise it needs to be approached in an organised fashion. The deep water lines of the JR56 survey were recorded in more difficult sea conditions and will require significant manual editing to achieve an optimum display.

Grid displays can be easily plotted on the HP1600 deskjet (A4), the large HP1055 for A2, A1,and A0, or sent to an A4 postscript file for export to CorelDraw or a similar package. Of these the only really satisfactory option at the moment is the last one. The HP1600 gives very poor colour. This is not a new problem, it has always been poor. The HP1055 gives beautiful colour but it has been found difficult to plot anything except A0 without using inordinate amounts of paper. This occurs (and may even be made worse) after setting the paper size and orientation using the plotter controls. The only extremely crude solution found was to switch the plotter off at the mains immediately after producing a small plot, cutting the plot off the roll manually, restarting the plotter and reloading the paper again ready for another plot. For some reason or other the extreme top boundary of the plotted grid is truncated, which points to a problem in the setup in the Simrad plotting software.

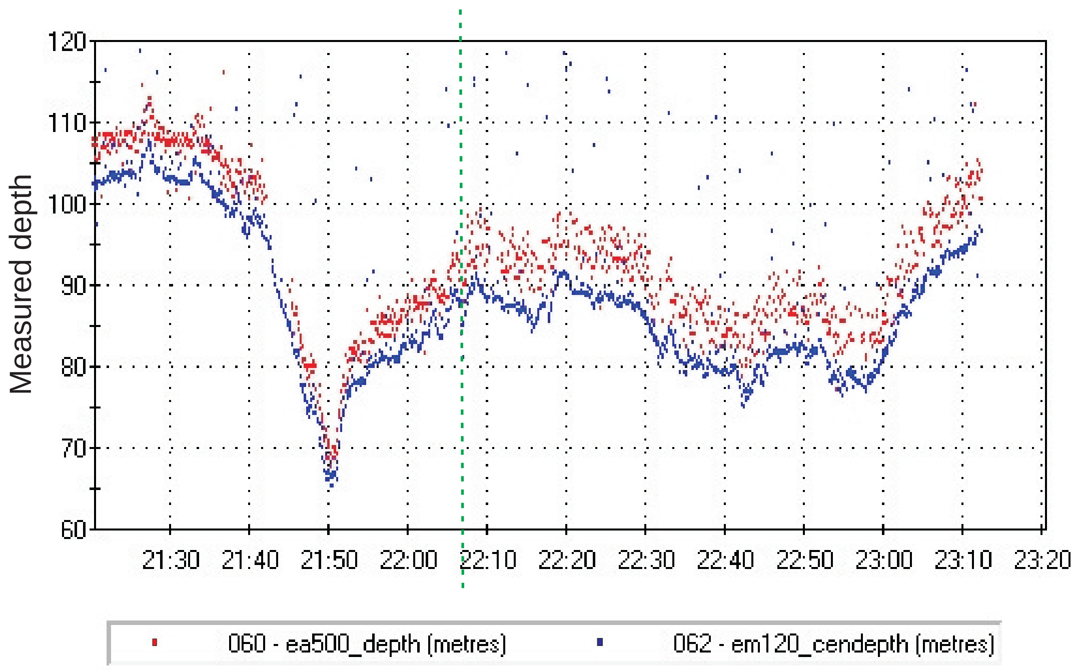


Figure 11. Comparison of depths logged from the EA500 bridge echo sounder (red dots) and the centre-beam of the EM120 (blue dots). Times are GMT on day 069; the ship was over Burdwood Bank. From 2120-2207 the EA500 was in “active” mode, i.e. Transmitting and receiving its own ping. After 2207 it was in “passive” mode, i.e. not transmitting but synchronised to and receiving the centre-beam ping from the EM120. Although the data are noisier in passive mode, a consistent 5 m offset can be seen.

4. TOPAS (CJP)

The TOPAS parametric sub-bottom profiler was run for most of the cruise. It was turned off for four days during the JR56 Drake Passage survey so as not to interfere with the EM120, for 10 hours in bad weather on day 056, and 7 hours during the call at Rothera.

Apart from the problems inherent in running several acoustic systems on one vessel, TOPAS was almost trouble-free when operated correctly. The complete system locked up early on day 069. The computer was re-booted several times and all the power supplies etc. checked. After 1 hour 20 min. another re-boot was successful but the cause of the problem could not be determined. Logging system hang-ups, which were quite frequent on the Arctic cruise, occurred only twice.

TOPAS puts an impressive amount of acoustic energy into the water and can achieve excellent resolution and penetration in soft sediments where the seabed is fairly flat, e.g. the continental rise and the sedimented areas in southern Drake Passage. It also performed well on the middle and outer continental shelf, imaging not only the draped sediment layer a few metres thick which we knew to be present, but also a till sheet up to 15m thick on the outer shelf. It is unusual for relatively high-frequency echo sounders to penetrate layers of poorly-sorted sediment with an uneven upper surface (in this case, iceberg furrows) because of scattering of sound waves.

Where TOPAS performs less well is on steep slopes, as very little of the energy in the narrow beam is reflected back to the ship. On a very large feature such as the continental slope the beam could be angled in to the slope to produce a more consistent return echo (max. beam angle athwartships is 40° and -ve is to port). Rough unsedimented ocean floor cannot be satisfactorily imaged. The old PES and 3.5 kHz echograms consisted of a series of hyperbolic diffractions which gave only an approximate record of what was under the ship.

On the inner continental shelf, with relief of several hundred metres over short distances, the maximum recorded trace length of 400 ms was a drawback. It necessitated very frequent manual delay changes to keep the seabed within the acquisition window. Automatic seabed tracking was tried a few times but without success.

Below are our recommended settings for TOPAS in deep-sea and shelf areas. The chirp source can also be used in shallow water, but the burst gives a clearer real-time (i.e. raw trace) picture of any stratification in the seabed.

<u>Throughout:</u> 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.

