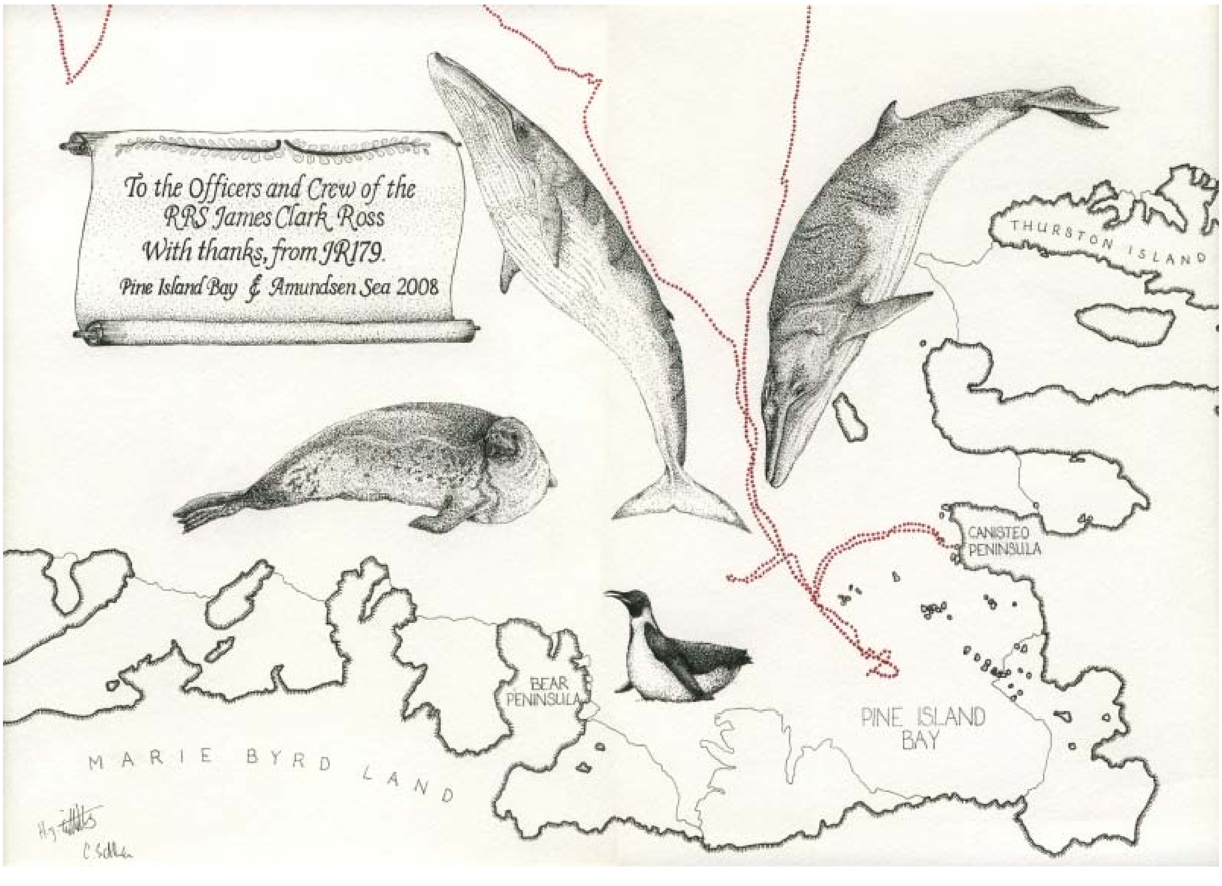
Cruise Report JR 179

RRS James Clark Ross

February to April 2008

Marine biological and marine geological and geophysical studies in the Amundsen and Bellingshausen Seas



This unpublished report contains initial observations and conclusions. It is not to be cited without permission of the director, British Antarctic Survey.

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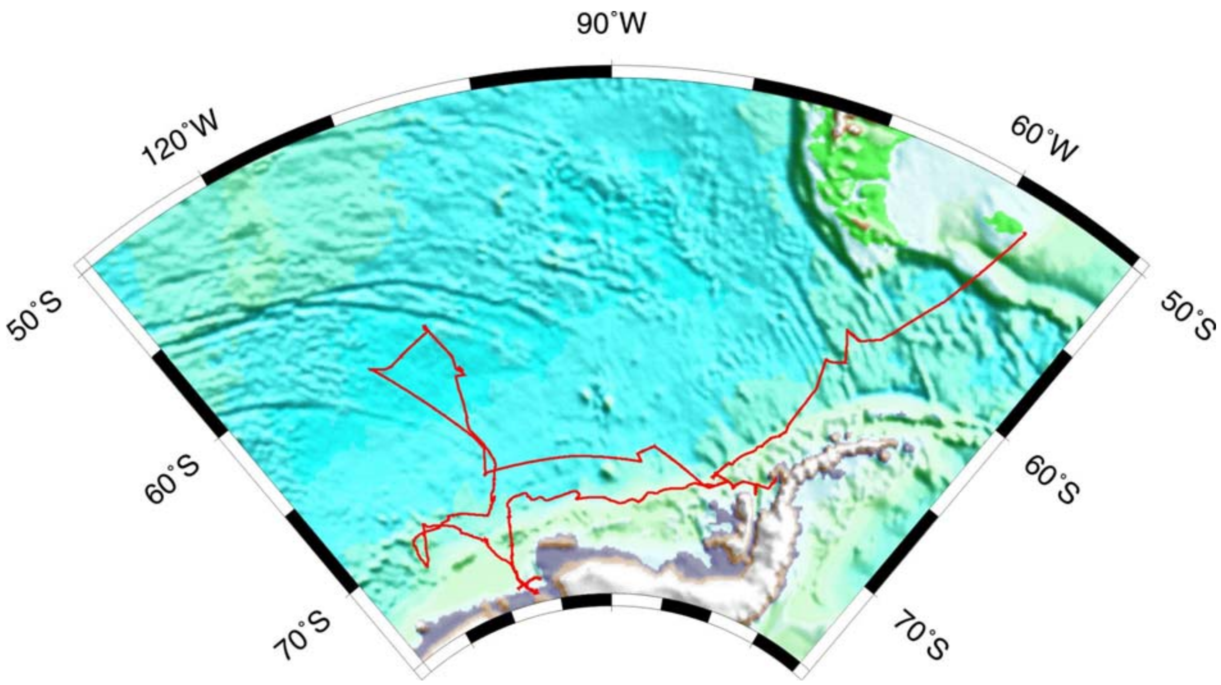
1. SUMMARY

On cruise JR179 a multidisciplinary programme was carried out in the Amundsen and Bellingshausen Seas, including benthic marine biological studies and marine geological and geophysical investigations. RRS *James Clark Ross* became the first UK vessel to reach Pine Island Bay, and also ventured further west the ever before. In view of the large amount of passage required to reach some of the remote study sites it was clear that many days of ship time could be saved by combining different activities into a single multidisciplinary cruise. The different science teams worked well together and some interesting discussions resulted.

The data and samples collected on the cruise will provide new insights into the distribution and diversity of benthic marine fauna on the Pacific margin of Antarctica, the stability (or instability) of the West Antarctic Ice Sheet during the late Quaternary, and variations in palaeoclimatic and palaeoceanographic conditions in the region during the Holocene. The work carried out on the cruise will contribute to several International Polar Year programmes.

Figure1: Cruise track of JR179:



2. List of Personel

2.1 Scientific and Technical (24)

P. Enderlein	BAS	Co-chief Scientist
R.D. Larter	BAS	Co-chief Scientist
C.-D. Hillenbrand	BAS	Marine Geologist
C.S. Allen	BAS	Palaeoceanographer
J.A. Smith	BAS	Marine Geologist
T.J. Deen	BAS	Marine Geophysicist
A.G.C. Graham	BAS	Marine Geophysicist
B.E. Hull	BAS	Marine Geophysicist
L.G. Collins	BAS	Micro palaeontologist
P.J Carter	Bristol University	Marine Geochemist
B.T.I. Reinardy	Swansea University	Glacial Sedimentologist
H.J. Blagbrough	BAS	Geological Technician
D. Pearce	BAS	Microbiologist
D.K.A. Barnes	BAS	Marine Biologist
H.J. Griffiths	BAS	Marine Biologist
A.G. Glover	Natural History Museum	Marine Biologist
S.S.M. Kaiser	University of Hamburg	Marine Biologist
J.C. Sands	BAS	Molecular Ecologist
J.M. Strugnell	University of Cambridge	Phylogeneticist (CAML, LTFF)
R.E. Malinowska	BAS	Molecular Biologist
J.G.R. Edmonston	BAS	ICT (Computing Engineer)
V. Afanasyev	BAS	AME (Electronic Engineer)
R.A. Phipps	NOC	Coring Technician
R.E. McCabe	BASMU	Doctor

AME = BAS Antarctic & Marine Engineering Section; BAS = British Antarctic Survey; BASMU = BAS Medical Unit; CAML = Census of Antarctic Marine Life; ICT = BAS Information Communications Technology Section; LTFF = Lloyd's Tercentenary Foundation Fellowship; NOC = National Oceanographic Centre;

2.2 Ship's Company (28)

M.J.S. Burgan	Master	A.M. Martin	Bosun's Mate
T.S. Page	Chief Officer	M.T. Rowe	SG1
J.L. Cox	2nd Officer	I. Raper	SG1
J.D. Lloyd-Jennings	3rd Officer	G.A. Dale	SG1
M.E.P. Gloistein	ETO comms	A.J.J. Estibiero	SG1
J.W. Summers	Do'sci'ops	K.J. Holmes	SG2
D.E. Anderson	Ch Engineer	E. Allen	MG1
T.R. Elliot	2nd Engineer	J. Coutts	MG1
J.S. Stevenson	3rd Engineer	A.A. Huntley	Chief Cook
R.H. Tulloch	4th Engineer	J.E. Lee	2nd Cook
D.P. Trevett	Deck Engineer	L.J. Jones	Sr Steward
A.K. Rowe	ETO Engineer	N.R. Greenwood	Steward
R.J. Turner	Purser	G. Raworth	Steward
D.J. Peck	Bosun	M. Weirs	Steward

Figure 2: Group Photo:

3. Timetable of Events

February 2008

18 Embarkation of scientific party and crew changeover.

19 Mobilisation.

20 Completing mobilisation. Ship bunkering and taking on stores. Propulsion motor tests continuing.

21 Bunkering avcat. RRS *James Clark Ross* departs from FIPASS at 1700 local time (2000Z). Final propulsion motor trials in Port William before proceeding south. Turn south off Cape Pembroke at 2230Z.

22 Deploy magnetometer at 1300Z. Crossing Drake Passage, collecting multibeam echo sounding, TOPAS, ADCP and magnetic data continuously.

23 Continuation of Drake Passage crossing, in worsening conditions. Adjust to more westerly heading at lunchtime to reduce rolling, then hove-to at 2130Z

24 Resume Drake Passage crossing at 0845Z as conditions improve. First CTD.

25 Passage along Antarctic Peninsula continental rise, then first piston core.

26 Passage southwards along continental slope, then second piston core. Magnetometer recovered before coring and not redeployed afterwards.

27 Trawling and CTD casts on slope west of Alexander Island.

28 Trawling, CTD casts and gravity coring west of Alexander Island

29 Box core and gravity core west of Alexander Island, then passage westwards along continental slope in Bellingshausen Sea.

March 2008

1 Two CTD casts and continuation of passage across Bellingshausen Sea.

2 Passage across Bellingshausen Sea.

3 Passage towards Amundsen Sea continental shelf.

4 Trawling on outer shelf, then box and gravity cores at two sites on passage to Pine Island Bay.

5 Trawling and box core at 1000 m site in Pine Island Bay.

6 XBT cast, trawling, box core and CTD cast at 1500 m site, then swath bathymetry survey of inner Pine Island Bay sill, followed by CTD cast and trawling at 500 m site.

7 Trawling and box core at 500 m site, then passage northwards to 1500 m 'tunnel valley' site, TOPAS profiling, two gravity cores and a box core.

8 Trawling at 1500 m 'tunnel valley' site, swath bathymetry survey to Canisteo Peninsula, boat landings on unnamed island, then return to 'tunnel valley' site.

9 Trawling at 'tunnel valley' site, then passage northwards to 1000 m site, CTD cast, trawling and box core.

10 Transit westwards to 500 m site, CTD cast, trawling and box core, then passage northwards out of Pine Island Bay.

11 Gravity core and box core in main shelf trough, passage to shelf edge, then CTD cast and trawling at 500 m site.

12 Completion of trawling at 500 m site at shelf edge, box core, CTD cast, then relocation to 1000 m site on continental slope, and trawling, two CTD casts and box core there.

13 CTD cast, trawling and box core at 1500 m site on continental slope, then passage westwards across Amundsen Sea.

14 Stopped overnight in ice, continued passage to seamount, then trawling there.

15 Completion of trawling on seamount, transit to core site, piston core and box core, then transit southwards to core site on continental margin surrounded by sea ice.

16 Two piston cores and a box core, then transit northwards out of ice.

17 Passage eastwards across Amundsen Sea, then piston core.

18 Box core, trawling then magnetometer deployed for transit northwards.

19 CTD cast, piston core, box core, then transit northwards.

20 Transit northwards.

21 Transit northwards, then box core and piston core.

22 Transit northwards, piston core, then continuing northwards. Magnetometer recovered before coring and not redeployed afterwards.

23 Transit northwards to near Tharp Fracture Zone, swath bathymetry and TOPAS survey to identify core site, piston core, further TOPAS survey, box core, CTD cast.

24 Transit westwards, then piston core.

25 Box core, then magnetometer deployed for transit southeastwards.

26 Transit southeastwards, then piston core. Magnetometer recovered before coring and not redeployed afterwards.

27 Transit southwards to target core site, but conditions preclude coring. Passage eastwards to Bellingshausen Sea.

28 Passage eastwards, box core, piston core, then continue passage.

29 Passage eastwards to Belgica Trough Mouth Fan, box core, piston core, then transit northwards.

30 Piston core and box core on distal part of Belgica Trough Mouth Fan, then passage eastwards and CTD cast.

31 Passage to continental shelf west of Alexander Island, then swath bathymetry and TOPAS survey.

April

1 Box core and two gravity cores west of Alexander Island, then passage to Marguerite Trough.

2 Two gravity cores, three box cores and CTD cast in Marguerite Trough, passage to trough near Rothera, then TOPAS survey, piston core and box core.

3 Another piston core and box core in trough near Rothera, trawling, then RRS *James Clark Ross* arrives at Rothera at 0930 local time (1230Z).

4 – 5 Rothera last call

6 Complete cargo work, then RRS *James Clark Ross* departs from Rothera at 1710 local time (2010Z).

7 Passage northeastwards along Antarctic Peninsula continental shelf, collecting multibeam echo sounding, TOPAS and ADCP data continuously.

8 Passage through Gerlache Strait and Bransfield Strait deploying whale bone mooring.

9 – 10 Passage to Falkland Islands

11 Arrive Falkland Islands and demobilisation

3. Introduction

JR179 was a combined biological and geological sciences cruise that involved work for three projects within current BAS core programmes. The biological work (nominally ten days on site) was part of the BIOPEARL (Biodiversity Dynamics: Phylogeography, Evolution and Radiation of Life) project, which is a component of the BIOFLAME programme. The original objectives were to determine the diversity and taxon richness of benthic organisms at a range of depths along the continental slope in the Amundsen and Bellingshausen seas.

Planned geological work (nominally 20 days on site) focussed mainly on sediment coring to serve the Quaternary West Antarctic Deglaciations project (QWAD, part of the GRADES programme) and the Pole-Equator-Pole project (PEP, part of the CACHE programme). The main objective of the QWAD work on JR179 was to obtain sediment cores from the deep ocean parts of the Amundsen and Bellingshausen seas, in order to examine them for evidence of instability of the West Antarctic Ice Sheet during any of the last several interglacial periods. The PEP objective was to recover expanded Holocene sedimentary successions in order to obtain high-resolution palaeoclimate records for this period by multi-proxy analysis.

The biological work on JR179 will contribute to the SCAR Program: CAML (Census of Antarctic Marine Life) of the International Polar Year (IPY) programme and the geological work will contribute to the Bipolar Climate Machinery (BIPOMAC) and Antarctic Climate Evolution (ACE) SCAR and IPY programmes.

Remote sensing indications of sea ice extent and distribution through the early part of the season suggested there could be a rare opportunity to access Pine Island Bay, which is a difficult place to reach by ship in most years. This opened up the possibility for BIOPEARL of studying benthic communities in the deep shelf basins in Pine Island Bay (up to 1600 m water depth) where no samples had been taken previously for biological studies. For QWAD it raised the possibility of obtaining core samples along the main cross-shelf trough, which represents the path of the palaeo-ice stream that was the outlet for ice from a large part of the WAIS during the last glacial period. A core transect along this trough, to constrain the age and rapidity of glacial recession, had been an objective on cruise JR141 two years ago but had not been possible then due to sea ice cover. Swath bathymetry data collected in Pine Island Bay, and on passage on the way in and out, would also be valuable to QWAD. Such data would increase the sparse existing swath bathymetry coverage, which reveals features formed at the base of the former ice sheet and during deglaciation.

As the cruise started in late February, it was important to reach the vicinity of Pine Island Bay as early as possible to have a good chance of getting in before new sea ice began to form. Therefore it was decided to head almost directly there from the Falklands, with the only interruptions to passage being work at two biological study sites along the Bellingshausen Sea margin (maximum of 4 days) and a small number of core sites on the continental rise west of the Antarctic Peninsula and on the shelf west of Alexander Island (maximum 1½ days).

Fortunately the ice conditions remained favourable and *JCR* became the first British ship ever to reach Pine Island Bay. We worked there for one week, carrying out a range of both biological and geological investigations. On returning to the continental margin, our plan was to carry out biological work at two more sites along the margin, using up most of the remaining BIOPEARL time, then to embark on the main part of the geological programme. This is essentially what was done, although some adjustments were forced on us by the distribution of sea ice along the margin, weather conditions, and unexpected difficulty in finding expanded Holocene sedimentary successions.

The last call of the season at Rothera was incorporated into the cruise at the end of the science time. Although this was carried out on a tight schedule and resulted in a very full ship for the passage back to Stanley, many on board were pleased to have the opportunity to go ashore at Rothera after six weeks at sea. This arrangement also provided a rare and potentially valuable opportunity for marine science staff to gain insight into another aspect of BAS operations.

5 Project Reports

5.1 GRADES - QWAD

5.1.1 Multibeam Echo Sounding and Sub-Bottom Acoustic Profiling (EM120 and TOPAS)

R. Larter, A. Graham, T. Deen & B. Hull

5.1.1.1 Objectives

The primary application of the EM120 and TOPAS on JR179 was as an aid to location of suitable core sites and to provide context for the sites. The visit to Pine Island Bay provided the opportunity to augment multibeam swath bathymetry data collected during previous RVIB *Nathaniel B. Palmer* and RV *Polarstern* cruises and thus expand coverage over sea-floor features that were produced beneath a formerly more extensive ice sheet. Thus the new data in this area will be of immediate value to the QWAD project. Most data collected during the rest of the cruise consisted of individual swaths and widely spaced TOPAS profiles, but despite their sparse distribution data from several areas will be useful for current science projects, as outlined below.

During both crossings of Drake Passage care was taken to offset the ship's track from previous swath bathymetry tracks, thus adding to the corridor of coverage that has been built up over several seasons as part of the BAS Long-Term Monitoring and Survey programme. The detailed bathymetric dataset that is being built up in this area will have a range of applications in areas such as physical oceanography, for studying interactions of current with sea-floor topography, in tectonic and palaeobathymetric reconstructions, and as a base map for choosing coring and dredging sites for geochemical and palaeoceanographic studies.

A small diversion from the most direct passage route between two core sites on the upper continental rise, and from the southernmost of these core sites to the first biological study site, made it possible to collect a continuous swath of multibeam data along the upper continental slope from 65° S to beyond 68° S. These data will be useful for studying spatial variability and considering the origins of geomophological features on the upper slope, and will be used for that purpose within the BAS PhD project that Bryony Hull is working on.

EM120 and TOPAS data were collected on transits to two core sites on the continental shelf off Alexander Island. The cores were collected as part of the QWAD project in order to provide the first constraints on the extent of the last grounded ice advance to cover this part of the shelf and the timing of its retreat. The sea-floor morphology and sediment units revealed by the sonar datasets will provide additional evidence regarding the glacial history of this shelf area.

On the way into Pine Island Bay we were able to follow the axis of the main cross-shelf trough, which had previously been identified as the path of a major palaeo-ice stream during the Last Glacial Maximum. A single swath of multibeam data already existed along part of this route, having been collected in 1999 on RVIB *Nathaniel B. Palmer* cruise 9902. Where ice conditions allowed, the new multibeam swath was positioned so that there was a small overlap with the previously collected data. On the return journey northwards the trough axis was again followed for part of the way, so along part of the trough there now three parallel swaths of multibeam data. These data will be used within the QWAD project for interpreting the basal processes of the palaeo-ice stream and the pattern of grounding line retreat along the trough.

Deep basins in the central part of Pine Island Bay had previously been interpreted as showing evidence of past erosion by sub-glacial meltwater. During transits between the biological study sites in this area it proved possible to fill many gaps in existing multibeam swath bathymetry data coverage. Additionally, a few hours of EM120 survey were dedicated to extending coverage over a sill rising to shallower than 500 m that appears to be almost continuous across the trough at about 74° 30'S. This feature is likely to have played a significant role in the retreat history of the grounding line, and may also constrain the modern flow of Circumpolar Deep Water to Pine Island Glacier.

The visit to the unnamed island near Canisteo Peninsula on day 068 provided an opportunity to collect additional multibeam data over an area flanking the main trough. For safety reasons in these relatively uncharted waters, the route chosen to the island followed the edge of an existing swath of multibeam data collected in 2000 on RVIB *Nathaniel B. Palmer* cruise 0001. The edge of the new swath was followed on the return journey, and thus the additional coverage amounts to about one full swath width. These data will provide useful constraints on the direction of ice flow and the basal regime in an area that flanked the palaeo-ice stream.

One particular multibeam objective during this cruise had been to attempt to follow a major turbidity current channel across the central and lower continental rise. Fortuitously, the transit from a deep water biological site to PC496 on days 078–079 ran nearly parallel to such a channel, and it remained within the multibeam swath along nearly the entire transit of more then 100 km. On leaving the PC496 site the channel was followed for another 100 km northwards, although did it meandered beyond the limits of swath in a couple of places.

TOPAS data collected on the long transits between core sites on the continental rise and abyssal plain in the Amundsen Sea, in combination with other similar data (e.g. Parasound data collected on RV *Polarstern* cruises) provide an opportunity for preliminary regional mapping of different types of sea-floor reflection character. Such maps can yield insights that help in interpretation of depositional processes and bottom current regime.

5.1.1.2 Work at sea

The EM120 and TOPAS were operated at almost all times when the ship was in motion. Typical operating parameters used for both systems are listed in Appendix 1.

Sound velocity profiles (SVPs) input to the EM120 were derived from CTD and XBT casts carried out during the cruise, with the exception of three periods. SVPs derived from some XBT and SVP casts carried out on previous cruises were used during the transits across Drake Passage, and an SVP from a CTD carried out on the outer shelf in the Amundsen Sea was used on the way into Pine Island Bay. Changes to the active SVP were recorded in the EM120 Event Log and are listed in the Table 1 below:

Table 1: Sound Velocity profiles used

SVP file name	Day/time activated
jr133_svp1.asvp	053/0109
jr104_xbt03.asvp	055/1002
jr179_ctd001.asvp	056/0154
jr179_ctd008.asvp	059/1643
jr179_ctd010.asvp	061/2308
jr141_ctd028.asvp	065/1131
jr179_xbt001.asvp	067/0326
jr179_ctd011.asvp	067/1637
jr179_ctd016.asvp	071/2036
jr179_ctd020.asvp	073/0408
jr179_ctd020_ed.asvp (fewer data values)	074/1150
jr179_ctd021.asvp	079/0648
jr179_ctd008.asvp (reactivated)	080/1204
jr179_xbt2.asvp	080/1730
jr179_xbt3.asvp	081/2034
jr179_ctd022.asvp	085/0320

jr179_xbt2.asvp (reactivated)	087/1324
jr179_xbt4.asvp	089/1803
jr179_ctd024.asvp	091/1129
jr179_ctd007.asvp	092/0155
jr179_ctd025.asvp	093/1530

EM120 data were logged as a number of separate 'surveys' corresponding to different areas of operation as follows:

Table 2: EM120 surveys

Survey Name	Area	Start day/time
JR179_a_transit	Southbound transit across Drake Passage	053/0109
JR179_b_antpen	Antarctic Peninsula continental margin	056/0104
JR179_c_Bell	Bellingshausen Sea continental margin	061/0645
JR179_d_PIB	Pine Island Bay	064/1131
JR179_e_amsea	Amundsen Sea (excluding Pine Island Bay)	071/1703
JR179_f_bell	Bellingshausen Sea continental rise	088/0125
JR179_c_Bell	See above – briefly reactivated at	091/1604
JR179_b_antpen	See above – reactivated at	091/1608
JR179_f_transit	Northbound transit across Drake Passage	100/0012

Ping editing of EM120 data were carried out on board using MB-System software.

TOPAS was operated using 'chirp' transmission mode throughout the cruise, even in continental shelf depths, because of the persistent 100 Hz noise, which has more noticeable effects when the other transmission modes are used. TOPAS was configured to automatically start writing a new data file when the old one reached 10 Mb in size, which was typically a period between 30 minutes and 2 hours, depending on ping rate.

5.1.1.3 Preliminary Results

Multibeam swath bathymetry data collected on the transit along the upper continental slope west of the Antarctic Peninsula confirmed that it is dissected by numerous gullies along most of its length. The challenge now is to analyse the characteristics, spacing and distribution and setting of the gullies on the slope to gain insight into the processes responsible for their formation.

Multibeam data collected near the southernmost of the two core sites on the rise and near the first biological site reveal spectacular erosional topography at the base of the continental slope. These data provide powerful support to the idea that many of the turbidity currents in this area are very high energy flows.

Multibeam data collected on the transits to and between core sites on the continental shelf off Alexander Island show clear evidence of relict subglacial bedforms, and the TOPAS data along the same lines show that these features are formed on a surface that is covered by a drape of postglacial sediments no more than 3 m in thickness (Fig. 3). Given the thin sediment cover it seems unlikely that the subglacial bedforms pre-date the last glacial maximum. Bedforms are most common in areas that constitute enclosed deeps or troughs on this part of the continental shelf (see Fig. 3). The troughs, which are oriented cross-shelf, are likely pathways for former ice streams which must have formed components of a much larger ice sheet at the last glacial maximum. Grounding line moraines observed on both the swath data and TOPAS profiler data support the notion of ice sheet grounding on the continental shelf (Fig. 3). However, grounding line features provide only a minimum estimate of how far the ice sheet extended onto the shelf, because the remainder of the outer shelf has been heavily ploughmarked by icebergs, at the sea floor. It remains to be seen whether the ice sheet was sourced locally from an ice cap over Alexander Island, or whether it comprised part of the larger APIS and WAIS, which also had significant drainage outlets to the east (Marguerite Bay) and to the west (Bellingshausen Sea) of Alexander Island at its maximum extent.

A variety of clear subglacial bedforms were also observed on mulitbeam data collected on transits into and out of Pine Island Bay. These included an area of long, elongated bedforms on the outer shelf where two parallel lines were surveyed during passage into the embayment. The patch of bedforms reveals new information on both the palaeo-extent and palaeo-drainage direction of a former ice stream, which emanated from the present day Pine Island/Thwaites glacier catchments. Like the Alexander Island examples above, TOPAS profiles show that these bedforms are only draped by a few metres of sediment, and are therefore probably of last glacial maximum age.

Further onto the shelf in Pine Island Bay, several ice marginal features were observed. One of these was already known from published literature, but others were unsurveyed prior to cruise JR179. Furthermore, multibeam and TOPAS collected on transit into Pine Island Bay suggests that the already-known marginal feature is actually more complex than first documented. The other grounding line features are often associated with additional zones or generations of subglacial bedforms, which lend support to interpretations of these features as having formed by grounded ice sheets, probably during their retreat. As an original target of cruise JR141, the observation of grounding line moraines will now allow us to constrain the retreat pattern of the ice sheet from the outer shelf to inner Pine Island Bay. A gravity core obtained from the top of one of these wedges on transit out of the embayment will provide an invaluable tie point at a known shelf ice margin, which can improve constraints over timing of ice sheet deglaciation; a transitional glacimarine unit comprises part of the sedimentary sequence recovered here, which can be used to reliably date the deglacial phase, using AMS radiocarbon techniques.

Multibeam data collected on the inner shelf in Pine Island Bay significantly increased our data coverage and knowledge of the geomorphology in this area. It is now clear that the region is characterised by a series of deep basins (former subglacial cavities), which have been significantly modified and eroded by subglacial meltwater. The deep cavities are often bounded by shallow sills, but which have been carved latterly by numerous channels, presumably acting as spillways during phases of outburst or meltwater ejection from the subglacial environment. These channels have been well imaged in some of the new multibeam data, and in one particular area our new data improve definition of, a single, large-scale meandering channel that previous workers have identified as a tunnel valley. As the meltwater and basin features are formed in bedrock, they may have been eroded and modified through successive glacial cycles. However, it is more than likely that they played at least some role in the function of the WAIS at the last glacial maximum. To this end, the geomorphic record from this area will be used to provide insights into the subglacial hydrological system, and the role of meltwater in modifying both the ice sheet bed and overlying ice flow. In their modern settings, the sills and basins may provide further interesting insights into the ways in which Circumpolar Deep Water is transported onto and stored upon the continental shelf in the Amundsen Sea Embayment.

Transit across inner Pine Island Bay to the un-named island off Canisteo Peninsula provided an opportunity to collect some rare multibeam and parametric echo sounding data on an area of the shelf where the glacial and structural geology was completely unknown (Fig. 4). The legs to-and-back from the island meant that a relatively wide swath coverage could be obtained. Added to existing *NB Palmer* multibeam data from this location, the width of the swath coverage was extended even further. Multibeam data over regional bathymetric highs showed a clear structural control on the geomorphology, with channels and other erosional forms exploiting joints or stratal boundaries in the bedrock exposed at the seafloor today (Fig. 4). The margin of the palaeo-ice stream signature flowing out of Pine Island Bay was also visualised at the start and end of the transits on swath bathymetry. Here, the data will provide a means at looking at changes in bed character across ice velocity-gradients at an ice stream margin. Finally, adjacent to the un-named island, the multibeam data imaged a spectacular basin lined with more subglacial bedforms. TOPAS profiles suggest these are also bedrock or bedrock-cored features. Their relatively short form indicates that an onset zone of faster flow is recorded here. The increase in palaeo-ice flow rate is probably a product of an abrupt change in the shelf bathymetry (i.e., topographic change in the ice sheet bed), changing from a shallow rugged sea floor near the un-named island, to a deep and contrastingly smooth basin seaward.

The biological trawls along the Amundsen Sea continental slope on days 072 and 073 were exploited as an opportunity to experiment with the beam steering capabilities of TOPAS, in order to see if they can be used to obtain better sub-bottom profile images on Antarctic continental slopes. Most 3.5 kHz and parametric profiler records over Antarctic continental slopes show little or no sub-bottom penetration. While this is usually attributed to the typical coarseness of the sediments a contributing factor is also likely to be that the beam is reflected at an equal and opposite angle to that at which it is incident on the slope, and thus the centre of the beam does not return to the ship. This effect is probably most marked on parametric systems as a consequence of their relatively narrow beam width (approximately 5 degrees). Tests showed that steering the beam towards the slope to obtain a normal incidence reflection significantly increased the strength of the reflection (Fig. 5). For future reference it is worth noting that the experiments showed the convention in the athwardship direction is that projections angles to port are positive, and in the alongship direction forward is positive. The slow speed of the ship during trawls (a fraction of a knot) resulted in collection of along-slope profiles that have unusually high spatial resolution. Some of these profiles reveal lens shaped bodies a few metres thick and a few hundred metres wide that are interpreted as deposits from small debris flows (Fig. 6). This observation lends support to the idea that numerous small-volume debris flows may have been important constructional elements on some parts polar continental slopes.

Moving off the shelf and out of the Amundsen Sea embayment towards the deeper ocean, multibeam data picked up a large meandering channel flowing on a broadly N-S direction, which was then followed and surveyed for more than 100 km northwards (Fig. 7). The asymmetric floor of the channel, levee geometries, and planform appearance of the feature shows that this is a turbidity channel, formed by episodic, turbulent sand-mud-water flows derived initially from the upper slope. It is an important feature in determining methods of sediment delivery to the deep ocean as well as for resolving sedimentary processes on the continental rise.

Elsewhere on the continental rise, TOPAS profiles recorded a surprising spatial variability in reflection characteristics, both at the sea floor and in the subsurface. The passage to and between core sites in region of the Polar Front allowed the distribution of sediment types to be mapped out on a regional basis. Some of the reflection classifications recorded on the lower rise and into the deep ocean include: (i) sea mounts, (ii) sediment waves, (iii) channels, (iv) uniform stratified reflector packages, (v) thick, disturbed stratified packages with signs of soft sediment deformation, including possible mud volcanoes emerging at the sea floor, and (vi) transparent, lobate shallow units, exhibiting a reduced subsurface penetration. Analysis of these different reflector characteristics will show a regional distribution of sediment types and patterns across the Amundsen Sea for the first time. They may be useful in interpreting zones of accumulation on the continental rise for future coring targets, and for interpreting the possible distribution of bottom currents in the Amundsen Sea, which remain poorly constrained today.

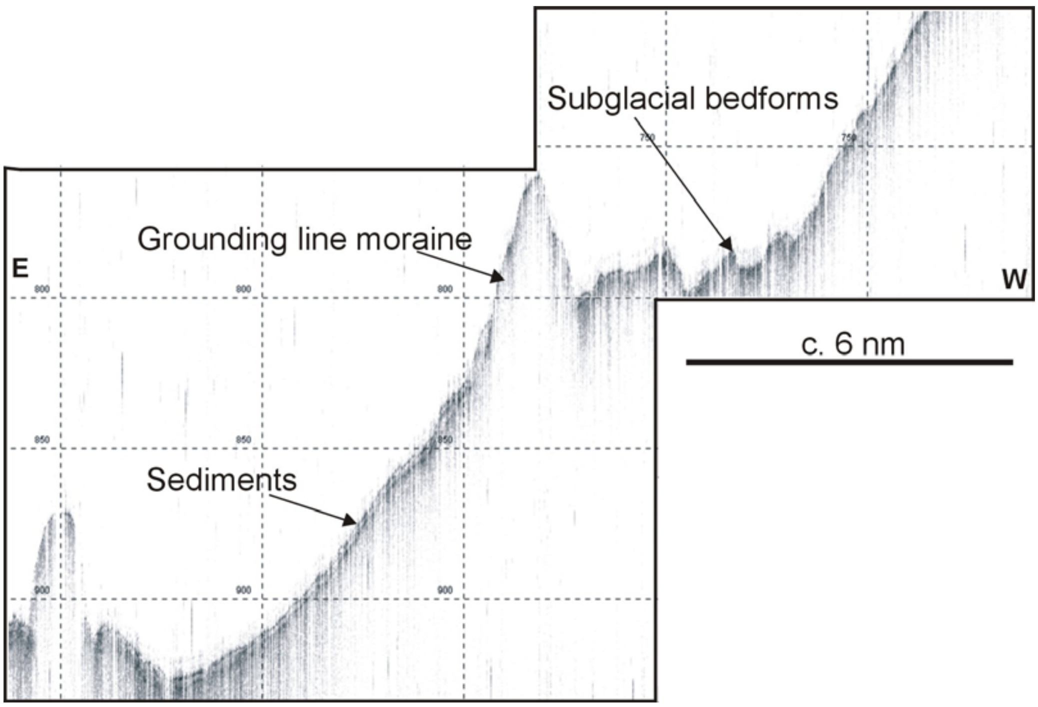


Figure 3: TOPAS profile offshore Alexander Island showing bedforms draped by thin sediments, and a prominent grounding line moraine at the sea floor.

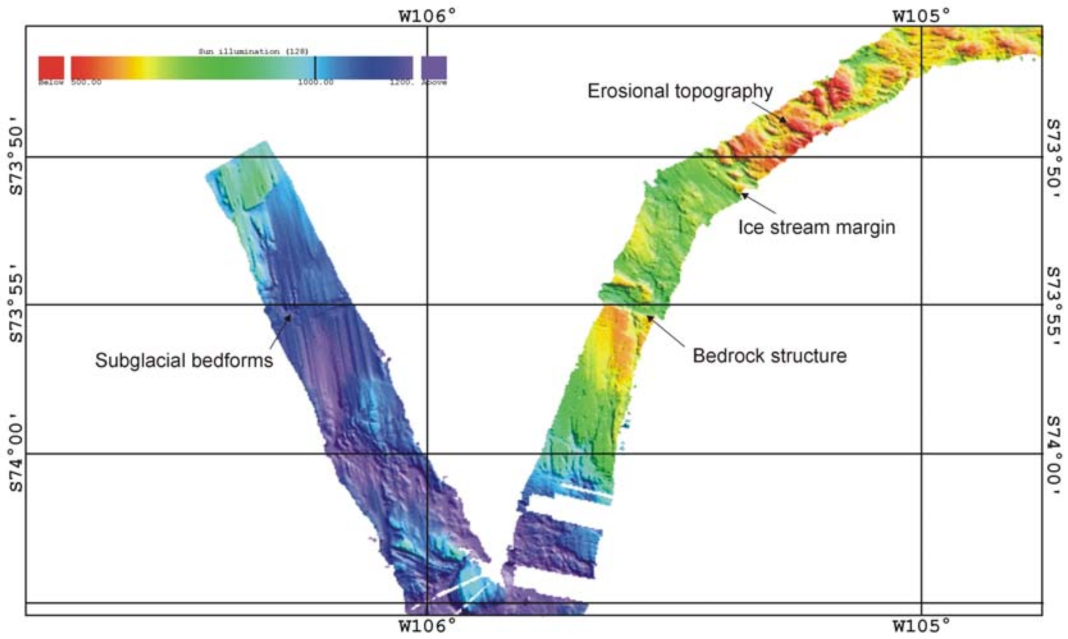


Figure 4: Example of EM120 data in the Pine Island Bay area showing subglacial bedforms, a palaeo-ice stream margin, erosional topography and clear bedrock structures at sea floor.

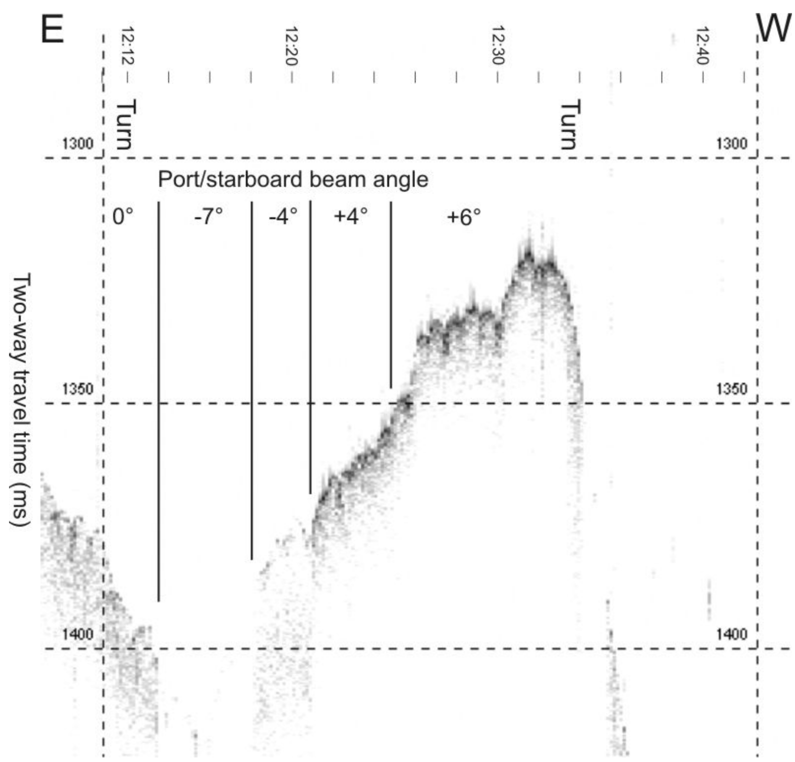


Figure 5: TOPAS profile along the Amundsen Sea continental slope. The profile is annotated to highlight the effects of steering the beam away from (starboard, negative angles) and towards (port, positive angles) the slope, which had an approximate gradient of 6.5° in a direction nearly at right angles to the profile.

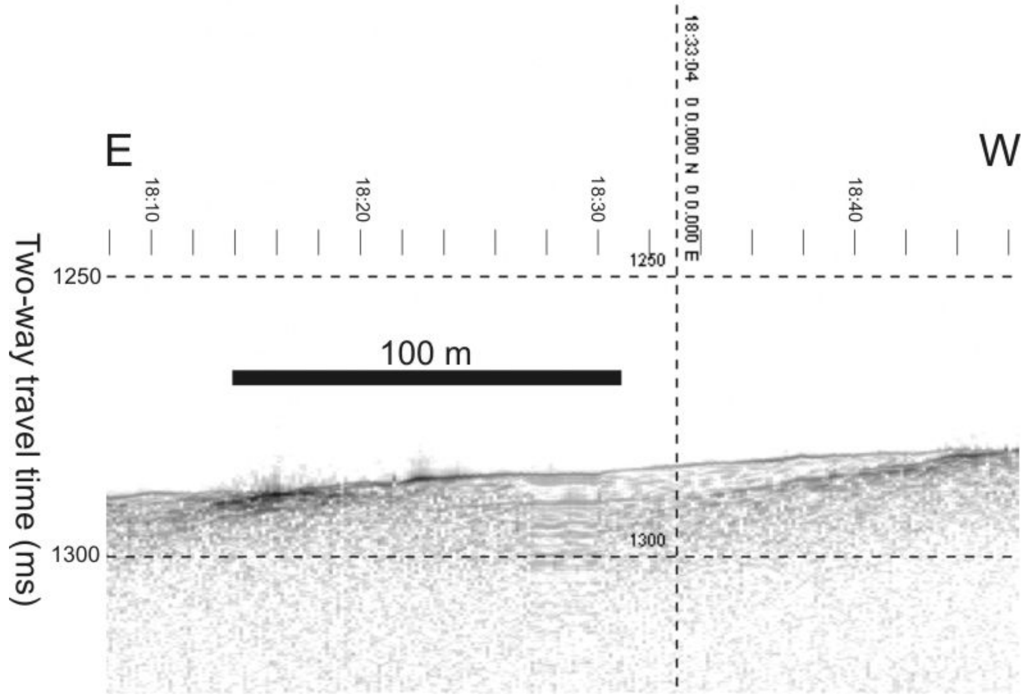


Figure 6: TOPAS profile along the Amundsen Sea continental slope collected with beam steered towards slope while trawling. The profile shows a lenticular body about 185 m wide by up to 5 m thick that is interpreted as having been deposited by a small debris flow. Such small flows may be the basic building blocks of many polar continental slopes, but are unlikely to be identifiable on profiles collected at normal survey speed with a vertically-directed beam.

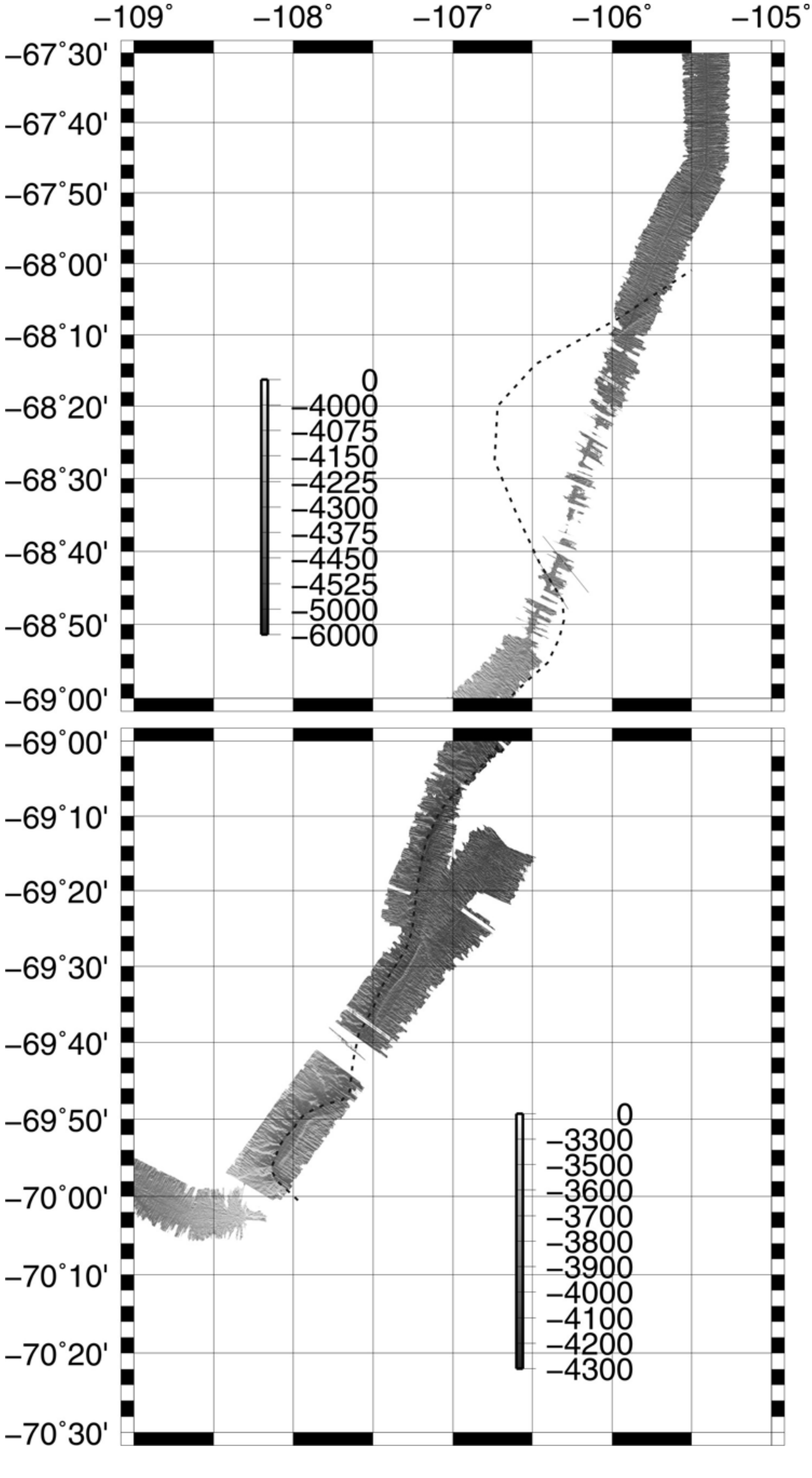


Figure 7: Turbidite channel on the continental rise, Amundsen Sea.