<u>Deep water (>3000 m)</u>
Chirp source, 15 ms pulse length, 1.5-5 kHz; bandpass filter settings 1400-1600/4900-5100 Hz
Manual triggering, generally 2.0, 2.5 or 3.0 sec (note you must type in a value 20 ms more than required!)
Gain 20-25 dB depending on water depth, seabed type and weather
Processing: filter ON, deconv ON (1 ppm), TVG ON (manual start about 500 ms above the

seabed, slope 60-100 dB/s depending on seabed type), scale 3000%

Shallow water (<1000 m)
Burst source, period 2-3, secondary frequency 2800 Hz
SSU triggering (ping interval varied from 2-6 sec depending on water depth and SSU mode)
Gain 8-15 dB depending on water depth, seabed type and weather
Processing: filter ON, AVC ON, scale 2000%

Post-processing

No replaying or post-processing of TOPAS data was done until acquisition stopped on days 067-068, as the processing workstation was generally being used for EM120 data. It would be very advantageous to have the EM120 and TOPAS processing software available on different workstations. By trying different settings in the processing menu it was possible to create good images of the seabed on the screen. The procedure for getting the images anywhere else and printing them, however, is unduly complicated and tends to lose resolution (snapshot, save file, ftp binary transfer to a PC, then import .tif file into a graphics program). We hope for a software update soon to allow the saving of processed data files.

Chart recorder

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 half-hour time mark was supplied from the radiocode clock at the aft end of the UIC room.

5. SIMRAD SYNCHRONISATION UNIT (CJD)

Following the problems encountered with the SSU on previous cruises, a Kongsberg Simrad engineer was on board for the first week of JR59. The following modifications were made to the unit:

- the version of SSU.exe was updated from v2.06 to v2.20
- the SSU.ini file was replaced with an updated version to comply with the above
- the network settings on the EA500 and EK500 were changed to enable proper communication with the unit. These had been found to be incorrect, with the effect that the SSU was unable to calculate the length of the transmitter receiver periods for these systems.

Synchronisation settings and .ini files are given in the Appendix.

Because several systems operate in a similar frequency range (EA500, EM120 and TOPAS) they need to transmit and receive in separate time periods to avoid interference. In deep water this results in a very low data density for each of the echo sounders. This is particularly a problem for the EM120 and TOPAS. To increase the data density, the KS engineer suggested letting the EM120 and EA500 trigger in the same period with the EA500 transmitter in "passive" mode. This seemed to work fine, with the EA500 listening to the transmit pulse from the EM120 rather than interfering with the latter.

On JR59 we used the SSU in one of three modes to control the EA500, EM120 and TOPAS. The EK500 was not required. The modes have all been re-named to indicate what they actually do - a great improvement on the old names "shallow", "safe", etc.

Deep water (>2000 m): EM&EA&EK TO
with TOPAS on manual triggering (see section 4) and the EA500 in passive mode.

Shallow water (generally <1000 m), surveyed areas: EM&EA&EK TO
with TOPAS on SSU triggering and the EA500 in passive mode.

Shallow water (generally <1000 m), unsurveyed areas: EM EA&EK TO
with TOPAS on SSU triggering and the EA500 in active mode.

When going from a deep to a shallow area or vice versa, the operator must change the system from deep to shallow mode. Note that this requires altering the TOPAS as well as the SSU settings. It can usually be done in about a minute.

6. OTHER EQUIPMENT (CJD, SAW, MOP, PM)

6.1. Sound Velocity Probe (SVP)

Sound velocity profiles were required, as input on the EM120, for the correction of the varying passage of sound waves through the water column (with salinity, temperature and depth). Profiles were obtained using a dipped sound velocity probe (SVP). The model being used on the JCR is Applied Microsystems Limited' Model SVPlus probe.

It is necessary to communicate with the probe in order, initially, to set it up for deployment and then to upload the data. There are two ways of communicating with the probe. The first way is directly via the EM120 logging workstation. The second is using the AML/Procomm software on the ITS laptop. Both methods are described below:

<u>Step 1. Connect Probe.</u>

- attach data cable to the probe.
- attach red power connector to probe.
- check data cable is attached at workstation (or to laptop)

<u>Step 2. Set up Probe.</u>

A. Via Workstation

- MBES workspace
- I/O Menu
- select "SVPlus Probe Profiling" (goes green)
- "Probe" -> "Probe Controls"
- check communication with probe by selecting "Push to Monitor Probe"
- amend Pressure Offset, Sample Mode and log file settings, as required
- (NB. log file name must be less than 8 characters)
- select "One Scan" to check settings and "list logfiles" to check for enough space
- select "Apply Settings" to apply
- "OK" to close
- disconnect data cable from probe and insert black dummy connector
- ensure both connectors are water tight

B. Via Laptop

- check data cable is attached to laptop
- from DOS, cd \aml
- run "aml"
- "Data" -> "Setup" to set the same parameters as above
- disconnect data cable from probe and insert black dummy connector
- ensure both connectors are water tight

Step 3. Uploading Data from Probe

A. Via Workstation

- connect data cable to probe/workstation
- I/O Menu -> select “SVPlus Probe Profiling”
- “Probe” -> “Probe Controls”
- “List Logfiles” -> check file is present
- “Fetch and Convert” to import
- this should automatically run the SSSP Editor on completion
- edit as required and save as *.asvp
- disconnect data cable from probe and insert black dummy plug
- remove power plug from probe and insert black dummy plug

B. Via Laptop

- connect data cable to probe/laptop
- from DOS, cd \aml
- run “aml”
- “File” -> “Copy” -> set source name to D: (for SVP) -> press enter
- “Data” -> “Export” -> *.rel (stored in c:\aml\data)
- manually edit .rel and remove “-“ lines
- disconnect data cable from laptop
- connect laptop to workstation
- cd c:\aml\data\procomm
- Alt-P -> check baud rate etc....
- Page-Up -> to upload file -> select 7)Ascii -> press enter to upload
- Ctrl-x to exit Procomm - this should automatically run the SSSP Editor on completion
- edit as required and save as *.asvp
- disconnect data cable from probe and insert black dummy plug
- remove power plug from probe and insert black dummy plug

Step 4. Change Sound Profile for EM120

- stop EM120 logging
- on Runtime Menu (MBES screen), change entry in “Current Sound Profile”
- select the *.asvp file required.

6.2. SVP Winch

During JR59 the sound velocity probe was deployed on eleven occasions, using the dedicated winch on the port side fo’c’sle deck. This winch and davit started life as the 3.5 kHz echo sounder deployment system and was converted during 2000 by MPD Hull.

The winch worked without problems during the cruise. Initially, trying to deploy the probe at a predetermined speed was not easy as there is no speed readout for the cable presently on the system. A veer and haul rate of 30 m/min was being aimed for, which is about half speed for the winch. As the winch is fitted with manually operated control valves it was not that easy to maintain a steady veer/haul rate without a speed readout. Subsequently the winch was operated at full speed (about 75 m/min) in both directions, running slightly faster when veering. This made it a lot easier to operate by the two people involved on the deck.

The bridge maintained position by controlling the vessel from the port side aft position, using the remote control to the dynamic positioning system. This allowed them to view the davit arm and the wire into the water, although the fore and aft wire angle still had to be reported from the deck.

Each deployment was to the maximum depth of 1000 m (except in shallow water, where the depth requested was 30-50 m less than the water depth; Table 1) and took approximately 30 minutes. It should be noted that the winch started to surge a little with the load on it when starting to haul from maximum depth. This was in response to the rolling of the vessel; therefore if a longer wire was ever considered, the winch might need some modifications to the hydraulics to cope with the increased load.

6.3. Expendable BathyThermographs (XBT's)

The XBT system was used fairly regularly during the cruise with 44 drops being executed. The system suffered no problems at all, with the only repeated casts being necessitated by faulty canisters (Table 1). Although the system worked well it has a 'fragile' feel to it. The PC has to be turned off between drops, as the XBT card in the PC apparently 'hangs' if the power is not cycled. (For obvious reasons this was not tested, but believed to be true) It is also known that the XBT card will not function at all if put into a PC faster than a 486. If the PC that is currently used for the system failed, it would be difficult to imagine how it would be replaced as all 'spare' machines on board are Pentium grade or better.

6.4. Ocean Logger

On arrival at the ship for the beginning of the previous cruise (JR58) there was a note from the last ETS member to the effect that the temperature and humidity sensors on the foremast had failed during the last cruise. There had been no time on their return to Stanley to investigate. Upon opening the junction boxes the problem was obvious. There was about 5mm of sea water in the bottom of the junction box that contains the temperature and humidity Rho-point modules. Fortunately the module that was nearest the bottom of the box (and therefore the one that was flooded) was the humidity module. Removing this wrecked unit, drying the box and re-sealing it proved effective in restoring comms to the foremast, and temperature data were recorded for the rest of the cruise. The ocean logger is due for replacement this season, and a more robust approach to construction needs to be considered, with possibly a 'box within a box' design being adopted.

During cruise JR59 no further problems were encountered with the Ocean Logger. The PC, software, and ancillary electronics all worked well. The only 'down time' that the system had was caused by the seawater pumps shutting down. This was caused on one occasion in rough weather by the pump gulping in some air, and for some hours on day 060 by brash ice blocking the filters. Both situations were rectified and the ocean logger was quickly working again.