5.1.2 Coring

C.-D. Hillenbrand, C. Allen, J. Smith, H. Blagbrough, P. Carter, L. Collins, B. Reinardy, A. Graham, B. Hull & R. Larter

The coring gear used during JR179 comprised the piston corer (PC) from NMF Sea Systems (Southampton), which was deployed as a gravity corer (GC) at shelf sites, and the BAS box corer (BC). The BC was deployed at selected coring sites (Table X) for the recovery of undisturbed sediments directly from the seabed surface. All recovered sediment cores were cut into sections of ≤1m length and properly labelled. The section ends were closed with plastic caps and sealed with tape. Together with the core catcher samples the sections were stored in the scientific cold room onboard JCR at a temperature of +4 °C. Magnetic susceptibility (MS) of the GCs and PCs (and of selected subcores taken from the BCs) was measured on whole cores at room temperature using a Bartington MS2C loop sensor that was connected to a Bartington susceptibility meter. Selected cores and core sections were split along their long axis using a router system and a cheese wire. After being photographed, lithology, structure and Munsell color of the split sediment cores were described following BAS standard methods. Smear slides were taken from each lithological unit and further analysed under a microscope. On GCs recovered from the shelf shear strength was measured with a handheld Torvane. Bulk samples were taken from the working halves of the sediment cores. Each split core section was covered in cling film and taped inside lay-flat polythene tubing. After completion of logging and sampling, the working and archive halves of the cores and the bulk samples were taken to the Scientific Cool Store.

The marine-geological coring targets for the QWAD project on cruise JR179 were as follows:

- Recovery of continuous, calcareous foraminifera-bearing high resolution records from drift sediments west of the Antarctic Peninsula.
- Recovery of sedimentary sequences spanning the last glacial period to present from the Antarctic Peninsula shelf north of Alexander Island.
- Recovery of sedimentary sequences spanning the last glacial period to present from the West Antarctic shelf offshore from Pine Island Bay.
- Recovery of continuous sediment records spanning the last 130 kyr to 800 kyr, respectively, from the upper West Antarctic continental rise, including at least some sequences bearing calcareous foraminifera tests throughout.
- Recovery of sedimentary sequences spanning the last 130 kyr to 800 kyr along a N-S transect from the Antarctic Polar Front (APF) to the West Antarctic continental rise

and along an E-W transect from the Antarctic Peninsula continental rise to the continental margin in the Amundsen Sea.

Cores PC466 and PC467 were recovered from the crests of Drifts 4 and 6 located on the continental rise west of the Antarctic Peninsula. The MS records of the two cores suggest that PC466 spans late Marine Isotopic Stage (MIS) 6 [191-130 ka] to MIS 1 [14-0 ka], while PC467 spans not more than MIS 4 [71-57 ka] to MIS 1. PC466 was split, but did not reveal an obvious lithological change in the core interval that was correlated with MIS 5 [130-71 ka]. Sieving of the core catcher samples of PC466 and PC467 indicated the presence of calcareous foraminifera tests at the core base. Cores PC466 and PC467 were recovered to analyse their relative palaeomagnetic intensity (RPI). The drift sediments west of the Antarctic Peninsula are supposed to be very suitable for RPI measurements, and the cores recovered during JR179 may contain enough calcareous planktonic and/or benthic foraminifera tests for establishing a reliable age model based on stable oxygen isotope stratigraphy. As a future step it is planned to use well dated RPI records of PC466 and PC467 as templates for correlating them with RPI records from other sediment cores recovered from the West Antarctic continental margin that are barren of calcareous microfossils.

Gravity cores GC468, GC469 and GC471 were deployed on the shelf north of Alexander Island in order to determine if grounded ice had advanced across the shelf in this area during the last glacial period. Unfortunately, the core catchers of cores GC468 and GC469 were damaged during the coring process (see section 7.5). As a consequence, recovery was incomplete at site GC468, and no sediment was retrieved at site GC469. At site GC468 basal sediments consist of a diatom ooze (probably of Holocene age), and a gravelly sandy mud (interpreted as an ice-proximal deposit) forms the basal sediments at site GC471. It is likely that only sediments younger than the last glacial period were recovered at both site GC468 and site GC471. During the later stage of the cruise site GC514 on the shelf north of Alexander Island (north of Rothschild Island) was targeted in order to retrieve a high-resolution Holocene sequence for project CACHE PEP-G (see section 5.2). Surprisingly, core GC514 recovered a relatively stiff glacial diamicton at its base, i.e. it must have fully penetrated sediments deposited during the Holocene and the last deglaciation.

GCs were collected along a transect from the outer to inner shelf in the eastern Amundsen Sea Embayment in order to fill a gap in the geographical coverage with sediment cores that had been recovered during cruises JR141 on RRS *James Clark Ross* and ANT-XXIII/4 on RV *Polarstern* in 2006. The main objective on cruise JR179 was to retrieve sequences from the middle and outer shelf that would span the whole time interval from ice-sheet grounding during the last glacial period to ice stream lift-off/retreat during the deglaciation, and finally to the seasonally open-marine setting characterising the present day environment. Site GC473 is located within a zone of mega-scale glacial lineations (MSGL) on the outer shelf, site GC475 within MSGL on the middle shelf (west of Burke Island), sites GC479/GC481 (note: core GC481 is a repeat of core GC479) on the flank of a tunnel valley on the inner shelf within Pine Island Bay, and site GC484 is located on a grounding zone wedge on the middle shelf. Radiocarbon and palaeomagnetic intensity dating of these sediment cores should allow reconstruction of the timing of grounded ice retreat from the shelf towards Pine Island Bay. Cores GC473 and GC475 recovered muddy diamicton at their base, which can be interpreted as an ice-proximal or even subglacial deposit. The entire sequence retrieved at site GC481 consists of terrigenous clay, which is likely to have been deposited by postglacial meltwater plumes originating from Pine Island and Thwaites Glaciers. The basal sediments of core GC484 consist of a soft diamicton interpreted as a deformation till. The deformation till was probably deposited on the middle shelf by a grounded ice stream at the end of the last glacial period, which implies that at least core GC484 recovered a full deglaciation sequence.

A set of five piston cores (PC489, PC491, PC493, PC494 and PC496) was recovered from the upper continental rise in the Amundsen Sea. The core sites were chosen on the basis of already available sediment core and subbottom profiler information collected on earlier cruises on RV *Polarstern*. The aim on JR179 was to recover sedimentary sequences deposited in proximity to the West Antarctic Ice Sheet (WAIS), which are capable of providing evidence for its (in-)stability during the last 800 kyr. Content and composition of iceberg-rafted debris (IRD) will be studied on the retrieved sediment cores in order to identify possible major draw-down events of the WAIS during the middle to late Pleistocene, in particular during MIS 11 [424-374 ka] and MIS 5.5 [130-115 ka]. Condensed sequences of calcareous foraminifera-bearing sandy muds were recovered at site PC491 and nearby site PC493, which are both located on one of the Marie Byrd Seamounts. Two additional condensed sequences that are likely to be located below the Calcite Compensation Depth (CCD), but are assumed to have a significantly higher temporal resolution, were collected from a sediment wave field (site PC489) and from the flank of a sediment drift (site PC496). Coring site PC494, near the crest of the neighbouring sediment drift to the one that was subsequently cored at site PC496, was intended to recover a high resolution sequence spanning the last 130 kyr. Preliminary evaluation of the MS record suggests that the base of core PC494 is younger than the beginning of MIS 6, but significantly older than its end. Originally, it was planned to retrieve two additional sedimentary sequences that are complementary to cores PC496 and PC494 from the same two sediment drifts, but time constraints caused these coring targets to be abandoned.

Sites PC494 and PC496 were also planned as the southern endpoints of a longitudinal core transect along 107-108°W extending from the West Antarctic continental margin northwards to the APF. The main objective was to investigate the composition and abundance of ice-rafted debris (IRD) along this core transect to study the dynamic behaviour of the WAIS during the climatic cycles of the last 800 kyr, in particular during MIS 11 and MIS 5.5. As a consequence of time constraints and sub-bottom profiler data that pointed to the presence of sandy layers (turbidites or lag deposits caused by winnowing) near the sea floor, the next core, PC499, was recovered just to the south of the Antarctic Polar Front (APF). Thus, site PC499, which recovered a condensed sequence consisting of diatomaceous ooze and diatom-bearing mud spanning the last ca. 480 kyr, is located more than 4.5° of latitude to the north of site PC496. Piston cores PC500 and PC501 were recovered 1.5° and 3° to the north of site PC499. These cores were collected for project CACHE PEP-G (see section 5.2) in order to recover high resolution, diatom-rich Holocene records. Unexpectedly, however, PC500 and PC501 retrieved condensed sequences of diatom oozes and muds resembling the sediments collected at site PC499. During a later stage of JR179 an attempt was made to close the large gap within the N-S transect along 107°W by recovering two additional cores at 66.7°S and 68.0°S. Unfortunately, at the northerly site PC505 the corer hit a sandy layer at 3-4 meters below the seafloor, was bent and recovered only a 9m long sediment core that is heavily disturbed (at least its lower part), while the southerly site had to be cancelled due to bad weather. It was then decided to collect cores along a W-E transect along ca. 68°S. Core PC507 was successfully recovered from the lower continental rise in the western Bellingshausen Sea, and core PC509 and nearby core PC510 were retrieved from the distal part of the Belgica Trough Mouth Fan. It was then intended to recover a sediment core from a seamount located on the Antarctic Peninsula lower continental rise as the eastern endpoint of the W-E transect, but also this coring target was cancelled because of time constraints and bad weather.

5.1.3. Landing on one of the Lindsey Islands near Canisteo Peninsula

J.A. Smith, C-D. Hillenbrand

During expedition ANT-XXIII/4 on RV *Polarstern* in 2006 Dr Jo Johnson (BAS) landed on an un-named island that belongs to the Lindsey Islands, located to the west of Canisteo Peninsula, and collected one rock sample from a glacially derived erratic boulder for cosmogenic surface exposure dating. Analysis of this sample yielded a minimum age for emergence of the island at 2.2 ka. Dr. Johnson also reported the presence of ornithogenic soil/penguin guano mantling many of the rock surfaces. The excellent preservation of guano coupled with the ease of dating it using radiocarbon techniques has meant that it has been used at several locations around Antarctica to provide a minimum age for deglaciation (based on the assumption that penguins colonise an area once it is ice-free). In theory such information could be used as an independent test of the exposure age previously obtained by Dr. Johnson. In addition, Dr Mike Bentley (QWAD project member based at Durham University) recently noted the presence of raised beach sequences on several of the Lindsey and Edwards Islands based on aerial photographs acquired by the USGS in the 1970's. Information on raised beaches in this area, such as their altitude and when they formed would provide important constraints on regional relative sea-level (RSL) models and hence, changes in ice volume.

The trip to the un-named island had two aims:

1. To collect penguin guano from rock surface on the un-named island for radiocarbon dating.
2. Identify and survey raised beaches and sample them for organic material (penguin bones, seal skin etc) suitable for dating.

The un-named island (73.82300'S, 102.94118'W) is a small island belonging to the Lindsey Islands, which are located to the west of Canisteo Peninsula on the Amundsen Sea continental shelf. *JCR* anchored to the west of the island on Saturday 8th March and two scientific teams were transferred to the island in humbers. The first boat, skippered by Tim Page, included Ralph Tulloch, James Smith and Claus-Dieter Hillenbrand. The second boat skippered by Jamie Lee, included Tony Estibeiro, Stephanie Kaiser and Peter Enderlein. Following a successful passage to the island, a suitable landing site was found and both craft were anchored. A brief reconnaissance of the island was first undertaken to look for suitable sequences of penguin guano to sample and to look for possible raised beaches to survey.

5.1.3.1. Penguin guano

In general, the guano formed a thin, often continuous layer on most ice/snow-free rock surfaces (Fig. 2a). Most deposits looked relatively fresh, were no more than 5 cm thick and probably relate to the existing Adélie penguin colony. However, thicker deposits (>10cm) of penguin guano were observed in naturally formed rock hollows, joints, fractures and other similar shelters. It is likely that such areas are protected against deflation by the wind and may represent the remains of several generations of penguin colonies. We focussed our sampling in two such locations.

Site A: One sampling site is located at the eastward facing base of a rock outcrop (possibly mafic dyke) that is elevated by approximately 1.2 m above the surrounding granitic bedrock of the island. Here, a thick wedge of very dry guano containing subangular to angular clasts had accumulated (Fig. 1). Due to time constraints only one sample was taken from the base of the wedge (at ca. 20 cm below the guano surface).

Site B: Another sampling site is located in a shallow depression on top of an east-west trending dyke (Fig. 2a-d). The sequence was characterised by a thin dry crust at the surface and a progressively finer, soupy guano matrix containing sub-angular to angular clasts (Fig. 2d). Samples were obtained from the base (19 cm), middle (12 cm) and surface (0-1cm) of the sequence.

5.1.3.2. Raised Beaches

A sequence of well developed raised beaches, with up to three clear terraces were identified on east side of island (Fig. 3a). Similar beaches were observed on the west side of the island but their morphology appeared to have been altered by the elephant seal colony (Fig. 3b). Due to time constraints, further compromised by the arrival of inclement weather, we did not manage to survey the beach profile or search for datable material before being called back to the boat. Based on one quick sight 3.5masl, the upper terrace was estimated to be 8.5masl.

Location	Sample Depth	Material	Comments
Site A	19-20cm	guano	
Site B	0-1cm	guano	
	11-12cm	guano	
	18-19cm	guano	

Table 3. Samples collected on the un-named island

Figure 8. Photograph of guano sampling site A.

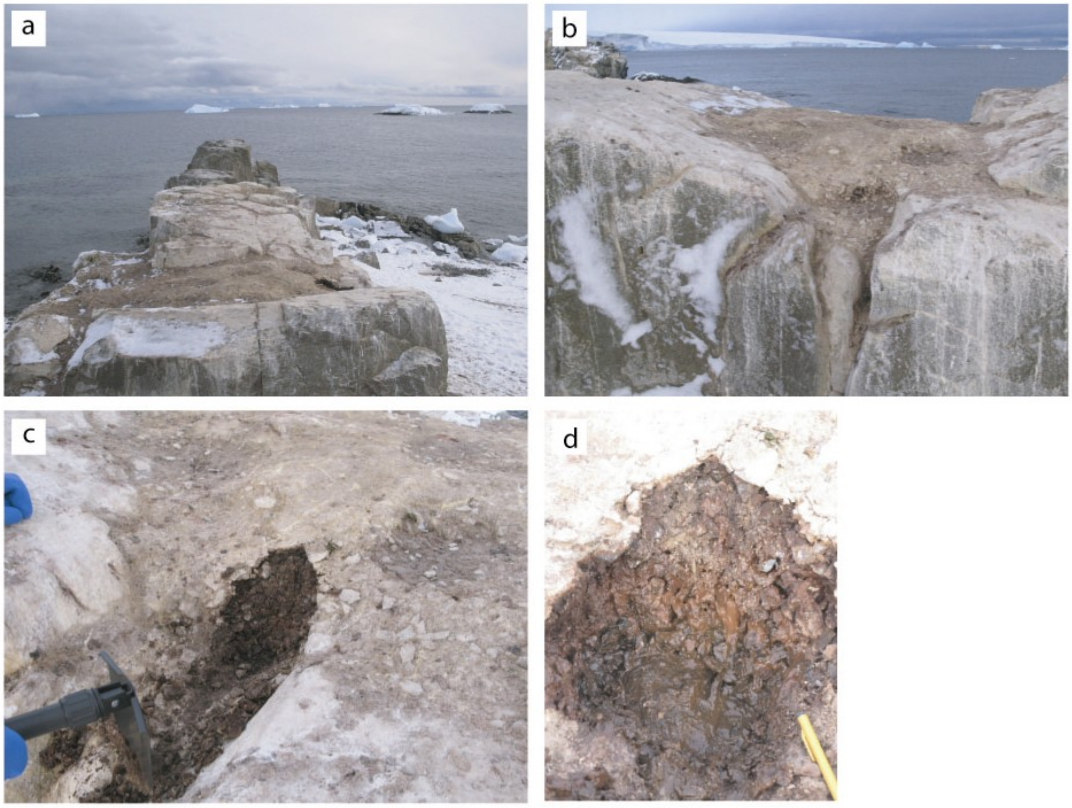


Figure 9. Photographs illustrating guano sample site B. (a) East-west view of dyke with thicker guano deposit in surface depression (sample site B), shown in more detail in b-d.

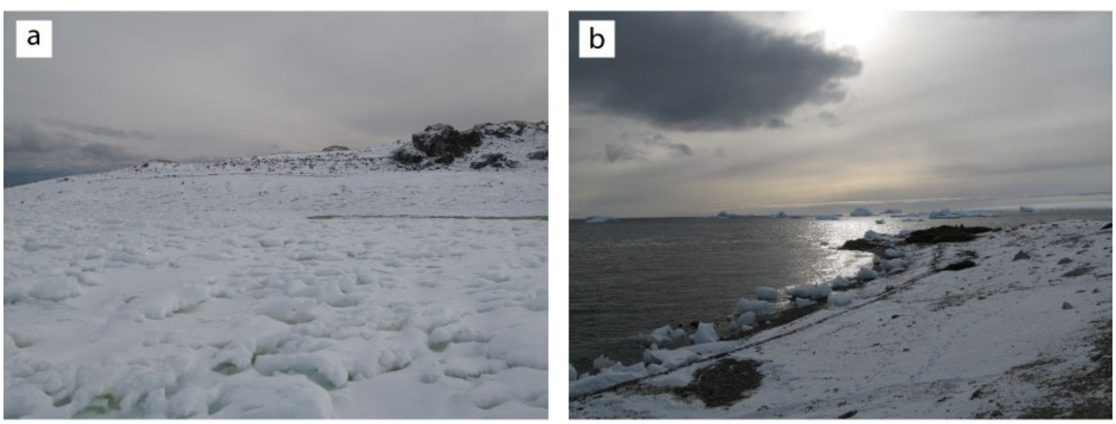


Figure 10. Photograph illustrating raised beaches on un-named island. (a) West-facing beach sequence showing high tide and palaeo-beach terraces (note elephant seal colony in background). (b) View of east-facing raised beach sequence taken from c. 3.5masl. Note the higher terraces defined by sub-angular, sub-rounded and rounded cobbles.

5.1.4 Physical Oceanography

Bryony Hull

Water samples were taken using the CTD at various depths in order to get a salinity profile of the water column, which can then be used to calibrate the sensor data on the CTD. The CTD sensor data can then be used in conjunction with the ADCP data to constrain the near-bottom currents on the slope off West Antarctica, in particular: the Southern Antarctic Peninsula, Bellingshausen Sea and Amundsen Sea regions. This will be of particular use in investigating the processes by which down-slope channels are formed, as one of the possible theories is that the currents are sometimes strong enough to resuspend sediment and then gravitational forces carry the turbid water downslope, eroding away the slope to form the channels.

The main limitation in using CTD data for this purpose is that the geostrophic velocities are calculated between two stations, the answer referring to a point halfway between them. This is fine down to the deepest common depth of the stations, but below this, the 'bottom triangle' problem is evident, particularly where there is a large difference in depth between stations. In earlier studies the geostrophic velocity of the deepest common point was used throughout the water column below this point, but this seriously over-estimates current velocities at the sea floor. Instead a linear gradient is now commonly used in oceanographic studies, assuming zero velocity at the sea floor, increasing to the velocity calculated at the deepest common depth.

Using the ADCP data will help with this problem also, as it gives velocities for the upper 86% of the water column in depths up to ~800m. Where the water depth is shallower than this, as it is on much of the upper slope, a useful indication of the probable near-bottom currents on the profile is provided. Where it is deeper, less of a picture will be provided, but it still gives an idea of what currents there are in the upper part of the water column. The CTD data can also be extrapolated to points outside of those measured, using the ADCP data as a guide.

Although neither of the above methods provides a direct measure of near sea-floor velocities, in places where they indicate high current velocities at the bottom of the measured interval we can infer that there may also be strong bottom currents.

5.1.5 Water collection for trace metal analysis

Paul Carter

Water was collected from the CTD rosette at 6 CTD sites (008, 011, 014, 021, 022, and 024) for trace metal analysis. Water column profiles of between 7 and 12 bottles were collected; the depths chosen based on the down cast CTD data in order to sample a range of water masses. In all cases the CTD was taken to bottom and a sample of bottom water taken.

Each sample was collected in a precleaned 4L Nalgene LDPE bottle and filtered through a 0.2μm Whatman filter, before being stored in another Nalgene 4L bottle. These were then stored in a double thickness plastic bag to avoid dust getting onto the bottles. Between each sample the filtering apparatus was triple rinsed with distilled water, and equipment and bottles were given a final rinse with a small amount of the sample in order to avoid environmental and cross-sample contamination.

Samples will be processed in the Earth Science Department, University of Bristol.

5.2 CACHE - PEP

Claire Allen, Lewis Collins, Hillary Blagbrough

5.2.1 Cruise Objectives:

The cruise objectives are included within the remit of the BAS core science project 'CACHE PEP'. The CACHE-PEP project was allocated 10 days science time within the combined JR179 cruise[1], with the principal aim of recovering high resolution marine sediments covering the last 10,000 years (the Holocene) from the Amundsen and Bellingshausen Sea sectors of the Southern Ocean. In addition to the coring programme we will carry out underway sampling of the ship's uncontaminated sea water supply to monitor modern phytoplankton assemblages and sample surface sediments for proxy evaluation and calibration.

The South Pacific sector is a potentially important site for global-teleconnections with systems such as the El-Nino Southern Oscillation but is only poorly studied. The sediment cores will contain a fossil-record of past oceanographic and hence climatic changes. We will use surface sediments as a modern analogue for proxy calibrations and evaluations and down-core sediments to reconstruct what conditions have been like in the past. This will help us to assess how unique modern climate change is and to examine how well models replicate past changes. This can tell us likely impacts of future climate change and how well models may (or may not!) forecast any changes.

To date, the BAS marine archive contains no sediment cores from the deep basins in the Pacific sector of the Southern Ocean. With the focus on high sedimentation records in un-surveyed waters, geophysical survey would be undertaken with the EM120 Swath bathymetry system, to find sites with suitable topography for retaining sediments, and the TOPAS sub-bottom profiler, to identify the highest resolution sediment sequences. The CACHE-PEP coring area extended north from the western limit of the shelf cruise track to the polar front. This afforded the potential to include the higher productivity region of the polar front zone (high productivity provides the material to build up thick, therefore high-resolution sediment records) and to maximise the distance from Drake Passage, to avoid aggressive bottom currents upstream of Drake Passage.

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[1] Once the combined cruise was resolved in planning, JR179 was allocated 20 days for passage time (based on the preliminary cruise track) and 10 days to each of the three projects involved (QWAD, CACHE-PEP G & BIOPEARL).

5.2.2 Coring

The coring transect was determined to begin at approximately 107°W. Although this was not the most westerly point of the transect, it was agreed that as the coring targets at 120°W were additional to the original cruise track that the northward transect would be along the approximate position of the original track at between 107-106°C to reconcile the transect with QWAD targets offshore from Pine Island Bay trough.

Surface sediment samples were designed to cover a depth-transect offshore to maximise the potential for proxy evaluation and calibration. Targets were matched with existing stations to minimise passage time and to maximise the mutual benefits between projects.

- Underway EM120 and TOPAS survey:

The 'EM120' multi-beam swath bathymetry system and the 'TOPAS' single beam sub-bottom profiler were primarily used to select potential core sites, a general summary of swath and TOPAS acquisition is provided in section 5.1.1. and performance appraisals for all equipment/operations are included in section 7.

- Piston Cores for recovery of expanded Holocene sections

The main CACHE-PEP coring phase of the cruise began on 20th March once the most had been made of the weather and sea ice breaks in Pine Island Bay and the Marie Byrd Seamounts. The ideal core recovery would have included a transect of 4-5 cores between the margin and the Polar Front. However, the TOPAS record resolved sequences with multiple reflectors within several metres of the surface implying highly compacted sediment sequences throughout the majority of the northward transect. A piston core was collected from the southern polar front zone (TPC499) in order to confirm the age and composition of the surface sediments. Preliminary analysis of smear slide content and down-core magnetic susceptibility revealed preservation of several glacial-interglacial cycles.

During transit along the northern flank of the continental rise TOPAS resolved multiple linear features several hundred metres wide with apparent W-E orientation. These anonymously large structures continued laterally over two degrees and appear to overlie a prominent unconformity of approximately mid-Pleistocene age throughout that area (Fig. 11).

Although we continued northwards to just south of -60° and westwards to -114°, we encountered no expanded, acoustically transparent, surface layers in the sub-bottom profiler data. Three additional sites were cored: 1) where the TOPAS record was slightly expanded and suggested higher sedimentation rates (cored to provide a northern site for the QWAD project); 2) a sediment drift downstream of a fractured seamount where finely layered sediment structure was resolved in the sub-bottom profiler; and 3) a discreet pocket of sediments with an apparently expanded reflector profile. However, preliminary biostratigraphical analysis confirmed that the cores recovered at these sites also contained condensed glacial-interglacial sequences.

Given the paucity of data for the South Pacific and the unexpected continuity of the sedimentary sequence throughout the survey area it was decided that the best opportunity to recover suitable Holocene sediments would be from lower sedimentation sites on the continental shelf. Three coring areas (west of Alexander Island, Marguerite Trough and Adelaide Trough) were chosen for their proximity to existing lake records and their potential to preserve reasonable length Holocene sequences (>3m). Despite bad weather preventing recovery of gravity cores in central Marguerite Bay, we successfully recovered Holocene sediments from all three sites. We recovered 4 gravity cores from west of Alexander Island and inner Marguerite Bay (GC513, GC514, GC515, & GC517) and 2 piston cores (TPC520 & TPC522) from thick sediment accumulations in Adelaide Trough.

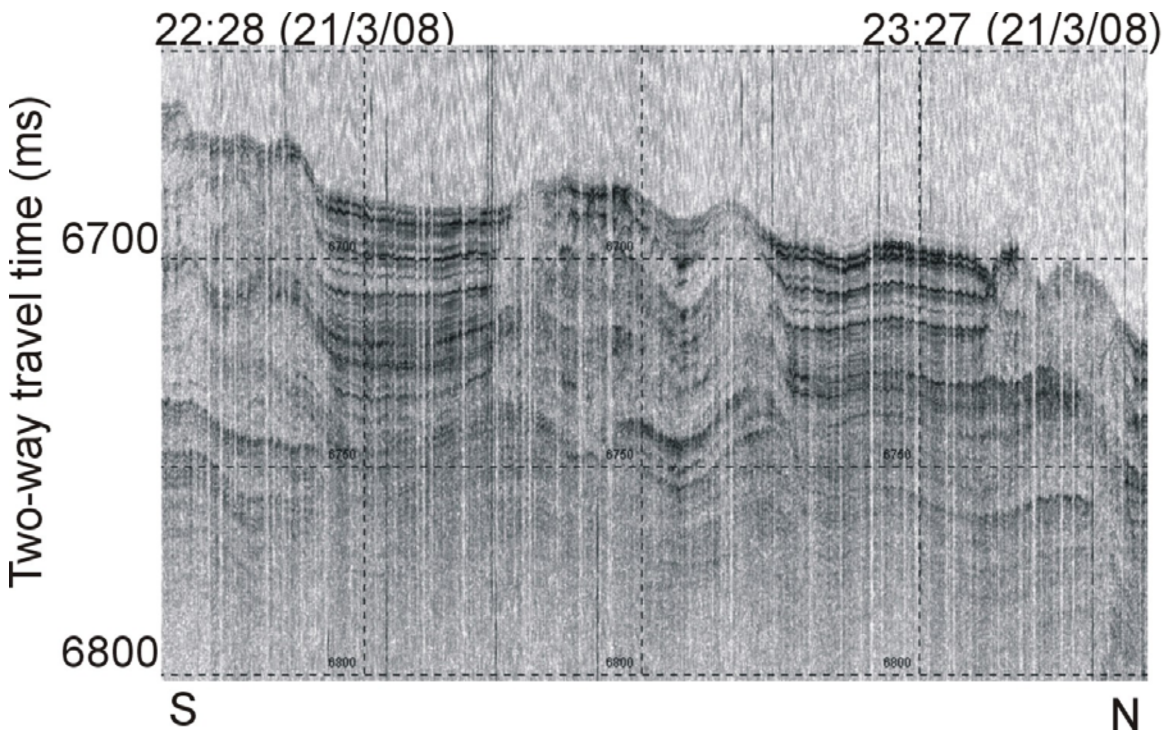

Figure 11. TOPAS profile showing anomalous structures on Amundsen Sea continental rise.

- Box cores for surface analogue studies

Sub-core samples were collected using box cores at several of the Biologists stations in Pine Island Bay as well as at some Geosciences coring stations to provide sediments for proxy calibrations and analogue studies on new and existing biogenic components. Comments on the use and recovery of samples and sub-cores at all of the box core sites is included in section 7.6. All the sub-cores taken for proxy calibration and evaluation were immediately placed for preservation and storage at -20°C (Table 4).

Table 4: Box core sub-cores recovered for proxy evaluation

BC476Z	-74.4833	-104.4166
BC477Y	-74.3578	-104.6698
BC483Z	-73.9915	-107.3842
BC487Y	-71.1797	-109.9040
BC490Y	-69.5947	-117.9822
BC492Y	-71.1500	-119.9575
BC504Z	-61.2453	-114.8793

5.2.3 Water sampling

Water samples were taken from the ships internal uncontaminated seawater supply (USS; intake at 6 mbss) regularly throughout the cruise in order to analyse the surface phytoplankton concentration, distribution and assemblage.

Water samples were treated with Lugols immediately after sampling, then stored in small, labelled plastic bottles ready for filtering. Up to 250 ml of each water sample was filtered using 0.2 µm Whatman Anodisc Filter Membranes on a fritted glass filter manifold (see Figure 12) and drained into a carboy reservoir using a vacuum pump system. The amount of water filtered varied from 12 ml to 250 ml from a single sample, depending on the diatom concentrations. To prevent excess salt from crystalising on the filters each sample was filter-rinsed with 500ml of de-ionised water. Filters were placed in clean, annotated, 50 mm plastic Petri dishes for protection and storage.

When the USS was not flowing, for example when the ship was in ice, samples were occasionally collected by rope and bucket. This was only undertaken when the ship was stationary, usually during deployment of gear on an existing station. The same method provided samples of sea-ice, some of which was immediately placed for preservation and storage at –20 °C and some of which was treated with Lugols, thawed and then filtered using the same method as for the water samples.

Samples will be analysed using a light microscope or Scanning Electron Microscope and will provide unique data on the autumn diatom community in the southern Antarctic Peninsula. The samples will augment existing sample coverage from the Antarctic Peninsula region collected during spring and summer (under Collaborative Gearing Scheme grants) to determine seasonal variability and distribution of diatom assemblages and to assess taphonomic processes in the water column. Of particular note are the sea ice samples that will provide important information about the different diatom assemblages found in different types and ages of ice.

Issues with the above method were that there is no clock available so that times of samples may not be 100% accurate. Also, other people using the de-ionised water supply drained the system necessitating equipment down time while internal filters were replaced and charged. Whilst this caused only slight inconvenience on this occasion, it could have resulted in treated samples being carried back to Cambridge for filtering.

Figure 12: Filter manifold

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Table 5: Filtered water samples

Sample #	Time	Latitude	Longitude	Fluorescence	SST (psu)	Salinity (°C)	EM120 Depth (m)
WS 621 (250 ml)	22/2/08 20:08	-59.83017	-65.40017	0.382	2.62	33.7789	3080.37
WS 622 (250 ml)	23/2/08 03:04	-57.20177	-61.28182	0.52	5.05	33.9061	3616.43
WS 623 (250 ml)	23/2/08 10:32	-58.58812	-62.79337	0.421	4.9	33.898	3672.48
WS 624 (250 ml)	23/2/08 21:04	-59.83017	-65.40017	0.382	2.62	33.7789	3080.37
WS 625 (250 ml)	24/2/08 17:50	-61.15671	-66.48107	0.832	2.84	33.8194	3769.84
WS 626 (250 ml)	25/2/08 12:09	-63.41004	-68.08016	1.941	1.81	33.6414	3485.83
WS 627 (250ml)	25/2/08 22:40	-64.91004	-69.07634	1.897	1.34	33.7903	2351.82
WS 628 (250ml)	26/2/08 12:19	-66.37012	-71.18243	1.827	0.95	33.7584	528.33
WS 629 (250ml)	27/2/08 03:19	-65.37385	-69.2476	1.875	1.25	33.8366	661.55
WS 630 (100ml)	29/2/08 21:00	-69.48524	-81.51134	1.478	-0.11	33.3558	522.2
WS 631 (100ml)	1/3/08 01:30	-69.80751	-83.71817	1.438	-0.17	33.2816	1020.78
WS 632 (100ml)	1/3/08 11:00	-70.32727	-86.06752	1.291	-0.46	33.2444	644.21
WS 633 (240ml)	1/3/08 19:30	-70.21418	-90.71007	0.953	-1.14	32.782	3240.22
WS 634 (250ml)	1/3/08 22:55	-70.1481	-91.08437	0.879	-0.49	33.2025	3545.76
WS 635 (250ml)	2/3/08 11:15	-69.94154	-98.08958	1.88	-1.37	32.9329	4232.19
WS 636 (250ml)	2/3/08 17:30	-69.94154	-98.08958	1.88	-1.37	32.9329	4232.19
WS 637 (250ml)	2/3/08 19:13	-69.99949	-98.88275	1.959	-1.59	32.8013	4768.59
WS 638 (100ml)	3/3/08 01:23	-69.81836	-101.76675	4.589	-1.63	32.5846	4022.34
WS 639 (100ml)	3/3/08 02:45	-69.65607	-102.14203	4.105	-1.61	32.5367	3896.8
WS 640 (100ml)	3/3/08 04:14	-69.47655	-102.39889	5.281	-0.68	33.2725	4089.45
WS 641 (100ml)	3/3/08 11:16	-69.83509	-105.33318	4.194	-1.72	32.5856	3848.9
WS 642 (100ml)	4/3/08 01:30	-71.8124	-106.32247	0.551	6.52	32.539	563.18
WS 643 (100ml)	4/3/08 01:30	-71.8124	-106.32247	0.551	6.52	32.539	563.18
WS 644 (150ml)	4/3/08 01:30	-71.8124	-106.32247	0.551	6.52	32.539	563.18

WS 645	4/3/08 16:00	-72.30281	-106.71896	2.091	-1.25	33.1324	701.62
WS 646 (100ml)	4/3/08 16:06	-72.36685	-106.77184	2.498	-1.63	33.1453	699.06
WS 647 (100ml)	4/3/08 18:29	-72.43822	-106.94959	2.571	-1.44	33.2199	711.62
WS 666 (100ml)	19/3/08 14:50	-69.22829	-106.67963	3.153	-0.76	33.2536	4227.92
WS649 (100ml)	5/3/08 15:55	-74.47835	-104.21686	0.583	-1.76	33.4117	1170.67
WS650 (100ml)	6/3/08 06:40	-74.35648	-104.74787	1.034	5.47	32.853	1390.4
WS651 (100ml)	8/3/08 11:10	-74.12083	-105.81174	1.699	-1.78	33.3658	1463.69
WS652 (100ml)	8/3/08 21:00	-73.5	-103.06	0.954	-1.73	33.3302	145.09
WS653 (100ml)	8/3/08 21:00	-73.82454	-103.07039	0.954	-1.73	33.3302	145.09
WS654 (100ml)	11/3/08 08:00	-72.72531	-107.29428	2.305	6.98	32.6603	690.67
WS655 (100ml)	11/3/08 08:00	-72.72531	-107.29428	2.307	6.99	32.6605	690.67
WS656 (100ml)	11/3/08 18:53	-71.47624	-110.00054	0.777	-1.89	33.0894	468.7
WS657 (12ml)	11/3/08 08:00	-72.72531	-107.29428	2.307	6.99	32.6605	690.67
WS658 (175ml)	13/3/08 02:51	-71.13893	-109.94406	0.575	-1.93	32.8221	1558.59
WS659 (200ml)	14/3/08 01:28	-70.51887	-112.48253	1.01	11.49	0.3845	6.14
WS660 (100ml)	12/3/08 08:15	-71.33367	-109.96666	0.605	-1.91	32.8676	465.75
WS661 (100ml)	13/3/08 02:59	-71.13893	-109.94408	0.576	-1.91	32.8294	1558.85
WS662 (100ml)	14/3/08 22:00	-69.59463	-117.98243	0.293	-1.06	33.6771	3281.21
WS663 (100ml)	15/3/08 15:15	-69.59463	-117.98243	0.293	-1.06	33.6771	3281.21
WS664 (100ml)	19/3/08 00:10	-69.22829	-106.67963	3.153	-0.76	33.2536	4227.92
WS665 (100ml)	19/3/08 06:07	-69.23077	-106.67973	2.494	-0.86	33.2615	4233.55
WS667 (100ml)	20/3/08 15:40	-63.0043	-106.98899	1.406	2.51	33.8976	5118.06
WS668 (125ml)	22/3/08 04:00	-63.0043	-106.98899	1.406	2.51	33.8976	5118.06
WS669 (100ml)	22/3/08 15:10	-60.88055	-107.97681	1.22	3.43	33.9111	5113.92
WS670 (100ml)	23/3/08 05:30	-60.88055	-107.97681	1.22	3.43	33.9111	5113.92
WS671 (100ml)	25/3/08 07:42	-61.24539	-114.87928	1.135	3.8	33.9666	5140.82
WS672 (100ml)	25/3/08 21:58	-63.28047	-111.78582	1.106	3.27	33.9326	5186.47
WS673 (100ml)	26/3/08 00:27	-63.68363	-111.15089	1.119	2.22	33.9196	5177.38
WS674 (100ml)	26/3/08 07:54	-64.74481	-109.42482	1.14	2.81	33.9121	5027.81
WS675 (100ml)	26/3/08 20:21	-66.67039	-106.23503	1.067	1.18	33.8897	4753.78
WS676 (100ml)	27/3/08 07:56	-67.49044	-106.67611	1.154	0.76	33.8589	4571.39
WS677 (100ml)	27/3/08 11:45	-67.49044	-106.67611	1.154	0.76	33.8589	4571.39
WS678 (100ml)	27/3/08 19:05	-67.9996	-103.9736	1.398	0.01	33.8345	4469.35
WS679 (200ml)	27/3/08 23:48	-68.00021	-101.50622	1.386	0.72	33.8368	4546.46
WS680 (200ml)	28/3/08 04:27	-68.0007	-99.31272	1.378	0.34	33.7439	4564.16
WS681 (200ml)	28/3/08 06:45	-67.99942	-98.1797	1.363	0.39	33.7502	4571.45
WS682 (200ml)	28/3/08 13:30	-67.99888	-94.98943	1.381	0.64	33.7139	5128.38
WS683 (200ml)	29/3/08 04:11	-68.10497	-91.95531	1.523	0.14	33.8472	6.68
WS684 (100ml)	29/3/08 05:30	-68.12378	-91.3833	1.416	0.18	33.6416	4244.94
WS685 (100ml)	29/3/08 10:15	-68.19786	-89.25993	3.497	-0.33	33.4405	3880.11
WS686 (100ml)	30/3/08 05:00	-67.92518	-86.62774	8	-0.13	33.5091	3855.81
WS687 (100ml)	29/3/08 11:45	-68.22205	-88.56554	3.454	-0.24	33.4026	4002.56
WS688 (100ml)	5/3/08 19:31	-74.47835	-104.21686	0.583	-1.76	33.4117	1170.67
WS693 (100ml)	2/4/08 19:25	-67.9107	-68.3523	4.533	-0.04	33.4615	5.66
WS692 (100ml)	2/4/08 11:00	-68.2376	-70.2035	4.602	0.09	33.6917	700.19
WS691 (100ml)	2/4/08 06:24	-68.7727	-69.8949	4.766	-1.82	32.681	1444.62

WS690 (100ml)	1/4/08 14:30	-68.6865	-73.0736	5.191	-0.29	33.7284	867.95
WS689 (100ml)	31/3/08 19:30	-68.9396	-76.3231	7.248	-0.02	33.837	6.39

Summary

Although the original aims of the CACHE-PEP work had to be amended due to the unexpected sediment facies encountered in the South Pacific and the specified time allocation was perceived as a ‘Geoscience’ resource, we were successful in acquiring Holocene marine records that expanding the existing cover of marine cores into previously unsampled regions and will permit valuable comparison with existing lake and ice cores. Furthermore we were able to acquire a valuable set of surface sediments for proxy calibration and evaluation from the Amundsen Sea. We collected a complete shelf to polar front transect of surface water and sea-ice samples from the Amundsen sector of the Southern Ocean with the potential to resolve any surface-to-sediment anomalies in productivity and sediment preservation.

5.3 BIOFLAME – BIOPEARL

5.3.1 Agassiz

H. Griffiths, D.K.A. Barnes, S. Kaiser, A. Glover, C.J. Sands, J. Strugnell, P. Enderlein

Objectives

Our main aim was to sample larger macro-and mega- size fractions of seabed dwelling (benthic) animals in the Bellingshausen and Amundsen Seas. Our sampling regime was designed to investigate patterns of biodiversity, biogeography and phylogeography in the benthos of these regions of the Southern Ocean. We planned for two sites to be situated in the Bellingshausen sea whilst the others lay to the west in the Amundsen Sea, including Pine Island Bay and a nearby seamount. We deployed an Agassiz trawl at three discrete depth horizons (approximately 500, 1000 and 1500 m) to investigate variability of taxa presence from continental shelf to continental slope depths and within two basins on the continental shelf.

The Amundsen Sea is amongst the least studied surface regions on earth. Prior to this cruise there have been no published reports of any sampling of shelf or slope fauna in this sea. Added to this, Pine Island Bay (PIB) is usually inaccessible to such sampling methods due to sea-ice conditions. Studies showing the distributions of sampling or species show the Amundsen Sea to be a major gap in knowledge of the biogeography of Antarctic marine fauna (Linse et al 2006, Barnes & Griffiths 2008). Our results, therefore, should not only be the first published for the region, but also provide a valuable comparison with data collected from the western Antarctic Peninsula, Scotia arc and the Ross Sea.

Work at sea

Our apparatus, an Agassiz trawl (AGT), was used to sample animals approximately 1 cm and larger in length, which comprise the larger macro- and the megafauna but did capture some smaller animals as well. The AGT was trawled at four depth transects (at depths of 500 m, 1000 m and 1500 m) in different regions of the Bellingshausen and Amundsen seas (Fig.map?). In addition further trawls were made at 500 m on the shelf of PIB and on one of the Mariebyrd seamounts at two depths (2000 m and 3000 m). Each of the 500 m and 1000 m stations comprised of three replicate trawls whilst at the 1500 m stations we made two replicates only. Unfortunately due to weather conditions only one transect could be completed in the

Bellingshausen Sea.

Figure 13a: Biostations during JR 179

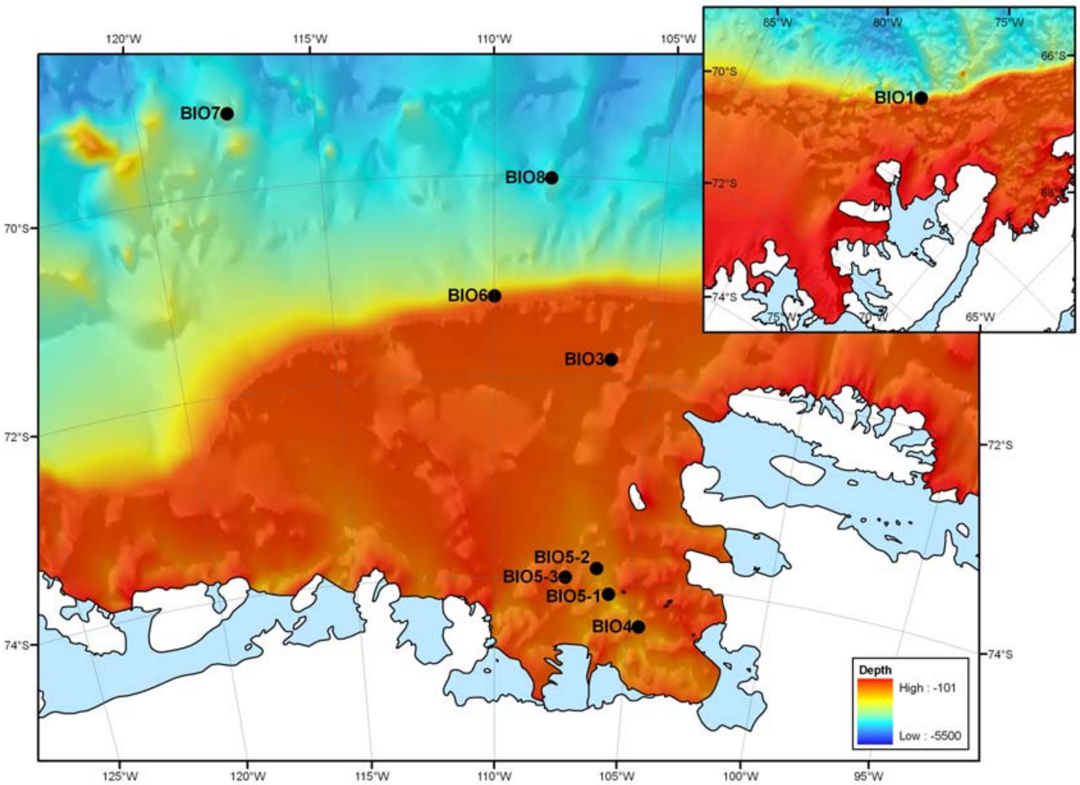
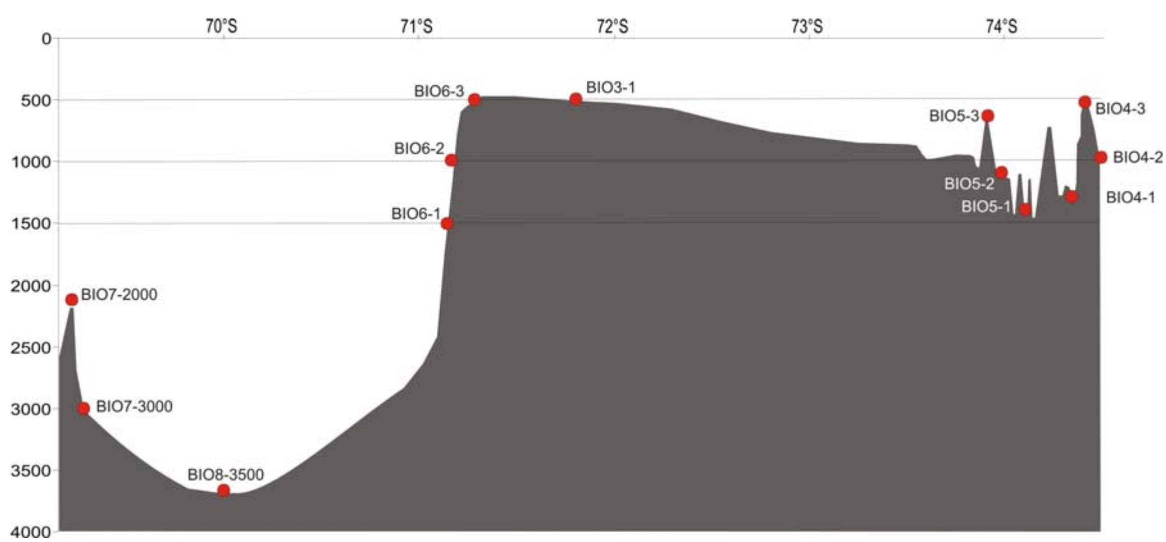


Figure 13b: Station Profile during JR179:



Our Agassiz trawl used a mesh size of 1 cm and had a mouth width of 2 m. At most stations the seabed topography was examined prior to trawl deployment using multibeam sonar (SWATH). The deployment protocol was standardised. While the AGT was lowered, the ship had to compensate for the wire lowering speed of 45 m.min-1 by steaming at 0.3 knots until the AGT reached the seabed and at 0.5 knots until the full trawling wire length was put out. The full trawling cable length we used was 1.5 times the water depth. The net was then trawled at 1 knot for 10 min at 200m and 500m water depth and for 15 min at 1000 m and 1500 m water depth. With the ship stationary the AGT was hauled at 20 m.min-1 in order to avoid damaging the gear. When the AGT had left the seafloor, the hauling speed was increased to 45 m.min-1 and the ship speed to 0.3 knots.