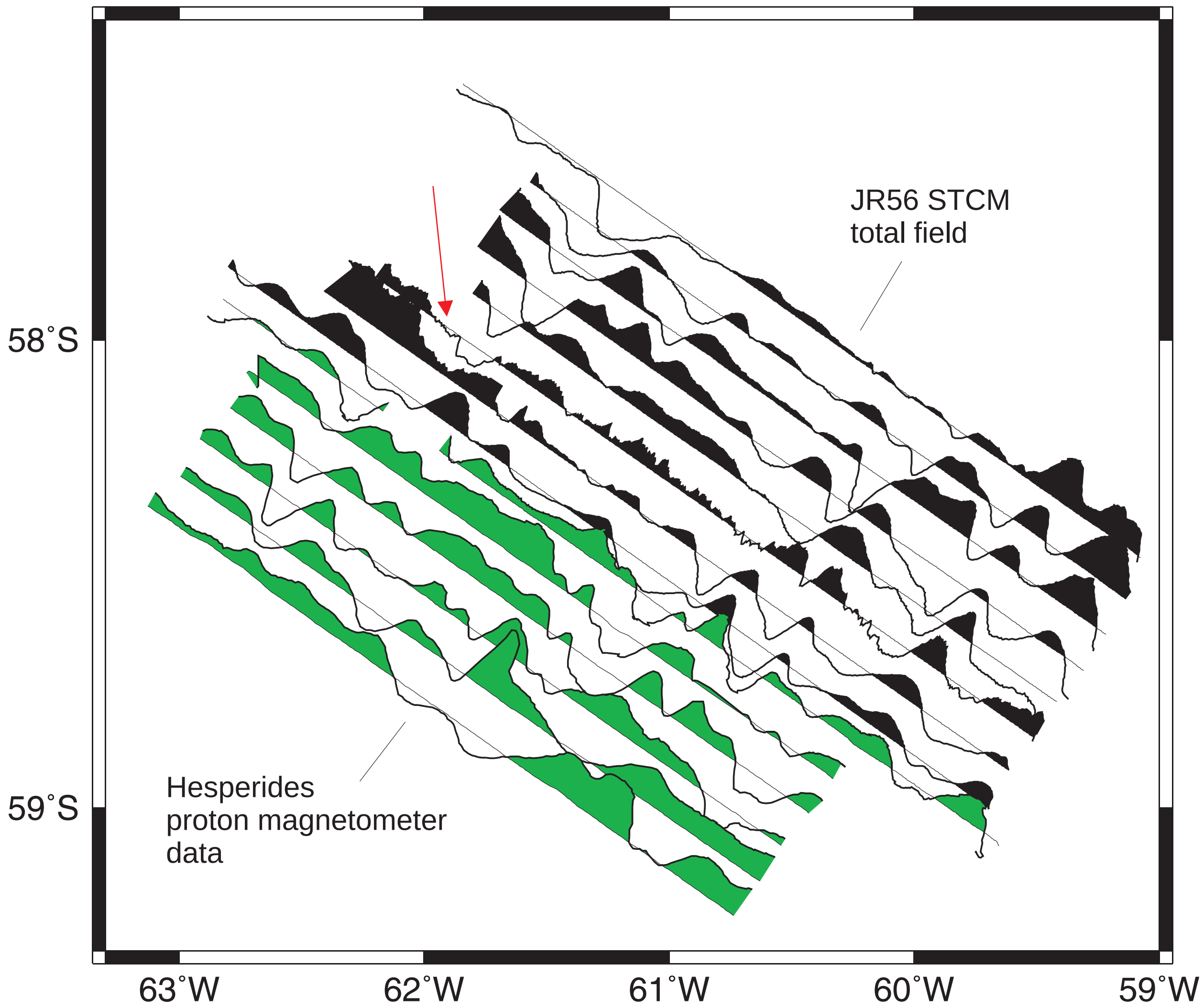


Figure 12. Magnetic anomalies plotted along track, Drake Passage (JR56) survey area. JR59 data in black, existing *Hesperides* data in green. Red arrow shows a line run in bad weather; note noisy data.

6.5. Acoustic Doppler Current Profiler

The ADCP was used continuously for the duration of the cruise and worked faultlessly throughout. Noticing that the computer that controls and displays the ADCP data is a 1991 vintage 286, there must be good cause to upgrade this to a more modern machine as the computer must be feeling its age by now.

6.6. STCM

The two shipboard three-component magnetometers on the JCR were run continuously throughout the voyage. Both operated quietly in the background without problems, logging correctly to the SCS. As usual the ‘new’ STCM was considerably noisier than the ‘old ‘one. This is probably due to the poor positioning of the sensor relative to the ship’s superstructure.

Four sets of figure of 8 calibration turns were carried out.

Day	Date	Time	Lat S	Long W
050	01 02 09	12:15-12:50	-57.728	-62.743
064	01 03 05	15:39-15:58	-66.368	-71.922
069	01 03 10	04:52-05:20	-57.442	-61.840
070	01 03 11	10:24-11:00	-52.044	-57.927

The results obtained on the long straight passages appeared to be very good. Fig. 11 shows the performance on the JR56 lines in central Drake Passage. Characteristic oceanic spreading anomalies are well recorded. The way in which the data become degraded in poor weather is also obvious.

6.7. EK500

The EK500 echo sounder was not actually needed on this cruise. It gets a mention though as it was turned on in order to demonstrate and confirm the operation of the SSU. During work on the SSU, the EK500 was turned on and on two occasions started reporting built in self test (BIST) faults on signal processor 1 (SP1 fault). This fault also meant that the EK500 would no longer synchronise with the SSU. The SP board was changed for the spare, and the fault disappeared. 20 minutes later the EK500 was again not responding to the SSU and was again reporting an SP1 fault. After a protracted series of phone calls to Simrad, detailed inspection of the boards and general ‘fault-finding’ conversations, it was noticed that the cooling fan was hardly pulling in any air. It was then noticed that the unit always worked when first turned on, only to fail after a period of time. Cleaning the fan filter increased the airflow by a factor of ten and saw the unit function faultlessly for the next 5 hours. Cleaning the filter regularly would seem to be a necessary activity. One recommendation did come out of the activities though, and that is that the unit and all the spares should be retuned to Simrad for updating and checking. We have apparently not got the latest firmware upgrades on some of the boards. A general service is probably a wise use of resources considering the importance placed on this equipment.23

7. DATA ACQUISITION SYSTEMS (CJD)

7.1 Scientific Computer System (SCS)

Data acquisition on the SCS was started at 19:30 GMT on February 16th (day 047)and the system ran, largely problem free, throughout the cruise. The following instruments were logged:

glonass	**dopplerlog**
ashtec-adu2	**emlog**
trimble	**simrad-ea500**
anemometer	**simrad-em120** (from Feb 21st)
tsshrp	**new_stcm**
oceanlogger	**gyro**
basstcm	

Acquisition was stopped briefly on February 21st and the sensor.scf file was altered to log the centre depth NMEA output from the Simrad EM120 system. At the same time, the Net Monitor was removed from sensor.scf, as the instrument was not in use.

Data for the gyro and new_stcm were logged to the server via the Java applications “gyro” and “AtoSCS”.

7.2 SCS/NTP Server

On day 060 it was noticed that the time on the EM120 logging machine (em120-101) was some 40 seconds behind the ship's clock. The problem was traced back to the NTP (Network Time Protocol) server on the SCS machine (so all systems that were synchronised to this were affected).

On investigation, it appeared that the NTP server had not been communicating with the Trimble since the SCS server/Trimble were power cycled at the beginning of February, following the power cut on JR58. Presumably the time on the SCS server had been drifting ever since this reboot. When the communications settings on the SCS server were checked, COM2 was no longer present (ie. in Control Panel -> Ports) - hence the NTP server was not receiving data from the Trimble.

On rebooting the SCS server, COM2 reappeared (although still appeared not to function), but COM1 disappeared. After rebooting a second time, both ports were present, although communication was only possible on COM1. On restarting data acquisition, several of the data streams were not getting any data (although valid data were coming as far as the ports in the Computing Room patch panel). The SCS was stopped and restarted several more times (including rebooting the server on one occasion), with a variety of different ports not receiving data on each occasion.

As the priority was to get data logging underway again, the following changes to the system were made:

- The Trimble GGA string (for the NTP server) was moved to COM1 and the NTP server subsequently worked without further problems (ie. all machines were being synchronised to the Trimble). COM1 was not previously in use (the data cable from the UPS is currently not plugged into anything).

- No data were coming in for the Oceanlogger on COM14 (on the Digi board). This was swapped to COM16, in place of the winch (which was not in use). The sensor.scf file was changed to reflect this.

The problems with ports on the Digi board are most likely transient and caused by I/O buffers not being flushed correctly. These will need to be checked whilst the SCS is not logging.

A label has been placed on the Trimble reminding users to check that the Tardis software on the SCS server is still running, should the Trimble be power cycled. It may also be worth routinely checking the Tardis screen on a daily basis, in future, to ensure that the software is communicating with the Trimble.

7.3 Level C

The program “scs2levc” was run on **jrub** throughout the cruise to convert the SCS data to Level C format. This ran without problems. An additional Level C stream ("em120") was created for the centre beam depth from the Simrad EM120. The “scs2levc” program was stopped and restarted to accommodate the new stream (after amending “scs2levc.xml” to include this).

The “bestnav” and “relmov” utilities were run on **jrub** to create their respective data streams.

8. CRUISE STATISTICS

Total cruise time	22 days (1410/048 to 1353/070)
Waiting on weather	0.4 days
Rothera call	0.3 days
SVP casts	0.4 days
STCM calibration turns	0.1 day
Down time	1.2 days
Underway data collection	20.8 days

(EM120, TOPAS, EA500, STCM, ADCP, ocean logger, navigational data). Several hours' worth of ocean-logger data were lost on day 060 because of persistent brash ice blocking the seawater pump.

Data recorded 25.9 GB of which	EM120	= 9.1 GB raw
		9.4 GB processed
	TOPAS	= 5.0 GB

9. CREW LIST

Ship's Company

Master	Christopher Elliott
Chief Officer	Robert Paterson
Second Officer	David Gooberman
Third Officer	Scott Baker
Fourth Officer	John Summers
Radio Officer	Charlie Waddicor
Chief Engineer	Dave Cutting
Second Engineer	Bill Kerswell
Third Engineer	Glynn Collard
Fourth Engineer	Steve Eadie
Electrical Engineer	Norman Thomas
Deck Engineer	Simon Wright
Catering Officer	Ken Olley
Bosun's Mate	David Williams
Seaman 1	John McGowan
Seaman 1	James Baker
Seaman 1	Marc Blaby
Seaman 1	Derek Jenkins
Motorman	Sydney Smith
Motorman	Mark Robinshaw
Chef	Roy Fox
Second Cook	Francis Hardacre
Senior Steward	Cliff Pratley
Steward	Tony Dixon
Steward	Ken Weston
Steward	James Newall

Scientific Party

Principal Scientist	Carol Pudsey (BAS)
Geophysicist	Peter Morris (BAS)
Electronic Engineer	Mark Preston (BAS)
I.T. support	Chris Drew (BAS)
Technical Consultant	Kjetil Aasekjar (Kongsberg Simrad)
Doctor	Philippa Bradbury (BASMU)

10. REFERENCES

Bart, P.J. & Anderson, J.B. 1995. Seismic record of glacial events affecting the Pacific margin of the northwestern Antarctic Peninsula. *A G U Ant. Res. Ser.* **68**, 75-95.

Pudsey, C.J., Barker, P.F. & Larter, R.D. 1994. Ice sheet retreat from the Antarctic Peninsula shelf. *Cont. Shelf Res.* **14**, 1647-1675.

Pudsey, C.J. and Evans, J. in press. First survey of Antarctic sub-ice shelf sediments reveals mid-Holocene ice shelf retreat. *Geology*.

Rebesco, M., Camerlenghi, A. & Zanolla, C. 1998. Bathymetry and morphogenesis of the continental margin west of the Antarctic Peninsula. *Terra Antartica*, **5,** 715-725.

11. ACKNOWLEDGEMENTS

Captain Chris Elliott, the officers and crew of the *James Clark Ross* for making it all possible, and being a pleasure to sail with.

Mark Preston and Chris Drew for technical support and assistance with watchkeeping.

Kjetil Aasekjar for fixing the SSU and teaching us how to play with our new toys, and amusing us with his CD of The Hitch-Hiker's Guide to the Galaxy each afternoon in the lab (and the cave-nerd below).

The Mate for the item of educational jargon on page 4.

Simon Wright and Dave Gooberman for the web page.

David Blake for his particular interest in this cruise, including arranging for the Kongsberg Simrad technical support.

Rob Larter, Julian Dowdeswell and Neil Mitchell for writing the JIF bid for the swath system, without which we would not be here.

Andy Willett at the UK Hydrographic Office, who supplied collector sheets first for the Larsen and then for Marguerite Bay at very short notice.

Mike Meredith who obtained the XBT's from the UK Hydrographic Office.

Steve Colwell at BAS for sending the weather maps - "twice a day, every day".

To all the above - Thanks for a great trip!

12. 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. *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)***

2. Recommended SSU settings for deep and shallow water are given on p. 23.

3. Recommended TOPAS settings for deep and shallow water are given on p. 21-22.

4. T*he HP1055 plotter is incorrectly set up and cannot be made to plot on any size smaller than A0 without wasting paper.* ***The setup for this plotter needs to be rectified****.*

5. *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)****.*

6. *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****.*

7. 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**).

8. **The SVP winch would benefit from a wire speed meter**.

9.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**.

10. The met. sensors on the foremast should be housed in a **more watertight container** when the ocean logger is replaced this year.

11. 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**.

12. There is a considerable amount of redundant cabling in the computer room left over from the days of Level ABC. To avoid confusion over which cable does what, **this should all be tidied up**.