Table 6: Phyla distribution :

Station ID	Ctenophora	Hemichordata	Miscellaneous	Chaetognatha	Echiura	Sipuncula	Nemertea	Brachiopoda	Chelicerata	Chordata	Bryozoa	Porifera	Annelida	Cnidaria	Mollusca	Crustacea	Echinodermata	No.of phyla per trawl
BIO1-AGT-1A								X			X		X	X	X	X		6
BIO1-AGT-1B								X			X		X			X		4
BIO1-AGT-2A				X			X		X	X	X	X	X	X	X	X	X	11
BIO1-AGT-2B										X					X		X	3
BIO1-AGT-2C				X						X	X		X		X	X	X	7
BIO1-AGT-3A				X						X	X		X	X		X	X	7
BIO1-AGT-3B									X	X		X		X		X	X	6
BIO1-AGT-3C										X	X	X		X	X	X	X	7
BIO3-AGT-1A					X	X	X		X	X		X	X	X	X	X	X	11
BIO3-AGT-1B			X		X	X	X	X	X				X	X	X		X	10
BIO3-AGT-1C						X	X						X	X			X	5
BIO4-AGT-1A							X	X	X				X	X	X	X	X	8
BIO4-AGT-1B										X			X		X	X	X	5
BIO4-AGT-2A					X			X	X			X	X	X	X	X	X	9
BIO4-AGT-2B						X		X	X		X	X	X	X	X	X	X	10
BIO4-AGT-2C					X	X		X	X		X	X	X	X	X	X	X	11
BIO4-AGT-3A		X			X	X	X	X		X	X	X	X	X	X	X	X	13
BIO4-AGT-3B								X	X	X	X	X	X	X	X	X	X	10
BIO4-AGT-3C								X	X	X	X	X	X	X	X	X	X	10
BIO5-AGT-1A							X				X	X	X	X	X	X	X	8
BIO5-AGT-1B											X		X	X	X		X	5
BIO5-AGT-2A							X											1
BIO5-AGT-2B						X		X					X	X		X	X	6
BIO5-AGT-2C					X								X		X	X	X	5
BIO5-AGT-3A										X	X	X	X	X	X	X	X	8
BIO5-AGT-3C								X		X	X	X	X	X	X	X	X	9
BIO5-AGT-3D			X					X	X	X	X	X	X	X	X	X	X	11
BIO6-AGT-1A													X	X	X	X	X	5
BIO6-AGT-1B	X									X		X		X	X	X	X	7
BIO6-AGT-2A				X			X		X			X		X	X	X	X	8
BIO6-AGT-2B									X	X			X	X	X	X	X	7
BIO6-AGT-2C			X						X				X	X	X	X	X	7
BIO6-AGT-3A								X	X	X	X	X	X	X	X	X	X	10
BIO6-AGT-3B								X	X	X	X	X	X	X	X	X	X	10
BIO6-AGT-3C								X	X	X	X	X	X	X	X	X	X	10
BIO7-AGT-2000			X											X	X	X	X	5
BIO7-AGT-3000				X							X	X	X	X	X	X	X	8
No. of trawls per phylum	1	1	4	5	6	7	9	16	17	19	20	20	30	31	31	32	34	

Once on board the samples were photographed as total catch and then hand-sorted into groups varying from Phylum to species level collections. Representatives of most taxa were photographed in detail. The wet-mass (biomass) of the different taxa was assessed by using calibrated scales (with accuracy and resolution of 0.001kg). Samples were taken from a selection of specimens for DNA and RNA analysis. Depending on the taxon, animals were either preserved in 96% ethanol, 4% buffered formalin or frozen at –20ºC.

Preliminary results

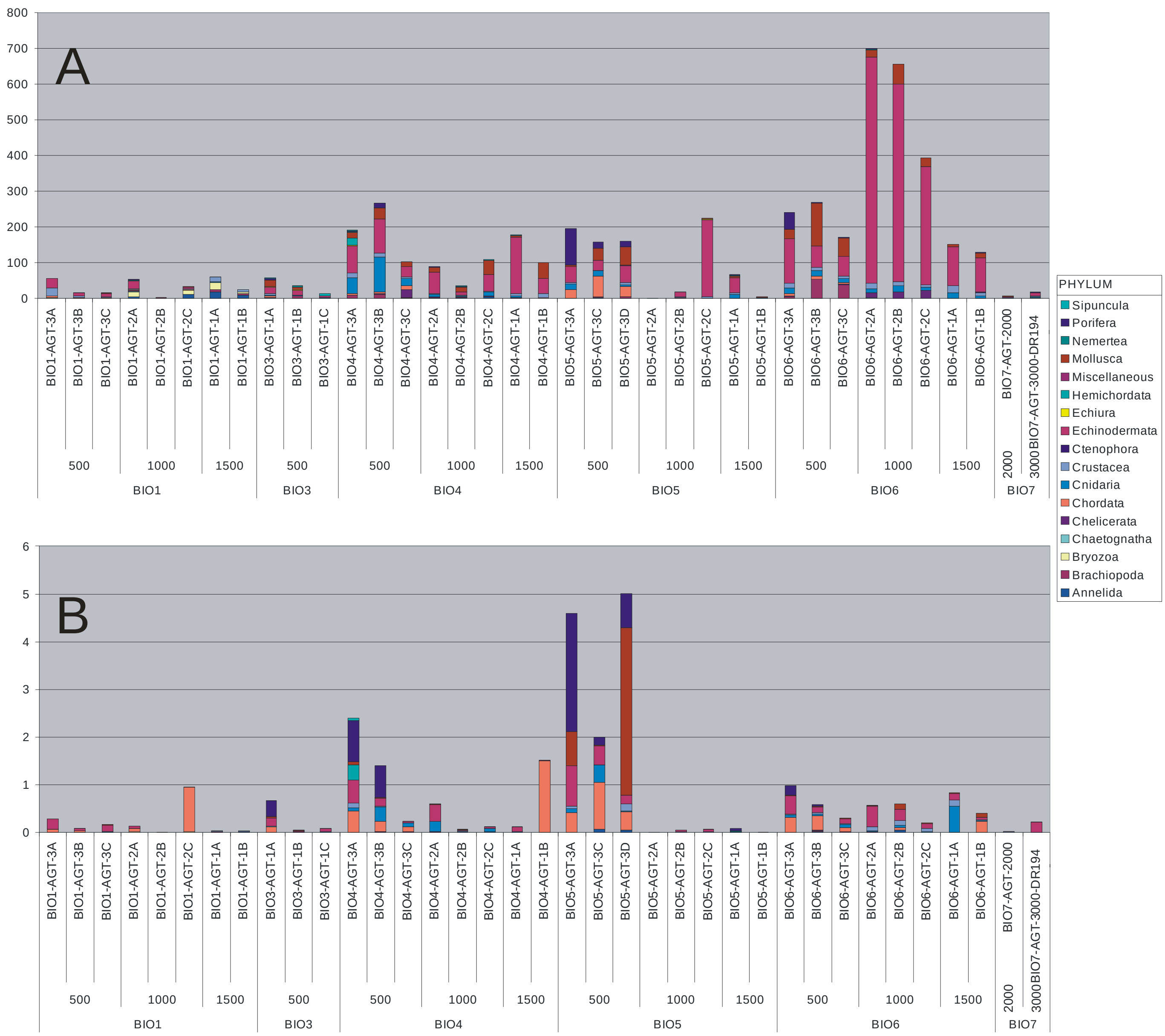
One of the first analyses done after the AGT catches were sorted and fixed was to count the number of phyla present in the catch, to assess the richness at Phylum level of the trawled area (fig?). The presence of phyla varied between 1 (BIO5-AGT-2A, 1000 m) and 13 (BIO4-AGT-3A, 500 m). Twelve of the trawls contained ten or more phyla and nine of these were shallow (500 m) trawls and the other three were from 1000 m. The 500 m stations at the BIO4 station included 14 different phyla in the 3 trawls, followed by the 500 m stations at the BIO3 station with 13. The lowest number of phyla were recoded at a site which had replicates was at BIO1 (1500 m) with 6 phyla. Overall, BIO4 was the richest station at phylum level being the highest number at each of the depths sampled.

Comparing the overall numbers (14A.) and wet-masses (14B) of animals between trawls and stations shows two very different patterns. BIO6 (the slope off PIB) has, by far, the highest numbers of animals, especially at the 1000 m depth range. Despite having more than double the number of individual animals this station did not have the highest total wet-mass. The BIO3 trawls had the greatest wet-masses and were up to 5 times heavier than those from BIO6.

Echinoderms (starfish, brittlestars, sea cucumbers, sea urchins and crinoids) dominated most trawls on numbers of individuals, with up to 623 found in a single trawl. The slope of PIB (BIO6) had particularly high numbers of echinoderms making up over 72% of the total number of animals caught. Despite making up a significant proportion of the wet-mass, at most stations the echinoderms did not dominate. Larger, heavier individual organisms such as the cephalopod molluscs and large sponges dominated the wet-mass at many stations. A large proportion of the wet-mass of several stations was made up of chordates (ascidians and fish).

Further analyses in Cambridge will be done on species level to reveal more insights to bathymetric and biogeographic trends in species diversity and distribution.

Figure 14: overall numbers (14A.) and wet-masses (14B) of animals between trawls and stations



5.3.1.1 Octopus captured during JR 179

Jan Strugnell

Prior to JR179 no octopus have been collected from the Amundsen sea. Therefore any octopus captured from this region were to be a new record.

In total, 16 octopus were caught during the JR179 cruise. 15 of these were caught using the Agassiz trawl and 1 individual was caught using the Epi-benthic sledge.

Small tissue samples were taken from each octopus captured and were stored for subsequent genetic analyses. The remaining whole octopus were fixed in 4% formalin for subsequent morphometric analyses.

Table 7: Octopus caught throughout the cruise.

date	station	Event	trawl	Depth (m)	cephalopods caught	Species ID
4/3/08	PIB – shelf	BIO3-AGT-1A	AGT	577-590	*Pareledone* cf *charcoti*	141
5/3/08	PIB – basin 1	BIO4-AGT-2A	AGT	1203-1208	*Cirroctopus* cf *glacialis*	229
6/3/08	PIB – basin 1	BIO4-AGT-3A	AGT	502-511	2 x *Pareledone* cf *charcoti*	389, 403
10/3/08	PIB – basin 2	BIO5-AGT-3A	AGT	553-558	*Cirroctopus* cf *glacialis*	618
10/3/08	PIB – basin 2	BIO5-AGT-3A	AGT	553-558	*Pareledone* cf *charcoti*	619
10/3/08	PIB – basin 2	BIO5-AGT-3D	AGT	536-544	3 x *Pareledone* cf *charcoti*	671, 672, 674
10/3/08	PIB – basin 1	BIO5-AGT-3D	AGT	536-544	*Megaleledone setebos*	673
10/3/08	PIB – basin 2	BIO5-EBS-3F	EBS	537-543	*Pareledone* cf *charcoti*	709
11/3/08	PIB – shelf break	BIO6-AGT-3A	AGT	481-486	*Pareledone* cf *charcoti*	775
11/3/03	PIB – shelf break	BIO6-AGT-3C	AGT	476-480	*Pareledone* cf *charcoti*	797
12/3/08	PIB – shelf break	BIO6-AGT-2B	AGT	989-998	*Pareledone* cf *charcoti*	891
12/3/08	PIB – shelf break	BIO6-AGT-2C	AGT	975-987	*Pareledone* cf *charcoti*	900
13/3/08	PIB – shelf break	BIO6-AGT-1B	AGT	1485-1491	*Benthoctopus* sp.	971

PIB = Pine Island Bay, AGT = Agassiz, EBS = Epibenthic sledge

The endemic Antarctic genus *Pareledone* accounted for 75% of the octopus which were caught during the cruise (fig. 15). It is well known that this genus has undergone widespread radiation in the Southern Ocean (Allcock et al 2001). Initial observations suggest that at least three species of *Pareledone* were captured on this cruise, however species within the genus

Pareledone are very difficult to distinguish from one another and thus further microscopic identification and dissection of the individuals caught will continue at Cambridge University and the British Antarctic Survey. *Pareledone charcoti* is thought to be circumpolar in its distribution and it is likely that some of the *Pareledone* individuals caught are indeed *Pareledone charcoti*.

Fig. 15: A sample of the *Pareledone* sp. captured aboard JR179.

The capture of the endemic monotypic *Megaleledone setebos* (fig. 16) from the Amundsen Sea region supports the theory that this species is circumpolar in its distribution, as it had previously been captured from eastern Antarctic (Lu & Stranks 1994), the Antarctic Peninsula (Kubodera & Okutani 1994; Piatkowski et al. 1998) and the Weddell Sea (Allcock et al 2001).

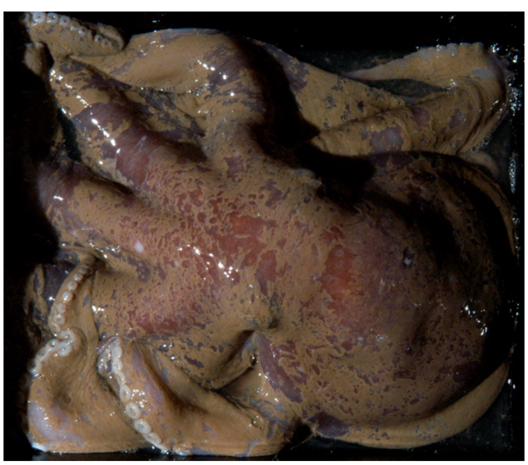


Fig. 16: *Megaleledone setebos*, captured from Pine Island Bay, Amundsen aboard JR179.

It is not clear at this stage, to which species the *Benthoctopus* individual captured (fig. 17) belongs. Two species of *Benthoctopus* are currently known from Antarctic waters and both are non-endemic. These are *Benthoctopus levis*, which has been described from off Heard Island and

Benthoctopus thielei described from the shores of Kerguelen. *Benthoctopus* specimens have also been reported from Elephant Island, South Shetlands (Kuehl 1988) but these were not identified to species level. It is also important to note that a cruise to the Antarctic Peninsula yielded specimens diagnosed as *Benthoctopus* cf. *levis* (Piatkowski et al. 1998). Further morphometric and genetic examination will be carried out on this individual at Cambridge University.

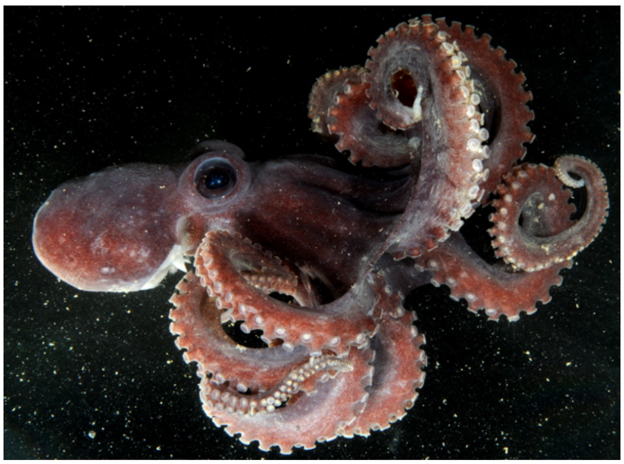


Fig. 17: *Benthoctopus* sp, captured from Pine Island Bay, Amundsen aboard JR179.

Two individuals of *Cirroctopus* were captured during the cruise. (fig.18). Three species of *Cirroctopus* are know from the Southern Ocean; *Cirroctopus glacialis*, *Cirroctopus mawsoni* and *Cirroctopus antarctica.* These species are known from the South Shetlands/Antarctic Peninsula, the Indian Ocean sector and the Pacific sector respectively (Collins and Rodhouse 2006). It is likely that the individuals caught on JR179 are *Cirroctopus glacialis* (Collins, pers. com.). The morphometrics and subsequent classification of these individuals will be investigated further by Martin Collins, a cirrate expert, at the British Antarctic Survey.

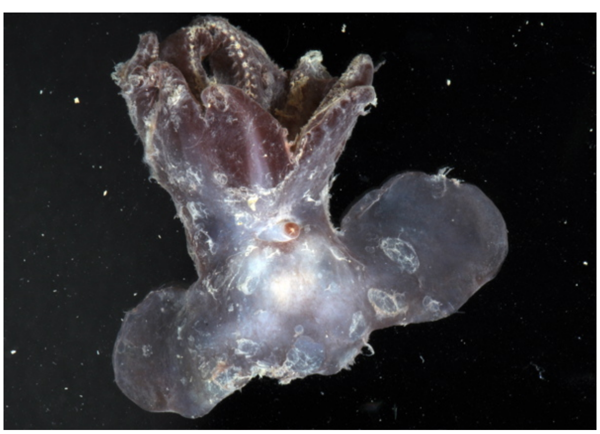


Fig. 18: *Cirroctopus* c.f. *glacialis*, captured from Pine Island Bay, Amundsen sea aboard JR179.

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5.3.1.2 Polychaetes collected from Agassiz Trawl samples

A. Glover

Objectives

The BIOPEARL II sampling program in the southern Bellingshausen and Amundsen Seas offered an outstanding opportunity for polychaete collections complementing previous expeditions undertaken by AG to the northern part of the West Antarctic Peninsula (WAP), as part of the FOODBANCS program (Glover et al., in press). Whilst the fauna collected using trawl nets is historically, the best studied, new species and records were expected, and to date there have been few studies which have combined live photography, morphology and DNA studies. In summary, my objectives were to 1) image trawl polychaetes alive preserving any colour morphology, 2) sub-sample the tissue and preserve for later DNA studies, 3) preseve the remaining specimen for morphology using clean techniques, 4) provide preliminary species identifications on-the-fly for additions to the overall AGT animal database.

b) Methods

Polychaetes were recovered from the sorted AGT samples and specimens live photographed using a Nikon Coolpix 4500 mounted on a stereo dissecting microscope. Sub-samples for DNA were taken and placed in RNALater buffer, frozen at -80C. Previous work by AG has demonstrated that this is the current most reliable method for preserving polychaete DNA. In addition, Whatman FTA cards were trialled for potential future use. These have the advantage that they require only a small amount of tissue and can be stored at room temperature indefinitely. The remainder of the specimen was identified to family and putative species, and fixed in 10% formaldehyde solution.

c) Preliminary results

A diverse polychaete assemblage was recovered, with a total of 87 identified specimens (from all the AGT samples combined), represented by 17 families and at least 39 different species, based on preliminary identifications alone (Table 8). The Polynoidae were by far the most diverse family, with 15 species identified from just 26 specimens. Future analyses will investigate how these species are distributed across sampling sites, and whether diversity and community structure are influenced by depth or other variables such as proximity to the Antarctic ice sheet. At the Natural History Museum in London, further identifications will be carried out, and pending future proposals in preparation, studies of systematics and biogeography using molecular methods.

Table 8: Polychaete species list, with fixation method, for Agassiz Trawl samples.

Taxonomy		Fixation			
Family	Species	ETOH	Formalin	FTA sub-sample	RNAlater sub-sample
Aphroditidae	Aphrodite sp. A		2		
	Laetmonice producta		7	3	6
Capitellidae	Capitellidae sp.		2		
Chaetopteridae	Chaetopterus sp.		1		
Dorvilleidae	Dorvilleid sp. A	1			
Eunicidae	Eunice pennata		1		1
	Eunice sp. B		1		
Flabelligeridae	Flabelligeridae sp. A		2		
Lumbrineridae	Lumbrineridae sp. A		2		1
Maldanidae	Maldanidae sp.		1		1
	Maldanidae sp. A	1	1		
	Maldanidae sp. B		4		1
	Maldanidae sp. C		1		1
	sp. indet.		1		
Nephtyidae	Nephtyidae sp.		5		

Nereididae	Nereididae sp. A		1		1
Opheliidae	Ammotrypane sp. A		1		
	Travisia sp. A	1	5		
Polynoidae	Eulagisca sp. A		2		
	Eulagisca sp. B		1	1	1
	Harmothoinae sp. A		1		1
	Harmothoinae sp. B		1		1
	Harmothoinae sp. C		1		
	Polynoidae sp.		7	1	
	Polynoidae sp. D		3		2
	Polynoidae sp. E		2		1
	Polynoidae sp. F		1		1
	Polynoidae sp. G		1		
	Polynoidae sp. H		1		
	Polynoidae sp. I		1	1	1
	Polynoidae sp. K		1	1	1
	Polynoidae sp. L		1	1	1
	Polynoidae sp. M		1	1	1
	Polynoidae sp. N		1	1	1
Sabellariidae	Sabellariidae sp. A		1	1	1
Sabellidae	Euchone sp. A		1		1
Serpulidae	Serpula narconensis	3	7		
	Vermiliopsis sp. A	1	1		
Spionidae	Laonice sp.A		5		1
Terebelliformia	Terebellid sp. A		1		1
Grand Total		7	80	11	29

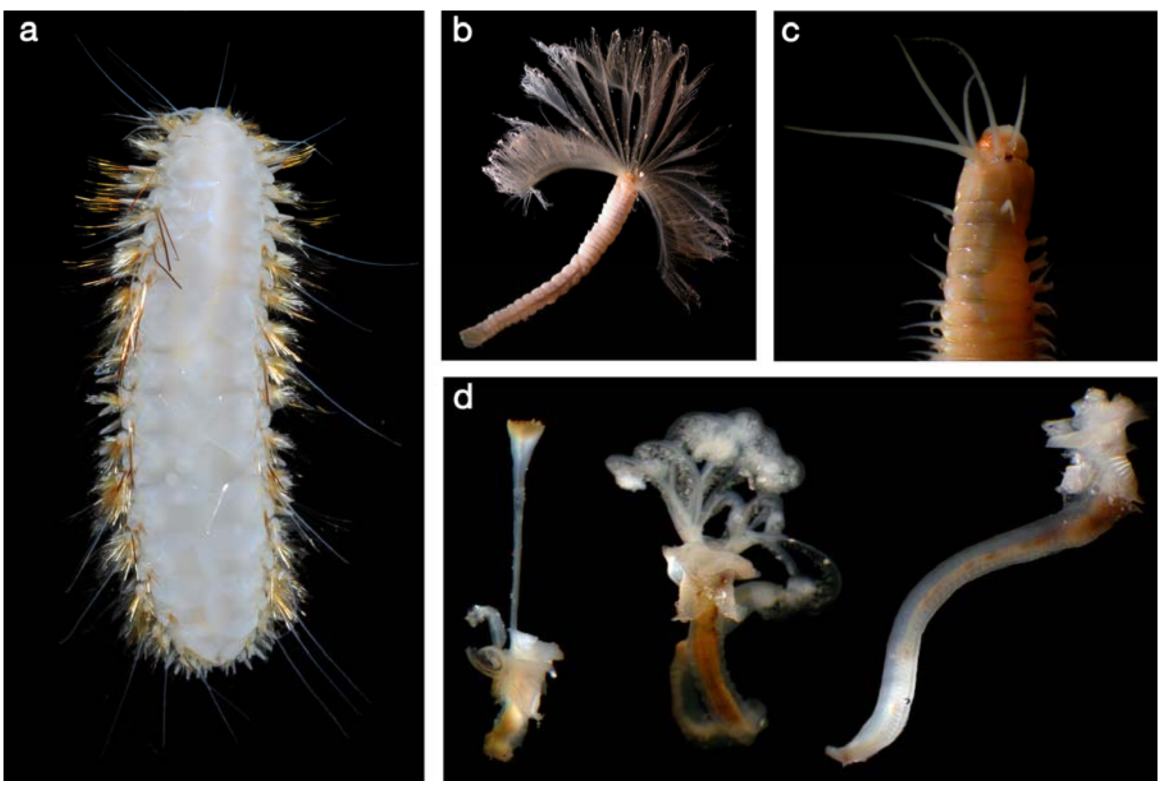

Fig. 19: Live photographs of polychaetes collected from AGT samples, a) *Laetmonice producta*, b) *Euchone* sp. A, c) *Eunice pennata*, d) *Vermilliopsis* sp. A. Photos b-d by A Glover, photo a by D Barnes.

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5.3.2 EBS

D.K.A. Barnes, S. Kaiser, A. Glover, C.J. Sands, H. Griffiths, J. Strugnell, P. Enderlein

Objectives

Almost nothing is known of biodiversity on the Amundsen Sea bed or which particular animals might live there. Thus sampling there potentially advances our knowledge more than those taken anywhere-else, except perhaps in the deep sea. It was considered a major priority though to design the sampling to be much more than a simple report of taxa or richness by site. Recent work (Kaiser et al. 2007) has highlighted that SO macrobenthic biodiversity can vary as much at small spatial scales (samples taken only tens km apart) as across whole ocean basins. To build on these findings we wanted to have a sampling strategy which enabled a comparison of the influences of depth and distance, that samples were taken. The selected design we hoped would provide the most detailed multiscale, multifactor study of any taxon reported from anywhere in the Southern Ocean – even more pertinent in the least sampled sea on the planet. Multiple Epi-Benthic Sledge (EBS) shelf/slope samples were taken ~10^2, 10^1 and 10^0 kilometres apart and we attempted to link the sample richness with environmental data on topography, granulometry and organic content (through examination of box core samples taken nearby for a geological project, see section 5.1.2). Particular attention was paid to richness and abundance of selected taxa, e.g. isopod crustaceans (see section 5.3.2.1) and polychaete annelids (see section 5.3.2.2) were investigated. Here preliminary results from the first samples to be analysed at higher taxonomic level (phylum and class) are presented.

Work at sea

Samples were collected by means of a modified epibenthic sledge (Brenke, 2005) in the Amundsen Sea, including Pine Island Bay. Sampling consisted of a total of 36 deployments in 4 different areas and across 4 different depth horizons (500, 1000, 1500 and 3500 m, Fig. 13). The first deployment was opportunistic and three times 500 m. From them on, at the three major sites the EBS was deployed twice at 1500 and 1000 m, respectively, and three times at each of two nearby sites at 500 m. Continuing the transect out of Pine Island Bay over the shelf break, we took three replicates at 3500 m in the deep sea.

The epibenthic sledge (EBS, Fig. 20) is proven apparatus for sampling small benthic macrofauna. The sledge is equipped with an epinet (below) and a supranet (above). The mesh size of the nets is 500µm. The cod ends are equipped with net-buckets containing a 300µm mesh window (Brenke, 2005). The EBS was trawled for 10 min on the sea bed on each occasion. In total, the operation time of each deployment ranged between 0.75 to 5 hours.

The sample processing following successful deployment had two components. The first of each 1500 and 1000 m samples (and the first two of 500 m samples) were sieved with cold sea water, and immediately fixed in 96% pre-cooled ethanol and kept for 48 hours in -20 °C for later DNA extraction. The second of each sample duplicate (the third of 500 m samples) were sieved with cold sea water. A subsample of either supra- or epinet was taken for live sorting. The remaining supra-and epi-samples were fixed in 4 % buffered formalin. After a few days, these samples were washed in cold sea water and transferred to 80 % ethanol.

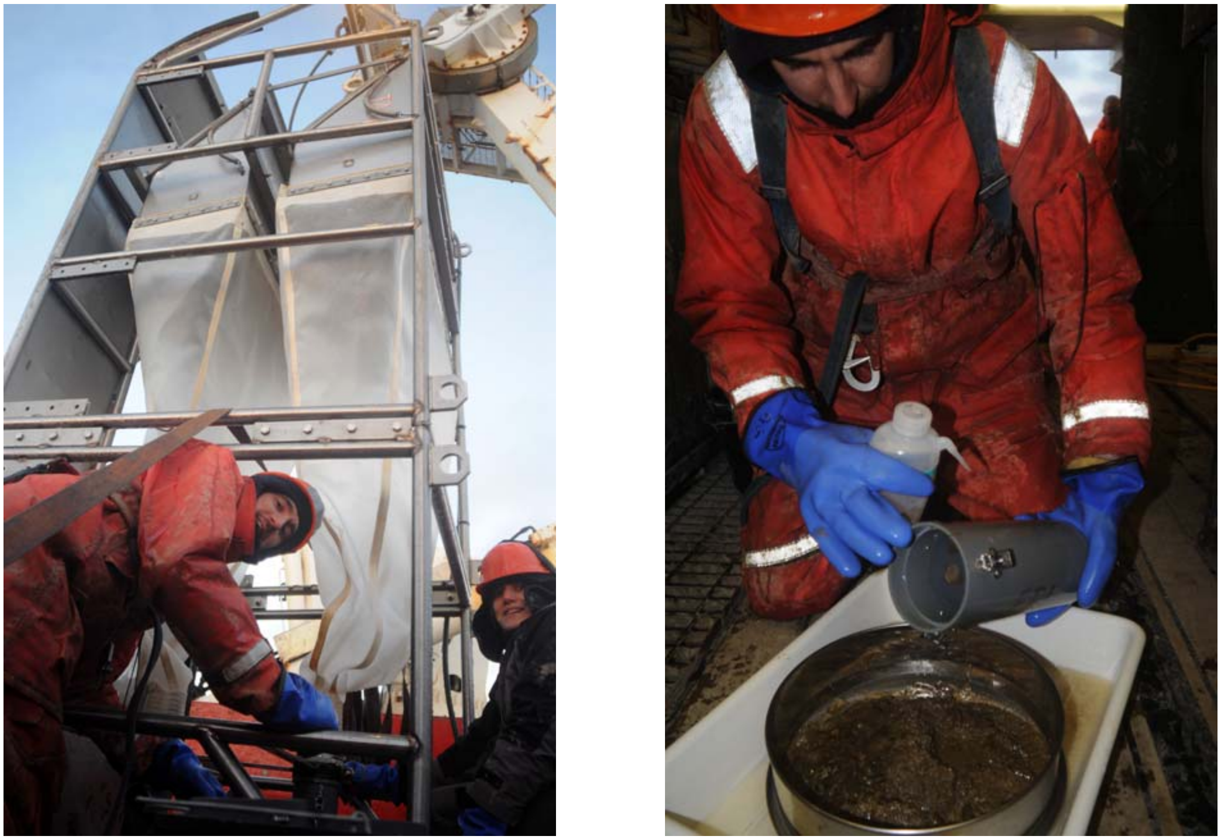

Figure 20: Collection of macrobenthos following an EBS deployment in the Amundsen Sea.

The EBS is securely fastened on the aft deck of JCR whilst scientists recover the samples in the cod ends of the Epi and Supra nets (left). These are then filtered to remove most of the sediment (right) before storing in precooled ethanol and eventual examination under binocular microscope.

The material was sorted into separate taxa using *Leica*, *Meiji* and *Wild* binocular microscopes. Bryozoans, molluscs, isopods and polychaetes were identified with higher resolution to differing taxonomic levels, but ultimately leading to 'morphospecies' categories. DNA was extracted from selected isopod taxa.

Preliminary results

Even though we have examined few samples, it is already clear that our Amundsen Sea samples are quite different from those which have been reported elsewhere and that we collected and studied in the Scotia arc (BIOPEARL I cruise, JR144). Firstly the first samples we have sorted to phylum and class levels appear to be extraordinarily rich, compared with the shelf almost anywhere. However, of course strict comparisons are difficult because of differing apparatus, protocol, taxonomic resolution and other variables. Nevertheless, even single samples yielded a third of all phyla (major body types) that are known on the planet (Table 21). In total 19 phyla and a minimum of 37 classes are represented in the samples sorted so far. Assemblage similarity in richness and composition has not yet been analysed but it seems as though there are some striking differences even within depth horizons, and that the magnitude of such differences varies with taxonomic level considered.

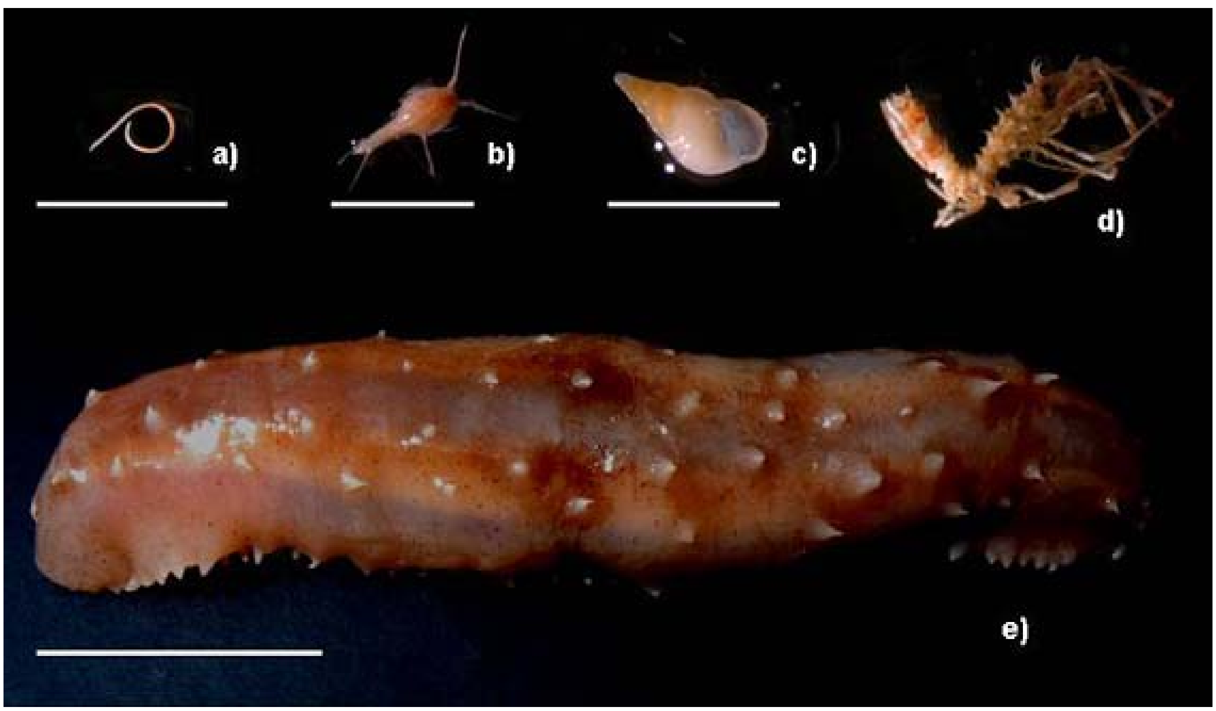

Figure 21: Animal size classes (examples of meio-, macro- and megafauna) sampled during JR 179 by the EBS; a) nematode, b) copepod, c) gastropod, d) antarcturid isopod, e) holothurian. Scale bar: a = 100 µm, b = 1 mm, c = 1 cm, d-e = 10 cm.

Although EBS are designed to collect larger meio-, macro and smaller megabenthos, the size spectrum of animals actually captured ranged from about 100 µm to about 50 cm, that is about 3.5 orders of magnitude (Fig. 5.3.2.ii). Perhaps the most surprising animal found in the samples was a hymenopteran insect, which we presume fell into the sample in the laboratory unless flying insects have colonised the seabed in Antarctica.

Table 9: Total number of phyla, classes, dominant taxa and its proportion (%) of fauna found in the epibenthic sledge samples.

Station	Number of phyla	Number of classes	Dominant taxa	Dominant taxa proportion of fauna (%)
BIO3-EBS-1A	13	23	Copepoda/ Malacostraca	~30 %
BIO4-EBS-1B	12	19	Copepoda/ Polychaeta	~70 %
BIO4-EBS-3A	16	29	Nematoda/ Polychaeta	~30 %
BIO4-EBS-3D	13	26	Copepoda/ Polychaeta	~90%
BIO5-EBS-3B	12	20	Copepoda/ Polychaeta	~80 %
BIO6-EBS-3A	10	20	Copepoda/ Malacostraca	~70 %

Work in progress

By the end of the cruise JR179 we had sorted samples from 6 stations to major taxa, thus leaving 30 station samples to investigate to this preliminary level. Following this initial sorting, collections of each major taxa will be examined further by specialists. Katrin Linse and David Barnes of BAS will examine the molluscs and bryozoans/brachiopods respectively. Stefanie Kaiser, Hamburg University will identify the isopod crustaceans while Adrian Glover will do the same for the polychaete individuals. Many other specialists, not taking part in JR179, have already been approached to attempt identifications of other taxa, either by visiting BAS or by sending specimens to them in their own institutes. Trends and discoveries in this data will be analysed and reported within and across taxa in time to come.

5.3.2.1 Richness and distribution of Isopoda (Crustacea, Malacostraca) in the Amundsen Sea

Stephanie Kaiser

Objectives

The overall objective of this project is to examine the richness of a model taxon (isopod crustaceans) on the least studied continental shelf and slope of the planet – the Amundsen Sea. Multiple comparisons of levels of novelty (e.g. how many new species) in this data would follow this, between a) samples, b) depths and c) regions. The data will be compared with samples from the Scotia Sea which were taken during the BIOPEARL I cruise (JR 144). The comparison between these two data sets, i.e. Scotia vs. Amundsen Sea data, will enable the crucial factor of total sample effort to be evaluated as the former is comparably well studied and the latter unstudied. The ratios of how many species or genera are found which are new in well, poorly and unstudied areas and on the shelf vs. slope depths should tell us how well we know the Antarctic fauna both by depth and geography. Furthermore the same data can be used to generate taxon accumulation curves for each area and depth which will show sampling-effort-independent levels of richness for these areas.

Isopod crustaceans as a model group are ideal as they are one of the groups that we have most combined shelf/slope and deep-sea knowledge on already (see Kussakin 1967, Brandt 1991, Wägele 1994, Gage 2004, Brandt *et al.* 2004, 2005). They have also already proved a powerful tool in investigation of spatial distribution in the deep sea (Kaiser *et al.* 2007). Interestingly, it has been found that few isopod species seem to be abundant while many occur more rarely (Brandt *et al.* 2007, Kaiser *et al.* 2007). One might wonder about their potential buffer function for the ecosystem in times of environmental change.

The study shall be performed (1) to gain insights into the richness and distribution along bathymetric and geographic transects of macrobenthic organisms such as isopods in the least known seas of the planet, (2) to document changes in species composition with depth, but also with increasing geographic distance between the samples, (3) to find out which factors drive biodiversity and distribution patterns of macrobenthic taxa such as isopods across spatial ranges (4), to acquire a comparable data set to BIOPEARL (5) to gather more data about intra- and interspecific genetic variations in order to get further information about speciation and diversification processes, gene flow and radiation of SO isopods.

Methods

Isopod material was sampled by means of an EBS (see 5.3.2). These samples were fixed in 96 % pre-cooled ethanol and be kept there for at least two days which will enable later DNA-extractions. All isopods were identified to family level, selected taxa (such as desmosomatids) to genus and, if possible, to species level. The DNA of 46 specimens of selected isopod taxa (i.e. Munnospidae, Macrostylidae and Desmosomatidae) was extracted on board by means of a QIAamp® DNA Mini Kit following the handbook´s instructions. Therefore, 2–3 pereopods were dissected to avoid further damage of the voucher specimen and to allow later morphological work or re-identification.

Preliminary results

First results from the EBS samples, which have been processed to date, have revealed isopod crustaceans to be well represented at all six stations examined. Isopod crustaceans were one of the dominant crustacean groups and comprised about 1200 specimens. These could be assigned to 13 different families, of which the asellotean families Munnopsidae and Desmosomatidae (Fig. 22) were the most dominant representing 83 % of the total isopod fauna, followed by Munnidae and Antarcturidae.

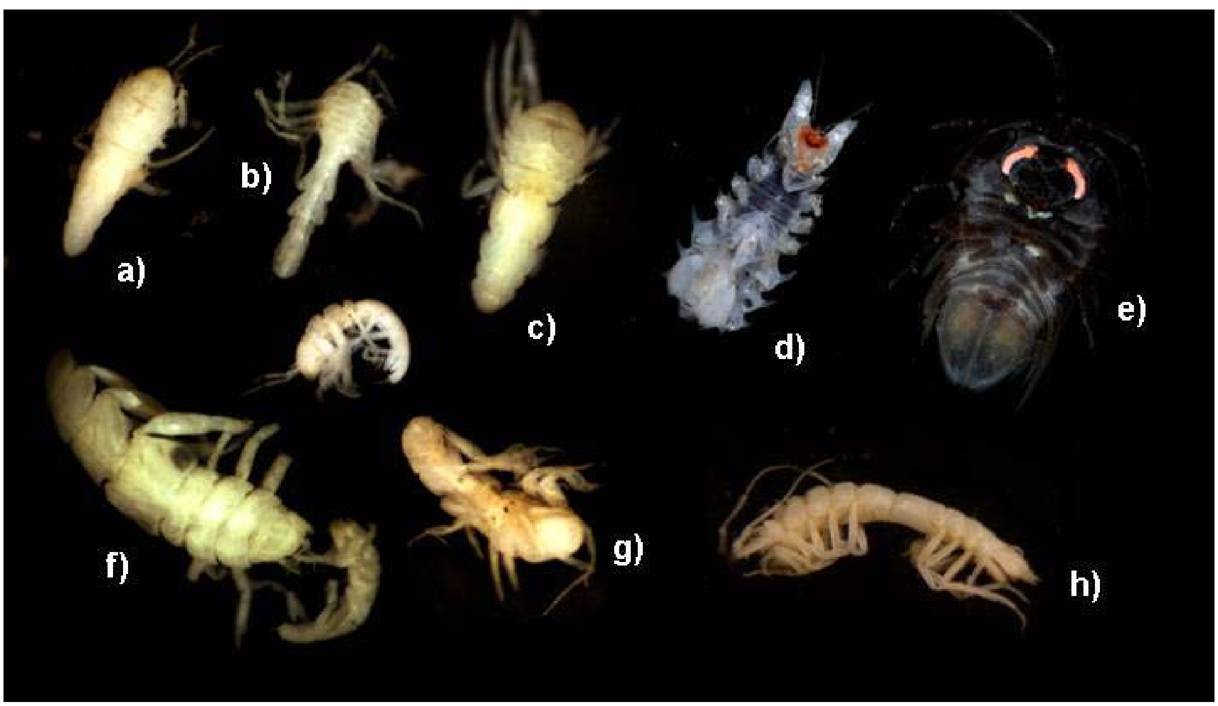

Figure 22: Examples of isopod families and genera sampled during BIOPEARL II; a–c, f–g)

Desmosomatidae: a) genus *Mirabilicoxa*; b) *Prochelator*, c) *Mirabilicoxa*, f–g) *Desmosoma*; d) Munnopsidae, genus *Sursumura*, e) Serolidae, genus *Cuspidoserolis*; h) Ischnomesidae.

Special attention was paid to the family Desmosomatidae. Within this family ten genera could be identified (i.e. *Austroniscus, Desmosoma, Eugerda, Exiliniscus, Mirabilicoxa, Nannoniscus, Prochelator, Pseudergella, Pseudomesus, Regabellator*). Of these *Mirablicoxa* was the most abundant and ubiquitous genus, occurring in numbers > 10 (individuals) at all six stations.

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5.3.2.2 Polychaetes collected from Epibenthic Sledge samples

A. Glover

Objectives

The JR179 BIOPEARL sampling program in the southern Bellingshausen and Amundsen Seas offered an outstanding opportunity for polychaete collections complementing previous expeditions undertaken by AG to the northern part of the West Antarctic Peninsula (WAP), as part of the FOODBANCS program (Glover et al., in press). Whilst the larger size fraction animals collected by trawl nets (e.g Agassiz or Otter trawls) is reasonably well known, the smaller size fraction of animals that are retained on a 500 or 300 µm sieve are poorly known. Polychaetes are extremely abundant in the sediment infauna, in some instances we have found dominance of over 50% by polychaetes in WAP shelf sediments when sampling using coring devices (Glover et al., in press). The large numbers recovered by EBS or coring devices precludes live sorting and identification of the whole sample. However, a sub-sampling approach was used in order to live image at least a portion of the sample. Previous work has indicated that bulk-fixation in ethanol for polychaetes produces very low PCR success rates (Mincks et al., in press), so some live-sorting is necessary to obtain material for molecular studies. My objectives were to 1) live-sort a sub-sample of the EBS samples destined for formalin fixation, 2) live image and preserve for DNA a selection of these specimens, 3) identify to species-level the remainder of the polychaete collection from all EBS samples during transit home and in ongoing studies at the Natural History Museum in London.

Methods

Live photography, fixation and sorting were as described in section 5.3.1.2. In some instances, the small size of specimens required the entire animal to be fixed for DNA work – in these cases, putative species identifications were undertaken.

Preliminary results

71 polychaetes were sub-sampled from 10 of the formalin-destined EBS samples for live photography and DNA work. The limited amount of time and large number of specimens precluded species-level identification, however, most of these species have been very rarely

photographed alive making these data extremely useful in future studies. Furthermore, the quality sub-samples for DNA work will be essential both for future systematic and biogeographic studies, and for developing primers that are effective on the less well fixed ethanol-preserved samples. To date, we have had no success in amplifying DNA from the ANDEEP program polychaete material, which was collected using a similar protocol to the ethanol-fixed EBS samples on BIOPEARL. Thus the RNALater samples collected from these EBS samples will be extremely useful in troubleshooting future DNA work.