Table 1. Sound Velocity Probe (SVP) Stations

Station no	Latitude S	Longitude W	Water depth m	Cast depth m	Time on station	Comments
1	54˚ 56.6'	60˚ 18.2'	1317	1000	1811-1913/049	no data
2	55˚ 10.9'	60˚ 29.9'	4375	50	2054-2120/049	test drop
3	55˚ 11.1'	60˚ 29.4'	4375	1000	2120-2230/049	
4	57˚ 43.8'	62˚ 44.2'	3963	1000	1250-1332/050	JR56 north
5	58˚ 59.8'	59˚ 41.1'	3936	1000	0214-0315/051	JR56 south
6	68˚ 27.6'	70˚ 02.0'	1280	1000	1947-2050/055	survey 5
7	67˚ 47.3'	68˚ 10.0'	690	650	1958-2045/057	Laubeuf Fjord
8	69˚ 11.0'	69˚ 40.0'	772	750	1610-1710/060	Schokalsky Bay
9	67˚ 38.7'	70˚ 32.6'	776	750	1113-1156/062	middle shelf
10	66˚ 39.9'	70˚ 48.3'	562	500	1400-1445/063	outer shelf
11	66˚ 22.1'	66˚ 22.1'	2775	1000	1452-1535/064	drift 5

Table 2. XBT Stations

Cast no	Type	Latitude S	Longitude W	Water depth m	Cast depth m	Time
1	T-5	57˚ 51.0'	62˚ 07.8'	3951	1320	0118/052
2	T-5	58˚ 59.7	59˚ 44.9'	4082	1144	1350/052
4	T-5	59˚ 59.0'	61˚ 12.8	4175	1178	2009/052
5	T-5	60˚ 53.1'	62˚ 32.0'	3570	1159	0150/053
6	T-5	61˚ 54.0'	64˚ 06.4'	3780	1240	0812/053
7	T-5	62˚ 47.7	65˚ 30.8	3202	1195	1357/053
8	T-5	63˚ 41.6	66˚ 58.7'	3410	1182	1950/053
9	T-5	64˚ 41.8	68˚ 28.1'	2740	1179	0150/054
11	T-5	65˚ 42.2'	70˚ 26.5'	2990	1275	0820/054
13	T-7	66˚ 34.4	70˚ 47'	545	528	1414/054

14	T-7	67˚ 25.7'	70˚ 28.3'	707	722	1949/054
15	T-7	68˚ 23.5'	70˚ 17.1'	574	574	0153/055
16	T-7	69˚ 04.1'	69˚ 42.0'	767	753	1305/055
17	T-7	67˚ 58.1	68˚ 28.5'	597	526	0038/057
18	T-7	68˚ 20.9'	67˚ 54.1'	523	537	1225/058
19	T-7	68˚ 45.1'	67˚ 47.8'	544	544	1549/058
20	T-7	69˚ 04.0'	67˚ 18.8'	675	680	1951/058
21	T-7	68˚ 13.3'	68˚ 49.8'	637	637	0948/059
22	T-7	68˚ 16.0	69˚ 31.0'	700	655	1118/059
24	T-7	69˚ 15.2'	69˚ 57.0'	748	570	2041/059
26	T-7	68˚ 40.6	69˚ 42.5'	618	511	0222/060
27	T-7	69˚ 30.4	69˚ 23.0'	580	580	2046/060
28	T-7	66˚ 59.1'	70˚ 16.1'	642	637	0703/062
29	T-7	66˚ 56.5'	70˚ 34.1'	750	760	2250/062
30	T-7	66˚ 26.9'	71˚ 27.7'	650	649	1812/063
31	T-7	66˚ 50.3'	71˚ 23.6'	470	481	2055/063
32	T-7	66˚ 37.9'	72˚ 05.3'	2990	1469	1304/064
33	T-5	66˚ 17.5'	72˚ 14.1'	3130	1784	2056/064
34	T-5	57˚ 50.7'	61˚ 53.9'	3991	1277	1145/067
35	T-5	57˚ 57.8	61˚ 20.2'	2690	1412	1356/067
36	T-5	58˚ 09.3'	60˚ 49.6	4218	1312	1551/067
37	T-5	58˚ 20.1'	60˚ 20.0'	3538	1331	1740/067
38	T-5	58˚ 31.1'	59˚ 50.0	3425	1386	1930/067
39	T-5	58˚ 42.0'	59˚ 20.0'	4226	1311	2123/067
40	T-5	58˚ 28.9'	59˚ 02.3'	4325	1303	1814/068
41	T-5	57˚ 58.3'	60˚ 25.3'	4478	1342	2330/068
42	T-5	57˚ 27.5'	61˚ 48.0'	3785	1292	0444/069
43	T-5	56˚ 21.2'	61˚ 19.9'	4077	1183	1139/069
44	T-5	55˚ 19.6'	60˚ 28.5'	4294	1137	1708/069

APPENDIX 1. SSU Synchronization settings and .INI files

1. Synchronization Settings in EA 500 and EK 500

To enable the Synchronization Unit to communicate correctly with the EK500 and the EA500, the following network settings must be set on the respective systems.

For both systems the "Local IP Address" and "Remote IP Address" must be set:

```
EA 500:
ETHERNET COM. MENU → Local IP Addr. → 129.177.031.101 →
ETHERNET COM. MENU → Remote IP Addr. → 129.177.031.100 →

EK 500:
ETHERNET COM. MENU → Local IP Addr. → 129.177.031.102 →
ETHERNET COM. MENU → Remote IP Addr. → 129.177.031.100 →
```

Next, the telegrams for both systems have to be set up as follows:

```
EA 500:
ETHERNET COM. MENU → Telegram Menu → Remote Control → On →
ETHERNET COM. MENU → Telegram Menu → Parameter → On →
ETHERNET COM. MENU → Telegram Menu → Depth → 1 →

EK 500:
ETHERNET COM. MENU → Telegram Menu → Remote Control → On →
ETHERNET COM. MENU → Telegram Menu → Parameter → On →
ETHERNET COM. MENU → Telegram Menu → Depth → Off →
```

Finally, the UDP port settings for the telegrams should be set.

```
EA 500:
ETHERNET COM. MENU → UDP Port Menu → Parameter → 2001 →
ETHERNET COM. MENU → UDP Port Menu → Depth → 2003 →

EK 500:
ETHERNET COM. MENU → UDP Port Menu → Parameter → 2002 →
ETHERNET COM. MENU → UDP Port Menu → Depth → 2003 →
```

The SSU.ini and PCTCP.ini files on the Synchronization Unit also required modification. These files are included below, with references to the settings altered above in **boldface**.

2. PCTCP.INI

```
[pctcp general]
time-zone=EST
time-zone-offset=300
host-name=ssu
full-name=
user=ssuuser
office=ssuoffice
office-phone=ssuphone
pfile=c:\pctcp\passwd
completion-domain=afrodite
domain=ssu.com
etc-dir=c:\pctcp
completion-domain=
completion-domain=

[pctcp kernel]
interface=ifcust 0
serial-number=1990-1017-2075
authentication-key=6799-3996-8293
window=1600
low-window=0
use-emm=no
kernel-int=0x61
ip-ttl=64
ip-precedence=routine
ip-precedence-matching=lax
ip-security=none
ip-delay=high
ip-reliability=low
ip-throughput=low
large-packets=8
small-packets=15
tcp-connections=5
udp-connections=5
router-discovery=no
mtu-discovery=yes
host-table=c:\pctcp\hosts
small-packet-size=160
loadhigh=yes
multicast=no
kernel-does-dns=no
huge-packets=0

[pctcp ifcust 0]
irq=10
dma=no
rcv-dma=0
xmt-dma=0
ip-address=129.177.31.100
subnet-mask=255.255.255.128
broadcast-address=255.255.255.128
interface-type=PKTDRV
frame-type=IEEE
```

3. Amended SSU.ini file

[General]
Modes=EM EA EK TO, EM&EA EK TO, EM EA&EK TO, EM&EA&EK TO
DepthMenu=1
DepthMode=0
ManualDepth=1000
DepthDataPort=2003
Systems=EA 500,EK 500,EM 120,TOPAS

[EA 500]
ModelType=EA 500
TriggerOutCh=0
TriggerOutActiveHigh=1
TriggerInCh=0
TriggerInActiveHigh=1
Network=1
ProcessTime=1
Multipulse=0
MaxTimeBeforeTriggerAnswer=20
SignalProcessTime=0

[EK 500]
ModelType=EK 500
TriggerOutCh=3
TriggerOutActiveHigh=1
TriggerInCh=3
TriggerInActiveHigh=1
Network=1
ProcessTime=1
Multipulse=0
MaxTimeBeforeTriggerAnswer=20
SignalProcessTime=0

[EM 120]
ModelType=EM 12
TriggerOutCh=1
TriggerOutActiveHigh=0
TriggerInCh=1
TriggerInActiveHigh=0
FinishCh=2
FinishActiveHigh=1
Network=0
ProcessTime=0
Multipulse=0
MaxTimeBeforeTriggerAnswer=300
SignalProcessTime=0

[TOPAS]
ModelType=TOPAS
TriggerOutCh=4
TriggerOutActiveHigh=0
TriggerInCh=4
TriggerInActiveHigh=1
Network=0

ProcessTime=1
Multipulse=1
MaxTimeBeforeTriggerAnswer=85
SignalProcessTime=0

[EM EA EK TO]
Groups=EM,EA,EK,TOPAS
TriggerSequence=0,1,2,3

[EM EA EK TO+EM]
MasterSystem=
RepeatCount=1
Systems=EM 120

[EM EA EK TO+EA]
MasterSystem=
RepeatCount=1
Systems=EA 500

[EM EA EK TO+EK]
MasterSystem=
RepeatCount=1
Systems=EK 500

[EM EA EK TO+TOPAS]
MasterSystem=
RepeatCount=1
Systems=TOPAS

[EM EA EK TO+EM+EM 120]
ModelType=EM 120
Trigger=1
TimeUsage=1
FixedTime=1000

[EM EA EK TO+EA+EA 500]
ModelType=EA 500
Trigger=1
TimeUsage=1
FixedTime=1000
PercentTimeAddon=50
IPAddress=129.177.031.101
Port=2001

[EM EA EK TO+EK+EK 500]
ModelType=EK 500
Trigger=0
TimeUsage=1
FixedTime=1000
PercentTimeAddon=50
IPAddress=129.177.031.102
Port=2002

```
[EM EA EK TO+TOPAS+TOPAS]
ModelType=TOPAS
Trigger=1
TimeUsage=1
FixedTime=1000
MultipulseEnabled=0
MultipulseInterval=1000
PercentTimeAddon=50

[EM&EA EK TO]
Groups=EM EA,EK,TOPAS
TriggerSequence=0,1,2

[EM&EA EK TO+EM EA]
MasterSystem=EM 120
RepeatCount=1
Systems=EM 120,EA 500

[EM&EA EK TO+EK]
MasterSystem=
RepeatCount=1
Systems=EK 500

[EM&EA EK TO+TOPAS]
MasterSystem=
RepeatCount=1
Systems=TOPAS

[EM&EA EK TO+EM EA+EM 120]
ModelType=EM 120
Trigger=1
TimeUsage=1
FixedTime=1000

[EM&EA EK TO+EM EA+EA 500]
ModelType=EA 500
Trigger=1
TimeUsage=1
FixedTime=1000
PercentTimeAddon=50
IPAddress=129.177.031.101
Port=2001

[EM&EA EK TO+EK+EK 500]
ModelType=EK 500
Trigger=0
TimeUsage=1
FixedTime=1000
PercentTimeAddon=50
IPAddress=129.177.031.102
Port=2002
```

[EM&EA EK TO+TOPAS+TOPAS]
ModelType=TOPAS
Trigger=1
TimeUsage=1
FixedTime=1000
MultipulseEnabled=0
MultipulseInterval=1000
PercentTimeAddon=50

[EM EA&EK TO]
Groups=EM,EA EK,TOPAS
TriggerSequence=0,1,2

[EM EA&EK TO+EM]
MasterSystem=
RepeatCount=1
Systems=EM 120

[EM EA&EK TO+EA EK]
MasterSystem=
RepeatCount=1
Systems=EA 500,EK 500

[EM EA&EK TO+TOPAS]
MasterSystem=
RepeatCount=1
Systems=TOPAS

[EM EA&EK TO+EM+EM 120]
ModelType=EM 120
Trigger=1
TimeUsage=1
FixedTime=1000

[EM EA&EK TO+EA EK+EA 500]
ModelType=EA 500
Trigger=1
TimeUsage=1
FixedTime=1000
PercentTimeAddon=50
IPAddress=129.177.031.101
Port=2001