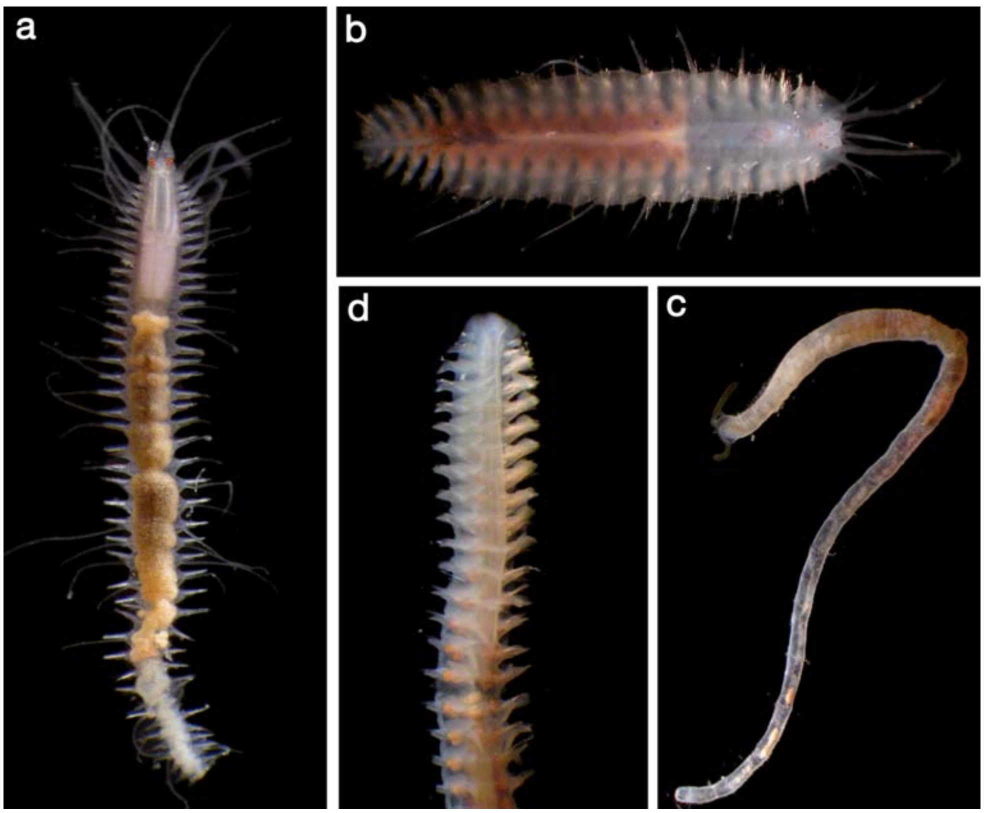

Fig. 23: Live photographs of polychaetes collected from EBS samples, a) Syllidae, b) Polynoidae, c) Acrocirridae d) *Laonice*

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Mincks, S.L., Dyal, P., Paterson, G.L.J. , Smith, C.R. (submitted). An abundant new species of *Aurospio* (Annelida, Spionidae) from Antarctica, with analysis of its ecology, reproductive biology and evolutionary history. Marine Ecology - an Evolutionary Perspective,

5.3.3. Metagenomics CTD

D.A. Pearce

Objectives

On JR144, community DNA was sampled from around the Scotia Arc to construct a metagenomic library in order to analyse the physiological potential of the Southern Ocean microbial community. In JR179, it was the intention to collect mRNA to analyse actual activity, and to compare a relatively low nutrient region to one influenced by upwelling and terrestrial run-off. To this end a large volume of water was collected from the Drake Passage (and then as often as opportunity allowed). The water content of these samples was reduced using tangential flow ultrafiltration (Figures 24-26) and mRNA extracted. Background sea water samples were taken for community analysis (LTMS-B Task 7). CTD runs for BIOPEARL were conducted. Seawater was collected and filtered for Manuel Hutterli (PSD), and opportunistic terrestrial sampling was undertaken where possible.

Work at sea

24th & 25th February: Sample 1 shallow (Bio CTD 001, 002 & 003) 350L at 30m (Chlorophyll Maximum) in transit from Stanley to Peninsula.

6th March: Sample 2a shallow (Bio CTD 012) at 30 m (Chlorophyll Maximum) 120L Pine Island Bay Area.

8th March: Sample 2b shallow (Bio CTD 013) at 30 m (Chlorophyll Maximum) 120L Pine Island Bay Area.

9th March: Sample 2c shallow (Bio CTD 014) at 30 m (Chlorophyll Maximum) 120 L Pine Island Bay Area.

10th March: Sample 3 shallow (Bio CTD 015) at 30 m (Chlorophyll Maximum) 120 L Pine Island Bay Area.

11th March: Sample 4 shallow (Bio CTD 016) at 30 m (Chlorophyll Maximum) 120 L Amundsen Sea.

13th March: Sample 5 shallow (Bio CTD 019) at 30 m (Chlorophyll Maximum) 120 L Amundsen Sea.

Between each site, containers were rinsed briefly with ethanol, this was then rinsed out and the containers filled three times with standard water and twice with Millipore water. This procedure resulted in a high demand for Milli-Q water (1200L) and the ships system coped well with this.

Associated support activity was also undertaken; the construction and testing of the tangential flow ultrafiltration system including sterilization techniques, trial runs with laboratory supply sea water, methods for phytoplankton removal and size fractionation, pressure testing and membrane integrity tests, membrane function and verification with microscopy (DAPI) / centrifugation.

Preliminary results

Further details will not be available for at least six months, due to the lengthy molecular biology required back at the ANGEL laboratory in Cambridge. However, the generation of a marine metagenomic library from JR144 was successful. On JR179, water samples were collected successfully and the microbial component concentrated. This will now involve further concentration (using centrifugal concentrators), size fractionation (pulse-field gel electrophoresis), DNA shearing, Fosmid library construction and sequencing. All terrestrial samples collected as requested.

Figure 24: TFF filter membrane

Figure 25: Sample handling

Figure 26: Sea water processing

5.3.4. Microbial CTDs

Rachel Malinowska

Objectives

The primary objective was to determine microbial abundance, community composition and structure in marine water and surface sediment to examine how communities change through a depth profile in the deep-sea. This data will be used for comparative analysis of water column and sediment-water interface communities to examine whether the majority of microbial processing of particulate organic carbon occurs in the water column or in the sediment. The second objective was test the hypothesis that Southern Ocean marine bacteria are widespread in distribution and not restricted to specific regions.

Work at sea

Sea water samples were collected through a depth profile at six sites (Table 10) using a CTD rosette equipped with 12, ten litre, Niskin bottles. Four litres of seawater was collected during each deployment from 10 depths in four 1 litre, sterile, Nalgene bottles for immediate filtration.

Table 10. Station data for CTD deployments

CTD	Latitude °S	Longitude °W	Station	Location	Sampled water depths [m]
004	-68.37	-75.85	Bio_1	Amundsen Sea	30, 100, 200, 400, 600, 800, 1000, 1200, 1300, 1500
009	- 69.81	-84.82	Bio_2	Amundsen Sea	30, 100, 200, 400, 600, 800, 1000, 1200, 1300, 1500
011	-74.35	-104.67	Bio_3	Pine Island Bay	30, 100, 150, 200, 400, 600, 800, 1000, 1300, 1500
020	-71.13	-109.94	Bio_4	Outer Pine Island Bay	30, 100, 200, 400, 600, 800, 1000, 1200, 1300, 1500
021	-69.23	-106.6	Deep-sea	Bellingshausen Sea	30, 500, 1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500
022	-60.53	-108.35	Deep-sea	Bellingshausen Sea Polar Front	30, 500, 1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500

Surface sediment samples were collected by box core deployment at six sites (Table 11). The surface of each box core was randomly sub-sampled into six 1.5 ml sterile, eppendorfs and stored at -20 ºC for analysis at BAS headquarters.

Table 11: Station data for box corer deployments

Station	Latitude °S	Longitude °W	Location	Bottom depth [m]
472	72° 18'.16	106° 43'.15	Amundsen Sea, outer shelf Pine Island Bay	702
495	70° 02'.92	108° 20'.95	Drift crest, Amundsen Sea	3468
504	61° 14'.72	114° 52'.76	Bellingshausen Abyssal Plain, Polar Front Zone	5137
506	67° 59'.91	095° 00'.60	Bellingshausen Sea	4430
508	68° 18'.63	086° 01'.93	Belgica Trough Mouth Fan	3560
519	68° 14'.25	070° 12'.21	Marguerite Bay, Holocene site	697
523	67° 51'.33	068° 12'.28	Marguerite Bay, Adelaide Trough	911

Bacterial cells from four litres of seawater from each depth through a profile were concentrated by vacuum filtration (< 30 kPa) through Whatman 3M nitrocellulose membrane filters held within Sartorius filtration units (Sartorius Ltd., Epsom).

One litre of seawater was filtered and cells resuspended in 6 ml uncontaminated seawater for immediate determination of bacterial density by 4'-6-Diamidino-2-phenylindole (DAPI) staining. Microbial cells were harvested by filtration (0.2 micron polycarbonate filter) from 1 ml of concentrated seawater suspension and stained with DAPI at a concentration of 2-5 $\mu ml^{-1,}$ washed and placed on a glass slide in Citifluor immersion oil (Citifluor Ltd., Canterbury) and coverslipped. Cells were counted by epi-fluorescence microscopy at an excitation wavelength of 350 nm. DAPI (4'-6-Diamidino-2-phenylindole) forms fluorescent complexes with natural double-stranded DNA of both active and apoptotic cells, showing fluorescence specificity for AT, AU and IC clusters. The remainder of the cell suspension was stored at -20°C for community structure analysis by fluorescence *in situ* hybridisation (FISH) at BAS headquarters.

Three litres of seawater were filtered for molecular sequencing work to be undertaken at BAS headquarters. Cells from the filter paper were resuspended in 6 ml uncontaminated seawater, aliquoted into sterile eppendorfs and centrifuged for 30 minutes at 15 rpm to pellet the cells for storage at -20°C.

Community structure and diversity analysis will be conducted using the following molecular methods; DAPI staining, FISH, denaturing gradient gel electrophoresis, clone library construction and sequencing.

Preliminary Results

A minimum of 1000 DAPI stained cells were counted per sample. Preliminary counts show DAPI stained cell numbers of approximately 4.23 $x10^5$ cells ml^{-1} in surface water. Little variation in cell number between surface sea-water samples (30 m) was observed although a decrease in cell number was seen with increasing water depth.

5.3.5 Genetics

Chester Sands, Jan Strugnell

Prior to this cruise, tissue samples taken from marine invertebrate fauna for genetic analysis have either been frozen or preserved in ethanol. Subsequent DNA extractions, using a variety of DNA extraction techniques have had mixed results, possibly because of strong enzymatic activity producing rapid degredation in DNA between capture and preservation / extraction (Goodall-Copestake, unpublished data). In order to obtain the highest possible yield and quality of genomic DNA for future genetic work, during JR179 as many DNA extractions have been completed on fresh tissue as was possible.

Genetic work envisaged from JR179 includes systematic work on complex groups that appear to have radiated in Antarctic marine environs, biogeographic studies testing hypotheses regarding species distributions through time and space, phylogeographic studies examining species distributions, boundaries and historical demographic factors that led to the current spatial patterns of diversity, population studies examining fine scale diversity in space and DNA barcoding of each morpho-species landed by the Agassiz trawl (AGT) for the Census of Antarctic Marine Life (CAML), Barcode of Life project.

DNA barcoding is a technique that uses a short gene sequence (usually cytochrome *c* oxidase subunit I, [COI]) from a standardized region of the genome as a diagnostic 'biomarker' for species. Different species have different DNA barcodes, and CAML hopes that a barcode of life database will make it possible to use barcodes to 1) identify specimens, 2) discover new species and 3) make taxonomy more effective for science and society.

The number of DNA extractions possible was limited by the time taken to excise fresh tissue from organisms during the processing of AGT samples (refer to section 5.3.1). In order to maximize efficiency, and later productivity, target groups were identified as priority for DNA extraction. Factors influencing the choice of groups were: confidence of successful DNA extraction under less than ideal conditions, likelihood of high sample numbers (5 or more) from each depth and or station for population comparisons, time available at stations where groups were likely to be found. At 1500 m stations there was ample time to sort between trawls, and often low numbers of individuals in a trawl. Thus it was possible to sample every individual caught. These groups were also targeted at 1000 m and 500 m. In addition to target groups, an effort was made to sample each new morphospecies that was landed.

During the AGT sorting process, target groups were identified and individuals given unique identifying numbers. Two tissue samples were taken, each approximately 20 mg (less for some groups or small individuals), one sample was transferred to a 1.7 mL micro-centrifuge tube containing 180 µl extraction buffer (Qiagen™ ATL buffer) and frozen at -80 °C, the second was transferred to a 1.7 mL micro-centrifuge tube containing 1 mL cold ethanol (100%) and stored at -20 °C. In some cases a third sample was taken and stored in RNALater™ and stored at -80°C for future testing of suitable target species for genomic work. Tissue was excised using either scalpel, scissors or two forceps. All individuals sampled, and types of sample (DNA extraction, ethanol preserved tissue sample, RNALater™ tissue sample) were recorded in the cruise database.

The groups targeted were amphipods, isopods, decapods, stelloids, pyconogonids, some holothurians, cephalopods and polychaetes. Figure (percent breakdown of DNA across sites) provides an indication of the groups sampled from each of the 36 AGTs.

Of the 1161 individual identification numbers given, 616 were individual specimens from which samples were dissected for DNA extraction on board and preservation in ethanol for extraction at a later date. We sampled 40 individual specimens in RNA Lata including 16 octopus. From the 616, 530 samples were extracted on board. The remaining samples were kept frozen at -80 °C for extraction back at BAS. We were able to extract many more samples than expected and as a result the limiting factor was in the supply of extraction kit that was on board. In future cruises it is recommended that an excess of extraction materials are on board. Furthermore, it is recommended that rather than the expensive Qiagen™ kits that result in a lot of plastic waste, simpler, cheaper extraction techniques such as “Salting Out” are employed. With the salting out procedure the chemicals used are easily obtained and contained, inexpensive, generally non-hazardous, results in very little plastic waste and similar quality and greater quantity of genomic DNA. It is also recommended that a larger capacity centrifuge is provided (24 tube rather than 18) as it increases the number of samples able to be processed at any one time.

5.3.6 EK60 acoustics & krill genetics

Peter Enderlein, Chester Sands, Jan Strugnell

Objectives

The main objective of this study was to opportunistic collect the first BAS acoustic data and krill samples on JCR along the western side of the Antarctic Peninsula and the Amundsen Sea to add to the temporal and spatial aspect to the current krill population using acoustics and genetic studies. By far the majority of the krill samples being worked on at BAS have been collected from South Georgia and the top of the Antarctic peninsula. Therefore any acoustics and krill samples collected from the Amundsen and Bellingshausen Seas on JR179 will significantly add to coverage to this dataset from around Antarctica.

EK60 acousitics

The EK60 was started on the Continental shelf on the 25.02 and run until Rothera on the 03.04. It was restarted on the 07.04 and stoped on the 10.04.

Software versions

Simrad ER60 v. 2.0

Sonardata Echolog 60 v 4.05.6208

Sonardata Echoview v 4.0.75.6342 Live viewing

HASP Dongle BAS3 licensed for base, bathymetry, analysis export, live viewing, school detection and virtual echogram was used to run the echolog and echoview in live viewing mode. The echosounder pc AP10 and the EK60 workstation 2 are integrated into the ship's LAN. ER60 .raw data files were logged to a Sun workstation jrua, using a Samba connection, which is backed up at regular intervals. All raw data were collected to 1000 m. Echolog was run on workstation 2 and wrote compressed files also directly to the Sun workstation via a Samba connection.

Echolog compression settings

Final compression settings used in Echolog for all frequencies were:

1) Power data only (angle data is still available from the raw files)

2) From 0 - 300 m (38 kHz), 0 – 300 (120 kHz) and 0 – 300 (200 kHz) data only (data from greater depths are available from the raw files)
3) Average samples where both Sv below –100 dB and TS below –20 dB
4) Maximum number of samples to average: 50
5) DO NOT use average samples below echosounder detected bottom unless sure of bottom detection

File locations

All raw data were saved in a general folder JR179, all echolog data were saved in the folder JR179 \echolog1 and echolog2.

EK60 (ER60) settings

The following settings where used during JR179:

Table 12: Acoustics EK60 settings

Variable	38 kHz	120 kHz	200 kHz
Ping interval (per sec)	2	2	2
Salinity (PSU)	34	34	34
Temperature (°C)	1	1	1
Sound velocity (m/s)	1453	1453	1453
Mode	Active	Active	Active
Transducer type	ES38	ES120-7	ES200-7
Transceiver Serial no.	009072033fa5	00907203422d	009072033f91
Transducer depth (m)	0	0	0
Absorption coef. (dB/km)	10.07	26.27	39.8
Pulse length (ms)	1.024	1.024	1.024
Max Power (W)	2000	500	300
2-way beam angle (dB)	-20.70	-20.70	-19.60
Sv transducer gain (dB)	24.07	21.38	22.03
Sa correction (dB)	-0.63	-0.39	-0.31
Angle sensitivity along	22	21	23
Angle sensitivity athwart	22	21	23
3 dB Beam along	-0.02	-0.12	0.17
3 dB Beam athwart	0	-0.07	-0.24
Along offset	6.96	7.48	6.44
Athwart offset	6.88	7.48	6.43

The EK60 was not controlled through the SSU, which unsurprisingly resulted in lots of interference in the EK60 data caused by the ADCP, the swath and the Doppler log. Also no post-processing was undertaken in Echoview.

Krill genetics

The Deck Engineer cleaned the JCR's salt water intake filter daily (when it was in use) throughout the duration of the cruise. The filter would often contain small organisms including fish, amphipods, mysids and krill.

Krill DNA is known to degrade very quickly after their death and therefore only live krill were sampled. Where possible, 10 krill were placed directly into cold 100% ethanol with a label containing the ships latitude and longitude and the date. In the event that there were more than 10 krill the remainder were frozen with an identical label.

It is important to note that salt water was not pumped into the JCR every day. Factors such as rough weather and large amounts of sea ice (such as in Pine Island Bay) sometimes prevented the salt water pumps from being used.

Table 13: Krill collected in the Bellingshausen and Amundsen Seas during JR179.

Date	Sample size (in ethanol)
1 March 2008	9
2 March 2008	10
12 March 2008	5
15 March 2008	1
19 March 2008	5
1 April 2008	10

Table 13 shows the numbers of krill that were collected and stored in ethanol on JR179. The krill DNA will be extracted at the British Antarctic Survey. Although the sample sizes of krill collected are quite small, they will are likely to provide a unique and rare insight into the population genetics of krill from the Bellingshausen and Amundsen Sea regions of Antarctica.

5.3.7 Census of Antarctic Marine Life (CAML) – Education and Outreach.

Jan Strugnell

As part of its "Evolution and Biodiversity in Antarctica" (EBA) program the Scientific Committee on Antarctic Research (SCAR) proposed that a Census of Antarctic Marine Life (CAML) be undertaken as a major activity during the International Polar Year (IPY). Funds for coordination activities for CAML were obtained from the Alfred P Sloan Foundation of New York, USA. CAML is one of 14 field programs being conducted under the ten year international umbrella program 'Census of Marine Life' which aims to 'describe the state of the world's oceans in terms of their former biodiversity, their present biodiversity, and their likely future biodiversity.'

The Census of Antarctic Marine Life's (CAML) mission statement is to 'investigate the distribution and abundance of Antarctica's vast marine biodiversity to develop a benchmark for the benefit of humankind.' The website address for the initiative is as follows:- http://www.caml.aq

CAML relies on research-active Antarctic nations providing ship time to scientists. BAS provided two berths on board the JCR for CAML, with CAML contributing towards the cost of flights. Myself and Steffi Kaiser were selected to be the CAML scientists. I was asked to keep an onboard diary with photos for Education and Outreach purposes for CAML. These have been posted on the CAML website http://www.caml.aq/voyages/james-clark-ross-early2008, the IPY website http://www.ipy.org/index.php?/ipy/detail/ and also the BAS website http://www.antarctica.ac.uk/living_and_working/diaries/rrs_james_clark_ross/antarctic2007_2008/

I wrote diary entries every few days for these websites which were submitted to the JCR Master and the BAS press office prior to publication. The diary entries include details of the science that was carried out on board the JCR and relevant photographs. A cruise track is also available from the CAML website.

5.3.8 ACES Deployments

A. Glover

Objectives

The Antarctic Chemosynthetic EcoSystems (ACES) project is jointly run by Adrian Glover at The Natural History Museum, London and Thomas Dahlgren at the University of Göteborg, Sweden. The goals of the project are to investigate chemosynthetic ecosystems of biogenic origin (i.e dependent on organic enrichment, not geological forces such as hydrothermal vents) in Antarctica. Recent studies have shown that two important sources of highly-localised and enriched organic matter in the deep sea are whale-carcasses that sink on death from the surface, and wood either washed out to sea (becoming waterlogged and eventually sinking) or from shipwrecks (Smith et al. 1989, Dando et al., 1992, Distel et al., 2000, Glover et al., 2005).

Our objective on the BIOPEARL cruise was to deploy 2 moorings equipped with Sonardyne homing beacons (for ROV location) and a package of wood (85kg of pine and oak) blocks and a selection of whale bones (155 kg of sperm whale and minke whale vertebra and jaw). Through collaboration with Prof Paul Tyler (University of Southampton) we will return in the 2010/2011 season with RRS James Cook and ROV Isis to recover these moorings and take samples of the wood and whale-fall biota.

Methods

The two moorings were set up as indicated in Fig 27. Approximately 90kg of ballast was used on the bone mooring, and 175kg of ballast on the wood mooring. Deployment was using the ships aft deck crane over the starboard side, with a quick release. At 2341 GMT on 08/04/08 the first mooring (bones) was deployed with ship on DP at 62°09.85S 57°19.5W, which appeared to sink very quickly. At 0000 GMT on 09/04/08 the second mooring (wood) was deployed with the ship on DP at 62°09.95’S 57°19.3W, which sank more slowly, although below a certain depth it would have increased speed due to the wood becoming compressed. Both moorings were at 2000m water depth, to the north of Hook Ridge, which rises to 1045m water depth.

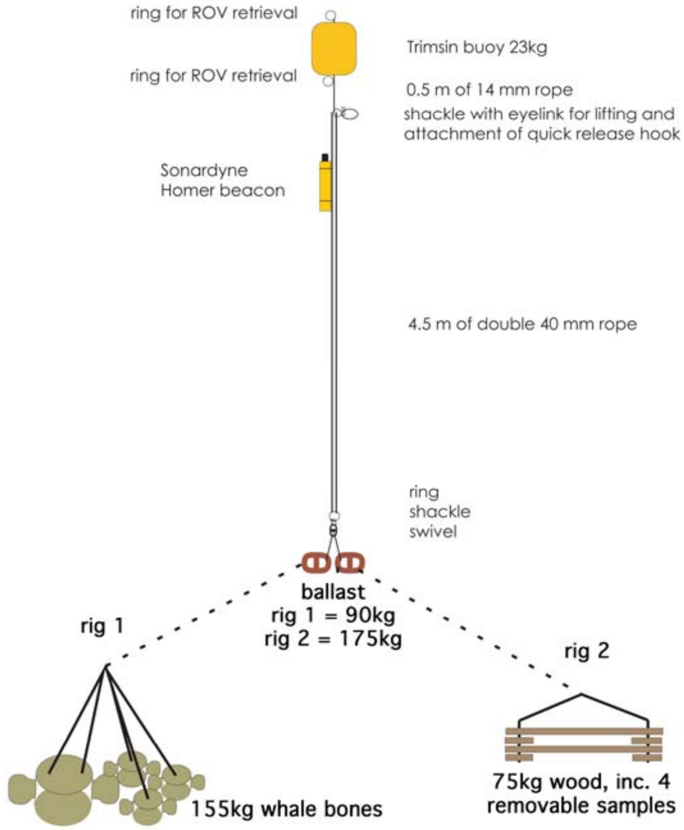

Fig 27: ACES mooring diagram

6 List of Scientific Equipment Used

6.1 Echo Sounders

Kongsberg Simrad EM120 multibeam echo sounder

Kongsberg Simrad TOPAS PS018 sub-bottom profiler

Kongsberg Simrad EA600 (Bridge navigational echo sounder)

Kongsberg Simrad EK60 echo sounder

Kongsberg Simrad sonar synchronisation unit (SSU)

6.2 Coring equipment and winches

NMF Sea Systems 12 m piston corer

Duncan and Associates box corer (300 mm square box)

30-tonne traction winch and CLAM wire monitoring system

6.3 Trawling equipment

Agassiz trawl

Epibenthic sledge

6.4 Potential Field Equipment

Shipboard three-component magnetometer (STCM)

SeaSpy towed Overhauser magnetometer

6.5 Oceanographic instruments

Seabird Conductivity-Temperature-Depth (CTD) system, also including oxygen sensor, fluorometer, transmissometer, PAR sensor and altimeter

Autosal

RDI 75 kHz Acoustic Doppler Current Profiler (ADCP)

BAS Oceanlogger, including thermosalinograph, fluorometer, uncontaminated seawater intake thermometer, air temperature thermometer and anemometer

Expendable bathythermograph probes (XBTs, type T5)

6.6 Navigation

Seatex Seapath 200 (input to EM120 and TOPAS)

Furuno GP-32 GPS receiver

Ashtech GG24 GPS+GLONASS receiver

Ashtech GDU-5 3D GPS receiver

TSS300 heave, roll and pitch sensor

Chernikeeff Aquaprobe Mk5 electromagnetic speed log

Sperry Doppler speed log

Gyro

6.7 Data Logging

NOAA Scientific Computer System (SCS) system

7 Equipment Performance

7.1 EM120 Multibeam echo sounder

T. Deen & R. Larter

Logging of EM120 data was initiated at 0222Z on 22nd February (day 053) over the northern flank of the Falklands Trough. The system was operated throughout the cruise at virtually all times when the vessel was in motion. Logging was stopped early on the 11th of April.

7.1.1 Standard settings

The EM120 was synchronised with the EA600 through the SSU. For most situations, the ping cycle was set to be calculated for the most appropriate ping frequency for the present depth. This was occasionally changed to a fixed ping cycle when on station.

The width of the beams was set to levels appropriate for the water depth and weather conditions. In relatively shallow water and good conditions, this could be as wide as 65º but may have to be narrowed to take weather conditions into account. In deeper water conditions, 50º was found to be more appropriate. Minimum and maximum depths were set as appropriate for the conditions: in most conditions the minimum depth was set to 100 m and the maximum depth set to a value larger than the deepest expected water depth. Exceptions to this were times when the EM120 was unable to find the seafloor reflector, when the ship was breaking ice and when travelling in deep water (> 3000m). On those occasions, the minimum and maximum depths were set to values bounding the expected sea floor depth.

Sound velocity profiles were changed as appropriate through the cruise. At the beginning of the cruise, a SVP previously taken in the area was used, and this was updated throughout the cruise as XBTs or CTDs were deployed in new water masses. Further details on SVP inputs may be found in Table 1.

7.1.2 Problems encountered

Several problems were encountered.

1. At the start of the cruise it was discovered that the SVP Upload Interface would not accept sound velocity profile (SVP) files produced by the latest version of the Bas_SVP program on the CTD control PC. A shortcut to an earlier version of the program (pre-JR177) was placed on the

desktop of the PC and was used to produce SVPs for import into the EM120 workstation throughout the cruise.

2. Further difficulty in uploading sound velocity profiles derived from CTDs was caused by the ‘AML Calc Format Profile’ box in the EM120 I/O Interfaces menu having been unticked, either during a previous cruise, or by accident while initialising the EM120 on this cruise.

3. The SVP Upload Interface does not decimate SVPs derived from CTDs in the same way as it operates on those derived from XBTs, so redundant points had to be manually removed using the SVP Editor to avoid problems with EM120 real-time processing that result from loading an SVP with more than 200 points.

4. The EM120 roll correction stopped working properly when departing the biological trawl site at 1130z on day 064, even though conditions were perfect and the Seapath system indicated rolls were < ±0.3°. The problem was clearly evident on the ping display, as we were crossing a very flat area of the outer shelf and yet the sea floor appeared to slope at a different angle on every ping, with fluctuations of up to 2° between pings. Processing of the data revealed that the problem had started with a very subtle difference in roll, which gradually became more pronounced. Powering down the EM120 using the ‘remote power’ switch on the blue cabinet in the UIC room, then restarting it and rebooting the operator workstation restored normal performance. However, the cause of this problem has not been established.

A few minutes after the EM120 was restarted to cure the roll correction problem, the SSU started intermittently failing to send triggers for several consecutive cycles at a time. After this behaviour had persisted for about an hour the SSU was rebooted and this seemed to cure the problem.

At about 2330z on day 078 the EM120 seemed to start getting bad navigation data, and the track shown on the survey display veered off from the true course as shown on other sources of navigation information, such as the Bridge Microplot system. The EM120 seemed unable to recover from this situation until the workstation was rebooted. The same thing happened again about four hours later, and this time the system was powered down via the ‘remote power’ switch in the UIC and restarted, then the workstation was rebooted. During the period when these symptoms occurred the Seatex system was indicating that it sometimes had acquired only a small number of satellites, so that might be the cause of the problem. When viewed using Neptune, data collected during at least the first of these navigation black-outs appear to have been incorrectly geographically referenced.

The roll correction fault recurred on day 081 while on station for PC499. The system was again powered down and the workstation rebooted. Shortly afterwards, while still on station, a navigation fault similar to the ones observed on day 078 occurred. Inspection of the Seatex GPS information screen revealed that this problem was a result of it tracking only one of two satellites. After a few minutes the Seatex acquired additional satellites and the problem apparent on the EM120 Survey window was rectified without any action being taken. The fact that this Seatex navigation problem occurred so close in time to the roll correction problem, coupled with the fact that the Seatex combines GPS and inertial motion data to calculate the roll corrections it passes to the EM120, raises the suspicion that the roll correction problems may be triggered by periods of poor quality GPS data.

The roll correction problem occurred again at while on station on day 088. On this occasion, the ship was stationary over a flat patch of seafloor, and this may have been due to the EM120 software imposing a very small vertical range on the ping display, which would exaggerate any inaccuracies in roll.

7.2 TOPAS Sub-bottom profiler

R. Larter & T. Deen

Logging was started at 1410Z on day 053, and continued almost continuously, except during station work, until early morning of the 11th of April.

7.2.1 Standard settings

Typical parameter settings on the control workstation are listed in Appendix X. In continental shelf depths (<1500 m) TOPAS was generally operated with an external trigger from the Sonar Sequencing Unit (SSU), to prevent interference on the EM120. On the SSU, TOPAS was in a separate group from the EM120 and EA600 echo sounders so that the EM120 and TOPAS pinged alternately. In deeper water the TOPAS ping interval that results from it being sequenced in this way is generally too long to obtain a useful profile, so it was sometimes operated on a fixed, internally-controlled ping cycle. Running TOPAS on an internally-controlled ping cycle inevitably results in interference on occasional EM120 pings, but care was taken to select a trigger interval that the current EM120 cycle time was not an exact multiple of, as if that is the case the multibeam system can sometimes lock on to TOPAS echoes and yield erroneous depths over an extended period of time. The TOPAS system was operated using a chirp source, with a signal strength of 85%. Time-variable gain was used to improve imaging of the seafloor on the screen display and on the real-time plotter.

7.2.2 Problems encountered

A problem encountered in powering up TOPAS for the first time on the cruise, on 22nd February (day 053), was traced to a failed 5A fuse in the plug on the power supply to the transceiver cabinets.

Once TOPAS was powered up and the software initialised on the control workstation, some problems were encountered in getting the RAW and PROC trace display windows to display any data. Both windows indicated that they were displaying a trace of zero time length, and the Acquisition window posted a warning about the record length that had been specified (400 ms at 20,000 samples per second) exceeding a buffer size. A much shorter record length, which the system accepted, was specified and then it was increased in steps to the desired length.

The provision of annotation messages to the EPC recorder from the dedicated laptop computer was intermittent. This appeared to be mainly due to a rather delicate connection between the data cable and the laptop. The laptop also seemed for hang up at times and had to be rebooted on several occasions. For the first two-thirds of the cruise time messages were written but EM120 depth messages were not. This appears to have been because the message instruction contained the wrong variable name ($EPC instead of $EMDPT). After one of the reboots the system started to use the correct variable name and the messages started to appear, presumably as a result of a different configuration file having been loaded. The words ‘LATITUDE’ and ‘LONGITUDE’ appear in the message banners, but no actual navigation data are written in the annotation messages. It would be useful for these data to be supplied to the laptop and written on the EPC records. It would also be helpful to have a simple way of synchronising the annotation messages with the time marks that appear every five minutes.

The EPC recorder does not succeed in reproducing the quality of image that is seen in the PROC trace window on the workstation screen. Better real-time plotters must be available.

On several cruises over at least the past four years 100 Hz noise in the raw data has been reported. This still persists (Fig. 28) and seriously contaminates any data collected using the 'burst' or 'Ricker' transmission modes. Largely for this reason, the 'chirp' transmission mode was used for almost all the data collected on the cruise, even on the continental shelf. The chirp correlation suppresses most of the noise, although some of it is still seen in the PROC trace data output from the correlation when high acquisition gain has been used.

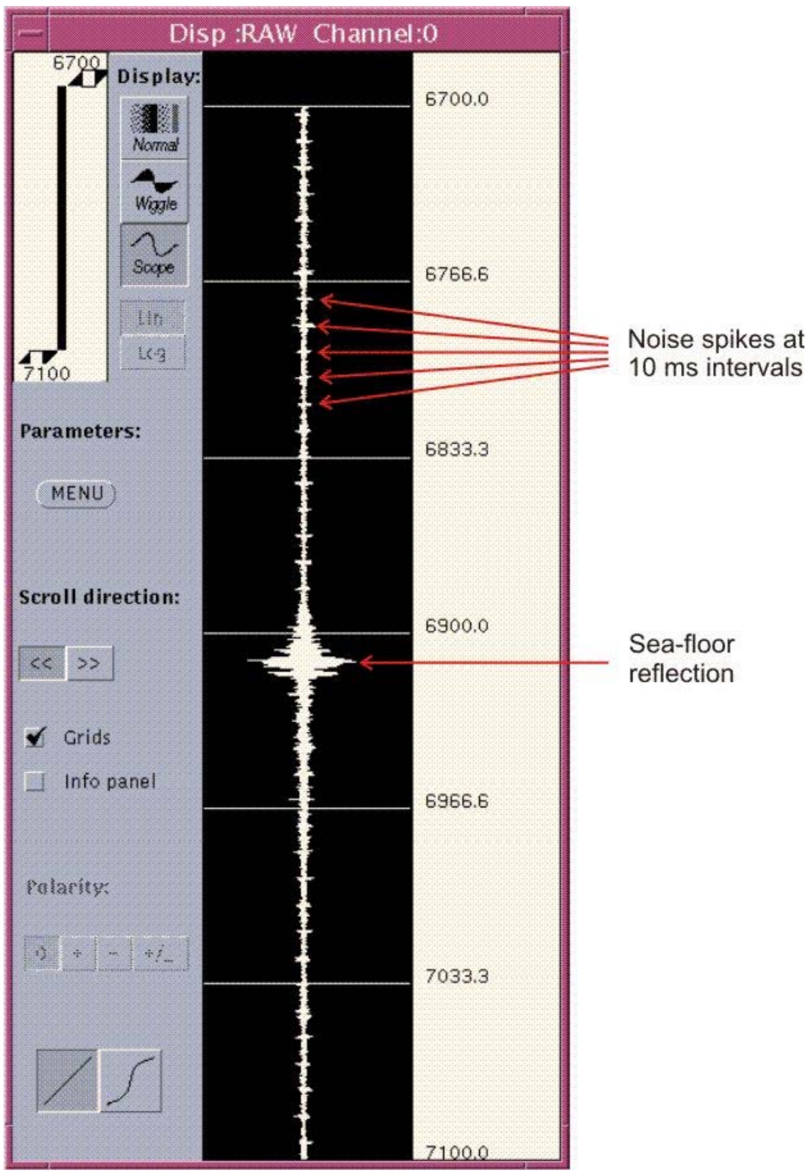

Fig. 28: Example of TOPAS raw trace display showing 100 Hz noise

7.3 EA600 Echo Sounder

The Kongsberg EA600 12 kHz echo sounder, the control console for which is located on the Bridge, was used for navigational purposes. The depths recorded by this system were logged on the NOAA SCS logging system. However, it should be noted that interference from other sonar systems results in some spurious depth readings, particularly when the TOPAS system is operated with a chirp transmission and not synchronized through the SSU. The main periods when TOPAS was operated in this mode were in deep water. As a consequence of the TOPAS interference on the EA600, the centrebeam data from the EM120 multibeam echo sounder will often yield a more complete depth profile along track that contains fewer spurious readings.

For most of the duration of the cruise the EA600 was triggered by the SSU, its trigger being synchronized with the EM120 one. It was also generally operated in ‘passive’ mode, in which it does not transmit pings itself but simply listens for the first return from the EM120 pings. Exceptions occurred on occasions when the EA600 was required for navigational purposes, at which times it was sometime switched to be ‘active’ and to an internal trigger.

7.4 EK 60 Echo sounder

The EK 60 was run independently from the rest of the acoustic instruments, as it was an opportunistic sampling. Therefore the EK60 was not controlled through the SSU, which unsurprisingly resulted in lots of interference in the EK60 data caused by the ADCP, the swath and the Doppler log. The EK 60 worked fine all the time, even with little supervision it seemed to be running fine. It froze only once and was restarted without any problems. The compressing by the Echolog60 worked fine until the Folder size reach about 6GB when it stopped working. Creating a new folder solved that problem. Also no post-processing was undertaken in Echoview.

7.5 Piston and gravity corer

C.-D. Hillenbrand, C. Allen, J. Smith, H. Blagbrough, P. Carter, L. Collins, B. Reinardy, A. Graham, B. Hull & R. Phipps

A piston corer (PC), which could be deployed as a gravity corer (GC), was hired from NMF Sea Systems (Southampton) for cruise JR179 in order to recover long marine sediment cores from sites on the Antarctic continental margin and in the deep sea. The system was used on previous cruises with JCR, and technical details are given in the cruise reports of JR19, JR48, JR71, and JR144. The PC was assembled to 12 m length (four 3m-long barrels), while the GC was normally assembled to 3 m length (one barrel). Only at sites GC513 and GC515 was a 6 m-long (two barrels) GC deployed. PCs and GCs were deployed via JCR's midship's gantry on the 6000+ m coring cable (Fig. 29). Four barrel stands were fixed to the ship's rail and davits were positioned to lift on the second and fourth barrel. A batch of two hundred 3 m-long plastic liners was stored in the scientific hold. The only significant damage to the piston corer at the 29 PC and GC stations of cruise JR179 was sustained at site PC505, where the second barrel (counted from the base of the PC) was heavily bent, while the first and third barrel were slightly bent. Presence of a sand layer at 3-4 m below the seafloor was the reason for the bending of core PC505, which recovered a 9 m-long disturbed sequence. At site GC479 the weight head of the GC had to be exchanged because of a suspected crack in the eye attachment on top. Subsequent closer inspection of the eye, however, revealed that the apparent crack was only a surficial scar. At site TPC520, a layer of sandy-gravel recovered at the base of an 11+ m core caused significant damaged to the core cutter and imploded the upper-most liner within the barrel. Although the corer itself was not seriously damaged, recovery of upper-most liner from the PC barrel was time consuming and caused considerable sediment disturbance.

Overall performance of the PC was very good. A total length of 173.9 meters of sediment core was recovered at 17 sites, and additional 12.3 meters were retrieved by the trigger corer (TC). The recovery rate, i.e. the ratio between core recovery and deployed barrel length, for the PC on JR179 was 85%. Implosion marks were observed on the uppermost liners in cores PC491 PC493, and PC520, but no indication for a related disturbance of the recovered sedimentary sequence was found on PC491 and PC493. Sediment smears on top of the weight head were observed at stations PC466, GC471, GC473, PC501, GC514, GC517 and PC522 indicating that the PC/GC overpenetrated at these sites. Overpenetration is also likely to have occurred at sites

TC466, TC467, TC494, TC496 and TC509. At the first PC and GC sites, plastic liners were labelled as soon as they were pulled out of the core barrels. Unfortunately, subsequent cleaning of the liners washed away the marks and labels. Thus, at the next sites the liners were labelled and marked before they were loaded into the barrels, which proved to be successful. The labelling and marking included (i) an arrow pointing to the core top; (ii) letters “a”, “b”, “c” and “d” for the bottom, second, third and top 3 m-liner; (iii) numbers “1”, “2” and “3” for the bottom, middle and top 1 m-section of each liner; and (iv) capitals “A” and “W” for the archive and working half of each 1 m-section.

When a PC arrived on deck after a successful deployment, the barrels were disconnected and the 3 m-long core liners were pulled out. At the first PC sites (PC466, PC467 and PC489) this procedure caused the sediment core to break at the boundaries between liners, resulting in a few centimetres of sediment contamination, disturbance, and even loss. At the following PC sites this kind of core disturbance was prevented by (i) taping the liners together, when they were loaded into the barrels, and (ii) holding the sediment core in place with a “stopper” (i.e. a closed empty liner), while the bottom two barrels were disconnected and the lower barrel was pulled out from the connector. Liners were taped together from site PC491 onwards, but at the first attempt at site PC491 the liners got stuck in the barrels during the loading, because (i) small remains of sediment from previous PC deployments were present within the barrels, and (ii) the inner diameter of some steel barrels was slightly too small (alternatively, the outer diameter of the plastic liners ordered for JR179 was slightly too large). Use of barrels with the largest inner diameter and thorough inside-cleaning of the barrels after each deployment solved these problems.

The core tops of most PCs were moderately disturbed because the excessive seawater captured on top of the core within the uppermost liner usually resuspended the surface sediments. This is a general problem of PCs, which is unspecific to the system used. On cruise JR179, the uppermost 3 m-liner of a PC was secured in a vertical position so that suspended particles could re-settle down to the core top (the settling process took between 3 and 24 hours, depending on the lithology of the sediment and the volume of the excess seawater). At site PC491 the weight of excess seawater in the uppermost liner pushed ca. 0.8 m of sediment out of the basal part of this liner (including the end cap). After this incident, two measures were taken that prevented loss of sediment at the other sites: 1) The end cap at the bottom of the uppermost liner was sealed with tape before the liner was put into a vertical position. 2) Clear seawater on top of the core that did not contain suspended sediment particles was drained as quickly as possible after core recovery.

At the twelve GC stations the NMF corer recovered 25.0 meters of sediment core, corresponding to a recovery rate of 60%. At the first two GC sites the core catchers (CC) were unable to keep the recovered sediment column within the liners and the blades of the CCs were turned inside out. This damage resulted in the partial or complete loss of sediment at sites GC468 and GC469. Doubling-up of the CCs helped to cope with this problem at the following GC sites, but at site GC475 the blades of the inner CC were bent inside out, and at site GC515 a part of the sediment column may have slipped out of the liner subsequently to the landing or during the haul. Relatively low recovery rate and problems with the CCs of the GCs suggest that the system used on JR179 is not ideal for coring diamictons or tills on the Antarctic shelf.

Figure 29: Deployment of the 12m-long NMF piston corer via JCR's midship's gantry at site PC493 (photo: R. Larter).

7.6 Box corer

C.-D. Hillenbrand, C. Allen, J. Smith, H. Blagbrough, P. Carter, L. Collins, B. Reinardy, A. Graham, B. Hull

The BAS box corer (BC) was used during JR179 to recover undisturbed surface sediments from the Antarctic continental margin and the deep sea. The BC was deployed on earlier cruises JR104 and JR141 (see related cruise reports), where it had proven to be a reliable corer. The original plan for cruise JR179 was to deploy the BC at shelf sites and to deploy a multiple-corer hired from NMF Sea Systems at deep-sea sites. However, as a consequence of time constraints caused by the required assistance of the NMF technician R. Phipps for the PC deployments the BC was used at both shallow and deep-water sites throughout the cruise.

The BC was deployed at 29 sites and recovered 8.3 meters of sediment. In general, the BC performance was good. The only serious problems resulting in no recovery were encountered at site BC478, where the veering of the BC had to be interrupted at ca. 5m above the seabed and where the BC did not trigger properly when it eventually landed at the seafloor, and at site BC511, where the trigger mechanism failed because the trigger hook was jammed by one of the two shackles. Although the spades did not close completely at a few other sites (e.g. BC492), the BC recovered a reasonable amount of sediment even at those stations. At site BC518, where a rock was jammed between the spades, the sediment was partially lost, and at site BC486 an apparently quite hard subsurface layer prevented significant penetration of the BC into the seafloor. A common problem encountered during JR179 (and during previous cruises) was that the BC fell over when reaching the seafloor. In that case, the recovered sediment surface was usually inclined, but intact (e.g. at site BC488, Fig. 30). At sites BC472, BC486, BC497 and BC502, however, the surface of the core was moderately to heavily disturbed. The fact that the BC fell over at a number of sites may be attributed to a general instability of the BC, when it had arrived at the seafloor. This conclusion is corroborated by the observation that the BC disturbance was particularly severe, when the swell was significant, for example at station BC497 (Fig. 31). In contrast, it is less likely that the weight of the wire given out after the BC had already landed at the seafloor toppled the BC over and dragged it down to the seabed. Attempts during JR179 to reduce the wire length given out after the BC had reached the seafloor had no obvious effect.

At the deep-sea stations the core recovery with the BC was relatively high. As a consequence it became problematic to recover sub-cores from the box. Usually, an empty liner segment was pushed into the sediment within the box and closed with an end cap that had a small hole. Then the hole in the cap was sealed, and the sub-core was pulled out. This procedure worked well at the shelf stations, where the sediment always stayed within the liner segment, but it failed at several deep-sea stations, where the sediment core broke or slipped out of the liner segment when the sub-core was pulled out. In that case, the following procedure was successfully applied: 1) A liner segment was pushed into the BC and closed with an end cap. 2) The sub-core was pushed downwards through the box as soon as the spades were opened. 3) As soon as the base of the liner segment appeared below the box it was closed with another end cap. Surplus mud was cleared from the BC so that the sub-cores could be removed easily from the core barrel.

Figure 30: Box core BC488, which apparently fell over during deployment. Note the inclined, but undisturbed sediment surface.

Figure 31: Box core BC497, which apparently fell over during deployment. Note the heavily disturbed sediment surface.

7.7 Agassiz Trawl

The Agassiz Trawl (AGT) used during the cruise was the same we used during JR144. It is the BAS Trawl which shows sign of use on the frame, but it works perfectly fine. It was usually deployed with a ship speed of 0.3 kn, veering the cable with max of 60 m/min up to 1.5 of water depth. The trawling time then varied between 5 and 15 min, depending on the substrate, water depth and purpose of the trawl. After the trawling the AGT was recovered at 30 m/min until AGT had cleared the seabed. Hauling speed was then increased to 45 m/min. It was used in winds up to 40 kn without any problems, as it is easy to handle on deck. During the cruise at no time the AGT got stuck on the seafloor resulting in little wear on the wires. The net got occasionally ripped mainly by rocks, so it was swapped to a new one half way through the cruise.

7.8 Epibenthic Sledge

The Epibenthic Sledge (EBS) used during the cruise was a brand new purpose build in Cambridge over the summer. It was the first time the EBS was used and it performed perfectly fine. The sledge itself, the new net and the new design of the cod end and the new designed weights worked very well together. The new codends are a major improvement, as they allow to retrieve the sample within minutes. Instead of unscrewing the hole cod end the new attachment ring stays on the sledge whereas the codend is only fixed by latches which where secured by clips. This made it a very reliable and quick process. The EBS was usually deployed with a ship speed of 0.3 kn, veering the cable with max of 60 m/min up to 1.5 of water depth. It was trawled then for 10 min. After the trawling the EBS was recovered at 30 m/min until the EBS had cleared the seabed. Hauling speed was then increased to 45 m/min. It was used in winds up to 30 kn without any problems. During the cruise at no time the EBS got stuck on the seafloor resulting in little wear on the wires. On soft muddy sediments the EBS sometimes sunk quite deep into the mud resulting in a large catch. In these occasions the most of the weights (only the two in the back stayed on) where removed to make the sledge lighter preventing the sledge to sink in to deep.

7.9 Cable Logging and Monitoring (CLAM) System

The CLAM system was used for monitoring the amount of wire out, hauling and veering rates and wire tension while trawling, coring and doing CTD casts. It would be helpful if there was an option to expand the y-axis of the wire tension display to use the full height of the screen, as only the lower half of the 10-tonne scale is used during most wire operations.

7.10 CTD Deployment and Data Acquisition

P. Carter & B. Hull

7.10.1 Introduction

A Conductivity-Temperature-Depth (CTD) unit and twelve bottle rosette was used to vertically profile the water column and collect water. Twenty-four casts were carried out in total. A number of the CTD casts and water collections were used by both Geoscience and Bioscience projects. At each of the biological sites, at least three CTDs were carried out: at 1500m, 1000m and 500m. Where more than 1 CTD was deployed at the same site, the second was only deployed to 30m, primarily for collecting large volumes of water. CTD positions are included in Table CTD1. CTD profiles were numbered consecutively without discrimination between the different types of station. Thus, the CTD file numbers do not correspond with numbered Biological site positions, and reference should be made to Table CTD1 when accessing CTD data. Where a name was given to the site ie BIO1, this is included in Table CTD1 for cross-reference. In an attempt to avoid confusion, CTDs will be referred to as CTD NNN.

7.10.2 CTD instrumentation

An SBE 32 twelve-position carousel water sampler, with each position having a 10 litre Niskin bottle fitted, an SBE9Plus CTD and an SBE11Plus deck unit were used. The SBE9Plus unit held dual SBE3Plus temperature and SBE4 conductivity sensors and a *Paroscientific* pressure sensor. An SBE35 Deep Ocean Standards Thermometer makes temperature measurements each time a bottle is fired, and time, bottle position and temperature are stored, allowing comparison of the SBE35 readings with the CTD and bottle data. Additional sensors for JR179 included an altimeter, a fluorometer, an oxygen sensor, a photosynthetically active radiation (PAR) sensor and a transmissometer. The altimeter returns real time accurate measurements of height off the seabed within approximately 100m of the bottom. This allows more accurate determination of the position of the CTD with respect to the seabed than is possible with the hull-mounted echo sounders, which in deep water often return depths that are several tens of meters different from the wire out measurement (differences may be due to errors in the wire out measurement, elastic stretching and thermal contraction of the wire, imperfections in the sound velocity profile used in the echo sounders, and the CTD package not being exactly above the sea-floor reflection point)

7.10.3 Deployment

The CTD was deployed from the mid-ships gantry. Prior to deployment the 12 bottles were 'cocked', the deck unit was switched on, SeaSave was opened and an acquisition file was made. The CTD was lowered, and taken to 10m, where it was soaked for ~2 minutes to ensure the pumps switched on and the sensors had adjusted to the water temperature from the air temperature. The CTD was the raised to the surface, and lowered for down cast measurement. Where the desired bottom depth was within 100m of the sediment, the altimeter was monitored. The final proximity to bottom was determined by the swell height, ensuring no damage to the CTD unit. The CTD was then brought to the surface, which intermittent breaks for firing bottles. Once the CTD had been stopped at the desired depth at least 20 seconds were allowed to elapse prior to firing the bottle in order to allow the sensor to equilibrate, and at least 20 seconds were allowed to elapse after firing before continuing the ascent to allow the SBE35 to take readings and recharge. Data acquisition was stopped once the unit was on deck, and water collection allowed once the CTD was lashed in the CTD annex. CTD data were collected at 24Hz and logged via the deck unit to a PC running Seasave Win32 version 5.37b (Sea-Bird Electronics, Inc.), which allows real-time viewing of the data.

A log of each CTD deployment was made on the intranet-based event logging pages. Records were made when the CTD began descent, when it reached bottom, when each bottle was fired and when it was on deck. Each log included the lat/long position, the time in GMT, the wire out, the bridge event number, and the action being recorded. The logging system is linked to a GPS time signal.

7.10.4 Problems encountered with CTD deployments

1. The altimeter failed to work on the first CTD deployment. No obvious fault was found, but the unit was rewired and the altimeter worked for all subsequent deployments.
2. Niskin bottle number 4 had to be removed from the frame after CTD013 and remounted prior to use for CTD014 deployment. The fitting connecting the top of the bottle to the

upper part of the frame had cracked, but a straight replacement was found. No further problems were encountered with this bottle.

3. Bottle 8 failed to fire on CTD017. No problem was found and the bottle worked on all future deployments.
4. The SBE35 thermometer failed to take readings for a number of bottle firings, though no reason or fault was found. The list of affected data can be found below.
5. CTD deployment was considered unwise in air temperatures below -5^{o}C, so a number of opportunities for deployment were forgone in order to preserve sensors.
6. The CTD wire became damaged between CTD022 and CTD023. The CTD wire was re-terminated, requiring a reduction of 30-40m in the wire length. CTD023 was terminated at ~300m when the fuse on the deck unit blew, indicating a short circuit on the termination. The termination was remade, and deployment of CTD024 went without issue.

7.10.5 Preliminary processing

7.10.5.1 SBE35 High Precision Thermometer

Data from the SBE35 thermometer were usually uploaded after every cast using the *SeaTerm* program. Once the readings had been written to an ascii file (named *jr179ctdNNN.cap*), the file was opened and the contents checked to make sure the correct number of readings had been stored. The memory of the SBE35 was then cleared using the '*samplenum=0*' command. To check that the memory was clear, the command '*ds*' was entered, which displays the number of data points stored in the instrument's memory. This number should be 0.

Once all data had been downloaded and the preliminary processing described above carried out, the directory containing all data for that CTD cast was copied to the Unix system for further processing in MatLab.

Some of the .cap files were missing values for a few bottles, the problem was not resolved.

jr179ctd012: .cap file missing bottle number 5

jr179ctd013: .cap file missing bottle number 4

jr179ctd014: .cap file missing bottle numbers 3, 5 & 9

jr179ctd015: .cap file missing bottle numbers 3 & 7

jr179ctd018: .cap file missing bottle number 2 jr179ctd019: .cap file missing bottle number 6

7.10.5.2 Salinity samples

Salinity samples were collected on the CTDs in Table 15. The water samples were collected in 200ml medicine bottles. Standard procedure was to rinse the bottle three times, before filling it to just below the neck to allow room for expansion during warming and to facilitate mixing of the bottle's contents prior to analysis. The rim of each bottle was wiped dry with a tissue, then a plastic seal inserted and the screw cap replaced. Ongoing crates of salt samples were kept in salinometer lab and allowed to equilibrate with ambient conditions for at least 24 hours prior to analysis.

The samples were analysed on one of the shipboard Guildline 8400B Autosal salinometers (s/n 65763), which had been standardised at the beginning of the cruise using Ocean Scientific International Ltd (OSIL) P146-series standard seawater. Prior to, and following, analysis of each water sample crate, a new bottle of standard seawater was analysed to ensure that the salinometer remained stable and in order to derive a calibration offset. In between batches of salinity analysis, the salinometer was flushed, and filled with, milliq. The salinometer was flushed several times with standard seawater left over from previous analyses before analysing the first standard associated with each crate. This was to prevent the dilution of (and thus low readings for) the standard prior to the first salinity crate. Standard procedure was to invert each sample bottle a few times in order to mix the contents but avoid the introduction of a large number of air bubbles into the sample. The salinometer cell was then flushed three times with the sample, prior to taking the first reading. The cell was then flushed once between subsequent readings, with at least three readings being taken for each sample.

Once analysed, the conductivity ratios were entered by hand into *jr179_master.xls*, converted to salinities and used for further CTD data processing.

Table 14: ‘Wire out’ is the wire out at the bottom depth of the CTD. ‘Min depth from Btm’ is altimeter data, where no value is given the CTD didn’t come within 100m of the bottom, its maximum measurement range. ‘Site name’ is the official name/number of the CTD site in the cruise plan and ‘event’ is the event number in the JR177 bridge science log. Numbered notes are found at the end of the table.

CTD#	J Day	Lat (deg, min)	Lon (deg, min)	Wire Out	Min depth from Btm	No. of bottles fired	Site name	Bridge Event
001	055	-61.30481	-67.89362	500	-	11	BIO_CTD_001	002
002	055	-61.30190	-67.89255	26	-	12	BIO_CTD_002	003
003	056	-61.30187	-67.89257	50	-	12	BIO_CTD_003	004
004	058	-68.37947	-75.85700	1444	-	12	BIO1_CTD_004	009
005	058	-68.47073	-76.11707	950	28	12	BIO1_CTD_005	012
006	059	-68.52468	-76.17179	430	26	8	BIO1_CTD_006	016
007	059	-68.55060	-76.13482	410	14	7	BIO1_CTD_007	020
008	059	-68.28734	-76.13468	3238	15	10	BIO1_CTD_008	021
009	061	-69.81704	-84.82900	1460	24	12	BIO2_CTD_009	025
010	061	-70.14806	-91.08468	3520	12	8	CTD_010	026
011	066	-74.35784	-91.08464	1387	10	12	BIO3_CTD_011	048
012	066	-74.40839	-104.65875	475	18	12	BIO4_CTD_012	050
013	068	-74.13193	-105.74632	1432	18	12	BIO5_CTD_013	063
014	069	-73.85270	-106.16912	945	18	12	BIO5_CTD_014	068
015	070	-73.98017	-107.41475	507	18	12	BIO5_CTD_015	075
016	071	-71.33346	-109.99989	458	11	12	BIO6_CTD_016	089
017	072	-71.33366	-109.96679	450	11	12	BIO6_CTD_017	100
018	072	-71.17946	-109.90443	967	17	12	BIO6_CTD_018	106
019	073	-71.17943	-109.90442	30	-	12	BIO6_CTD_019	107
020	073	-71.13893	-109.94407	1520	21	12	BIO6_CTD_020	109
021	079	-69.23075	-106.67977	4195	10	10	CTD_021	128
022	084	-60.53528	-108.30586	5175	7	12	CTD_022	140
023	090	-67.76993	-83.25058	351	-	0	CTD_023	151
024	090	-67.76993	-83.25046	4005	8	12	CTD_024	151

Table 15. Water samples taken for salinity calibrations

CTD no	Wire Out	Pressure	Niskin bottle no	Sample bottle no	Comments
jr179ctd004	1444	1467	1	1	
	1444	1467	2	2	
	1322	1302	3	3	
	1200	1217	4	4	
	1000	1014	5	5	
	800	812	6	6	
	600	608	7	7	
	400	406	8	8	
	5	8	12	9	Bottles 9, 10 & 11 for biologists
jr179ctd005	950	963	1	10	
	950	963	2	11	
	900	861	3	12	
	800	785	4	13	
	700	709	5	14	
	600	607	6	15	
	500	506	7	16	
	400	405	8	17	
	5	8	9	18	Bottles 10, 11 & 12 not fired
jr179ctd006	430	437	1	1	
	430	437	2	2	
	400	407	3	3	
	350	356	4	4	
	300	305	5	5	
	250	255	6	6	
	200	205	7	7	
	5	8	8	8	Bottles 9, 10, 11 & 12 not fired
jr179ctd007	410	417	1	9	
	410	417	2	10	
	350	357	3	11	
	300	305	4	12	
	250	255	5	13	
	200	204	6	14	
	5	9	7	15	Bottles 8, 9, 10, 11 & 12 not fired
jr179ctd008	3238	3305	1	16	
	3238	3305	2	17	
	2976	3002	3	18	
	2500	2547	4	19	
	2000	2036	5	20	
	1500	1526	6	21	
	1000	1016	7	22	
	500	509	8	23	

	5	10	10	24	Bottle 9 for biologists, bottles 11 & 12 not fired
jr179ctd011	1387		1	1	
	1300		2	2	
	1200		3	3	
	1000		4	4	
	800		5	5	
	600		6	6	
	400		7	7	
	250		8	8	
	200		9	9	
	150		10	10	
	100		11	11	
	30		12	12	
jr179ctd017	450	457	1	13	
	450	457	2	14	
	400	406	3	15	
	350	355	4	16	
	300	304	5	17	
	250	253	6	18	
	200	203	7	19	
	100	102	9	20	
	50	52	10	21	
	5	7	11	22	
	5	7	12	23	Bottle 8 failed to fire
jr179ctd018	967	982	1	1	
	967	982	2	2	
	900	914	3	3	
	800	812	4	4	
	700	710	5	5	
	600	609	6	6	
	500	507	7	7	
	400	406	8	8	
	350	355	9	9	
	5	7	12	10	Bottles 10 & 11 for biologists
jr179ctd020	1520	1545	1	11	
	1520	1545	2	12	
	1299	1322	3	13	
	1200	1221	4	14	
	999	1017	5	15	
	800	815	6	16	
	600	611	7	17	
	400	409	8	18	
	199	206	9	19	
	100	106	10	20	
	30	35	11	21	
	5	10	12	22	

7.11 Acoustic Doppler Current Profiler (ADCP)

B. Hull

7.11.1 Introduction

RRS *James Clark Ross* had a 75 kHz RD Instruments Ocean Surveyor (OS75) ADCP installed during August 2005, replacing the old 150 kHz RDI unit that had seen many years of service. The OS75, in principle, is capable of profiling to deeper levels in the water column, and can also be configured to run in either narrowband or broadband modes.

7.11.2 Instrument and configuration

The OS75 unit is sited in the transducer well in the hull of the *JCR*. This is flooded with a mixture of 90% de-ionised water and 10% monopropylene glycol. With the previous 150 kHz unit, the use of a mixture of water/antifreeze in the transducer chest required a post-processing correction to derived ADCP velocities. However, the new OS75 unit uses a phased array transducer that produces all four beams from a single aperture at specific angles. A consequence of the way the beams are formed is that horizontal velocities derived using this instrument are independent of the speed of sound (vertical velocities, on the other hand, are not), hence this correction is no longer required.

The OS75 transducer on the *JCR* is aligned at approximately 60 degrees relative to the centre line. This differs from the recommended 45 degrees. The hull depth was measured by Robert Patterson (Chief Officer) on a previous cruise, and found to be 6.47m. Combined with a value for the distance of the transducer behind the sea-chest window of 100-200 mm and a window thickness of 50 mm, this implies a transducer depth of 6.3m. This is the value assumed for JR179. The heading feed to the OS75 is the heading from the Seapath GPS unit.

The OS75 was controlled using Version 1.42 of the RDI VmDas software. The logging PC also had Version 1.13 of the RDI WinADCP software installed, which was occasionally used to view the data in real-time. The OS75 ran in two modes during JR179: narrowband (with bottom-tracking on) and narrowband (with bottom-tracking off). Both modes were enabled with sixty-five 16-metre bins. Narrowband profiling was also enabled with an 8-metre blanking distance. The time between pings was set to 2 seconds, again following advice from Dr. Deb Shoosmith. Salinity at the transducer was set to zero, and Beam 3 misalignment was set to 60.08 degrees (see above discussion). The full configuration files for each of the modes used are given in the Appendix.

7.11.3. Notes for Instrument Setup

Set up the ADCP to run in narrowband mode

Open VMDAS

> file > collect data

> options > edit data options

ADCP setup tab: ADCP set up from file (using required command file)

set time between ensembles to 2 seconds

Recording tab: name: JR179_ (filenames will then update in correct format)

number:1

max size: 10

dual output directories: U: drive (making unix the primary drive)

C: local (as secondary drive)

Transform tab: heading source: nmea/prdid

tilt source: fixes tilts 0, 0

Command Files should have line of code added to run the ADCP through the SSU:

```
; Set Trigger In/Out  [ADCP run through SSU]
CX1,3
```

ADCP needs to be pinging every five seconds or faster for decent data

- can be checked by looking at *N1R files and picking out lines starting $PADCP

7.11.4. Outputs

The ADCP writes files to a network drive that is samba-mounted from the Unix system. (Should the network fail, there is an alternative write path to the local ADCP PC hard drive to preserve data until the link is restored). When the Unix system is accessed (via samba) from a separate networked PC, this enables post-processing of the data without the need to move files.

Output files are of the form JR179_XXX_YYYYYY.ZZZ, where XXX increments each time the logging is stopped and restarted, and YYYYYY increments each time the present file size exceeds 10 Mbyte.

ZZZ are the filename extensions, and are of the form:-

.N1R (NMEA telegram + ADCP timestamp; ASCII)

.ENR (Beam coodinate single-ping data; binary)

.VMO (VmDas configuation; ASCII)

.NMS (Navigation and attitude; binary)

.ENS (Beam coordinate single-ping data + NMEA data; binary)

.LOG (Log of ADCP communication and VmDas error; ASCII)

.ENX (Earth coordinate single-ping data; binary)

.STA (Earth coordinate short-term averaged data; binary)

.LTA (Earth coordinate long-term averaged data; binary)

7.11.5. Post-processing of data

OS75 data were processed on JR179 using Matlab code originated by IFM Kiel. This was adapted by Dr. Mark Inall, Dr. Deb Shoosmith, Angelika Renner, Mark Brandon and Hugh Venables for use with the *JCR* system. The master file for the processing is "OS75_JCR_FINAL_JR179.m", which calls a lengthy sequence of routines to execute the following steps:-

1. Read RDI binary file with extension .ENX and ASCII file with extension .N1R into Matlab environment.
2. Remove missing data and data with bad navigation.
3. Merge Seapath attitude data with single-ping ADCP data.
4. Correct for transducer misalignment and velocity scaling error (calculated during first run-through of code, applied during second).
5. Derive ship velocity from Seapath navigation data.
6. Perform quality control on data, such that four-beam solution only is permitted. Other screening is performed based on maximum heading change between pings, maximum velocity change between pings, and the error velocity.
7. Average data into ensembles of pre-defined length.
8. Calculates transducer misalignment and velocity scaling error (computation done on first run-through of code, to be applied during second).
9. Velocities from depths deeper than 86% of the bottom-tracking depth are set to missing.
10. Determine absolute velocities from either bottom-track ship velocity or Seapath GPS.

Final data are stored in Matlab format. Filenames are of the form:

1) JR179_000_000000_A_hc.mat, where A is the highest number of the user-incremented files. (This is the number that VmDas increments every time logging is stopped and restarted). This contains structured arrays "c" (ensembled-averaged data), and "b" (absolute velocities)

2) JR179_00A_00000Bd.mat, where A is as above, and B is the number VmDas increments every time filesize exceeds 10 Mbyte. This contains single-ping data in structured array "d".

3) JR179_00A_00000Bd_ATT.mat. As (2), but containing ship's attitude data rather than ADCP data.

4) JR179_00A_000000_ATT.mat. As (3), but for the whole section of data in the user-incremented series A

7.11.6. Navigational Issues

The navigational repeater gets navigation data from the Seapath, extracts the information wanted, and feeds it into VmDas. During JR179, the navigation repeater was set to pass on $INGGA, $INVTG (at 1 Hz), and $PRDID (at 3 Hz).

Throughout a large portion of the cruise, the .log file showed errors for these strings, most commonly a GGA error:

```
[2008/03/18, 06:26:16.589]: CScreenNav::ProcessNmea() - Invalid PRDID data.

[2008/03/18, 07:14:36.148]: CScreenNav::ProcessNmea() - Invalid GGA data.

[2008/03/18, 07:14:36.179]: NMEA [NAV_PROCESS] Invalid GGA data.

[2008/03/18, 18:57:17.717]: CScreenNav::ProcessNmea() - Invalid VTG data.
```

It was noted that every time a PRDID or VTG error occurred, there was a 360.00 in the heading of that NMEA string. It is thought that the software expects a 0.00 instead, and that these would not cause problems for the data.

The GGA errors occurred during periods when the Seapath had acquired too few satellites to calculate an accurate position. It is not known at present how much the errors will affect the data.

7.12 Expendable Bathythermograph (XBT) System

Four XBT casts were made during the cruise, all with T5 probes, which record to a maximum depth of 1860 m (Table 16).

The XBT system on which the data were recorded worked well throughout the cruise. Sound velocity profiles were calculated from the XBT data using an option on the system, assuming a constant salinity. Salinity values were read from the Oceanlogger display and input to the XBT system manually. The uncontaminated seawater supply to the Oceanlogger had to be switched off for periods during the cruise because of problems caused by sea ice (see following section). On these occasions the most recent valid salinity measurement was used. Both the Raw data files (.rdf) and the Extended data files (.edf), which include the calculated sound velocity profiles, were automatically copied to the unix cruise data directory by a synchronisation process. Velocity profile data were then imported into the multibeam data acquisition system using the SVP Upload Interface (accessed by clicking the middle mouse button on the desktop background).

Table 16: XBT casts

Cast no.	Filename	Time/date	Latitude S	Longitude W	Water depth (m)	Cast length (m)	Serial Number	Geographical Location	Remarks
1	T5_00001	0304/066	74° 22.307'	104° 47.096'	1185	1185	314329	Pine Island Bay	Disregard data after probe hit sea floor
2	T5_00002	1716/080	67° 03.667'	105° 44.101'	4697	1408	314325	Amundsen Sea	Data spike at 1409 m, so disregard subsequent data
3	T5_00003	1948/081	64° 23.668'	107° 03.147'	4985	1830	326806	Amundsen Sea	
4	T5_00004	1637/088	67° 59.916'	95° 00.604'	4430	942	322240	Bellingshausen Sea	Data spike at 943 m, so disregard subsequent data

7.13 Oceanlogger

The Oceanlogger was operated during the cruise in order to monitor changes in surface water properties that could affect sound propagation, and to provide surface water salinity values for calculation of sound velocity profiles from XBT data. Whenever the ship was moving through sea ice, the pump that supplies uncontaminated seawater to the Oceanlogger had to be stopped because fragments of ice clogged the filters.

The approximate periods during which the uncontaminated seawater supply was off were:

1300Z on 3rd March to 0900Z on 6th March

0200Z to 1300Z on 11th March

1800Z on 13th March to 2000Z on 14th March

2000Z on 15th March to 2000Z on 17th March

1600Z to 2000Z on 30th March

2000Z on 6th April to 2100Z on 7th April (not immediately restarted on leaving Rothera)

7.14 Magnetometers

7.14.1 SeaSpy Proton Precession Magnetometer

The SeaSpy magnetometer was deployed over the port quarter during the crossings of Drake Passage (days 053–057 and 100–102), during the transits between core sites while heading northwards and later southeastwards in the Amundsen Sea (days 078–082 and 085–086). Data were logged to the SCS, but for most of the cruise no data were transferred to the Level C file. This problem was eventually traced to a control file from which the datastream name had been deleted, and during the final week of the cruise the data were transferred to a Level C file. In order to generate merged cruise data files in standard formats (MGD77 and GMT), data were copied from the SCS ‘compressed’ format file (seaspy.ACO) and reformatted (this was done before the Level C problem was fixed).

7.14.2 Shipboard Three-Component Magnetometer (STCM)

After 1730Z on 1st March (day 061) the STCM z-sensor indicated constant values at its range maximum while in the southern Bellingshausen and Amundsen Seas. Once we started to head northwards in the Amundsen Sea it started to record magnetic field fluctuations again. The problem appears to be that the sensor has an inadaequate range or is improperly calibrated to cope with the steep magnetic field (and hence high z-component values) that occurs at high latitudes. Thus, as presently configured, the STCM on JCR appears to be unsuitable for use in high latitudes.

All of the data collected since September 2007 had been recorded to one very large file. There is still no data feed from the STCM to the SCS, so data must be downloaded separately from the PC that controls the system.

7.15 Navigation Systems

The navigation systems on board comprised:

7.15.1 Seapath System

This combined GPS and motion reference unit provides navigational data for the Kongsberg EM120 multibeam and TOPAS sub-bottom profiler systems. In previous seasons differential corrections were obtained from a Racal Skyfix unit via an Inmarsat feed and applied in real time by the GPS receiver. However, the subscription to the Skyfix service has been discontinued, so differential GPS data were not available during this cruise. Data from this unit were logged onto both the Kongsberg EM120 system and the NOAA Scientific Computing System (SCS).

7.15.2 Furuno GP-32 GPS Receiver

This GPS receiver is located on the Bridge and used primarily for navigation. The position fixes from the unit were logged to the NOAA SCS.

7.15.3 Ashtech GG24 GPS/GLONASS Receiver

This was operated throughout the cruise and position fixes calculated by this system were logged to the NOAA SCS.

7.15.4 Ashtech G12 GPS System

This dual redundant GPS unit is used by the ship’s dynamic positioning system.

7.15.5 Ashtech GDU-5 3D GPS and TSS300 Systems

These instruments provide heading, pitch, roll and heave information. Data from both systems were logged to the NOAA SCS.

7.16 NOAA Shipboard Computing System

Since the summer of 2000, the main shipboard data logging system has been a Windows NT based system provided by the U.S. National Oceanic and Atmospheric Administration (NOAA), called the Scientific Computer System (SCS). The SCS program allows data to be logged centrally on a server featuring RAID disk tolerance. Time stamping of data is achieved by synchronising to a GPS receiver. The SCS is also a NTP server which allows other machines onboard to synchronise their time.

Data on the SCS system is stored in two formats:

RAW data written to disk in exactly the same format it was sent from the instrument.

ACO ASCII Comma Delimited, data is stored in plain ASCII text.

Once the Data has been logged to disk the ACO files are exported to the Level C of the former ABC data logging system using NFS. A process on the Level C reads the data in and writes to the Level C database. The Level C continues to be used to allow scientists to use existing routines to extract data.

The following data streams were logged to the SCS during JR179:

Stream name	Data Source
gps_glos	Ashtech GG24 GPS/GLONASS Receiver
gps_ash	Ashtech 3D GPS
gps_nmea	Furuno GP-32 GPS Receiver
anemom	Anemometer
tsshrp	TSS300 heave, roll and pitch sensor
oceanlog	Oceanlogger
em_log	Chernikeeff Aquaprobe Mk5 electromagnetic speed log
dop_log	Sperry doppler speed log (water speed)
sim500	Kongsberg Simrad EA600 single-beam echo sounder (12 kHz)
em120	Kongsberg Simrad EM120 multibeam echo sounder (12 kHz)
winch	Cable Logging and Monitoring (CLAM) System
seatex	Seapath combined differential GPS and motion reference unit
seaspy	SeaSpy towed Overhauser magnetometer
gyro	Gyro
truewind	Calculated true wind speed and direction
streamstates	Status log of other data streams

Despite repeated attempts to restart the Level C data stream for the seaspy magnetometer, no data were copied across from the SCS

8 ICT and AME Reports

8.1 ICT Report

J Edmonston

Short Summary of ICT problems / resolutions of note during JR179

Netware system.

JRNA performed with no major problems through the cruise.

SYS volume filled to within 600k of available disk space.

This was resolved by deleting old logs from Backup Exec.

Unix systems

Unix systems performed without problems.

EM120

Em120 had some problems with roll correction whilst in the Pine Island Bay area.

Roll correction was massively exaggerated and corrected pings were therefore inaccurate.

Problem was due to low availability of satellites to the seatex system and not the Motion reference unit, and resolved itself when more satellites (ie more than 4), were available.

Another system of this problem was track "jumps", as the number of satellites dropped the ships track would appear off track from previous course.

Rebooting the seatex and transducers solved this problem.

Occaisonal lock-ups during the latter part of the cruise, during the geo section.

Pings not updating, ping display freezing.

Again rebooting the transducers solved this problem.

It should be noted that when powering up the transducers, some time should allowed for power to cycle through the entire system and the boot-up sequence to be allowed to complete before starting the operator interface.

The operator interface, if started before the EM120 transducers and associated sub systems are ready, will not find the echo sounder.

Only when all systems are fully powered and operational will the operator interface start with no errors.

ADCP

ADCP would report errors in the logs if unhappy with the number of satellites received from the seatex. I believe this was part of the course for the locations we were in. As seen in the EM120, seatex systems.

EK60

I believe the EK60 performed to expectations, the only problem I was made aware of was echolog not being able to compress new data, stopping compression of echologs on 21st March.
This was due to the folder it was trying to write to already containing 6.5Gb of compressed data. 6.5Gb being the maximum file size that windows was happy with.
Renamed old echolog folder to echolog1, created a new folder called echolog2.
Echolog then started correctly, and was told to write new compressed data to echolog2, and from then on performed correctly.

STCM.

STCM stopped logging correctly 1st March. This was due to the Z component being out of range.
The z component being too high due to the instrument's proximity to the pole.
At this point it is unknown if this is a limitation in the instrument, or the software and will be investigated by ETS.

SCS

SCS performed with no unexpected problems.
Data logging was stopped, and restarted briefly to allow creation of a new tsshrp log, the previous one approaching the maximum file size.

XBT

XBT machine was used with no problems.

CDT

CDT machine was used with no problems.

8.2 AME Report

Cruise: JR179   Start date: 21/02/08   Finish date: 08/04/08
Name of AME engineer: Vsevolod Afanasyev
Name of principle scientist (PSO): Larter R. / Enderlein P.

Instrument	**Used ?**	**Comments**
XBT (aft UIC) (PC, I/F box, handgun)	Y	White gun used ok – left in place on aft port bulwark for next cruise.
Scintillation counter (prep lab)		
AutoSal (labs on upper deck) S/N 63360		
AutoSal (labs on upper deck) S/N 65763	Y	OK
AutoSal (labs on upper deck) S/N 68533		
Portasal S/N 68164		
Magnetometer STCM1 (aft UIC)	Y	Z component was constant for a number of weeks. It looks the range is not as it should be for near mag pole work.
AME workshop PC	Y	OK

GPS, MRU, Gyro

GPS Furuno GP32 (bridge – port side)	Y	OK
DGPS Ashtec ADU5 (bridge – port side)	Y	Needs episodic reset.
DGPS, MRU Seatex Seapath (UIC – swath suite)	Y	OK

DGPS Ashtec Glonass GG24 (bridge – starboard side)		
Gyro synchro to RS232 Navitron NT925HDI (UIC – aft)		
TSS HRP (UIC repeater)		

ACOUSTIC

Instrument	Used ?	Comments
ADCP (aft UIC)	Y	OK
PES (aft UIC)		
EM120 (for'd UIC)	Y	
TOPAS (for'd UIC)	Y	
EPC plotter (used with TOPAS)		
EK60 (mid UIC)	Y	OK
HP deskjet 1 (used with EK)		
HP deskjet 2 (used with EK)		
SSU (for'd UIC)	Y	OK
SVP S/N3298 (cage when unused)		
SVP S/N3314 (cage when unused)		
10kHz IOS pinger		
Benthos 12kHz pinger S/N 1316 + bracket		
Benthos 12kHz pinger S/N 1317 + bracket		
MORS 10kHz transponder		
Sonardyne USBL (aft UIC)		

OCEANLOGGER

Instrument	Used ?	Comments
Main logging PC hardware and software	Y	OK
Barometer (back of logger rack) #V145002 (7/03)	Y	OK
Barometer #V145003 (7/03)	Y	OK
Barometer #Y2610005		
Barometer #W4620001		
Air humidity & temp (for'd mast) #15619015		Still only one in place. Spare on bench in workshop.
Air humidity & temp #15619025		
Air humidity & temp #28552023 (HT1, 7/03)		
Air humidity & temp #18109036 (HT2, 7/03)		
Thermosalinograph SBE45 (prep lab) #0130	Y	OK
Thermosalinograph SBE45 # 4532920-0072		
Thermosalinograph SBE45 #4524698-0018 (7/04)		
Fluorometer (prep lab)	Y	OK
TIR sensor (pyranometer) (for'd mast) #990684		TIR sensors in place unknown but ok.
TIR sensor #32374 (TIR1, 7/03)		
TIR sensor #990685		
TIR sensor		

#011403 (TIR2, 7/03)		
PAR sensor (for'd mast) #990069		PAR sensors in place unknown but ok.
PAR sensor #990070		
PAR sensor #30335 (PAR1, 7/03)		
PAR sensor # 010224 (PAR2, 7/03)		
Flow meter (prep room) #45/59462	Y	OK
Uncontaminated seawater temp (transducer space)	Y	OK

CTD (all kept in cage/ sci hold when not in use)

Instrument	Used ?	Comments
Deck unit 1 SBE11plus S/N 11P15759-0458		
Deck unit 2 SBE11plus S/N 11P20391-0502	Y	OK
Underwater unit SBE9plus #09P15759-0480 Press #67241		
Underwater unit SBE9plus #09P20391-0541 Press #75429	Y	OK
Underwater unit SBE9plus #09P30856-0707 Press #89973		
Underwater unit SBE9plus #09P35716-0771 Press #93686		
Carousel & pylon SBE32 #3215759-0173		One bottle (4) had to be repaired
Carousel & pylon SBE32 #0248		
CTD swivel linkage	Y	OK
CTD swivel S/N196115	Y	OK
CTD swivel S/N196111		

CTD contd – C & T & pumps – please state which primary and secondary

Temp sensor SBE3plus #03P2191		
Temp sensor SBE3plus #03P2307	Y	Secondary
Temp sensor SBE3plus #03P2366	Y	Primary
Temp sensor SBE3plus #03P2679		
Temp sensor SBE3plus #03P2705		
Temp sensor SBE3plus #03P2709		
Temp sensor SBE3plus #03P4235		
Temp sensor SBE3plus #03P4302		
Cond sensor SBE4C #041912		
Cond sensor SBE4C #041913		
Cond sensor SBE4C #042222	Y	Secondary
Cond sensor SBE4C #042248		
Cond sensor SBE4C #042255		
Cond sensor SBE4C #042289	Y	Primary
Cond sensor SBE4C #042813		
Cond sensor SBE4C #042875		
Pump SBE5T # 54488	Y	Primary
Pump SBE5T # 54458	Y	Secondary
Pump SBE5T # 52371		
Pump SBE5T # 52395		
Pump SBE5T # 52400		
Pump SBE5T # 53415		

CTD contd

Instrument	Used ?	Comments
Fluorometer Aquatracka MkIII #088216		
Fluorometer Aquatracka MkIII #088249	Y	OK
Standards Thermometer SBE35 #3515759-0005		
Standards Thermometer SBE35 # 3527735-0024	Y	First part of the cruise small number of readings missing.
Standards Thermometer SBE35 # 3535231-0047		
Altimeter PA200 #2130.26993		
Altimeter PA200 #2130.27001	Y	Failed on first deployment, OK after that.
Transmissometer C-Star #CST-396DR		
Transmissometer C-Star #CST-527DR		
Transmissometer C-Star CST 846DR	Y	OK
Oxygen sensor SBE43 #0242		
Oxygen sensor SBE43 #0245	Y	OK
Oxygen sensor SBE43 #0620		
Oxygen sensor SBE43 #0676		
PAR sensor #7235		
PAR sensor #7252		
PAR sensor	Y	OK

#7274		
PAR sensor #7275		

Notes on any other part of CTD e.g. faulty cables, wire drum slip ring, bottles, swivel, frame, tubing etc.		Fault in wire occurred (mechanical damage). 15(?)m removed from wire and then reterminated. It survived one 4000m test so far. CTD temperature at retrieval needs more attention and work.

AME UNSUPPORTED INSTRUMENTS BUT LOGGED

Instrument	**Used ?**	**Comments**
EA600 (bridge and UIC remote)	Y	OK
Anemometer		
Gyro		
DopplerLog		
EMLog		
CLAM winch monitoring system	Y	OK

At the end of the cruise, please ensure that:

- the XBT is left in a suitable state (store in cage if not to be used for a while – do not leave on deck or in UIC as it will get kicked around). Remove all deck cables at end of cruise prior to refit.
- the salinity sample bottles have been washed out and left with deionised water in – please check this otherwise the bottles will build up crud and have to be replaced.
- the CTD is left in a suitable state (washed (including all peripherals), triton + deionised water washed through TC duct, empty syringes put on T duct inlets to keep dust out and stored appropriately). Be careful about freezing before next use – this will damage the C sensors (run through with used standard

seawater to reduce the chance of freezing before the next use). Remove all the connector locking sleeves and wash with fresh water. Blank off all unconnected connectors. See the CTD wisdom file for more information. If the CTD is not going to be used for a few weeks, at the end of your cruise please clean all connectors and attach dummy plugs or fit the connectors back after cleaning if they are not corroded.

- the CTD winch slip rings are cleaned if the CTD has been used – this prevents failure through accumulated dirt.
- the SVP is left in a suitable state (washed and stowed). Do not leave this on deck without a cover for any length of time as it rusts. Stow inside at end of cruise.
- all manuals have been returned to the designated drawers and cupboards.
- you clean all the fans listed below every cruise or every month, whichever is the longer.

Please clean the intake fans on the following machines:

Instrument	Cleaned?
Oceanlogger	Y
EM120, TOPAS, NEPTUNE UPSs	Y
Seatex Seapath	N

Down wire net monitor

Although this is not JCR ships fit, it would be prudent to mention it here due its development by AME. The DWNM version 3 prototype developed during the latter half of 2007 was used for JR177. It has performed well considering the limited time resources. Problems encountered were due to two reasons: faulty underwater connectors and shock from two accidental drops to the deck. The latter caused breaks on the stripboard used for the prototype electronics, and component disconnections. The underwater connection problems were due to old, damaged or worn out connectors for which there were no spares as well as a few new connectors which suffered from the frequent disconnection and reconnection they were subjected to by moving the DWNM between three pieces of equipment.

Many improvements have been noted and will be implemented in time for next year. More than one DWNM unit will be made so that swapping will not be necessary. Spare cables will be made or purchased, as well as spare connectors and new connectors for those already worn.

A number of slight changes with the electronics and software will be made from the results of this cruise. The main intended change is to fit a battery into the DWNM housing to supply power to the motor actuators, specifically to overcome the problem of the RMT25 being used on the much higher resistance 17mm wire. The poorly chosen nickel batteries can then be removed from the RMT25 release mechanism.

Additional notes and recommendations for change / future work

Items to be purchased/added to database:

Previously not on database
Large scissors x 2 (+1 for immediate use in workshop)
Solder flux pen x 1 (+1 for immediate use in workshop)
Desolder braid x 1 (+1 for immediate use in workshop)
IC test clips (8,14,20 way) x 1 of each (+1 of each for immediate use in workshop)
Belt strap (for opening cylindrical underwater housings) x 1 (+1 for immediate use in workshop)
Approx 30cm circumference stainless steel jubilee clips (hose clamp) x 5

On database
Medium adjustable spanner 8” x 2 (increase database stock level) (+2 for immediate use in workshop)
Large adjustable spanner 12” x 2 (increase database stock level) (+2 for immediate use in workshop)

Suggestions for additional items
Portable phone for workshop (current phone muffled)
0-2000m archival depth logger (to attach to confirm depth sensor operation)

9. Acknowledgements

We thank Captain Burgan, the officers and crew of the RRS *James Clark Ross* for helping to make this a successful and enjoyable cruise. Once again, the quality of support for the scientific programme from all of the ship's company was second-to-none. We are grateful to Captain Burgan for indulging our ambition to work in an area reknonwed for its persistent ice cover. Once we had ventured beyond the footprint of the geostationary satellite BAS uses for internet communications Mike Gloistein succeeded in finding an Inmarsat link on most days to keep us in communication with the rest of the world. The Engineers enabled the cruise to get underway in the first place by fixing the propulsion motor that failed during the previous cruise, and thereafter they kept everything running smoothly so that no time was lost due to mechanical problems. Rich and the Galley crew kept everyone well fed, and Rich tried his best to keep up our levels of fitness.

John Summers and the deck crew applied expert seamanship to the deployment and recovery of a wide range of scientific equipment, sometimes in very unpleasant conditions. Thanks to Doug Trevett's efforts little time was lost as a result of winch problems, and he also fought the ice in the uncontaminated sea water supply filters to keep it flowing most of the time. Richie Phipps worked flexibly and mainly on his own to prepare the corer for each piston core and gravity core, and coordinated every deployment and recovery.

Thanks are also due to many in the BAS Operations, Logistics and Personnel Sections, and to Pauline in the Stanley office, for arranging for people and equipment to be in the right places at the right time and making sure all of the people were well prepared.

10. Acronyms

ADCP	Acoustic Doppler Current Profiler
AGT	Agassiz Trawl
BAS	British Antarctic Survey
CLAM	Cable Logging And Monitoring system
CTD	Conductivity-Temperature-Depth
EBS	Epibenthic Sledge
ETS	Engineering Technology Section
FIPASS	Falkland Islands Port And Storage System
GPS	Global Positioning System
ITS	Information Technology Section
JCR	RRS *James Clark Ross*
MSGL	Mega-Scale Glacial Lineations
NOAA	U.S. National Oceanic and Atmospheric Administration
SCS	Shipboard Computing System
SSU	Sonar Sequencing Unit
STCM	Shipboard Three-Component Magnetometer
TOPAS	TOpographic PArametric Sonar
SVP	Sound Velocity Probe/Profile
UIC	Underway Instrumentation and Control room
WAIS	West Antarctic Ice Sheet
XBT	Expendable Bathythermograph

11 Recommendations

1. We understand that AME are investigating the availability of CTD conductivity sensors with a greater tolerance of cold temperatures. This must be a high priority, as it is plainly ridiculous for a polar research vessel not to be able to make key oceanographic measurements in cold conditions. If more robust sensors cannot be found we must develop protocols that permit data to be collected while minimising risk to the equipment.

2. The recently upgraded Bas-SVP program on the CTD PC at the start of this cruise did not produce sound velocity profiles that were useable in the EM120 multibeam system. An older version of the program was used, but the problem with the latest version needs to be investigated.

3. It would be helpful if the SVP Upload Interface (a BAS script) on the EM120 workstation would decimate sound velocity profile data obtained from CTDs in the same way as it handles data from XBTs

4. TOPAS raw data are still degraded by noise spikes that occur about 100 times a second (see Fig. 28), rendering the Burst and Ricker transmission modes virtually unusable. The source of this noise and the stage at which it is getting into the system needs to be investigated.

5. The navigation data input to the TOPAS system should be restored. At present the system is recording no navigation data so any replayed data can only be located by making a note of the recording time and referencing a separate navigation file. TOPAS data were recorded with an input from the Seapath GPS for at least the first four years that the system was operated on JCR.

6. A more reliable system for providing annotation messages to the TOPAS EPC plotter is needed. The annotations often stopped without warning and the only way we could find to restart them was to reboot the ancient Windows98-based laptop that feeds them to the plotter. It would also be helpful if there were a simple way of synchronising the annotations with the time lines that are marked on the record every 5 minutes.

7. The TOPAS EPC plotter does not reproduce the quality of image shown in the PROC trace window on the workstation. Higher quality real-time plotting devices must be available. The TOPAS shipboard monitor is a vital aid in selecting core sites, so the quality of the image is important.

8. The UK marine geology community needs access to a piston corer that can be deployed with barrel lengths considerably longer than 12 m so that marine geologists and palaeoceanographers can obtain high resolution core records from fine-grained sedimentary sequences that extend further back in time. Longer piston corers are standard equipment in most other countries that have active marine geological programmes.

9 As a polar research vessel the JCR should have a dedicated gravity corer that can be deployed with barrel lengths of at least 6 m and with barrels that have an internal diameter of 10 cm or more. A gravity corer with these specifications is a standard, simple tool for sampling polar continental shelf sediments that include layers of coarse and unsorted sediment. A lesson from this cruise is that adapting a piston corer for use as a gravity corer is not a viable approach to getting good core recovery from sediments of this nature.

10. The STCM needs to be recalibrated so that the z-sensor does not exceed its working range at high latitudes (where the magnetic field has a steep inclination so that most of the field is in the z direction). If this is not possible, different sensors with a larger range are required. Note that the Falkland Islands are a particularly bad place to adjust the range of the sensors because they are in a region where the magnetic field is anomalously weak.

11. It would be helpful if the STCM could be adapted to log data to the SCS. In the interim, AME technicians working on board should be asked to download data and start new log files at intervals not exceeding one month. Prior to this cruise data had been logging to the same file since September and the file was so large that it was unusable with most standard software.