[EM EA&EK TO+EA EK+EK 500]
ModelType=EK 500
Trigger=0
TimeUsage=1
FixedTime=1000
PercentTimeAddon=50
IPAddress=129.177.031.102
Port=2002

[EM EA&EK TO+TOPAS+TOPAS]
ModelType=TOPAS
Trigger=1
TimeUsage=1
FixedTime=1000
MultipulseEnabled=0
MultipulseInterval=1000
PercentTimeAddon=50

[EM&EA&EK TO]
Groups=EM EA EK,TOPAS
TriggerSequence=0,1

[EM&EA&EK TO+EM EA EK]
MasterSystem=EM 120
RepeatCount=1
Systems=EM 120,EA 500,EK 500

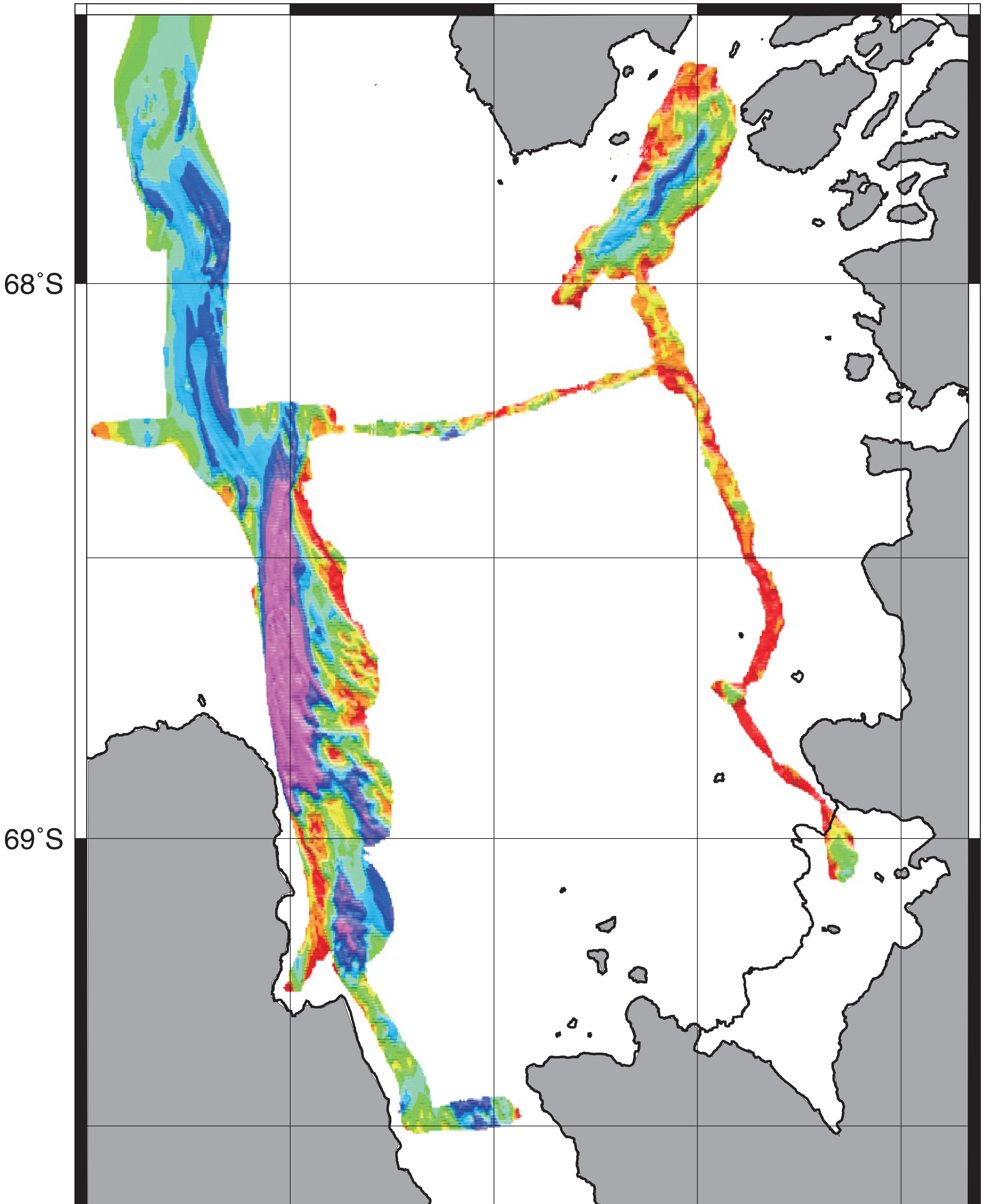
[EM&EA&EK TO+TOPAS]
MasterSystem=
RepeatCount=1
Systems=TOPAS

[EM&EA&EK TO+EM EA EK+EM 120]
ModelType=EM 120
Trigger=1
TimeUsage=1
FixedTime=1000

[EM&EA&EK TO+EM EA EK+EA 500]
ModelType=EA 500
Trigger=1
TimeUsage=1
FixedTime=1000
PercentTimeAddon=50
IPAddress=129.177.031.101
Port=2001

[EM&EA&EK TO+EM EA EK+EK 500]
ModelType=EK 500
Trigger=0
TimeUsage=1
FixedTime=1000
PercentTimeAddon=50
IPAddress=129.177.031.102
Port=2002

[EM&EA&EK TO+TOPAS+TOPAS]
ModelType=TOPAS
Trigger=1
TimeUsage=1
FixedTime=1000
MultipulseEnabled=0
MultipulseInterval=1000
PercentTimeAddon=50


68˚S
69˚S
71˚W
70˚W
69˚W
68˚W
67˚W