Appendices

A) Bridge Event Log

Time	Event	Lat	Lon	Comment
09/04/2008 00:15	169	-62.16731	-57.30298	Magnetometer deployed to 200m
09/04/2008 00:03		-62.16474	-57.32137	Vessel off DP
09/04/2008 00:00	168	-62.16478	-57.32137	2nd Whale/Wood buoy deployed
08/04/2008 23:41	168	-62.16375	-57.32441	1st Whale buoy deployed
08/04/2008 23:22		-62.16324	-57.32646	Vessel Set Up In D.P.
03/04/2008 09:53	167	-67.77147	-68.29274	AGT 3 On deck
03/04/2008 09:51	167	-67.77153	-68.29303	AGT 3 At the surface
03/04/2008 09:44	167	-67.77178	-68.29427	AGT 3 Off the seabed
03/04/2008 09:39	167	-67.77201	-68.29532	AGT 3 Hauling
03/04/2008 09:33	167	-67.77278	-68.29884	AGT 3 Veered to 310m
03/04/2008 09:31	167	-67.77293	-68.2995	AGT 3 On the seabed
03/04/2008 09:21	167	-67.7731	-68.30017	AGT 3 Deployed
03/04/2008 09:20	167	-67.7731	-68.30016	AGT 3 Off the deck
03/04/2008 09:15		-67.77308	-68.30017	Vessel set up on station for AGT 3 deployment
03/04/2008 09:00		-67.76871	-68.28925	Vessel off D.P. and repositioning for AGT 3
03/04/2008 08:57	166	-67.7687	-68.28928	AGT 2 On deck
03/04/2008 08:56	166	-67.76873	-68.28941	AGT 2 At the surface
03/04/2008 08:50	166	-67.76895	-68.29049	AGT 2 Off the seabed
03/04/2008 08:44	166	-67.76922	-68.29163	AGT 2 Hauling
03/04/2008 08:38	166	-67.76994	-68.29494	AGT 2 Veered to 320m
03/04/2008 08:36	166	-67.77011	-68.29568	AGT 2 On the seabed
03/04/2008 08:25	166	-67.77028	-68.29633	AGT 2 Deployed
03/04/2008 08:24	166	-67.77028	-68.29634	AGT 2 Off the deck
03/04/2008 08:11	165	-67.77027	-68.29636	AGT 1 On deck
03/04/2008 08:08	165	-67.77029	-68.29637	AGT 1 At the surface
03/04/2008 08:00	165	-67.77087	-68.29725	AGT 1 Off the seabed
03/04/2008 07:57	165	-67.77107	-68.29754	AGT 1 Hauling
03/04/2008 07:50	165	-67.77253	-68.29979	AGT 1 Veered to 300m
03/04/2008 07:49	165	-67.77266	-68.29998	AGT 1 on the seabed
03/04/2008 07:40	165	-67.7729	-68.30037	AGT 1 Deployed
03/04/2008 07:37	165	-67.77289	-68.30037	AGT 1 Off the deck
03/04/2008 07:35		-67.77289	-68.30034	Vessel set up on station in DP for AGT
03/04/2008 06:39		-67.85563	-68.20477	AGT rigged
03/04/2008 05:45	164	-67.85565	-68.20479	Box corer recovered
03/04/2008 05:26	164	-67.85565	-68.20481	Box core taken
03/04/2008 04:59	164	-67.85563	-68.20483	Box Corer deployed. Water depth 934m
03/04/2008 04:40	163	-67.85564	-68.20479	Piston corer recovered
03/04/2008 04:13	163	-67.85561	-68.20478	Piston corer @ surface
03/04/2008 04:00	163	-67.85562	-68.20481	Piston core taken
03/04/2008 03:39	163	-67.85563	-68.20481	Piston Corer deployed
03/04/2008 03:29	163	-67.85564	-68.20483	Commence deploying piston corer - water depth 934m
03/04/2008 03:20		-67.85593	-68.20451	V/L on DP for coring
03/04/2008 02:26		-67.79077	-68.08362	Vessel off DP and relocating
03/04/2008 01:41	162	-67.79156	-68.08417	Box Corer on deck
03/04/2008 01:37	162	-67.79156	-68.08412	Box Corer at the surface
03/04/2008 01:21	162	-67.79154	-68.08412	Box corer clear of seabed

03/04/2008 01:19	162	-67.79151	-68.084	Box Corer on the seabed
03/04/2008 00:56	162	-67.79154	-68.08419	Box corer deployed. Depth 886m
03/04/2008 00:19	161	-67.79157	-68.08423	Piston corer recovered
03/04/2008 00:15	161	-67.79157	-68.08437	Piston corer in cradle
03/04/2008 00:10	161	-67.79157	-68.08424	Piston Corer at the surface
02/04/2008 23:41	161	-67.79154	-68.0842	Piston Corer clear of the seabed
02/04/2008 23:40	161	-67.79155	-68.08419	Piston corer on seabed
02/04/2008 23:21	161	-67.79157	-68.08418	Piston corer deployed. Depth 886m
02/04/2008 14:18		-68.23763	-70.20326	Vessel off DP
02/04/2008 13:35	160	-68.23757	-70.20331	Box corer recovered
02/04/2008 13:30	160	-68.23759	-70.20327	Box Corer at the surface
02/04/2008 13:22	160	-68.23757	-70.20333	Box corer clear of seabed
02/04/2008 13:21	160	-68.23756	-70.20328	Box Corer on the seabed
02/04/2008 13:07	160	-68.23756	-70.20324	Box corer deployed
02/04/2008 12:48	159	-68.23755	-70.20319	CTD on deck
02/04/2008 12:33	159	-68.23754	-70.20321	CTD @ 676m
02/04/2008 12:18	159	-68.23754	-70.20333	CTD Deployed
02/04/2008 12:14	159	-68.23755	-70.20321	CTD off the deck
02/04/2008 11:41	158	-68.2375	-70.20331	Box corer on deck
02/04/2008 11:38	158	-68.23749	-70.20332	Box Corer at the surface
02/04/2008 11:28	158	-68.23746	-70.20331	Box corer off seabed
02/04/2008 11:27	158	-68.23746	-70.20335	Box Corer on the seabed
02/04/2008 11:11	158	-68.23753	-70.20348	Box corer deployed. Depth 708m
02/04/2008 10:55		-68.23755	-70.20351	Vessel set up on station in D.P.
02/04/2008 06:09		-68.79177	-69.88411	All secure
02/04/2008 05:50	157	-68.79178	-69.88406	Gravity corer recovered
02/04/2008 05:27	157	-68.79178	-69.88411	Gravity core taken
02/04/2008 05:04	157	-68.79178	-69.88408	Gravity corer deployed. Depth 1002m
02/04/2008 04:21	156	-68.79173	-69.88405	Box corer recovered
02/04/2008 04:02	156	-68.79173	-69.88411	Box core taken
02/04/2008 03:33	156	-68.79177	-69.88412	Box Corer deployed. Water depth 1003m
02/04/2008 03:16	155	-68.79177	-69.88411	Gravity corer recovered
02/04/2008 02:54	155	-68.79178	-69.88405	Gravity corer off seabed
02/04/2008 02:52	155	-68.79177	-69.88406	Gravity Corer on the seabed
02/04/2008 02:31	155	-68.79178	-69.8841	Gravity corer deployed. Depth 1002m
02/04/2008 02:00		-68.79149	-69.88422	Vessel Set Up In D.P. for coring
01/04/2008 15:03		-68.68648	-73.0737	All secure
01/04/2008 14:50	154	-68.68649	-73.07371	Gravity corer retreved and back on deck
01/04/2008 14:49	154	-68.68647	-73.07368	Gravity Corer housed
01/04/2008 14:35	154	-68.68646	-73.07369	Gravity corer off seabed
01/04/2008 14:33	154	-68.68647	-73.07363	Gravity corer on seabed
01/04/2008 14:17	154	-68.68651	-73.07361	Gravity corer deployed. Depth 882m
01/04/2008 13:58		-68.68505	-73.07358	Vessel Set Up In D.P. Side Gantry unlashed
01/04/2008 12:23		-68.7893	-73.11114	Vessel off DP and relocating
01/04/2008 12:05	153	-68.78932	-73.1111	Gravity corer retreved and back on deck
01/04/2008 12:01	153	-68.78929	-73.11114	Gravity corer incradle
01/04/2008 12:00	153	-68.78931	-73.11113	Gravity Corer at the surface
01/04/2008 11:44	153	-68.79137	-73.19148	Gravity corer off seabed
01/04/2008 11:43	153	-68.79006	-73.14215	Start hauling Gravity Corer
01/04/2008 11:42	153	-68.7923	-73.23226	Gravity Corer on the seabed
01/04/2008 11:21	153	-68.78927	-73.11113	Gravity corer deployed. Depth 1098m

01/04/2008 10:39	152	-68.78928	-73.11113	Box Corer on deck
01/04/2008 10:37	152	-68.78928	-73.11113	Box Corer at the surface
01/04/2008 10:18	152	-68.78927	-73.11111	Box corer clear of seabed. Hauling for recovery
01/04/2008 10:17	152	-68.78928	-73.11112	Box Corer on the seabed
01/04/2008 09:49	152	-68.78931	-73.11112	Box Corer deployed. Depth 1099m
01/04/2008 09:48	152	-68.78931	-73.11116	Box Corer off the deck
01/04/2008 09:30		-68.7893	-73.11283	Vessel Set Up In D.P. Mid-ships gantry unlashed
31/03/2008 03:13		-67.76994	-83.25013	Gantry secure
31/03/2008 03:05	151	-67.76996	-83.25008	CTD recovered
31/03/2008 01:36	151	-67.76992	-83.25023	CTD @ 4005m
31/03/2008 00:27	151	-67.76992	-83.25047	CTD Re-Deployed
30/03/2008 22:24	151	-67.76994	-83.25047	CTD back on deck for checks
30/03/2008 22:22	151	-67.76997	-83.2505	CTD at the surface
30/03/2008 22:15	151	-67.76995	-83.25048	CTD at 351m. Problems with CTD reported by winch control
30/03/2008 22:02	151	-67.76994	-83.25059	CTD Deployed - water depth 4056m
30/03/2008 21:59	151	-67.76996	-83.2506	CTD off the deck
30/03/2008 21:05		-67.76987	-83.2504	Vessel set up on station for CTD deployment
30/03/2008 08:48		-67.92522	-86.62776	All secure
30/03/2008 08:32	150	-67.92527	-86.62772	Box Corer on deck. Unit not triggered
30/03/2008 08:29	150	-67.92525	-86.6278	Box Corer at the surface
30/03/2008 07:33	150	-67.92519	-86.62778	Box corer clear of seabed. Hauling for recovery
30/03/2008 07:30	150	-67.92519	-86.62779	Box Corer on the seabed
30/03/2008 06:06	150	-67.9252	-86.62773	Box Corer deployed. Water depth 3870m
30/03/2008 05:36	150	-67.92521	-86.62778	Piston corer recovered
30/03/2008 05:06	150	-67.9252	-86.62781	Piston corer @ surface
30/03/2008 04:14	150	-67.92519	-86.62773	Piston core taken
30/03/2008 03:00	150	-67.92515	-86.62767	Piston corer deployed. Depth 3872m
30/03/2008 02:40		-67.92508	-86.63083	Vessel Set Up In D.P.
29/03/2008 23:19		-68.31055	-86.03252	All secure
29/03/2008 22:16	149	-68.31057	-86.03252	Piston Corer back on deck
29/03/2008 22:11	149	-68.31061	-86.03254	Piston Corer clear of the water
29/03/2008 22:05	149	-68.31063	-86.03248	Piston Corer latched into bucket housing
29/03/2008 21:46	149	-68.31062	-86.03248	Piston corer @ surface
29/03/2008 20:57	149	-68.31065	-86.03243	Piston Corer clear of the seabed. Commenced hauling for recovery
29/03/2008 20:56	149	-68.31066	-86.03241	Piston Corer at the sea bed
29/03/2008 19:48	149	-68.31059	-86.03243	Piston corer deployed - Water depth 3586m
29/03/2008 19:39	149	-68.31059	-86.03244	Commence deploying piston corer
29/03/2008 19:08	148	-68.31058	-86.03246	Box corer recovered
29/03/2008 18:16	148	-68.31059	-86.03242	Box core taken
29/03/2008 17:05	148	-68.31059	-86.03242	Box corer deployed. Depth 3586m
29/03/2008 16:57		-68.31058	-86.03234	Vessel on DP for coring. Water depth 3586m
28/03/2008 21:41		-67.99854	-95.01018	All secured on deck. Vessel off DP and proceeding
28/03/2008 20:22	147	-67.99853	-95.01014	Piston Corer back on deck
28/03/2008 20:17	147	-67.99856	-95.01013	Piston Corer clear of the water
28/03/2008 20:10	147	-67.99855	-95.01011	Piston Corer latched into bucket housing
28/03/2008 19:48	147	-67.99852	-95.01029	Piston corer @ surface
28/03/2008 18:48	147	-67.99853	-95.01015	Piston core taken
28/03/2008 17:23	147	-67.99858	-95.0101	Piston corer deployed
28/03/2008 17:06	147	-67.99858	-95.01007	Commence deploying piston corer
28/03/2008 16:37	146	-67.99859	-95.0101	XBT Deployed
28/03/2008 16:28	145	-67.99858	-95.01009	Box corer recovered

28/03/2008 15:26	145	-67.99858	-95.01001	Box corer clear of seabed. Hauling
28/03/2008 15:24	145	-67.99857	-95.01003	Box Corer on the seabed
28/03/2008 14:00	145	-67.99861	-95.00998	Box corer deployed. Depth 4447m
28/03/2008 13:45		-67.99848	-95.0112	Vessel Set Up In D.P. for coring
27/03/2008 02:47		-66.70876	-106.1999	Vessel off DP
27/03/2008 01:09	144	-66.70884	-106.19949	Bent PC barrels recovered on poop deck
27/03/2008 00:42	144	-66.70879	-106.19979	Piston corer at deck level. Barrels bent
27/03/2008 00:35	144	-66.70876	-106.19979	Piston corer in cradle
27/03/2008 00:32	144	-66.70876	-106.19978	Piston Corer at the surface
26/03/2008 23:10	144	-66.70876	-106.1997	Piston Corer clear of the seabed. hauling
26/03/2008 23:07	144	-66.70876	-106.19966	Piston Corer at the sea bed
26/03/2008 21:37	144	-66.70879	-106.19968	Piston Corer deployed. Deth 4760m
26/03/2008 21:13		-66.70931	-106.19969	Vessel set up on station in DP for Piston Corer deployment
26/03/2008 20:49	143	-66.73162	-106.1991	Magnetometer recovered to deck.
25/03/2008 09:03	143	-61.25166	-114.86835	Magnetometer deployed to 200m
25/03/2008 08:54		-61.24535	-114.87929	Mid-ships gantry secured. Vessel out of DP and proceeding
25/03/2008 08:20	142	-61.24536	-114.87933	Box Corer on deck
25/03/2008 08:17	142	-61.24536	-114.87933	Box Corer at the surface
25/03/2008 07:00	142	-61.24539	-114.87931	Box core taken
25/03/2008 05:12	142	-61.24538	-114.87925	Box Corer deployed. Depth 5183m
25/03/2008 04:49	141	-61.2454	-114.87921	Piston corer recovered
25/03/2008 04:20	141	-61.24541	-114.87917	Piston corer @ surface
25/03/2008 03:09	141	-61.24538	-114.87931	Piston Corer clear of the seabed. hauling
25/03/2008 03:07	141	-61.24538	-114.8793	Piston Corer at the sea bed
25/03/2008 01:30	141	-61.24539	-114.87918	Piston corer deployed. Depth 5157m
25/03/2008 01:07		-61.24542	-114.8792	Vessel set up in DP for piston core
24/03/2008 03:30		-60.54802	-108.36152	Vessel off DP
24/03/2008 02:57	140	-60.53529	-108.30587	CTD Recovered on deck
24/03/2008 01:15	140	-60.53529	-108.30586	CTD @ 5175m
23/03/2008 23:39	140	-60.53527	-108.30587	CTD Deployed - water depth 5200m
23/03/2008 23:37	140	-60.53527	-108.30587	CTD off the deck
23/03/2008 23:05	139	-60.53525	-108.3022	Box corer on deck
23/03/2008 23:03	139	-60.53523	-108.30217	Box Corer at the surface
23/03/2008 21:51	139	-60.53526	-108.30221	Box corer clear of seabed. Hauling
23/03/2008 21:50	139	-60.53527	-108.30219	Box Corer on the seabed
23/03/2008 20:10	139	-60.53528	-108.30219	Box Corer deployed. Depth 5200m
23/03/2008 20:08	139	-60.53528	-108.30218	Box Corer off the deck
23/03/2008 20:00		-60.53513	-108.30216	V/L on DP for Box core and CTD
23/03/2008 15:02	138	-60.53465	-108.30269	Piston corer recovered
23/03/2008 14:56	138	-60.53464	-108.30268	Piston corer in cradle
23/03/2008 14:54	138	-60.53464	-108.30266	Piston Corer at the surface
23/03/2008 12:21	138	-60.53468	-108.30268	Piston corer on seabed
23/03/2008 12:21	138	-60.53468	-108.30268	Piston Corer clear of the seabed. hauling
23/03/2008 11:42	138	-60.5347	-108.30272	Piston corer deployed. Depth 5200m
23/03/2008 11:29		-60.53458	-108.30279	Vessel Set Up In D.P.
22/03/2008 16:00		-62.88801	-106.28867	All secure
22/03/2008 15:09	137	-62.888	-106.28887	Piston corer recovered
22/03/2008 15:02	137	-62.88802	-106.28873	Piston corer in cradle
22/03/2008 14:56	137	-62.88807	-106.28854	Piston Corer at the surface
22/03/2008 13:25	137	-62.88803	-106.28862	Piston corer off sea bed. Start hauling
22/03/2008 13:22	137	-62.88803	-106.28856	Piston corer on seabed

22/03/2008 11:39	137		-106.28847	Piston Corer deployed
22/03/2008 11:14		-62.88805	-106.28701	Vessel Set Up In D.P. Side Gantry unlashed
22/03/2008 11:04	136	-62.88588	-106.27481	Magnetometer recovered to deck.
21/03/2008 20:30	136	-64.38856	-107.05143	Magnetometer deployed to 200m
21/03/2008 20:26		-64.39354	-107.05154	Vessel off D.P. and proceeding
21/03/2008 19:47	135	-64.39448	-107.05246	XBT Deployed
21/03/2008 19:19	134	-64.39393	-107.05256	Piston corer recovered
21/03/2008 18:48	134	-64.39209	-107.0484	Piston corer @ surface
21/03/2008 17:38	134	-64.3946	-107.05228	Piston core taken
21/03/2008 17:36	134	-64.39449	-107.04495	Piston corer on seabed
21/03/2008 16:03	134	-64.39431	-107.05347	Piston corer deployed
21/03/2008 15:15	133	-64.3945	-107.05248	Box Corer on deck
21/03/2008 15:11	133	-64.39429	-107.05273	Box Corer at the surface
21/03/2008 14:00	133	-64.39443	-107.05253	Start hauling Box Corer
21/03/2008 13:59	133	-64.39454	-107.05243	Box corer on seabed
21/03/2008 12:27	133	-64.3945	-107.05245	Box corer deployed. Depth 4992m
21/03/2008 11:57	133	-64.39454	-107.05241	Vessel Set Up In D.P. Side Gantry unlashed
21/03/2008 11:31	131	-64.36282	-107.05177	Magnetometer recovered to deck.
20/03/2008 17:26		-67.04765	-105.73916	All secure
20/03/2008 17:21	132	-67.05471	-105.7369	XBT completed
20/03/2008 17:17	132	-67.06057	-105.73518	XBT deployed @ 6 knots
20/03/2008 16:57		-67.09407	-105.72517	Commence slowing to 6 knots for XBT
19/03/2008 14:45		-69.35232	-107.09826	Vessel off DP
19/03/2008 14:45	131	-69.27806	-106.86441	Magnetometer deployed to 200m
19/03/2008 12:56	130	-69.22908	-106.68043	Box Corer on deck
19/03/2008 12:53	130	-69.23026	-106.68149	Box Corer at the surface
19/03/2008 11:53	130	-69.23013	-106.68023	Box corer clear of seabed. Hauling
19/03/2008 11:50	130	-69.23073	-106.68032	Box Corer on the seabed
19/03/2008 10:28	130	-69.23012	-106.68021	Box Corer deployed. Water depth 4250m
19/03/2008 10:26	130	-69.23012	-106.68017	Box Corer off the deck
19/03/2008 10:06	129	-69.23009	-106.6802	Piston Corer clear of the water
19/03/2008 10:00	129	-69.22981	-106.69862	Piston Corer latched into bucket housing
19/03/2008 09:57	129	-69.23014	-106.68016	Piston Corer at the surface
19/03/2008 08:37	129	-69.23012	-106.68014	Piston Corer clear of the seabed
19/03/2008 08:36	129	-69.23009	-106.68017	Piston Corer at the sea bed
19/03/2008 07:16	129	-69.23008	-106.68016	Piston corer deployed
19/03/2008 07:02	129	-69.23023	-106.67999	Commence deployment of piston corer
19/03/2008 06:32	128	-69.23079	-106.67971	CTD recovered
19/03/2008 05:05	128	-69.23079	-106.67977	CTD @ 4195m
19/03/2008 03:55	128	-69.23076	-106.67975	CTD Deployed. Depth 4250m
19/03/2008 03:40		-69.2308	-106.67977	Vessel Set Up In D.P. Side Gantry unlashed
19/03/2008 03:29	127	-69.23405	-106.68586	Magnatromiter recovered to deck.
19/03/2008 03:22	127	-69.24156	-106.69716	Start recovering magnetometer
18/03/2008 21:48	127	-69.97898	-108.26156	Magnetometer deployed
18/03/2008 21:42		-69.98332	-108.27036	Vessel out of DP and proceeding
18/03/2008 21:23	126	-69.98333	-108.27031	EBS No3 on deck
18/03/2008 21:21	126	-69.98341	-108.2705	EBS No3 at the surface
18/03/2008 20:00	126	-69.98892	-108.28179	EBS No3 off the seabed
18/03/2008 19:09	126	-69.99272	-108.28694	EBS 3 commence hauling
18/03/2008 18:48	126	-69.99767	-108.29374	EBS @ 5000m
18/03/2008 18:19	126	-70.00009	-108.29692	EBS 3 on seabed

18/03/2008 17:50	126	-70.0018	-108.29931	Resume veering cable
18/03/2008 17:29	126	-70.00181	-108.29932	Stop veering EBS @ 1758m
18/03/2008 16:55	126	-70.00179	-108.29931	EBS 3 - redeployed
18/03/2008 16:04	126	-70.00176	-108.29928	EBS 3 recovered
18/03/2008 15:50	126	-70.00179	-108.29935	Recovering EBS No3 due to winch problems
18/03/2008 15:39	126	-70.00327	-108.30366	EBS No3 Stopped due to winch problems
18/03/2008 15:28	126	-70.00344	-108.30111	EBS No3 Deployed. Depth 3517m
18/03/2008 15:05	125	-70.00404	-108.30168	EBS No2 On deck
18/03/2008 13:43	125	-70.01039	-108.30848	EBS No2 Off seabed
18/03/2008 12:45	125	-70.01491	-108.31333	Start hauling EBS No2
18/03/2008 12:25	125	-70.01994	-108.31862	EBS No2 veered to 5000m
18/03/2008 11:55	125	-70.02227	-108.32112	EBS No2 on the seabed
18/03/2008 10:43	125	-70.02789	-108.32703	EBS No2 deployed
18/03/2008 10:41	125	-70.02808	-108.32726	EBS No2 off the deck
18/03/2008 10:25	124	-70.02809	-108.32725	EBS No1 on deck
18/03/2008 10:23	124	-70.02818	-108.32737	EBS No1 at the surface
18/03/2008 09:03	124	-70.03439	-108.33405	EBS No1 off the seabed
18/03/2008 08:06	124	-70.03883	-108.33877	Commenced recovery of EBS No1
18/03/2008 07:46	124	-70.04399	-108.34427	EBS @ 5000m
18/03/2008 06:46	124	-70.04879	-108.34925	EBS veered to 2000m
18/03/2008 06:04	124	-70.04874	-108.34933	EBS No1 deployed - V/l stationary
18/03/2008 05:27	123	-70.04878	-108.34932	Box corer recovered
18/03/2008 04:33	123	-70.04877	-108.3493	Box core taken (3447m)
18/03/2008 03:15	123	-70.04879	-108.34936	Box Corer deployed. Depth 3500m
18/03/2008 02:46	122	-70.04867	-108.35208	Piston Corer back on deck
18/03/2008 02:40	122	-70.04864	-108.35194	Piston corer in cradle
18/03/2008 02:20	122	-70.04873	-108.35029	Piston Corer at the surface
18/03/2008 01:29	122	-70.04893	-108.34492	Piston Corer clear of the seabed
18/03/2008 01:28	122	-70.04891	-108.34493	Start Hauling piston corer
18/03/2008 01:27	122	-70.04891	-108.34494	Piston corer on seabed
18/03/2008 00:11	122	-70.0496	-108.33701	Piston corer deployed. Depth 3380m
17/03/2008 23:35		-70.04971	-108.33387	Vessel set up on station in DP for Piston Corer deployment
16/03/2008 11:06	121	-71.12914	-119.92345	Piston Corer clear of the water
16/03/2008 10:59	121	-71.12944	-119.92276	Piston Corer latched into bucket housing
16/03/2008 10:54	121	-71.12966	-119.92166	Piston Corer at the surface
16/03/2008 10:09	121	-71.13063	-119.91475	Vessel back in Auto Head DP
16/03/2008 10:06	121	-71.13062	-119.91386	Piston Corer clear of the seabed
16/03/2008 10:03	121	-71.13065	-119.91532	Piston Corer at the sea bed
16/03/2008 10:00	121	-71.13062	-119.91381	Vessel stopped in position in full DP for Piston Corer
16/03/2008 09:21	121	-71.13087	-119.90808	Piston Corer deployed. Deth 2117m
16/03/2008 09:20	121	-71.13089	-119.90788	Piston Corer un-latched from housing
16/03/2008 09:02		-71.13015	-119.90639	Vessel set up in Auto Head DP for second Piston Corer deployment
16/03/2008 08:33	120	-71.13663	-119.89148	Box Corer on deck
16/03/2008 08:16		-71.15576	-119.96413	Vessel off D.P. relocating to open water for second Piston Corer deployment
16/03/2008 07:58	120	-71.15375	-119.95643	Box corer clear of surface - Gantry problem
16/03/2008 07:27	120	-71.15184	-119.95441	Box core taken
16/03/2008 07:23	120	-71.15168	-119.95442	Box corer 50m from seabed - proceed with core
16/03/2008 06:37	120	-71.15005	-119.95776	Box corer deployed. water depth 2109m
16/03/2008 06:01		-71.15007	-119.96053	V/L on DP for Box core
16/03/2008 05:38		-71.1559	-119.98383	V/L off DP relocating for box core
16/03/2008 05:34	119	-71.15555	-119.98376	Piston corer recovered

16/03/2008 05:27	119	-71.15491	-119.98174	Piston Corer latched into bucket housing
16/03/2008 05:01	119	-71.15278	-119.97171	Piston corer @ surface
16/03/2008 04:31	119	-71.15146	-119.96458	Piston core taken
16/03/2008 04:27	119	-71.15142	-119.9646	60m off sea bed
16/03/2008 03:46	119	-71.15035	-119.96184	Piston corer deployed. depth 2110m
16/03/2008 03:16		-71.15004	-119.9617	Vessel Set Up In D.P.
15/03/2008 18:13		-69.59461	-117.98245	All secure
15/03/2008 17:54	118	-69.59463	-117.98248	Box corer recovered
15/03/2008 17:07	118	-69.59461	-117.98245	Box corer clear of seabed
15/03/2008 17:02	118	-69.59461	-117.98247	Box corer 50m from seabed - proceed with core
15/03/2008 15:58	118	-69.59464	-117.98249	Box corer deployed. Depth 3314m
15/03/2008 15:23	117	-69.59463	-117.98244	Piston corer recovered
15/03/2008 15:11	117	-69.59465	-117.98241	Piston corer in cradle
15/03/2008 15:07	117	-69.59466	-117.98242	Piston Corer at the surface
15/03/2008 14:00	117	-69.59467	-117.98243	Piston corer off sea bed. Start hauling
15/03/2008 13:57	117	-69.59467	-117.98242	Piston Corer at the sea bed
15/03/2008 12:55	117	-69.59464	-117.98241	Piston Corer deployed. Deth 3317m
15/03/2008 12:28		-69.5944	-117.98348	Vessel Set Up In D.P. Side Gantry unlashed
15/03/2008 07:10		-69.2143	-117.4895	All secure
15/03/2008 06:41	116	-69.21427	-117.48963	AGT recovered
15/03/2008 05:49	116	-69.21248	-117.50073	AGT clear of seabed
15/03/2008 05:15	116	-69.21131	-117.5079	Commence hauling AGT
15/03/2008 04:59	116	-69.20949	-117.51856	AGT @ 3000m
15/03/2008 03:49	116	-69.20647	-117.53297	AGT Deployed. Depth 2244m
15/03/2008 03:38		-69.20641	-117.53351	Vessel Set Up In D.P.
15/03/2008 01:53		-69.27039	-117.32143	Vessel off DP and relocating
15/03/2008 01:42	115	-69.27028	-117.32152	AGT Recovered
15/03/2008 00:30	115	-69.2646	-117.32681	AGT Off seabed
14/03/2008 23:46	115	-69.2611	-117.32994	Commenced recovery of the AGT
14/03/2008 23:30	115	-69.25718	-117.33357	AGT veered to 4200m
14/03/2008 23:08	115	-69.25544	-117.33517	AGT on seabed
14/03/2008 22:05	115	-69.25049	-117.33969	AGT deployed
14/03/2008 22:03	115	-69.25034	-117.33981	AGT off the deck
14/03/2008 21:54		-69.25142	-117.33888	Vessel set up in DP for AGT deployment
14/03/2008 21:28		-69.21459	-117.3507	Vessel off DP to reposition for AGT deployment
14/03/2008 21:05		-69.21461	-117.35071	Vessel Set Up In D.P. awaiting instructions
13/03/2008 17:29		-71.16292	-110.08092	All secure
13/03/2008 17:12	114	-71.16291	-110.08093	Box corer recovered
13/03/2008 16:50	114	-71.16291	-110.08087	Box core taken (1372m)
13/03/2008 16:17	114	-71.16293	-110.08094	Box corer deployed
13/03/2008 15:41	113	-71.16292	-110.08102	EBS 1B Recovered
13/03/2008 15:04	113	-71.16223	-110.07273	EBS 1B Off seabed
13/03/2008 14:34	113	-71.15985	-110.07124	Start hauling EBS 1B
13/03/2008 14:23	113	-71.1593	-110.06232	EBS 1B Veered to 2150m
13/03/2008 13:40	113	-71.15871	-110.05137	EBS 1B Deployed
13/03/2008 13:35		-71.15866	-110.05133	Vessel Set up in DP for EBS 1B
13/03/2008 13:00		-71.15958	-110.10947	Vessel off D.P. relocating to EBS 1B start position
13/03/2008 12:58	112	-71.15961	-110.1095	EBS 1A On Deck
13/03/2008 12:18	112	-71.15887	-110.10123	EBS 1A Off seabed
13/03/2008 11:43	112	-71.1584	-110.09242	Commenced recovery of EBS 1A
13/03/2008 11:32	112	-71.15796	-110.08356	EBS 1A veered to 2200m

13/03/2008 11:16	112	-71.15775	-110.0795	EBS 1A on the seabed
13/03/2008 10:44	112	-71.15733	-110.07137	EBS 1A deployed
13/03/2008 10:41	112	-71.1572	-110.07085	EBS 1A off the deck
13/03/2008 10:31		-71.1572	-110.07086	Vessel repositioned and in DP for EBS 1A
13/03/2008 10:10		-71.15397	-110.04062	Vessel off DP and repositioning clear of ice for EBS 1A
13/03/2008 10:06	111	-71.15396	-110.04068	AGT 1B on deck
13/03/2008 10:04	111	-71.15394	-110.04032	AGt 1B at the surface
13/03/2008 09:29	111	-71.15331	-110.03157	AGT 1B off the seabed
13/03/2008 09:04	111	-71.15277	-110.02561	Commenced recovery of AGT 1B
13/03/2008 08:48	111	-71.15171	-110.01306	AGT 1B veered to 2225m
13/03/2008 07:54	111	-71.1504	-109.99813	AGT 1B deployed
13/03/2008 07:33	110	-71.14987	-109.99526	AGT 1A recovered
13/03/2008 06:54	110	-71.14873	-109.98907	AGT 1A off seabed
13/03/2008 06:30	110	-71.14782	-109.98372	AGT 1A commence hauling
13/03/2008 06:14	110	-71.14625	-109.97136	AGT 1A @ 2215m
13/03/2008 06:00	110	-71.14559	-109.9655	AGT 1A on seabed
13/03/2008 05:23	110	-71.14454	-109.95653	AGT 1A deployed
13/03/2008 05:18		-71.14425	-109.95533	V/L on DP for 1500m AGT
13/03/2008 04:17		-71.13906	-109.94357	V/L off DP
13/03/2008 04:03	109	-71.13905	-109.9436	CTD Recovered on deck
13/03/2008 03:24	109	-71.13895	-109.94403	CTD @ 1520m
13/03/2008 02:53	109	-71.13894	-109.94406	CTD Deployed - water depth 1567m
13/03/2008 02:42		-71.13896	-109.94394	Vessel Set Up In D.P.
13/03/2008 02:35		-71.13903	-109.93662	Vessel off DP and relocating
13/03/2008 01:54	108	-71.17954	-109.9041	Box Corer on deck
13/03/2008 01:52	108	-71.17954	-109.90413	Box corer @ surface
13/03/2008 01:34	108	-71.17946	-109.90931	Box corer off seabed. start hauling
13/03/2008 01:33	108	-71.17942	-109.90421	Box Corer on the seabed
13/03/2008 01:31	108	-71.17947	-109.90395	Box corer 50m off seabed
13/03/2008 01:09	108	-71.17945	-109.90442	Box corer deployed. Water depth 996m
13/03/2008 00:49	107	-71.17947	-109.90442	CTD on deck
13/03/2008 00:46	107	-71.17945	-109.9044	CTD @ Surface
13/03/2008 00:44	107	-71.17945	-109.90442	CTD @ 30m
13/03/2008 00:38	107	-71.17945	-109.90441	CTD 2 Deployed
13/03/2008 00:37	107	-71.17944	-109.90443	CTD 2 @ Surface
13/03/2008 00:10	106	-71.17945	-109.90437	CTD on deck
13/03/2008 00:07	106	-71.17945	-109.90439	CTD @ Surface
12/03/2008 23:43	106	-71.17942	-109.90438	Commenced recovery of CTD
12/03/2008 23:42	106	-71.17943	-109.90439	CTD at depth 967m
12/03/2008 23:21	106	-71.17945	-109.90441	CTD deployed
12/03/2008 23:18	106	-71.17945	-109.90441	CTD off the deck
12/03/2008 22:54	105	-71.1803	-109.90536	EBS 2B on deck
12/03/2008 22:51	105	-71.1803	-109.90535	EBS 2B at the surface
12/03/2008 22:25	105	-71.17927	-109.90012	EBS 2B off the seabed
12/03/2008 22:06	105	-71.17887	-109.89505	Commenced recovery of EBS 2B
12/03/2008 21:55	105	-71.17817	-109.88644	EBS 2B veered to 1501m
12/03/2008 21:46	105	-71.17798	-109.88417	EBS 2B on the seabed
12/03/2008 21:24	105	-71.17746	-109.87873	EBS 2B deployed
12/03/2008 21:21	105	-71.17748	-109.878	EBS 2B off the deck
12/03/2008 21:04	104	-71.17747	-109.87782	EBS 2A on deck
12/03/2008 21:03	104	-71.17747	-109.87782	EBS 2A at the surface

12/03/2008 20:37	104	-71.17666	-109.87168	EBS 2A off the seabed
12/03/2008 20:10	104	-71.17599	-109.86495	Commenced recovery of EBS 2A
12/03/2008 19:59	104	-71.17519	-109.85656	EBS 2A @ 1601m
12/03/2008 19:50	104	-71.17495	-109.85418	EBS 2A on seabed
12/03/2008 19:28	104	-71.1744	-109.84872	EBS 2A deployed
12/03/2008 19:25		-71.17433	-109.84809	V/L on DP for EBS
12/03/2008 18:58		-71.18525	-109.95151	V/L off DP
12/03/2008 18:28	103	-71.18457	-109.94965	AGT 2C recovered
12/03/2008 18:03	103	-71.18393	-109.94367	AGT 2C clear of seabed
12/03/2008 17:42	103	-71.18337	-109.93849	AGT 2C commence hauling
12/03/2008 17:27	103	-71.18214	-109.92658	AGT 2C @ 1500m
12/03/2008 17:17	103	-71.1817	-109.92241	AGT 2C on seabed
12/03/2008 16:54	103	-71.18113	-109.91695	AGT 2C deployed
12/03/2008 16:38	102	-71.18106	-109.91641	AGT 2B recovered
12/03/2008 16:14	102	-71.18047	-109.91059	AGT 2B off seabed
12/03/2008 15:54	102	-71.18002	-109.90591	Start hauling AGT 2B
12/03/2008 15:39	102	-71.17905	-109.89437	AGT 2B Veered to 1500m
12/03/2008 15:30	102	-71.17871	-109.89026	AGT 2B On seabed
12/03/2008 15:07	102	-71.17821	-109.88455	AGT 2B Deployed. Depth 1001m
12/03/2008 14:52	101	-71.17817	-109.88386	AGT 2A Recovered and back on deck
12/03/2008 14:28	101	-71.17764	-109.87791	AGT 2A Off seabed
12/03/2008 14:07	101	-71.17719	-109.87277	Start Hauling AGT 2A
12/03/2008 13:51	101	-71.1751	-109.86299	AGT 2A Veered to 1540m
12/03/2008 13:18	101	-71.17438	-109.85459	AGT 2A Deployed. Depth 1029m
12/03/2008 13:00		-71.17419	-109.85312	Vessel Set Up In D.P.
12/03/2008 10:50		-71.33366	-109.96671	Vessel off D.P. relocating to 1000m bio station
12/03/2008 10:39	100	-71.33366	-109.96671	CTD on deck
12/03/2008 10:36	100	-71.33366	-109.96672	CTD at the surface
12/03/2008 10:19	100	-71.33367	-109.96673	Commenced CTD recovery
12/03/2008 10:18	100	-71.33367	-109.96672	CTD at 450m
12/03/2008 10:05	100	-71.33367	-109.96676	CTD deployed
12/03/2008 10:02	100	-71.33367	-109.96676	CTD off the deck
12/03/2008 09:36	99	-71.33368	-109.96671	Box Corer on deck
12/03/2008 09:34	99	-71.33368	-109.96672	Box Corer at the surface
12/03/2008 09:22	99	-71.33366	-109.96677	Commenced recovery of the Box Corer
12/03/2008 09:21	99	-71.33366	-109.96675	Box Corer on the seabed
12/03/2008 09:05	99	-71.33364	-109.96674	Box Corer deployed. Water depth 481m
12/03/2008 09:04	99	-71.33365	-109.96675	Box Corer off the deck
12/03/2008 07:58	98	-71.33362	-109.96671	EBS 3F recovered
12/03/2008 07:43	98	-71.33408	-109.96665	EBS 3F off seabed
12/03/2008 07:33	98	-71.33496	-109.96658	EBS 3F commence hauling
12/03/2008 07:22	98	-71.33781	-109.96628	EBS 3F @ 729m
12/03/2008 07:16	98	-71.33828	-109.96627	EBS 3F on seabed
12/03/2008 07:04	98	-71.33903	-109.96614	EBS 3F deployed
12/03/2008 06:51	97	-71.33911	-109.9661	EBS 3E recovered
12/03/2008 06:39	97	-71.33951	-109.96606	EBS 3E clear of seabed
12/03/2008 06:27	97	-71.34052	-109.96591	EBS 3E commence hauling
12/03/2008 06:17	97	-71.34318	-109.96552	EBS 3E @ 730m
12/03/2008 06:12	97	-71.34373	-109.96542	EBS 3E on seabed
12/03/2008 05:59	97	-71.34455	-109.96528	EBS 3E Deployed
12/03/2008 05:37	96	-71.34471	-109.96521	EBS 3D recovered

12/03/2008 05:23	96	-71.34516	-109.96517 EBS 3D clear of seabed
12/03/2008 05:11	96	-71.34611	-109.96509 EBS 3D commence hauling
12/03/2008 05:00	96	-71.34891	-109.96478 EBS 3D @ 730m
12/03/2008 04:55	96	-71.34937	-109.9647 EBS 3D On seabed
12/03/2008 04:42	96	-71.3502	-109.96466 EBS 3D Deployed
12/03/2008 04:34		-71.35063	-109.96495 V/L on DP for EBS
12/03/2008 04:16		-71.34224	-110.01912 V/L off DP relocating
12/03/2008 04:09	95	-71.34248	-110.0191 EBS 3C recovered
12/03/2008 03:56	95	-71.34352	-110.01913 EBS 3C Off seabed
12/03/2008 03:44	95	-71.34454	-110.01909 Start hauling EBS 3C
12/03/2008 03:34	95	-71.34701	-110.01912 EBS 3C Veered to 730m
12/03/2008 03:28	95	-71.3478	-110.01908 EBS 3C On seabed
12/03/2008 03:16	95	-71.3488	-110.01908 EBS 3C Deployed
12/03/2008 03:12		-71.34905	-110.0191 Vessel Set Up In D.P.
12/03/2008 02:40		-71.33569	-110.01324 Vessel off DP to relocate
12/03/2008 02:36	94	-71.33577	-110.01329 EBS 3B Recovered
12/03/2008 02:22	94	-71.33692	-110.01325 EBS 3B Off seabed
12/03/2008 02:00	94	-71.34074	-110.01325 EBS 3B Veered to 729m
12/03/2008 01:54	94	-71.34124	-110.01325 EBS 3B On seabed
12/03/2008 01:43	94	-71.34215	-110.01326 EBS 3B Deployed. Depth 480m
12/03/2008 01:35	93	-71.34222	-110.01321 EBS 3A Recovered
12/03/2008 01:18	93	-71.3435	-110.01326 EBS 3A Off seabed
12/03/2008 01:09	93	-71.34425	-110.01327 Start hauling EBS 3A
12/03/2008 00:58	93	-71.34715	-110.0133 EBS 3A Veered to 729m
12/03/2008 00:42	93	-71.34845	-110.0133 EBS 3A Deployed. depth 476m
12/03/2008 00:38		-71.34868	-110.01332 Vessel Set Up In D.P.
12/03/2008 00:18		-71.34354	-110.00592 Vessel off D.P. relocating to EBS 3A start position
11/03/2008 23:45	92	-71.34629	-110.00596 AGT 3C off the seabed
11/03/2008 23:37	92	-71.34693	-110.00591 Commenced recovery of AGT 3C
11/03/2008 23:31	92	-71.34838	-110.00599 AGT 3C veered to 710m
11/03/2008 23:26	92	-71.3492	-110.00595 AGT 3C on the seabed
11/03/2008 23:15	92	-71.35013	-110.00596 AGT 3C deployed
11/03/2008 23:13	92	-71.35022	-110.00597 AGT 3C off the deck
11/03/2008 23:11		-71.35037	-110.0059 Vessel on Station in DP for AGT 3C deployment
11/03/2008 22:54		-71.33657	-109.99843 Vessel off D.P. relocating to AGT 3C start position
11/03/2008 22:53	91	-71.33663	-109.99844 AGT 3B on deck
11/03/2008 22:50	91	-71.33683	-109.99846 AGT 3B at the surface
11/03/2008 22:38	91	-71.33789	-109.99841 AGT 3B off the seabed
11/03/2008 22:29	91	-71.33865	-109.9984 Commenced recovery of AGT 3B
11/03/2008 22:13	91	-71.34227	-109.99837 AGT 3B on the seabed
11/03/2008 22:01	91	-71.3432	-109.99836 AGT 3B deployed
11/03/2008 22:00	91	-71.34317	-109.99836 AGT 3B off the seabed
11/03/2008 21:47	90	-71.34342	-109.99836 AGT 3A on deck
11/03/2008 21:42	90	-71.3435	-109.99838 AGT 3A at the surface
11/03/2008 21:30	90	-71.34449	-109.99836 AGT 3A off seabed
11/03/2008 21:21	90	-71.34518	-109.99839 Commenced recovery of AGT 3A
11/03/2008 21:10	90	-71.34815	-109.99838 AGT 3A veered to 716m
11/03/2008 21:05	90	-71.34884	-109.9984 AGT 3A on the seabed
11/03/2008 20:53	90	-71.34976	-109.9984 AGT 3A deployed
11/03/2008 20:51	90	-71.34999	-109.99841 AGT 3A off the deck
11/03/2008 20:49		-71.34999	-109.99839 Vessel set up on station in DP for AGT 3A deployment

11/03/2008 20:27		-71.33347	-110.00005	Vessel off DP and repositioning for AGT 3A deployment
11/03/2008 20:25	89	-71.33347	-110.00003	CTD on deck
11/03/2008 20:23	89	-71.33347	-110.00005	CTD at the surface
11/03/2008 20:10	89	-71.33348	-110.00004	CTD at depth 458m. Commenced recovery
11/03/2008 19:58	89	-71.33348	-110.00003	CTD deployed
11/03/2008 19:57	89	-71.33348	-109.99996	CTD off the deck.
11/03/2008 19:50		-71.33358	-109.99995	V/L on DP for CTD - Water depth 479m
11/03/2008 11:01		-72.72533	-107.2916	Vessel out of DP and proceeding
11/03/2008 08:43	88	-72.7253	-107.29433	Box Corer on deck
11/03/2008 08:41	88	-72.7253	-107.29433	Box Corer at the surface
11/03/2008 08:28	88	-72.72531	-107.29431	Commenced recovery of the Box Corer
11/03/2008 08:27	88	-72.72531	-107.29431	Box Corer on the seabed
11/03/2008 08:07	88	-72.72532	-107.29429	Box Corer deployed. Water depth 705m
11/03/2008 08:05	88	-72.72532	-107.29427	Box Corer off the deck
11/03/2008 07:46	87	-72.72531	-107.29426	Gravity corer recovered
11/03/2008 07:27	87	-72.72532	-107.29427	Gravity core taken
11/03/2008 07:08	87	-72.72533	-107.29425	Gravity corer deployed
11/03/2008 07:05	87	-72.72532	-107.29426	Commence deployment of gravity corer
11/03/2008 06:30		-72.72536	-107.29547	V/l on DP for coring
10/03/2008 20:50		-73.99137	-107.38432	Vessel off DP to continue Swath survey
10/03/2008 20:23	86	-73.99136	-107.3843	Box Corer on deck
10/03/2008 20:21	86	-73.99136	-107.3843	Box Corer at the surface
10/03/2008 20:11	86	-73.99137	-107.38432	Commenced recovery of the Box Corer
10/03/2008 20:10	86	-73.99137	-107.38432	Box Corer on the seabed
10/03/2008 19:56	86	-73.99137	-107.38431	Box corer deployed
10/03/2008 19:09	85	-73.99139	-107.38413	EBS 3F recovered
10/03/2008 18:55	85	-73.99088	-107.38637	EBS 3F off seabed
10/03/2008 18:44	85	-73.99019	-107.38932	EBS 3F commence hauling
10/03/2008 18:34	85	-73.98851	-107.3964	EBS 3F @ 800m
10/03/2008 18:18	85	-73.98774	-107.39967	EBS 3F deployed
10/03/2008 18:02	84	-73.98769	-107.39991	EBS 3E recovered
10/03/2008 17:45	84	-73.98687	-107.4019	EBS 3E off seabed
10/03/2008 17:35	84	-73.98615	-107.40278	EBS 3E commence hauling
10/03/2008 17:24	84	-73.98324	-107.40459	EBS 3E @ 800m
10/03/2008 17:19	84	-73.98283	-107.40484	EBS 3E on seabed
10/03/2008 17:06	84	-73.98191	-107.40613	EBS 3E deployed
10/03/2008 16:55	83	-73.98181	-107.40638	EBS 3D recovered
10/03/2008 16:41	83	-73.98114	-107.40819	EBS 3D clear of seabed
10/03/2008 16:31	83	-73.98052	-107.4098	Commence hauling EBS 3D
10/03/2008 16:20	83	-73.9781	-107.41604	EBS 3D @ 801m
10/03/2008 16:04	83	-73.97703	-107.41882	EBS 3D Deployed
10/03/2008 16:00		-73.97695	-107.41906	Vessel Set Up In D.P.
10/03/2008 15:29		-73.98562	-107.38672	Vessel off DP and relocating
10/03/2008 15:10	82	-73.98465	-107.38883	EBS 3C Off seabed
10/03/2008 15:01	82	-73.98408	-107.39032	Start hauling EBS 3C
10/03/2008 14:50	82	-73.98093	-107.39717	EBS 3C Veered to 800m
10/03/2008 14:34	82	-73.98077	-107.39859	EBS 3C Deployed
10/03/2008 14:09	81	-73.98103	-107.39978	EBS 3B Recovered
10/03/2008 13:53	81	-73.98004	-107.40572	EBS 3B Off seabed
10/03/2008 13:44	81	-73.97937	-107.40391	Start hauling EBS 3B
10/03/2008 13:32	81	-73.97688	-107.4103	EBS 3B Veered to 800m

10/03/2008 13:16	81	-73.97582	-107.41297 EBS 3B Deployed. Depth 557m
10/03/2008 13:00	80	-73.97584	-107.41291 EBS 3A Recovered
10/03/2008 12:58	80	-73.97579	-107.41301 EBS 3A @ Surface
10/03/2008 12:44	80	-73.97486	-107.41531 EBS 3A Off seabed
10/03/2008 12:35	80	-73.97423	-107.4171 Start hauling EBS 3A
10/03/2008 12:24	80	-73.97193	-107.42286 EBS 3A Veered to 800m
10/03/2008 12:08	80	-73.97084	-107.42561 EBS 3A Deployed. Depth 570m
10/03/2008 11:57		-73.97062	-107.42623 Vessel on station in DP for EBS deployment
10/03/2008 11:38		-73.98426	-107.39843 Vessel off D.P. relocating to EBS 3A start position
10/03/2008 11:35	79	-73.98411	-107.3988 AGT 3D on deck
10/03/2008 11:27	79	-73.98355	-107.40014 AGT 3D at the surface
10/03/2008 11:14	79	-73.9827	-107.40231 AGT 3D off the seabed
10/03/2008 11:04	79	-73.98201	-107.40407 Commenced recovery of AGT 3D
10/03/2008 10:56	79	-73.9804	-107.4082 AGT 3D veered to 828m
10/03/2008 10:50	79	-73.97973	-107.40988 AGT 3D on the seabed
10/03/2008 10:44	79	-73.9794	-107.41073 Resumed veering cable
10/03/2008 10:42	79	-73.9792	-107.41126 Stopped veering cable. Cable out 255m
10/03/2008 10:30	79	-73.97838	-107.41334 AGT 3D deployed
10/03/2008 10:30	79	-73.97843	-107.41323 AGT 3D off the deck
10/03/2008 10:28		-73.97825	-107.41363 Vessel on Station in DP for AGT 3D deployment
10/03/2008 10:05		-73.99034	-107.37956 Vessel off D.P. relocating to AGT 3B re-run position
10/03/2008 10:03	78	-73.99034	-107.37955 AGT 3C on deck
10/03/2008 10:01	78	-73.99035	-107.37952 AGT 3C at the surface
10/03/2008 09:47	78	-73.98938	-107.38215 AGT-3C off the seabed
10/03/2008 09:37	78	-73.98869	-107.38406 Commenced recovery of AGT 3C
10/03/2008 09:27	78	-73.98658	-107.38975 AGT 3C veered to 816m
10/03/2008 09:21	78	-73.98578	-107.392 AGT 3C on the seabed
10/03/2008 09:05	78	-73.98478	-107.39483 AGT 3C deployed
10/03/2008 08:53	77	-73.98454	-107.39549 AGT 3B on deck
10/03/2008 08:51	77	-73.98455	-107.39547 AGT 3B at the surface
10/03/2008 08:37	77	-73.98366	-107.39789 AGT 3B off the seabed
10/03/2008 08:28	77	-73.98307	-107.39958 Commenced recovery of AGT 3B
10/03/2008 08:17	77	-73.98088	-107.40545 AGT 3B veered to 817m
10/03/2008 08:11	77	-73.98005	-107.4078 AGT 3B on seabed
10/03/2008 07:55	77	-73.97901	-107.41059 AGT 3B deployed
10/03/2008 07:30	76	-73.97882	-107.41117 AGT 3A recovered
10/03/2008 07:12	76	-73.97782	-107.41397 AGT 3A off seabed
10/03/2008 07:04	76	-73.97731	-107.41541 AGT 3A commence hauling
10/03/2008 06:52	76	-73.97494	-107.42207 AGT 3A @ 822m
10/03/2008 06:46	76	-73.97422	-107.42334 AGT 3A on seabed
10/03/2008 06:16	76	-73.97229	-107.42964 AGT 3A deployed
10/03/2008 05:50	75	-73.9788	-107.41835 CTD recovered
10/03/2008 05:32	75	-73.97968	-107.41614 CTD @ 507m
10/03/2008 05:20	75	-73.98017	-107.41475 CTD deployed - water depth 553m
10/03/2008 05:08		-73.98002	-107.41598 V/L on DP for CTD
10/03/2008 01:54		-73.89167	-106.27503 Vessel off DP and relocating
10/03/2008 01:17	74	-73.8917	-106.27501 Box 2A On Deck
10/03/2008 01:14	74	-73.8917	-106.275 Box 2A @ Surface
10/03/2008 00:54	74	-73.8917	-106.27501 Start hauling Box 2A
10/03/2008 00:53	74	-73.89168	-106.27501 Box 2A On seabed
10/03/2008 00:23	74	-73.89167	-106.27501 Box 2A deployed. Depth 1106m

09/03/2008 23:29	73	-73.89166	-106.27509 EBS 2B on deck
09/03/2008 23:27	73	-73.89156	-106.27538 EBS 2B at the surface
09/03/2008 23:00	73	-73.89	-106.28109 EBS 2B off the seabed
09/03/2008 22:43	73	-73.88899	-106.28473 Commenced recovery of EBS 2B
09/03/2008 22:27	73	-73.88648	-106.29379 EBS 2B veered to 1551m
09/03/2008 22:18	73	-73.88595	-106.2957 EBS 2B on the seabed
09/03/2008 21:56	73	-73.88467	-106.30027 EBS 2B deployed
09/03/2008 21:54	73	-73.8848	-106.2996 EBS 2B off the deck
09/03/2008 21:40	72	-73.8845	-106.30093 EBS 2A on deck
09/03/2008 21:38	72	-73.88439	-106.30134 EBS 2A at the surface
09/03/2008 21:13	72	-73.88294	-106.30649 EBS 2A off the seabed
09/03/2008 21:04	72	-73.88295	-106.30649 EBS 2A clear. Continuing to haul easy
09/03/2008 21:02	72	-73.88296	-106.30646 EDS 2A fast on seabed. Vessel stopped. Hauling easy
09/03/2008 20:50	72	-73.88223	-106.30905 Commenced recovery of EBS 2A
09/03/2008 20:39	72	-73.88014	-106.31659 EBS 2A veered to 1502m
09/03/2008 20:30	72	-73.87962	-106.31847 EBS 2A on the seabed
09/03/2008 20:10	72	-73.87848	-106.32275 EBS 2A deployed
09/03/2008 20:09	72	-73.87841	-106.32293 EBS 2A off the deck
09/03/2008 20:02		-73.87795	-106.32357 V/L on DP for EBS
09/03/2008 19:46		-73.87404	-106.29142 V/L off DP
09/03/2008 19:32	71	-73.87332	-106.28742 AGT 2C recovered
09/03/2008 19:06	71	-73.87136	-106.29061 AGT 2C clear of seabed
09/03/2008 18:46	71	-73.86973	-106.29325 AGT 2C start hauling
09/03/2008 18:30	71	-73.86567	-106.29862 AGT 2C @ 1600m
09/03/2008 18:20	71	-73.86429	-106.29989 AGT 2C on seabed
09/03/2008 17:57	71	-73.86265	-106.30261 AGT 2C Deployed
09/03/2008 17:54		-73.86252	-106.30299 V/L on DP for AGT 2C
09/03/2008 17:34		-73.87542	-106.2714 V/L off DP relocating for redeployment
09/03/2008 17:21	70	-73.87519	-106.27365 AGT 2B recovered
09/03/2008 16:55	70	-73.87446	-106.28106 AGT 2B clear of seabed
09/03/2008 16:37	70	-73.87392	-106.28594 AGT 2B commence hauling
09/03/2008 16:21	70	-73.8718	-106.29939 AGT 2B @ 1550m
09/03/2008 16:11	70	-73.87115	-106.30349 AGT 2B on seabed
09/03/2008 15:48	70	-73.87055	-106.30762 AGT 2B Deployed. Depth 1130m
09/03/2008 15:30		-73.87057	-106.30769 Vessel Set Up In D.P.
09/03/2008 15:13		-73.86281	-106.27252 Vessel off DP and relocating
09/03/2008 15:08	69	-73.8628	-106.27248 AGT 2A Recovered and back on deck
09/03/2008 14:42	69	-73.86304	-106.27672 AGT 2A Off seabed
09/03/2008 14:23	69	-73.86406	-106.27935 Start hauling AGT 2A
09/03/2008 14:08	69	-73.86252	-106.29304 AGT 2A Veered to 1580m
09/03/2008 13:59	69	-73.86205	-106.29728 AGT 2A On seabed
09/03/2008 13:35	69	-73.86185	-106.29909 AGT 2A Deployed. Depth 1054m
09/03/2008 13:28		-73.86184	-106.29918 Vessel Set Up In D.P.
09/03/2008 13:04		-73.85251	-106.16882 Vessel off DP station
09/03/2008 12:44	68	-73.85276	-106.16921 CTD Recovered on deck
09/03/2008 12:19	68	-73.85274	-106.16928 CTD @ 942m
09/03/2008 12:00	68	-73.85271	-106.1692 CTD deployed
09/03/2008 11:57	68	-73.8527	-106.16921 CTD off the deck
09/03/2008 11:38		-73.8527	-106.16914 Completed Swath run. Set up on station in DP for CTD. Mid-ships gantry unlashed.
09/03/2008 09:21		-74.12415	-105.81226 Aft Deck secure. Vessel off DP and proceeding to 1000m site.
09/03/2008 09:06	67	-74.12413	-105.81233 EBS 1B on deck

09/03/2008 09:04	67	-74.12408	-105.81262	EBS 1B at the surface
09/03/2008 08:30	67	-74.12226	-105.82059	EBS 1B off the seabed
09/03/2008 07:51	67	-74.12003	-105.83045	Commenced recovery of EBS 1B
09/03/2008 07:42	67	-74.11856	-105.83686	EBS 1B @ 2250m
09/03/2008 06:52	67	-74.11701	-105.84398	EBS 1B deployed
09/03/2008 06:47	67	-74.11701	-105.84392	V/L on DP for EBS redeployment
09/03/2008 06:26		-74.12282	-105.80997	V/L off DP
09/03/2008 06:18	66	-74.12285	-105.81	EBS 1A recovered
09/03/2008 05:40	66	-74.12112	-105.81945	EBS 1A clear of seabed
09/03/2008 05:05	66	-74.11971	-105.82839	EBS 1A commence hauling
09/03/2008 04:54	66	-74.11819	-105.83786	EBS 1A @ 2250m
09/03/2008 04:38	66	-74.11756	-105.84209	EBS 1A on seabed
09/03/2008 04:06	66	-74.11696	-105.84581	EBS 1A Deployed
09/03/2008 03:37		-74.11697	-105.84578	Vessel Set Up In D.P.
08/03/2008 12:50		-74.12192	-105.79544	Vessel off DP station
08/03/2008 12:15	65	-74.1237	-105.79489	AGT Back on deck
08/03/2008 12:10	65	-74.12359	-105.79558	AGT @ Surface
08/03/2008 11:36	65	-74.12212	-105.80426	AGT 1B off the seabed
08/03/2008 11:12	65	-74.12107	-105.81044	Commenced recovery of AGT 1B
08/03/2008 10:56	65	-74.11877	-105.82389	AGT 1B veered to 2222m
08/03/2008 10:40	65	-74.1176	-105.83075	AGT 1B on the seabed
08/03/2008 10:05	65	-74.11605	-105.83972	AGT 1B deployed
08/03/2008 10:03	65	-74.11596	-105.84022	AGT 1B off the deck
08/03/2008 09:56		-74.11592	-105.84054	Vessel Set Up In D.P.
08/03/2008 09:29				Vessel off D.P. relocating to AGT 1B start position
08/03/2008 09:21	64	-74.13156	-105.74864	AGT 1A at the surface
08/03/2008 08:47	64	-74.13009	-105.75723	AGT 1A off the seabed
08/03/2008 08:22	64	-74.12899	-105.76383	Commenced recovery of AGT-1A
08/03/2008 08:05	64	-74.12662	-105.77751	AGT 1A veered to 2240m
08/03/2008 07:49	64	-74.12549	-105.78426	AGT 1A on seabed
08/03/2008 07:14	64	-74.12394	-105.79324	AGT 1A deployed - water depth 1512m
08/03/2008 06:50		-74.12379	-105.79196	Deployment of AGT delayed due to investigation of winch problem
08/03/2008 06:45		-74.12351	-105.79327	V/L on DP for AGT deployment
08/03/2008 06:24		-74.13194	-105.74637	V/L off DP. Relocating for AGT deployment
08/03/2008 06:06	63	-74.13194	-105.74632	CTD recovered
08/03/2008 05:32	63	-74.13195	-105.74632	CTD @ 1432m
08/03/2008 05:02	63	-74.13193	-105.74634	CTD deployed
08/03/2008 04:50		-74.13159	-105.74649	V/L on DP
08/03/2008 04:36		-74.13783	-105.74349	V/L off DP
08/03/2008 04:06	62	-74.13783	-105.74355	Gravity corer recovered
08/03/2008 03:37	62	-74.13784	-105.74345	Gravity corer off seabed
08/03/2008 03:36	62	-74.13784	-105.74346	Gravity Corer on the seabed
08/03/2008 03:05	62	-74.13782	-105.74357	Gravity corer deployed
08/03/2008 03:00		-74.13786	-105.74347	Arrived at new location
08/03/2008 02:53		-74.1383	-105.74045	Relocate
08/03/2008 02:00	61	-74.13832	-105.7403	Box Corer on deck
08/03/2008 01:38	61	-74.13833	-105.7403	Box Corer at the surface
08/03/2008 01:35	61	-74.13832	-105.74031	Box corer off seabed. start hauling
08/03/2008 01:33	61	-74.13833	-105.74033	Box corer on seabed
08/03/2008 01:30	61	-74.13834	-105.74034	Box corer 50m off seabed
08/03/2008 00:58	61	-74.13833	-105.74035	Box corer Deployed. Depth 1484m

08/03/2008 00:34	60	-74.13831	-105.7403	Gravity corer retreved and back on deck
08/03/2008 00:32	60	-74.13831	-105.74029	Gravity Corer housed
08/03/2008 00:29	60	-74.13831	-105.7403	Gravity Corer at the surface
08/03/2008 00:06	60	-74.13834	-105.74031	Start hauling Gravity Corer
08/03/2008 00:04	60	-74.13833	-105.74032	Gravity corer on seabed
07/03/2008 23:36	60	-74.13834	-105.74035	Gravity corer deployed
07/03/2008 23:35	60	-74.13834	-105.74034	Gravity Corer unhoused
07/03/2008 23:30		-74.13827	-105.74089	Vessel Set Up In D.P. Side Gantry unlashed
07/03/2008 22:44		-74.4043	-104.79477	Completed Topaz survey. Repositioning for Gravity Core site
07/03/2008 21:16		-74.1561	-105.65963	Completed Swath survey. Commencing Topaz survey.
07/03/2008 18:36	59	-74.39879	-104.74987	All secure
07/03/2008 18:11	59	-74.3988	-104.74986	Box corer recovered
07/03/2008 17:59	59	-74.3988	-104.74987	Box corer clear of seabed. Hauling
07/03/2008 17:58	59	-74.3988	-104.74987	Box corer on seabed
07/03/2008 17:39	59	-74.39844	-104.75163	Box corer deployed
07/03/2008 16:49	58	-74.3939	-104.75506	EBS 3F recovered
07/03/2008 16:36	58	-74.39334	-104.75867	EBS 3F clear of seabed
07/03/2008 16:19	58	-74.39268	-104.75941	EBS 3F commence hauling
07/03/2008 16:08	58	-74.39025	-104.76344	EBS 3F @ 753m
07/03/2008 16:03	58	-74.3896	-104.76458	EBS 3F on seabed
07/03/2008 15:53	58	-74.38947	-104.76484	EBS 3F Deployed
07/03/2008 15:49		-74.38948	-104.76482	Vessel Set Up In D.P.
07/03/2008 14:40		-74.40058	-104.75008	Vessel off D.P. relocating to EBS 3F start position
07/03/2008 14:36	57	-74.4006	-104.75013	EBS 3E Recovered and back on deck
07/03/2008 14:20	57	-74.39959	-104.75182	EBS 3E Off seabed
07/03/2008 14:07	57	-74.39862	-104.75351	Start Hauling EBS 3E
07/03/2008 13:56	57	-74.39601	-104.75796	EBS 3E Veered to 764m
07/03/2008 13:51	57	-74.39564	-104.75862	EBS 3E on seabed
07/03/2008 13:40	57	-74.3954	-104.75905	EBS 3E Deployed
07/03/2008 13:25	56	-74.39537	-104.75901	EBS 3D Recovered and back on deck
07/03/2008 13:22	56	-74.39531	-104.75911	EBS 3D @ Surface
07/03/2008 13:08	56	-74.3943	-104.761	EBS 3D Off seabed
07/03/2008 12:55	56	-74.39337	-104.7627	Start Hauling EBS 3D
07/03/2008 12:45	56	-74.39092	-104.76717	EBS 3D Veered to 761m
07/03/2008 12:39	56	-74.39047	-104.76798	EBS 3D On seabed
07/03/2008 12:29	56	-74.39038	-104.76814	EBS 3D Deployed
07/03/2008 12:15		-74.39035	-104.76819	Vessel Set Up In D.P.
07/03/2008 11:47		-74.36362	-104.79804	Vessel off D.P. relocating to EBS 3D start position
07/03/2008 11:33		-74.36364	-104.798	Vessel Set Up In D.P. awaiting instructions
07/03/2008 10:41		-74.40232	-104.62466	Vessel off DP to continue Swath survey
07/03/2008 10:31	55	-74.4023	-104.62474	EBS 3C on deck
07/03/2008 10:29	55	-74.40223	-104.62513	EBS 3C at the surface
07/03/2008 10:17	55	-74.40153	-104.62722	Ebs 3C off the seabed. Vessel moving off at 0.3kts for recovery
07/03/2008 10:11	55	-74.40153	-104.62729	Commenced hauling cable
07/03/2008 10:10	55	-74.40153	-104.62725	Cable veered to 600m
07/03/2008 10:05	55	-74.40152	-104.62727	Tension rise (3t)(cable out 577m) cable veered and ship stopped.
07/03/2008 09:55	55	-74.40095	-104.62941	Commenced recovery of EBS 3C
07/03/2008 09:44	55	-74.39878	-104.63653	EBS 3C veered to 750m
07/03/2008 09:40	55	-74.39852	-104.63736	EBS 3C on the seabed
07/03/2008 09:24	55	-74.39747	-104.6403	EBS 3C deployed
07/03/2008 09:22	55	-74.39734	-104.64071	EBS 3C off the deck

07/03/2008 08:25		-74.39609	-104.64687 Vessel on station in DP standing by
07/03/2008 06:24		-74.40207	-104.65133 Ice conditions make 500m site unworkable. V/L off DP
07/03/2008 05:46		-74.399	-104.65079 V/L on DP assessing ice conditions
07/03/2008 05:31		-74.40544	-104.60185 V/L off DP
07/03/2008 05:27	54	-74.40559	-104.60143 EBS 2B recovered
07/03/2008 05:13	54	-74.40487	-104.60447 EBS 2B clear of seabed
07/03/2008 05:01	54	-74.40417	-104.60741 EBS 2B commence hauling
07/03/2008 04:51	54	-74.40239	-104.61474 EBS 2B @ 750m
07/03/2008 04:31	54	-74.40126	-104.61944 EBS 2B deployed
07/03/2008 04:13	53	-74.40116	-104.61995 EBS 2A recovered
07/03/2008 03:57	53	-74.4004	-104.62327 Increase speed back to 0.3 knot
07/03/2008 03:47	53	-74.4004	-104.62326 Ship stopped due to snag on seabed
07/03/2008 03:43	53	-74.4002	-104.62415 Start hauling EBS 2A
07/03/2008 03:33	53	-74.39847	-104.63207 EBS 2A Veered to 760m
07/03/2008 03:11	53	-74.39734	-104.63731 EBS 2A Deployed
07/03/2008 03:07		-74.39717	-104.63794 Vessel Set Up In D.P.
07/03/2008 02:51		-74.407	-104.60073 Vessel off DP. Relocating for EBS deployment
07/03/2008 02:46	52	-74.40701	-104.60073 AGT 3C On deck
07/03/2008 02:42	52	-74.40679	-104.60164 AGT 3C @ Surface
07/03/2008 02:27	52	-74.40597	-104.60511 AGT 3C Off seabed
07/03/2008 02:20	52	-74.40561	-104.60676 Start Hauling AGT 3C
07/03/2008 02:09	52	-74.40413	-104.61303 AGT 3C On Seabed
07/03/2008 01:54	52	-74.4033	-104.61645 AGT 3C Deployed
07/03/2008 01:15	52	-74.40289	-104.61835 AGT 3B On Deck
07/03/2008 01:04	52	-74.4029	-104.61836 AGT 3B @ Surface
07/03/2008 00:49	52	-74.40195	-104.62093 AGT 3B Off seabed
07/03/2008 00:39	52	-74.4013	-104.62274 Start hauling AGT 3B
07/03/2008 00:28	52	-74.39892	-104.62936 AGT 3B Veered to 750m
07/03/2008 00:24	52	-74.39847	-104.63054 AGT 3B On seabed
07/03/2008 00:09	52	-74.39778	-104.63253 AGT 3B deployed
06/03/2008 23:51	51	-74.39724	-104.63409 Vessel on Station in DP for AGT 3B deployment
06/03/2008 23:35	51	-74.41422	-104.64297 Vessel off DP and relocating station
06/03/2008 23:33	51	-74.41414	-104.64314 AGT 3A on deck
06/03/2008 23:28	51	-74.41376	-104.64427 AGt 3A at the surface
06/03/2008 23:28	51	-74.41376	-104.64427 AGT 3A at the surface
06/03/2008 23:15	51	-74.41294	-104.64643 AGt 3A off the seabed
06/03/2008 23:06	51	-74.4123	-104.6482 Commenced recovery of AGT 3A
06/03/2008 22:55	51	-74.4099	-104.65466 AGT 3A veered to 753m
06/03/2008 22:50	51	-74.40934	-104.65615 AGt 3A on seabed
06/03/2008 22:38	51	-74.40855	-104.65835 AGT 3A deployed
06/03/2008 22:37	51	-74.40839	-104.65873 AGT 3A off the deck
06/03/2008 22:28		-74.40839	-104.65871 Mid-ships gantry secured. Preparing for AGT deployment
06/03/2008 22:20	50	-74.40839	-104.65869 CTD on deck
06/03/2008 22:18	50	-74.40839	-104.65869 CTD at the surface
06/03/2008 22:03	50	-74.40839	-104.65872 CTD @ 475m commenced recovery
06/03/2008 21:52	50	-74.40838	-104.65874 CTD deployed
06/03/2008 21:49	50	-74.40837	-104.65878 CTD off the deck.
06/03/2008 21:33		-74.40887	-104.66175 Completed Swarth survey. Vessel on station in DP for CTD deployment
06/03/2008 17:43		-74.35786	-104.67017 All secure
06/03/2008 17:24	49	-74.35785	-104.67016 Box corer recovered
06/03/2008 17:01	49	-74.35785	-104.67024 Box corer clear of seabed. Hauling

06/03/2008 17:00	49	-74.35785	-104.67024	Box corer on seabed
06/03/2008 16:57	49	-74.35785	-104.67025	Box corer 50m off seabed
06/03/2008 16:30	49	-74.35788	-104.67027	Box Corer deployed. Water depth 1435m
06/03/2008 16:02	48	-74.35787	-104.67025	CTD recovered
06/03/2008 15:55	48	-74.35786	-104.67021	CTD @ 150m
06/03/2008 15:53	48	-74.35784	-104.67022	CTD @ 200m
06/03/2008 15:52	48	-74.35784	-104.67022	CTD @ 250m
06/03/2008 15:48	48	-74.35785	-104.6702	CTD @ 400m
06/03/2008 15:44	48	-74.35787	-104.67023	CTD @ 600m
06/03/2008 15:40	48	-74.35786	-104.67026	CTD @ 800m
06/03/2008 15:35	48	-74.35786	-104.67022	CTD @ 1000m
06/03/2008 15:30	48	-74.35786	-104.67024	CTD @ 1200m
06/03/2008 15:25	48	-74.35786	-104.67026	Start Hauling CTD
06/03/2008 15:24	48	-74.35787	-104.67027	CTD @ 1391m
06/03/2008 15:01	48	-74.35787	-104.67032	CTD @ 300m
06/03/2008 14:51	48	-74.35784	-104.67028	CTD Deployed
06/03/2008 14:36		-74.35803	-104.66949	Vessel Set Up In D.P.
06/03/2008 14:22		-74.35958	-104.72389	Vessel off DP station
06/03/2008 14:03	47	-74.35955	-104.72415	EBS 2B Back on deck
06/03/2008 13:28	47	-74.35865	-104.73437	EBS 2B off the seabed
06/03/2008 13:02	47	-74.35804	-104.74195	EBS 2B Start hauling
06/03/2008 12:52	47	-74.35724	-104.7516	EBS 2B Veered to 2102m
06/03/2008 12:38	47	-74.35689	-104.75599	EBS 2B On seabed
06/03/2008 12:11	47	-74.35624	-104.76395	EBS 2B Deployed
06/03/2008 12:05		-74.35617	-104.76444	Vessel Set Up In D.P.
06/03/2008 11:47		-74.36253	-104.71779	Vessel out of DP repositioning for EBS 2B
06/03/2008 11:44	46	-74.36249	-104.71837	EBS 2A on deck
06/03/2008 11:42	46	-74.36244	-104.71897	EBS 2A at the surface
06/03/2008 11:09	46	-74.36167	-104.72878	EBS 2A off the seabed
06/03/2008 10:45	46	-74.36114	-104.73588	Commenced recovery of EBS 2A
06/03/2008 10:33	46	-74.35972	-104.74601	EBS 2A veered to 2098m
06/03/2008 10:19	46	-74.35907	-104.74953	EBS 2A on the seabed
06/03/2008 09:49	46	-74.35834	-104.75832	EBS 2A deployed
06/03/2008 09:48	46	-74.35831	-104.75862	EBS 2A off the deck
06/03/2008 09:38		-74.35825	-104.7595	Vessel on station in DP for EBS deployment
06/03/2008 09:20		-74.36065	-104.69726	Vessel off DP. Relocating for EBS deployment
06/03/2008 09:15	45	-74.36054	-104.69859	AGT 1B at the surface
06/03/2008 08:42	45	-74.35973	-104.70843	AGT 1B off the seabed
06/03/2008 08:19	45	-74.35918	-104.71522	Commenced recovery of AGT 1B
06/03/2008 08:03	45	-74.35795	-104.73008	AGT 1B veered to 2100m
06/03/2008 07:49	45	-74.35741	-104.73678	AGT 1B on seabed
06/03/2008 07:14	45	-74.35654	-104.74731	AGT 1B deployed
06/03/2008 06:03		-74.35652	-104.74786	V/L on DP
06/03/2008 05:40		-74.36181	-104.69682	V/L off DP
06/03/2008 05:37	44	-74.36175	-104.69771	AGT 1A recovered
06/03/2008 05:02	44	-74.36099	-104.70819	AGT 1A clear of seabed
06/03/2008 04:37	44	-74.36049	-104.71529	AGT 1A commence hauling
06/03/2008 04:21	44	-74.35927	-104.73059	AGT 1A 2150m
06/03/2008 04:07	44	-74.35858	-104.73759	AGT 1A on seabed
06/03/2008 03:31	44	-74.35749	-104.74789	Start deploying AGT 1A
06/03/2008 03:19		-74.35743	-104.74818	Vessel Set Up In D.P.

06/03/2008 03:09	43	-74.35932	-104.77238	XBT completed
06/03/2008 03:04	43	-74.37231	-104.78537	XBT deployed
06/03/2008 01:30		-74.48348	-104.42005	Vessel off DP station
06/03/2008 01:17	42	-74.48348	-104.42003	Box Corer on deck
06/03/2008 01:14	42	-74.48348	-104.42004	Box Corer at the surface
06/03/2008 00:52	42	-74.48347	-104.42006	Box corer off seabed. start hauling
06/03/2008 00:51	42	-74.48347	-104.42006	Box Corer on the seabed
06/03/2008 00:49	42	-74.48347	-104.42006	Box corer 50m off seabed
06/03/2008 00:25	42	-74.48347	-104.42004	Box Corer deployed. Water depth 1096m
06/03/2008 00:22	42	-74.48347	-104.42002	Box Corer at the surface
05/03/2008 23:59		-74.48356	-104.41866	Vessel repositioned and on station in DP for box corer
05/03/2008 23:41		-74.49154	-104.32122	Vessel out of DP repositioning for Box core
05/03/2008 23:23	41	-74.49154	-104.32118	EBS 2B on deck
05/03/2008 23:21	41	-74.49155	-104.32117	EBS 2B at the surface
05/03/2008 22:55	41	-74.49108	-104.32265	EBS 2B off the seabed
05/03/2008 22:38	41	-74.49001	-104.32604	Commenced recovery of EBS 2B
05/03/2008 22:27	41	-74.4878	-104.3329	EBS 2B veered to 1600m
05/03/2008 22:18	41	-74.48725	-104.33463	EBS 2B on the seabed
05/03/2008 21:57	41	-74.48692	-104.33576	EBS 2B deployed
05/03/2008 21:55	41	-74.4869	-104.33582	EBS 2B off the deck
05/03/2008 21:40	40	-74.4869	-104.3358	EBS 2A on deck
05/03/2008 21:38	40	-74.4869	-104.33579	EBS 2A at the surface
05/03/2008 21:11	40	-74.48661	-104.33669	EBS 2A off seabed
05/03/2008 20:53	40	-74.48548	-104.3402	Commenced hauling EBS 2A
05/03/2008 20:43	40	-74.48316	-104.34489	EBS 2A veered to 1601m. Increasing ships speed to 1kt
05/03/2008 20:34	40	-74.48247	-104.34615	EBS 2A on the seabed
05/03/2008 20:12	40	-74.48204	-104.34748	Re-deployed EBS 2A
05/03/2008 20:11	40	-74.48203	-104.34749	EBS 2A off the deck
05/03/2008 20:06		-74.48195	-104.34766	Vessel repositioned and on station in D.P.
05/03/2008 19:39		-74.47776	-104.21424	V/L off DP
05/03/2008 19:34	40	-74.47817	-104.21602	EBS 2A recovered
05/03/2008 19:22	40	-74.47901	-104.2199	EBS 2A stop veering- commence recovery
05/03/2008 19:12	40	-74.47948	-104.22293	EBS 2A deployed
05/03/2008 18:41	39	-74.4805	-104.23253	AGT 2C recovered
05/03/2008 18:12	39	-74.47967	-104.23897	AGT - 2C Off sea bed
05/03/2008 17:57	39	-74.4791	-104.24283	AGT 2C- commence hauling
05/03/2008 17:47	39	-74.47787	-104.25215	AGT 2C @ 1542m
05/03/2008 17:38	39	-74.47749	-104.25662	AGT 2C on seabed
05/03/2008 17:15	39	-74.47693	-104.25941	AGT 2C Deployed
05/03/2008 17:01	39	-74.47694	-104.2594	V/L on DP for AGT 2C
05/03/2008 16:34		-74.48553	-104.23074	V/L off DP relocating for next deployment
05/03/2008 16:32	38	-74.48538	-104.23137	AGT 2B recovered
05/03/2008 15:59	38	-74.48364	-104.23898	AGT 2B Off seabed
05/03/2008 15:44	38	-74.48278	-104.24284	Start hauling AGT 2B
05/03/2008 15:29	38	-74.4801	-104.25476	AGT 2B At 1519m
05/03/2008 15:20	38	-74.4793	-104.25827	AGT 2B On seabed
05/03/2008 15:00	38	-74.47857	-104.26157	AGT 2B Deployed
05/03/2008 14:57	38	-74.47857	-104.26153	AGT 2B Overboard
05/03/2008 14:50		-74.47855	-104.26155	Vessel Set Up In D.P.
05/03/2008 14:20		-74.485	-104.2266667	Vessel off DP station
05/03/2008 14:16	37	-74.4844	-104.21265	AGT Back on deck

05/03/2008 13:45	37	-74.4829	-104.21928	AGT 2A Off seabed
05/03/2008 13:27	37	-74.48181	-104.22423	Start hauling AGT 2A
05/03/2008 13:10	37	-74.47895167	-104.2367183	AGT 2A @ 1.5 times depth (1770m)
05/03/2008 13:00	37	-74.47833333	-104.2416667	AGT 2A On seabed
05/03/2008 12:33	37	-74.47666667	-104.2433333	Start deploying AGT 2A
05/03/2008 12:25	37	-74.47666667	-104.2433333	Vessel Set Up In D.P.
05/03/2008 01:21		-73.10733333	-107.0481667	Vessel off DP station
05/03/2008 00:52	36	-73.10739	-107.04818	Gravity corer retreved and back on deck
05/03/2008 00:51	36	-73.10739	-107.04818	Gravity corer in cradle
05/03/2008 00:49	36	-73.10739	-107.04818	Gravity Corer at the surface
05/03/2008 00:36	36	-73.10739	-107.04819	Gravity corer off seabed
05/03/2008 00:34	36	-73.10739	-107.04818	Gravity corer on seabed
05/03/2008 00:32	36	-73.10739	-107.04817	Gravity corer 50m off seabed
05/03/2008 00:16	36	-73.10738	-107.04818	Gravity corer deployed
05/03/2008 00:15	36	-73.10738	-107.04819	Gravity corer overboard
04/03/2008 23:30	35	-73.10739	-107.04822	Box Corer on deck
04/03/2008 23:27	35	-73.1074	-107.04821	Box Corer at the surface
04/03/2008 23:14	35	-73.10742	-107.04817	Commenced recovery of Box Corer
04/03/2008 23:13	35	-73.10745	-107.04817	Box Corer on the seabed
04/03/2008 22:57	35	-73.10741	-107.04819	Box Corer deployed. Water depth 778m
04/03/2008 22:55	35	-73.10741	-107.04818	Box Corer off the deck
04/03/2008 22:49		-73.10741	-107.04819	On station in DP for Box Corer
04/03/2008 22:25		-73.11076	-107.04688	Relocation north
04/03/2008 22:16		-73.10741	-107.04821	On station in DP for Box Corer
04/03/2008 22:07		-73.11928	-107.0501	Relocation north
04/03/2008 21:57		-73.11936	-107.05032	On station in DP for Box Corer
04/03/2008 17:35		-72.30282	-106.71893	V/L off DP proceeding SxW
04/03/2008 17:16	34	-72.30281	-106.71895	Piston corer recovered
04/03/2008 17:04	34	-72.30282	-106.71894	Piston corer clear fo seabed
04/03/2008 17:02	34	-72.30281	-106.71895	Piston Corer at the sea bed
04/03/2008 17:00	34	-72.30281	-106.71893	Piston corer 50 m from seabed
04/03/2008 16:46	34	-72.30282	-106.71896	Piston Corer deployed
04/03/2008 15:59	33	-72.30281	-106.71897	Box Corer on deck
04/03/2008 15:56	33	-72.30281	-106.71896	Box Corer at the surface
04/03/2008 15:45	33	-72.30282	-106.71898	Box corer clear of seabed. Hauling
04/03/2008 15:42	33	-72.30283	-106.71898	Box Corer on the seabed
04/03/2008 15:41	33	-72.30283	-106.71895	Box corer 50m off seabed
04/03/2008 15:27	33	-72.30281	-106.71896	Box corer deployed. depth 699m
04/03/2008 15:20		-72.30282	-106.71896	Vessel Set Up In D.P. Side Gantry unlashed
04/03/2008 11:28		-71.78587	-106.19221	Vessel off DP station
04/03/2008 11:12	32	-71.78586	-106.19215	EBS 1C on deck
04/03/2008 11:10	32	-71.78585	-106.19245	EBS 1C at the surface
04/03/2008 10:56	32	-71.78586	-106.19604	EBS 1C off the seabed
04/03/2008 10:48	32	-71.78585	-106.1983	EBS 1C hauling Ships speed 0.3kts
04/03/2008 10:36	32	-71.78581	-106.20811	EBS 1C veered to 800m Increasing ships speed to 1kt
04/03/2008 10:31	32	-71.78579	-106.20943	EBS 1C on the seabed
04/03/2008 10:17	32	-71.78581	-106.21314	EBS 1C deployed Ships speed 0.3kts
04/03/2008 10:03	31	-71.7865	-106.21603	EBS 1B on deck
04/03/2008 10:00	31	-71.78686	-106.21601	EBS 1B at the surface
04/03/2008 09:47	31	-71.78793	-106.21573	EBS 1B off the seabed
04/03/2008 09:39	31	-71.78785	-106.2158	EBS 1B hauling. Ships speed 0.3kts

04/03/2008 09:27	31	-71.79152	-106.21395	EBS 1B veered to 800m Ships speed increased to 1kt
04/03/2008 09:22	31	-71.79192	-106.21374	EBS 1B on seabed
04/03/2008 09:08	31	-71.79296	-106.21238	EBS 1B deployed Ships speed 0.3kts
04/03/2008 08:40	30	-71.79149	-106.23127	EBS 1A on deck
04/03/2008 08:39	30	-71.79149	-106.23129	EBS 1A at the surface
04/03/2008 08:17	30	-71.79265	-106.22682	EBS 1A hauling. Ships speed 0.3kts
04/03/2008 08:12	30	-71.79359	-106.22511	EBS 1A veered to 800m Ships speed increased to 1kt
04/03/2008 08:00	30	-71.79504	-106.21932	EBS 1A on seabed
04/03/2008 07:45	30	-71.7959	-106.21654	EBS 1A deployed Ships speed 0.3kts
04/03/2008 06:49	29	-71.79151	-106.29506	AGT 1-C Recovered
04/03/2008 06:27	29	-71.79265	-106.29481	AGT clear of seabed
04/03/2008 06:17	29	-71.79347	-106.29386	Reduce to 0.3 knot
04/03/2008 06:07	29	-71.7958	-106.29109	AGT 1-C stopped @ 860m
04/03/2008 06:00	29	-71.79664	-106.29	AGT 1-C on seabed
04/03/2008 05:42	29	-71.79804	-106.28778	AGT 1-C Deployed
04/03/2008 05:17	28	-71.79607	-106.30145	AGT 1-B Recovered
04/03/2008 04:53	28	-71.79773	-106.29851	AGT-1-B Clear of seabed
04/03/2008 04:44	28	-71.7985	-106.29759	Reduce to 0.3 knot
04/03/2008 04:34	28	-71.80116	-106.29476	AGT 1-B stopped @ 869m
04/03/2008 04:27	28	-71.80205	-106.29388	AGT 1-B on seabed
04/03/2008 04:07	28	-71.80337	-106.29084	AGT - 1B Deployed
04/03/2008 03:54		-71.80398	-106.28965	V/L on station ready for AGT
04/03/2008 03:26		-71.80681	-106.34261	V/L off DP
04/03/2008 03:07	27	-71.80666667	-106.3433333	AGT - 1A on deck
04/03/2008 02:58	27	-71.80685833	-106.34263	AGT - 1A @ surface
04/03/2008 02:43	27	-71.80739	-106.34084	AGT Off seabed
04/03/2008 02:33	27	-71.807895	-106.3390733	Start hauling AGT
04/03/2008 02:19	27	-71.81034167	-106.3300267	AGT - 1A @ 860m
04/03/2008 02:12	27	-71.81094167	-106.3314883	AGT - 1A @ seabed
04/03/2008 01:54	27	-71.81195167	-106.3242433	AGT - 1A Deployed
04/03/2008 01:10		-71.81166667	-106.3216667	Vessel on Station in DP
01/03/2008 22:55		-70.1481	-91.08466	Vessel off DP station
01/03/2008 22:45	26	-70.14807	-91.08464	CTD on deck
01/03/2008 22:43	26	-70.1481	-91.08465	CTD at the surface
01/03/2008 21:38	26	-70.14808	-91.08469	Commenced CTD recovery
01/03/2008 21:36	26	-70.14809	-91.08477	CTD @ 3520m
01/03/2008 20:32	26	-70.14808	-91.08471	CTD deployed
01/03/2008 20:30	26	-70.14802	-91.08474	CTD off the deck.
01/03/2008 20:21		-70.14805	-91.08468	Vessel Set Up In D.P. Gantry unlashed
01/03/2008 20:15		-70.15191	-91.08222	Repositioning vessel for CTD station
01/03/2008 06:37		-69.81704	-84.82546	All secure
01/03/2008 06:09	25	-69.81704	-84.82923	CTD`recovered
01/03/2008 05:30	25	-69.817	-84.82906	CTD @ depth 1460m
01/03/2008 04:59	25	-69.81706	-84.82911	CTD deployed - water depth 1520m
01/03/2008 04:30		-69.81691	-84.83025	V/L on DP for 1500m CTD
29/02/2008 10:26	24	-69.08664	-76.38741	Gravity Corer housed.
29/02/2008 10:24	24	-69.08665	-76.38746	Gravity Corer at the surface
29/02/2008 10:12	24	-69.08668	-76.38742	Commenced recovery of the Gravity Corer
29/02/2008 10:10	24	-69.08669	-76.38742	Gravity Corer on the seabed
29/02/2008 09:53	24	-69.08651	-76.38721	Gravity Corer deployed
29/02/2008 09:51	24	-69.08653	-76.38729	Gravity Corer unhoused

29/02/2008 09:04	23	-69.08644	-76.38719	Box Corer on deck
29/02/2008 09:00	23	-69.08637	-76.3871	Box Corer at the surface
29/02/2008 08:46	23	-69.08635	-76.38706	Commenced recovery of Box Corer
29/02/2008 08:45	23	-69.08636	-76.3871	Box Corer on the seabed
29/02/2008 08:26	23	-69.08635	-76.38708	Box Corer deployed. Water depth 683m
29/02/2008 08:23	23	-69.08636	-76.38706	Box Corer off the deck
29/02/2008 08:00		-69.08645	-76.38772	Vessel on Station in DP. Setting up on deck for Box core
29/02/2008 01:10		-68.62014	-74.3045	Vessel off DP station
29/02/2008 00:43	22	-68.54357	-74.00276	Gravity corer retreved and back on deck
29/02/2008 00:40	22	-68.54357	-74.0028	Gravity corer in cradle
29/02/2008 00:39	22	-68.54358	-74.00278	Gravity corer at surface
29/02/2008 00:26	22	-68.54357	-74.0028	Gravity corer off seabed
29/02/2008 00:24	22	-68.54358	-74.0028	Gravity corer on seabed
29/02/2008 00:23	22	-68.54358	-74.00279	Gravity corer 50m off seabed
29/02/2008 00:07	22	-68.54355	-74.00279	Gravity corer re-deployed
28/02/2008 23:44	22	-68.54361	-74.00281	Gravity corer retreved and back on deck
28/02/2008 23:40	22	-68.54363	-74.0028	Gravity corer in cradle
28/02/2008 23:39	22	-68.54358	-74.00275	Gravity corer at surface
28/02/2008 23:27	22	-68.54361	-74.00268	Gravity corer off seabed
28/02/2008 23:25	22	-68.54359	-74.00274	Gravity corer on seabed
28/02/2008 23:22	22	-68.5436	-74.00276	Gravity corer 50m off seabed
28/02/2008 23:08	22	-68.5436	-74.00275	Gravity corer deployed
28/02/2008 23:05	22	-68.54358	-74.00275	gravity corer overboard
28/02/2008 22:51		-68.54355	-74.00297	Vessel Set Up In D.P. Gantry unlashed
28/02/2008 16:27		-68.28734	-76.13469	All secure
28/02/2008 16:18	21	-68.28733	-76.13462	CTD recovered
28/02/2008 15:11	21	-68.28734	-76.13468	CTD @ 3238m
28/02/2008 14:15	21	-68.28666667	-76.135	CTD Deployed
28/02/2008 13:55	21	-68.28666667	-76.135	Vessel Set Up In D.P. Gantry unlashed
28/02/2008 11:00		-68.55033	-76.15125	Vessel off DP station
28/02/2008 10:57		-68.55057	-76.13488	Mid-ships gantry secured
28/02/2008 10:51	20	-68.55058	-76.13485	CTD on deck
28/02/2008 10:49	20	-68.55058	-76.13488	CTD at the surface
28/02/2008 10:35	20	-68.5506	-76.13485	Commenced CTD recovery
28/02/2008 10:33	20	-68.55034	-76.13455	CTD @ 410m
28/02/2008 10:20	20	-68.5506	-76.13483	CTD deployed
28/02/2008 10:17	20	-68.55058	-76.13488	CTD off the deck.
28/02/2008 10:12		-68.5506	-76.13482	Vessel on Station in DP
28/02/2008 09:44		-68.53226	-76.19228	Off DP. Repositioning vessel for CTD 7
28/02/2008 09:23	19	-68.53223	-76.19229	AGT-3C on deck. Ship stopped.
28/02/2008 09:22	19	-68.53227	-76.19243	AGT-3C at the surface
28/02/2008 08:49	19	-68.53575	-76.20184	AGT-3C veered to 704m. Increasing ships speed to 1.0kts
28/02/2008 08:44	19	-68.53622	-76.20316	AGt-3C on seabed. Increasing speed to 0.5kts
28/02/2008 08:28	19	-68.53716	-76.20572	AGT-3C deployed
28/02/2008 08:26	19	-68.53728	-76.20602	AGT-3C off the deck. Vessel tracking 045 degrees at 0.3kts
28/02/2008 08:11	18	-68.53719	-76.20597	AGT-3B on deck. turning vessel 180 degrees for third run
28/02/2008 08:08	18	-68.53701	-76.2055	AGT-3B at the surface
28/02/2008 07:56	18	-68.53631	-76.20354	AGT-3B off the seabed
28/02/2008 07:48	18	-68.53585	-76.20229	AGT-3B hauling. Speed 0.3kts
28/02/2008 07:36	18	-68.53369	-76.19645	AGT-3B veered to 700m. Speed increased to 1kt
28/02/2008 07:31	18	-68.5332	-76.19509	AGT-3B on seabed. Increasing to 0.5kts

28/02/2008 07:15	18	-68.53228	-76.19254	AGT-3B deployed
28/02/2008 07:12	18	-68.53209	-76.19202	AGT-3B off the deck. Vessel tracking 225 degrees at 0.3kts
28/02/2008 06:54	17	-68.53193	-76.19165	AGT recovered
28/02/2008 06:39	17	-68.53107	-76.1892	AGT clear of seabed
28/02/2008 06:33	17	-68.53075	-76.18835	Resume hauling
28/02/2008 05:53	17	-68.52837	-76.18191	Problem with air supply
28/02/2008 05:51	17	-68.5282	-76.18132	Reduce to 0.3knots. commence hauling
28/02/2008 05:41	17	-68.5263	-76.17608	Increase to 1knot for bottom trawl
28/02/2008 05:37	17	-68.52591	-76.17501	AGT on sea bed
28/02/2008 05:16	17	-68.52474	-76.17172	Commence deployment of AGT for 500m trawl
28/02/2008 04:57	16	-68.52469	-76.17182	CTD recovered
28/02/2008 04:39	16	-68.52471	-76.17182	CTD @ 430m
28/02/2008 04:24	16	-68.52469	-76.17179	CTD deployed - water depth 470m
28/02/2008 03:58		-68.52441	-76.17259	V/L on DP for 500m CTD
28/02/2008 02:27	15	-68.477	-76.14143333	Vessel off DP station
28/02/2008 02:05	15	-68.47706167	-76.14143333	AGT - 2C back on deck. Ship back to auto pos
28/02/2008 02:02	15	-68.47693	-76.14095167	AGT - 2C at surface
28/02/2008 01:40	15	-68.475785	-76.13705167	AGT - 2C Off sea bed
28/02/2008 01:23	15	-68.474845	-76.13362167	Start hauling AGT
28/02/2008 00:58	15	-68.471725	-76.12327667	AGT - 2C on seabed
28/02/2008 00:32	15	-68.470395	-76.11901	AGT - 2C Deployed
28/02/2008 00:17	15	-68.47011333	-76.11807333	Vessel set up on station in D.P.
27/02/2008 23:40	14	-68.48506	-76.1663	Vessel off DP station
27/02/2008 23:21	14	-68.48504	-76.16631	AGT -2B On deck
27/02/2008 23:14	14	-68.48486	-76.16576	AGT-2B at surface
27/02/2008 22:51	14	-68.48364	-76.16172	AGT-2B off the seabed
27/02/2008 22:30	14	-68.48254	-76.1582	Commenced AGT-2B recovery
27/02/2008 21:42	14	-68.47792	-76.14216	AGT-2B deployed
27/02/2008 21:26	13	-68.47767	-76.14121	AGT-2A on deck
27/02/2008 21:25	13	-68.47761	-76.14101	AGT-2A at the surface
27/02/2008 21:04	14	-68.47813	-76.14287	AGT-2B on the seabed
27/02/2008 21:02	13	-68.47638	-76.13693	AGT-2A Off seabed
27/02/2008 20:42	13	-68.4753	-76.13333	Commenced AGT-2A Recovery
27/02/2008 20:26	13	-68.4726	-76.12423	AGT-2A @1500m
27/02/2008 20:17	13	-68.47184	-76.12158	AGT-2A At seabed
27/02/2008 19:52	13	-68.47053	-76.1172	AGT-2A Deployed
27/02/2008 19:41		-68.47044	-76.11705	Mid-ships gantry secured
27/02/2008 19:31	12	-68.47046	-76.11704	CTD on deck
27/02/2008 19:28	12	-68.47046	-76.11704	CTD at the surface
27/02/2008 19:05	12	-68.47045	-76.11704	CTD @ 950m
27/02/2008 18:44	12	-68.47074	-76.11707	CTD deployed - water depth 990m
27/02/2008 18:40		-68.47086	-76.11711	V/L on DP for CTD
27/02/2008 16:47		-68.39909	-75.91957	V/L off DP
27/02/2008 16:34	11	-68.39893	-75.9189	AGT recovered
27/02/2008 15:59	11	-68.39723	-75.91242	AGT clear of seabed
27/02/2008 15:28	11	-68.39561	-75.90628	Reduce to 0.3 knots for recovery
27/02/2008 15:12	11	-68.39315	-75.89665	Increase to 1 knot
27/02/2008 14:57	11	-68.392	-75.892	AGT At seabed
27/02/2008 14:21	11	-68.39	-75.885	AGT Deployed
27/02/2008 13:59	10	-68.39	-75.885	AGT On deck
27/02/2008 13:58	10	-68.39	-75.885	AGT @ Surface

27/02/2008 13:25	10	-68.388	-75.88	AGT Off seabed
27/02/2008 12:55	10	-68.387	-75.867	Start hauling AGT
27/02/2008 12:38	10	-68.383	-075..867	AGT @ 2250m
27/02/2008 12:25	10	-68.382	-75.858	AGT At seabed
27/02/2008 11:19	10	-68.379	-75.858	AGT Deployed
27/02/2008 11:15	10	-68.38	-75.858	AGT Overboard
27/02/2008 10:56	9	-68.37949	-75.85697	Mid-ships gantry secured
27/02/2008 10:46	9	-68.37949	-75.85697	CTD on deck
27/02/2008 10:44	9	-68.37949	-75.85698	CTD at the surface
27/02/2008 10:05	9	-68.37949	-75.85696	CTD @ 1444m
27/02/2008 09:31	9	-68.37947	-75.85697	CTD deployed . EA600 depth 1500 metres.
27/02/2008 09:28	9	-68.37948	-75.85695	CTD off the deck.
27/02/2008 09:20	9	-68.37949	-75.85698	Vessel set up on station in D.P.
27/02/2008 02:30	8	-67.675	-74.66	Vessel off DP station
27/02/2008 01:25	8	-67.675	-74.66	Piston Corer back on deck
27/02/2008 01:18	8	-67.675	-74.66	Piston Corer at the surface
27/02/2008 00:28	8	-67.675	-74.66	Piston Corer at the sea bed
27/02/2008 00:22	8	-67.675	-74.66	piston corer 100m from sea bed
26/02/2008 23:38	8	-67.675	-74.66	piston corer deployed
26/02/2008 22:54	7	-67.66275	-74.67691	Magnetometer recovered to deck.
26/02/2008 00:17	7	-64.90713	-69.08469	Magnetometer deployed
25/02/2008 23:30	6	-64.91006	-69.07628	Piston Corer back on deck
25/02/2008 23:00	6	-64.91003	-69.07632	Piston Corer latched into bucket housing
25/02/2008 22:55	6	-64.91004	-69.07632	Piston Corer at the surface
25/02/2008 22:40	6	-64.91002	-69.07637	Trigger weight on deck
25/02/2008 22:39	6	-64.91006	-69.07635	Trigger weight at the surface
25/02/2008 22:00	6	-64.91003	-69.07635	Commenced recovery of Piston Corer
25/02/2008 21:59	6	-64.91003	-69.07637	Piston Corer at the sea bed
25/02/2008 21:12	6	-64.91004	-69.07633	Piston Corer deployed
25/02/2008 20:55	6	-64.91004	-69.07627	Vessel on station for Piston Corer deployment
25/02/2008 20:17	6	-64.91803	-69.0884	Vessel Set Up In D.P.
25/02/2008 20:15	5	-64.9173	-69.08339	Magnetometer recovered to deck.
25/02/2008 00:47	5	-61.29972	-67.89214	Deploy Magnetometer
25/02/2008 00:23	4	-61.30183	-67.89257	CTD on deck
25/02/2008 00:13	4	-61.30188	-67.89256	CTD @ 30m
25/02/2008 00:07	4	-61.30188	-67.89256	CTD Deployed
24/02/2008 23:49	3	-61.30188	-67.89257	CTD on deck
24/02/2008 23:40	3	-61.30191	-67.89255	CTD @ 30m
24/02/2008 23:31	3	-61.30191	-67.89244	CTD Deployed
24/02/2008 23:08	2	-61.3032	-67.89514	CTD on deck.
24/02/2008 23:03	2	-61.30415	-67.89393	CTD at the surface
24/02/2008 22:46	2	-61.30449	-67.89421	CTD at 500 metres.
24/02/2008 22:33	2	-61.30481	-67.89362	CTD in the water. Deploying to 500m
24/02/2008 22:31	2	-61.30482	-67.89349	CTD off the deck.
24/02/2008 22:24	2	-61.30491	-67.89334	Vessel set up on station in D.P.
24/02/2008 22:19	1	-61.30579	-67.89174	Magnetometer recovered to deck.
22/02/2008 12:55	1	-54.52412	-59.14088	Deploy Magnetometer

B) AGT Event Log

Time	Latitude	Longitude	Station event name	Bridge event NO	Depth (m)	Heading	Speed (kn)	Action	Cable length
03/04/2008 09:52	-67.77149	-68.29284	live-AGT-3		241.74	38.1	0.7	on deck	-13
03/04/2008 09:43	-67.77182	-68.29441	live-AGT-3		243	33.29	0.1	off bottom	239
03/04/2008 09:37	-67.77211	-68.29577	live-AGT-3		240	34.71	1	end trawl	310
03/04/2008 09:32	-67.77281	-68.29895	live-AGT-3		223	40.36	0.7	start trawl	310
03/04/2008 09:30	-67.77295	-68.29958	live-AGT-3		223	44.09	0.4	on bottom	234
03/04/2008 09:20	-67.7731	-68.30018	live-AGT-3	167	226.3	48	0.3	in water	-7
03/04/2008 08:47	-67.76907	-68.29098	live-AGT-2		261	39.96	0.3	off bottom	258
03/04/2008 08:42	-67.76931	-68.29208	live-AGT-2		250	38.86	0.7	end trawl	320
03/04/2008 08:37	-67.77001	-68.29524	live-AGT-2		250	39.3	0.6	start trawling	320
03/04/2008 08:35	-67.77015	-68.29585	live - AGT2		245	38.14	0.3	on bottom	248
03/04/2008 08:25	-67.77028	-68.29634	live-AGT-2	166	242	29.42	0	in water	1
03/04/2008 08:08	-67.77027	-68.29634	live-AGT-1		230	29.77	0.4	on deck	-8
03/04/2008 08:00	-67.77081	-68.29716	live-AGT-1		230	28.95	0.4	off bottom	223
03/04/2008 07:55	-67.77123	-68.29779	live-AGT-1		230.59	28.85	1.1	end trawl	300
03/04/2008 07:50	-67.77251	-68.29976	live-AGT-1		226	29.45	0.4	start trawl	300
03/04/2008 07:48	-67.7727	-68.30005	live-AGT-1		226	29.63	0.3	on bottom	238
03/04/2008 07:39	-67.7729	-68.30037	live-AGT-1	165	225	28.95	0.3	in water	-4
15/03/2008 06:39	-69.21423	-117.48989	BIO7-AGT-2000		2222	104.81	0.6	on deck	-8
15/03/2008 05:48	-69.21245	-117.50085	BIO7-AGT-2000		2220.84	105.59	0.3	off bottom	2198
15/03/2008 05:14	-69.21124	-117.50827	BIO7-AGT-2000		2203.64	106.16	1.2	end trawl	3000
15/03/2008 04:58	-69.20942	-117.51902	BIO7-AGT-2000		2213.55	105.84	0.5	start trawl	3000
15/03/2008 04:43	-69.20887	-117.52231	BIO7-AGT-2000		2216	105.84	0.6	on bottom	2226
15/03/2008 03:47	-69.2064	-117.53327	BIO7-AGT-2000	116	2248	101.77	0.7	in water	-11
15/03/2008 01:40	-69.27017	-117.32164	BIO7-AGT-3000-DR194			102.56	1.2	on deck	-8
15/03/2008 00:21	-69.26393	-117.32739	BIO7-AGT-3000-DR194		3174.01	114.66	0.7	off bottom	3348
14/03/2008 23:45	-69.26094	-117.33009	BIO7-AGT-3000-DR194		3213.47	115.33	1.3	end trawl	4200
14/03/2008 23:30	-69.26094	-117.33009	BIO7-AGT-3000-DR194		3165.95	115.33	1.3	start trawl	4200
14/03/2008 23:12	-69.25584	-117.33482	BIO7-AGT-3000-DR194		3193	115.19	0.2	on bottom	3269
14/03/2008 22:04	-69.25044	-117.33971	BIO7-AGT-3000-DR194	115	3118.67	113.93	0.5	in water	-7
13/03/2008 10:04	-71.15394	-110.04038	BIO6-AGT-1B		1487	211.42	0.3	on deck	-12
13/03/2008 09:28	-71.1533	-110.03149	BIO6-AGT-1B		1489.6	211.21	0.3	off bottom	1484
13/03/2008 09:02	-71.15269	-110.02459	BIO6-AGT-1B		1491.25	214.05	1	end trawl	2225
13/03/2008 08:47	-71.15169	-110.01271	BIO6-AGT-1B		1484.69	213.19	0.5	start trawl	2222
13/03/2008 08:31	-71.15111	-110.00633	BIO6-AGT-1B		1484.19	218.31	0.3	on bottom	1470
13/03/2008 07:53	-71.1504	-109.99806	BIO6-AGT-1B	111	1483	218.5	0.2	in water	-2
13/03/2008 07:28	-71.14976	-109.99463	BIO6-AGT-1A		1534.51	229.32	0.3	on deck	-6
13/03/2008 06:53	-71.14873	-109.98904	BIO6-AGT-1A		1504.17	244.83	0.3	off bottom	1508
13/03/2008 06:29	-71.14779	-109.98333	BIO6-AGT-1A		1530.99	244.04	1	end trawl	2215
13/03/2008 06:14	-71.14627	-109.97148	BIO6-AGT-1A		1515.63	244.3	1.1	start trawl	2215
13/03/2008 05:59	-71.14558	-109.96544	BIO6-AGT-1A		1518.94	244.29	0.6	on bottom	1535
13/03/2008 05:22	-71.14452	-109.95634	BIO6-AGT-1A	110	1521.5	220.38	0.3	in water	0
12/03/2008 18:25	-71.18452	-109.94913	BIO6-AGT-2C		964.52	213.38	0.3	on deck	-2
12/03/2008 18:02	-71.18392	-109.94353	BIO6-AGT-2C		970.46	213.48	0.3	off bottom	976
12/03/2008 17:42	-71.18339	-109.93867	BIO6-AGT-2C		975.45	214.5	0.5	end trawl	1500
12/03/2008 17:26	-71.18211	-109.92639	BIO6-AGT-2C		986.93	213.53	0.6	start trawl	1500
12/03/2008 17:17	-71.18171	-109.92249	BIO6-AGT-2C		986.36	208.87	0.3	on bottom	1005
12/03/2008 16:54	-71.18112	-109.91693	BIO6-AGT-2C	103	986.38	208.51	0.3	in water	1

12/03/2008 16:37	-71.18105	-109.91638	BIO6-AGT-2B		987.25	214.38	0.2	on deck	-16
12/03/2008 16:13	-71.18048	-109.91045	BIO6-AGT-2B		984.69	213.15	0.4	off bottom	989
12/03/2008 15:53	-71.18002	-109.90541	BIO6-AGT2B		988.93	211.96	1	end trawl	1500
12/03/2008 15:38	-71.17901	-109.89387	BIO6-AGT-2B		997.95	208.99	0.5	start trawl	1500
12/03/2008 15:29	-71.17868	-109.89002	BIO6-AGT-2B		1000.82	208.19	0.2	on bottom	1014
12/03/2008 15:06	-71.1782	-109.88429	BIO6-AGT-2B	102	1024.71	196.85	0.3	in water	
12/03/2008 14:51	-71.17817	-109.88385	BIO6-AGT-2A		1002.54	196.46	0.3	on deck	-16
12/03/2008 14:27	-71.17761	-109.87777	BIO6-AGT-2A		1002.8	206.23	0.4	off bottom	1006
12/03/2008 14:06	-71.17718	-109.87242	BIO6-AGT-2A		1005.79	201.3	1.1	end trawl	1540
12/03/2008 13:51	-71.17512	-109.86314	BIO6-AGT-2A		1079.85	194.76	0.5	start trawl	1540
12/03/2008 13:41	-71.17478	-109.85927	BIO6-AGT-2A		1096.21	194.32	0.3	on bottom	1051
12/03/2008 13:18	-71.17427	-109.85339	BIO6-AGT-2A	101	1029.48	194.95	0.2	in water	-1
11/03/2008 23:57	-71.33411	-109.96665	BIO6-AGT-3C		481.79	356.44	0.3	on deck	499
11/03/2008 23:44	-71.34636	-110.00596	BIO6-AGT-3C		478.24	355.95	0.3	off bottom	503
11/03/2008 23:36	-71.34713	-110.00596	BIO6-AGT-3C		480.31	355.81	1	end trawl	710
11/03/2008 23:30	-71.3486	-110.00597	BIO6-AGT-3C		476.49	355.81	0.5	start trawl	710
11/03/2008 23:26	-71.34918	-110.00594	BIO6-AGT-3C		472.15	355.67	0.3	on bottom	476
11/03/2008 23:14	-71.35016	-110.00596	BIO6-AGT-3C	92	485.41	355.9	0.3	in water	-7
11/03/2008 22:52	-71.33668	-109.99844	BIO6-AGT-3B		482.26	356.38	0.3	on deck	-15
11/03/2008 22:37	-71.33792	-109.99841	BIO6-AGT-3B		479.13	356.33	0.3	off bottom	502
11/03/2008 22:28	-71.33879	-109.9984	BIO6-AGT-3B		480.14	356.48	1	end trawl	731
11/03/2008 22:18	-71.34157	-109.99838	BIO6-AGT-3B		480.95	356.25	0.5	start trawl	731
11/03/2008 22:13	-71.34225	-109.99837	BIO6-AGT-3B		484.77	356.57	0.3	on bottom	478
11/03/2008 22:00	-71.34329	-109.99836	BIO6-AGT-3B	91	481.63	356.3	0.3	in water	-11
11/03/2008 21:46	-71.34342	-109.99835	BIO6-AGT-3A		479.62	356.24	0.1	on deck	-15
11/03/2008 21:29	-71.34451	-109.99836	BIO6-AGT-3A		479.03	356.24	0.3	off bottom	489
11/03/2008 21:20	-71.34542	-109.99839	BIO6-AGT-3A		485.72	356.07	1	end trawl	716
11/03/2008 21:10	-71.34815	-109.99838	BIO6-AGT-3A		480.74	355.73	0.5	start trawl	716
11/03/2008 21:05	-71.34883	-109.9984	BIO6-AGT-3A		476.05	355.78	0.3	on bottom	474
11/03/2008 20:52	-71.34991	-109.9984	BIO6-AGT-3A	90	483.7	355.97	0.3	in water	-8
10/03/2008 11:28	-73.98362	-107.40002	BIO5-AGT-3D		532.7	130.55	0.2	on deck	-12
10/03/2008 11:13	-73.98259	-107.40258	BIO5-AGT-3D		535.81	130.66	0.3	off bottom	546
10/03/2008 11:02	-73.98259	-107.40258	BIO5-AGT-3D		535.81	130.66	0.3	end trawl	546
10/03/2008 10:56	-73.98045	-107.40805	BIO5-AGT-3D		544.05	131.07	0.5	start trawl	828
10/03/2008 10:50	-73.97975	-107.40982	BIO5-AGT-3D		552.22	130.74	0.4	on bottom	544
10/03/2008 10:29	-73.97835	-107.4134	BIO5-AGT-3D	79	550.02	130.39	0.3	in water	-2
10/03/2008 10:02	-73.99035	-107.37954	BIO5-AGT-3C		536.16	136.08	0.1	on deck	-11
10/03/2008 09:47	-73.98941	-107.3821	BIO5-AGT-3C		533.52	136.73	0.3	off bottom	536
10/03/2008 09:36	-73.98866	-107.38413	BIO5-AGT-3C		541.75	136.62	1	end trawl	816
10/03/2008 09:26	-73.98637	-107.39039	BIO5-AGT-3C		539.03	136.35	0.5	start trawl	814
10/03/2008 09:20	-73.98577	-107.39204	BIO5-AGT-3C		543.95	136.73	0.4	on bottom	542
10/03/2008 09:04	-73.98474	-107.39493	BIO5-AGT-3C	78	536.94	136	0.3	in water	0
10/03/2008 08:50	-73.98452	-107.39552	BIO5-AGT-3B		535.83	136.32	0.3	on deck	-8
10/03/2008 08:37	-73.98361	-107.39803	BIO5-AGT-3B		535.72	136.9	0.3	off bottom	551
10/03/2008 08:27	-73.98302	-107.39972	BIO5-AGT-3B		536.48	136.59	0.5	end trawl	817
10/03/2008 08:16	-73.98361	-107.39803	BIO5-AGT-3B		535.72	136.9	0.3	start trawl	551
10/03/2008 08:11	-73.98007	-107.40773	BIO5-AGT-3B		544.32	136.48	0.3	on bottom	547
10/03/2008 07:54	-73.97894	-107.4108	BIO5-AGT-3B	77	552.4	136.53	0.3	in water	-6
10/03/2008 07:29	-73.97882	-107.41117	BIO5-AGT-3A		551.52	136.47	0	on deck	-11
10/03/2008 07:13	-73.97853	-107.4145	BIO5-AGT-3A		552.36	136.16	5.1	off bottom	553
10/03/2008 07:02	-73.97716	-107.41581	BIO5-AGT-3A		552.75	136.28	0.9	end trawl	822

10/03/2008 06:52	-73.97488	-107.42227	BIO5-AGT-3A		557.8	136.47	0.5	start trawl	822
10/03/2008 06:46	-73.97426	-107.42412	BIO5-AGT-3A		556.81	136.08	1.3	on bottom	562
10/03/2008 06:15	-73.97223	-107.4298	BIO5-AGT-3A	76	574.66	137.25	0.3	in water	-8
09/03/2008 19:32	-73.87333	-106.2874	BIO5-AGT-2C		1130.86	111.69	0.3	on deck	-18
09/03/2008 19:06	-73.87137	-106.29061	BIO5-AGT-2C		1093.64	112.83	0.2	off bottom	1086
09/03/2008 18:45	-73.86971	-106.29328	BIO5-AGT-2C		1136.83	112.33	1	end trawl	1600
09/03/2008 18:30	-73.86564	-106.29866	BIO5-AGT-2C		1070.3	112.31	0.4	start trawl	1600
09/03/2008 18:19	-73.86425	-106.2999	BIO5-AGT-2C		1065.53	114.02	0.2	on bottom	1047
09/03/2008 17:56	-73.86256	-106.30291	BIO5-AGT-2C	71	1059.67	107.97	0.5	in water	-12
09/03/2008 17:20	-73.87519	-106.27369	BIO5-AGT-2B		1089.43	97.9	0.2	on deck	-19
09/03/2008 16:54	-73.87446	-106.28125	BIO5-AGT-2B		1088.36	96.99	0.4	off bottom	1086
09/03/2008 16:36	-73.87382	-106.28653	BIO5-AGT-2B		1094.02	98.17	1	end trawl	1550
09/03/2008 16:21	-73.87181	-106.29934	BIO5-AGT-2B		1109.85	97.22	0.5	start trawl	1550
09/03/2008 16:12	-73.8712	-106.30316	BIO5-AGT-2B		1112.98	98.13	0.3	on bottom	1090
09/03/2008 15:47	-73.87055	-106.30762	BIO5-AGT-2B	70	1088.8	98.35	0	in water	1
09/03/2008 15:07	-73.97223	-107.4298			574.66	137.25	0.3		-8
09/03/2008 14:40	-73.86312	-106.2768	BIO5-AGT-2A		1078.95	111.3	0.4	off bottom	1054
09/03/2008 14:22	-73.86399	-106.27998	BIO5-AGT-2A		1053.71	112.08	1.1	end trawl	1520
09/03/2008 14:07	-73.86246	-106.29361	BIO5-AGT-2A		1052.8	111.71	0.3	start trawl	1520
09/03/2008 13:58	-73.86204	-106.29749	BIO5-AGT-2A		1054.58	112.77	0.2	on bottom	1051
09/03/2008 13:34	-73.86185	-106.29907	BIO5-AGT-2A	69	1053.33	111.56	0.2	in water	-11
08/03/2008 12:12	-74.12371	-105.79488	BIO5-AGT-1B		1492.69	107.5	0.3	on deck	-10
08/03/2008 11:36	-74.12214	-105.80412	BIO5-AGT-1B		1533.78	107.01	0.3	off bottom	1499
08/03/2008 11:10	-74.12095	-105.81108	BIO5-AGT-1B		1494.73	107.29	1	end trawl	2222
08/03/2008 10:55	-74.11876	-105.82395	BIO5-AGT-1B		1518.46	107.42	0.4	start trawl	2222
08/03/2008 10:40	-74.1176	-105.83075	BIO5-AGT-1B		1482.04	107.32	0.3	on bottom	1462
08/03/2008 10:04	-74.11604	-105.83981	BIO5-AGT-1B	65	1447.55	108.06	0.3	in water	-3
08/03/2008 09:25	-74.13174	-105.74758	BIO5-AGT-1A		1482.64	107.29	0.3	on deck	-11
08/03/2008 08:47	-74.13008	-105.75727	BIO5-AGT-1A		1486.22	107.39	0.3	off bottom	1476
08/03/2008 08:20	-74.12886	-105.76445	BIO5-AGT-1A		1517.67	107.34	1	end trawl	2240
08/03/2008 08:05	-74.12664	-105.77741	BIO5-AGT-1A		1504.84	106.97	0.5	start trawl	2240
08/03/2008 07:49	-74.12552	-105.78406	BIO5-AGT-1A		1494.1	106.95	0.3	on bottom	1469
08/03/2008 07:14	-74.12395	-105.79318	BIO5-AGT-1A	64	1492.84	107.28	0.3	in water	8
07/03/2008 02:46	-74.40703	-104.6007	BIO4-AGT-3C		530.35	90.95	0.1	on deck	-11
07/03/2008 02:28	-74.40606	-104.60467	BIO4-AGT-3C		512.78	91.4	0.3	off bottom	501
07/03/2008 02:19	-74.40546	-104.60733	BIO4-AGT-3C		505.71	104.66	1	end trawl	750
07/03/2008 02:19	-74.40546	-104.60733	BIO4-AGT-3C		505.71	104.66	1	end trawl	750
07/03/2008 02:13	-74.40458	-104.61111	BIO4-AGT-3C		498.81	104.95	0.6	start trawl	750
07/03/2008 02:08	-74.40411	-104.61311	BIO4-AGT-3C		493.94	104.49	0.4	on bottom	493
07/03/2008 01:53	-74.40328	-104.61654	BIO4-AGT-3C	52	491.32	106.13	0.3	in water	-4
07/03/2008 01:04	-74.4029	-104.61836	BIO4-AGT-3B		491.88	87.63	0.1	on deck	-9
07/03/2008 00:48	-74.40191	-104.62105	BIO4-AGT-3B		492.37	87.79	0.3	off bottom	489
07/03/2008 00:37	-74.40108	-104.62325	BIO4-AGT-3B		488.37	84.9	0.9	end trawl	750
07/03/2008 00:27	-74.39886	-104.62954	BIO4-AGT-3B		496.63	85.17	0.5	start trawl	750
07/03/2008 00:22	-74.39831	-104.63101	BIO4-AGT-3B		504.67	85.33	0.3	on bottom	518
07/03/2008 00:08	-74.39741	-104.63363	BIO4-AGT-3B	52	518	85.41	0.3	in water	-5
06/03/2008 23:32	-74.41407	-104.64335	BIO4-AGT-3A		506.59	94.16	0.2	on deck	-18
06/03/2008 23:15	-74.41291	-104.64651	BIO4-AGT-3A		501.4	93.91	0.2	off bottom	496
06/03/2008 23:04	-74.41208	-104.64871	BIO4-AGT-3A		502.47	93.91	1.1	end trawl	753
06/03/2008 22:54	-74.40986	-104.65477	BIO4-AGT-3A		510.84	94.66	0.5	start trawl	753
06/03/2008 22:50	-74.40941	-104.65603	BIO4-AGT-3A		510.4	94.37	0.4	on bottom	546

06/03/2008 22:37	-74.40855	-104.65835	BIO4-AGT-3A	51	513.14	97.53	0.3 in water	-2
06/03/2008 09:18	-74.36061	-104.69777	BIO4-AGT-1B		1410.52	121.66	0.3 on deck	-18
06/03/2008 08:41	-74.35972	-104.70859	BIO4-AGT-1B		1406.63	121.81	0.3 off bottom	1418
06/03/2008 08:17	-74.35908	-104.7162	BIO4-AGT-1B		1404.3	121.8	1 stop trawling	2100
06/03/2008 08:02	-74.35791	-104.73057	BIO4-AGT-1B		1408.29	121.86	0.6 start trawling	2100
06/03/2008 07:49	-74.3574	-104.73698	BIO4-AGT-1B		1413.48	121.75	0.3 on bottom	1435
06/03/2008 07:15	-74.35659	-104.74683	BIO4-AGT-1B	45	1416.73	111.47	0.3 in water	3
06/03/2008 05:39	-74.36179	-104.69713	BIO4-AGT-1A		1405.05	121.9	0.3 on deck	-14
06/03/2008 05:01	-74.36098	-104.70827	BIO4-AGT-1A		1400.98	121.67	0.3 off bottom	1428
06/03/2008 04:37	-74.36049	-104.71532	BIO4-AGT-1A		1404.01	121	0.2	2150
06/03/2008 04:36	-74.36044	-104.71605	BIO4-AGT-1A		1404.38	121.66	1 stop trawl	2150
06/03/2008 04:21	-74.35925	-104.73077	BIO4-AGT-1A		1415.91	127.02	0.5 start trawl	2150
06/03/2008 04:07	-74.3586	-104.73739	BIO4-AGT-1A		1416	126.61	0.3 on bottom	1466
06/03/2008 03:32	-74.35754	-104.74756	BIO4-AGT-1A	44	1416.19	128.22	0.4 in water	-3
05/03/2008 18:40	-74.4805	-104.23253	BIO4-AGT-2C		1169.05	121.03	0.1 on deck	-16
05/03/2008 18:11	-74.47967	-104.23899	BIO4-AGT-2C		1156.09	121.36	0.3 off bottom	1141
05/03/2008 17:56	-74.47901	-104.24326	BIO4-AGT-2C		1150.58	121.58	1 end trawl	1542
05/03/2008 17:46	-74.47742	-104.25704	BIO4-AGT-2C		1026.39	121.94	0.3 start trawl	1040
05/03/2008 17:36	-74.47742	-104.25704	BIO4-AGT-2C		1026.39	121.94	0.3 on bottom	1040
05/03/2008 17:15	-74.47693	-104.25941	BIO4-AGT-2C	39	1051.39	122.46	0 in water	-8
05/03/2008 16:32	-74.48541	-104.23125	BIO4-AGT-2B			112.47	0.3 on deck	-16
05/03/2008 15:57	-74.48354	-104.23944	BIO4-AGT-2B		1190.7	112.57	0.3 off bottom	1162
05/03/2008 15:43	-74.48276	-104.24292	BIO4-AGT-2B		1162.83	112.66	1 end trawl	1519
05/03/2008 15:28	-74.48001	-104.25516	BIO4-AGT-2B		1037.05	112.52	0.5 start trawl	1519
05/03/2008 15:19	-74.4792	-104.25874	BIO4-AGT-2B		1014.76	112.83	0.3 on bottom	1031
05/03/2008 14:56	-74.47854	-104.26161	BIO4-AGT-2B	38	993.66	150.73	0.1 in water	-2
05/03/2008 14:16	-74.48438	-104.21274	BIO4-AGT-2A		1181.09	113.35	0.4 on deck	-18
05/03/2008 13:47	-74.48286	-104.21941	BIO4-AGT-2A		1217.41	113.22	0.3 off bottom	1183
05/03/2008 13:25	-74.48162	-104.22502	BIO4-AGT-2A		1203.06	113.87	1 end trawl	1770
05/03/2008 13:10	-74.4789	-104.23699	BIO4-AGT-2A		1208.15	113.63	0.6 start trawl	1770
05/03/2008 12:59	-74.47793	-104.24141	BIO4-AGT-2A		1148.2	114.36	0.3 on bottom	1199
05/03/2008 12:32	-74.47724	-104.24445	BIO4-AGT-2A	37	1125.21	114.48	0 in water	-3
04/03/2008 06:43	-71.79151	-106.29502	BIO3-AGT-1C		582.07	330.32	0 on deck	-8
04/03/2008 06:27	-71.7927	-106.29475	BIO3-AGT-1C		586.22	330.86	0.3 off bottom	577
04/03/2008 06:16	-71.79352	-106.2938	BIO3-AGT-1C		589.43	330.8	0.9 end trawl	860
04/03/2008 06:06	-71.79584	-106.29104	BIO3-AGT-1C		581.79	330.98	0.6 start trawl	860
04/03/2008 06:00	-71.79668	-106.28995	BIO3-AGT-1C		576.64	324.75	0.3 on bottom	577
04/03/2008 05:42	-71.79803	-106.2878	BIO3-AGT-1C	29	571.68	300.22	0.3 in water	-1
04/03/2008 05:17	-71.7961	-106.3014	BIO3-AGT-1B			310.62	0.3 on deck	-15
04/03/2008 05:11	-71.79648	-106.30055	BIO3-AGT-1B			310.42	0.3	-7
04/03/2008 04:54	-71.79775	-106.29849	BIO3-AGT-1B		589.38	311.15	0.3 off bottom	588
04/03/2008 04:43	-71.79865	-106.29748	BIO3-AGT-1B		590	310.45	1 end trawl	869
04/03/2008 04:33	-71.80119	-106.29473	BIO3-AGT-1B		578.64	310.23	0.6 start trawl	869
04/03/2008 04:07	-71.80336	-106.29085	BIO3-AGT-1B	28	573.08	309.97	0.3 in water	-4
04/03/2008 03:09	-71.80684	-106.34267	BIO3-AGT-1A		595.49	288.86	0 trawl and net on deck	-13
04/03/2008 03:00	-71.80683	-106.34268	BIO3-AGT-1A		593.32	289	0 on deck	-16
04/03/2008 02:43	-71.80735	-106.34079	BIO3-AGT-1A		596.09	315.52	0.3 off bottom	576
04/03/2008 02:31	-71.80802	-106.3385	BIO3-AGT-1A		590.35	310.41	1 end trawl	863
04/03/2008 02:18	-71.81035	-106.32991	BIO3-AGT-1A		577.27	306.41	0.5 start trawl	863
04/03/2008 02:12	-71.81095	-106.3277	BIO3-AGT-1A		572.29	306.89	0.3 on bottom	570
04/03/2008 01:53	-71.81195	-106.32402	BIO3-AGT-1A	27	570.77	307.9	0.2 in water	-3

28/02/2008 09:23	-68.53223	-76.19228	BIO1-AGT-3C		462.87	61.92	0.3	on deck	-17
28/02/2008 09:09	-68.533	-76.19441	BIO1-AGT-3C		464.24	62.4	0.7	off bottom	459
28/02/2008 09:00	-68.53359	-76.196	BIO1-AGT-3C		460.05	61.9	1.4	end trawl	704
28/02/2008 08:49	-68.53571	-76.20173	BIO1-AGT-3C		468.73	62.68	0.5	start trawl	704
28/02/2008 08:44	-68.53621	-76.20312	BIO1-AGT-3C		468.88	61.59	0.3	on bottom	479
28/02/2008 08:27	-68.53719	-76.20577	BIO1-AGT-3C	19	464.77	61.59	0.6	in water	-6
28/02/2008 08:10	-68.53716	-76.20587	BIO1-AGT-3B		465.62	234.75	0.9	on deck	-20
28/02/2008 07:56	-68.53633	-76.20359	BIO1-AGT-3B		467.36	234.19	0.9	off bottom	460
28/02/2008 07:46	-68.53567	-76.20182	BIO1-AGT-3B		468.77	234.52	1.5	end trawl	700
28/02/2008 07:35	-68.53367	-76.19637	BIO1-AGT-3B		463.12	234.04	0.2	start trawl	700
28/02/2008 07:30	-68.53319	-76.19505	BIO1-AGT-3B	18	464.11	234.82	0.5	on bottom	482
28/02/2008 07:14	-68.53223	-76.19238	BIO1-AGT-3B		464.11	212.06	0.7	in water	-7
28/02/2008 06:54	-68.53196	-76.19171	BIO1-AGT-3A		462.88	209.91	0.6	on deck	-18
28/02/2008 06:39	-68.53109	-76.18926	BIO1-AGT-3A		466.6	209.26	0.3	off bottom	462
28/02/2008 06:33	-68.53075	-76.18835	BIO1-AGT-3A		466.87	209.98	0.2	resumed hauling	636
28/02/2008 05:56	-68.52858	-76.18244	BIO1-AGT-3A		464.69	209.21	1.1	suspended hauling	636
28/02/2008 05:51	-68.52823	-76.18142	BIO1-AGT-3A		464.34	209.6	0.7	end trawl	710
28/02/2008 05:41	-68.52632	-76.17614	BIO1-AGT-3A		463.08	209.81	0.4	start trawl	710
28/02/2008 05:36	-68.52585	-76.17489	BIO1-AGT-3A		466.97	210.06	0.7	on bottom	483
28/02/2008 05:20	-68.52494	-76.17221	BIO1-AGT-3A	17	467.84	210.79	0.3	in water	-7
28/02/2008 02:04	-68.47707	-76.14137	BIO1-AGT-2C		974.47	174.68	0.6	on deck	-14
28/02/2008 01:39	-68.47577	-76.13694	BIO1-AGT-2C		972.28	173.97	0.4	off bottom	973
28/02/2008 01:20	-68.47466	-76.13324	BIO1-AGT-2C		977.44	174.79	0.8	end trawl	1500
28/02/2008 01:05	-68.47254	-76.12623	BIO1-AGT-2C		952.71	174.19	1.2	start trawl	1500
28/02/2008 00:54	-68.47159	-76.12306	BIO1-AGT-2C		957.82	175.18	0.7	on bottom	962
28/02/2008 00:30	-68.47037	-76.1189	BIO1-AGT-2C	15	993.82	175.1	0.5	in water	-3
27/02/2008 23:18	-68.48503	-76.16634	BIO1-AGT-2B		970.52	173.89	0.3	on deck	-17
27/02/2008 22:51	-68.48365	-76.16179	BIO1-AGT-2B		940.08	174.4	0.3	off bottom	936
27/02/2008 22:28	-68.48239	-76.15763	BIO1-AGT-2B		926.5	173.98	1.1	end trawl	1500
27/02/2008 22:13	-68.47975	-76.14907	BIO1-AGT-2B		944.53	173.71	0.8	start trawl	1500
27/02/2008 22:03	-68.47887	-76.14612	BIO1-AGT-2B		957.5	174	0.9	on bottom	969
27/02/2008 21:41	-68.4779	-76.14207	BIO1-AGT-2B	14	966.23	174.97	0.1	in water	-7
27/02/2008 21:25	-68.47766	-76.14118	BIO1-AGT-2A		965.33	174.57	0.4	on deck	-18
27/02/2008 21:02	-68.47639	-76.13697	BIO1-AGT-2A		958.58	174.3	0.3	off bottom	958
27/02/2008 20:41	-68.47521	-76.13302	BIO1-AGT-2A		964.38	173.89	0.6	end trawl	1500
27/02/2008 20:26	-68.47263	-76.12432	BIO1-AGT-2A		938.67	174.74	0.9	start trawl	1500
27/02/2008 20:17	-68.47185	-76.12158	BIO1-AGT-2A		981.95	175.85	0.2	on bottom	1007
27/02/2008 19:54	-68.47067	-76.11765	BIO1-AGT-2A		987.41	177.08	0.5		6
27/02/2008 19:51	-68.47052	-76.11721	BIO1-AGT-2A	13	979.51	177.71	0.4	in water	-2
27/02/2008 16:34	-68.39895	-75.91893	BIO1-AGT-1B		1548.95	173.87	0.6	on deck	-15
27/02/2008 15:57	-68.39715	-75.91225	BIO1-AGT-1B		1520.28	174.93	0.3	off bottom	1508
27/02/2008 15:28	-68.39564	-75.90639	BIO1-AGT-1B		1489.14	174.23	1.2	end trawl	2251
27/02/2008 15:11	-68.39312	-75.89656	BIO1-AGT-1B		1485.91	174.29	0.4	start trawl	2250
27/02/2008 15:03	-68.39245	-75.89392	BIO1-AGT-1B		1480.68	174.01	0.9	on bottom	1806
27/02/2008 14:20	-68.39026	-75.8854	BIO1-AGT-1B	11	1463.19	184.64	0.7	in water	-9
27/02/2008 13:58	-68.39011	-75.88481	BIO1-AGT-1A		1443.96	154.44	0.4	on deck	-19
27/02/2008 13:23	-68.38827	-75.87998	BIO1-AGT-1A		1473.96	199.41	0.6	off bottom	1474
27/02/2008 12:54	-68.38641	-75.8752	BIO1-AGT-1A		1497.27	198.83	1	end trawl	2250
27/02/2008 12:38	-68.38334	-75.86705	BIO1-AGT-1A		1469.71	198.94	0.6	start trawl	2250
27/02/2008 12:24	-68.38197	-75.86349	BIO1-AGT-1A		1471.53	199.38	0.6	on bottom	1517
27/02/2008 12:13	-68.38131	-75.86173	BIO1-AGT-1A		1470.38	199.83	0.5		915

27/02/2008 11:37	-68.3797	-75.85752	BIO1-AGT-1A		1511.23	256.31	0.2		836
27/02/2008 11:15	-68.3797	-75.85752	BIO1-AGT-1A	10	1511.23	256.31	0.2	in water	2

C) EBS Event Log

Time	Latitude	Longitude	Station event name	Bridge event number	Depth (m)	Heading	Speed (kn)	Action	Cable length
18/03/2008 21:21	-69.98338	-108.27043	BIO8-EBS-3500D		3637	21.72	0.4	on deck	-11
18/03/2008 19:59	-69.98897	-108.28186	BIO8-EBS-3500D		3603.03	21.79	0.1	off bottom	3673
18/03/2008 19:07	-69.99287	-108.28719	BIO8-EBS-3500D		3622.89	21.28	1.1	end trawl	5000
18/03/2008 18:47	-69.99789	-108.294	BIO8-EBS-3500D		3595.52	21.7	0.3	start trawl	5000
18/03/2008 18:21	-69.9999	-108.29669	BIO8-EBS-3500D		3581	22.82	0.3	on bottom	3587
18/03/2008 17:52	-70.0018	-108.29928	BIO8-EBS-3500D			21.79	0.4		2076
18/03/2008 17:51	-70.00181	-108.2993	BIO8-EBS-3500D			22.79	0.2		2076
18/03/2008 17:45	-70.0018	-108.29931	BIO8-EBS-3500D			22.94	0.8		1823
18/03/2008 17:31	-70.0018	-108.29933	BIO8-EBS-3500D			22.75	0.6		1758
18/03/2008 16:53	-70.00179	-108.29929	BIO8-EBS-3500D	126	3563.77	22.01	0.2	in water	-9
18/03/2008 16:02	-70.00181	-108.29933	BIO8-EBS-3500C			35.81	0.5	on deck	-10
18/03/2008 15:49	-70.00179	-108.29934	BIO8-EBS-3500C			35.86	0.4		331
18/03/2008 15:34	-70.00249	-108.30098	BIO8-EBS-3500C			45.22	3.1		320
18/03/2008 15:28	-70.0034	-108.3011	BIO8-EBS-3500C	126		45.32	0.5		33
18/03/2008 15:23	-70.00376	-108.30144	BIO8-EBS-3500C			46.53	0.3		14
18/03/2008 15:19	-70.00406	-108.30172	BIO8-EBS-3500C	126	3535.99	54.74	0.3	in water	-7
18/03/2008 15:03	-70.00405	-108.3017	BIO8-EBS-3500B			53.87	0.3	on deck	-13
18/03/2008 13:44	-70.0103	-108.30841	BIO8-EBS-3500B			58.27	0.5	off bottom	3467
18/03/2008 12:44	-70.015	-108.3134	BIO8-EBS-3500B			40.69	1	end trawl	5000
18/03/2008 12:24	-70.01998	-108.31867	BIO8-EBS-3500B		3464	40.03	0.7	start trawl	4994
18/03/2008 11:55	-70.02223	-108.32106	BIO8-EBS-3500B		3465	41.23	0.3	on bottom	3485
18/03/2008 10:43	-70.02791	-108.32708	BIO8-EBS-3500B	125		34.97	0.6	in water	1
18/03/2008 10:23	-70.02816	-108.32734	BIO8-EBS-3500A			35.22	0.5	on deck	-1
18/03/2008 09:03	-70.03438	-108.33406	BIO8-EBS-3500A			14.02	0.6	off bottom	3478
18/03/2008 08:05	-70.03896	-108.33888	BIO8-EBS-3500A			15.3	1	end trawl	5000
18/03/2008 07:45	-70.04413	-108.34443	BIO8-EBS-3500A			16.23	0.2	start trawl	5000
18/03/2008 07:15	-70.04656	-108.34686	BIO8-EBS-3500A		3501	15.45	2.1	on bottom	3482
18/03/2008 06:04	-70.04875	-108.34931	BIO8-EBS-3500A	124	3499	2.18	0.7	in water	6
13/03/2008 15:04	-71.16223	-110.07273	BIO6-EBS-1B		1460.89	193.94	0.4	off bottom	1447
13/03/2008 14:32	-71.15974	-110.07019	BIO6-EBS-1B		1427.27	194.25	0.9	end trawl	2150
13/03/2008 14:22	-71.15929	-110.06215	BIO6-EBS-1B		1495.25	174.72	0.3	start trawl	2150
13/03/2008 14:08	-71.1591	-110.05863	BIO6-EBS-1B		1452.36	180.85	0.3	on bottom	1434
13/03/2008 13:40	-71.15872	-110.05141	BIO6-EBS-1B	113	1427.93	181.86	0.3	in water	-11
13/03/2008 12:51	-71.15948	-110.10931	BIO6-EBS-1A			192.9	0.3	on deck	-14
13/03/2008 12:16	-71.15885	-110.10095	BIO6-EBS-1A		1449.77	193.77	0.3	off bottom	1498
13/03/2008 11:43	-71.1584	-110.09255				194.21	0.2		2200
13/03/2008 11:41	-71.15838	-110.09166	BIO6-EBS-1A		1473.81	197.78	1	end trawl	2200
13/03/2008 11:31	-71.15795	-110.08351	BIO6-EBS-1A		1460.1	193.87	0.3	start trawl	2200
13/03/2008 11:16	-71.15723	-110.07112	BIO6-EBS-1A		1457.25	190.17	0.4	on bottom	-6
13/03/2008 10:42	-71.15723	-110.07112	BIO6-EBS-1A	112	1457.25	190.17	0.4	in water	-6
12/03/2008 22:51	-71.1803	-109.90536	BIO6-EBS-2B		985.56	215.14	0.4	on deck	-5
12/03/2008 22:25	-71.17927	-109.90011	BIO6-EBS-2B		999.04	214.99	0.3	off bottom	1052
12/03/2008 22:05	-71.17885	-109.8948	BIO6-EBS-2B		1001.8	215.09	0.9	end trawl	1501

12/03/2008 21:55	-71.17818	-109.88653	BIO6-EBS-2B		1003.94	208.42	0.3	start trawl	1501
12/03/2008 21:46	-71.17799	-109.88426	BIO6-EBS-2B		1004.77	208.94	0.2	on bottom	1032
12/03/2008 21:22	-71.17747	-109.87834	BIO6-EBS-2B	105	1006.54	208.72	0.3	in water	-7
12/03/2008 21:02	-71.17746	-109.87765	BIO6-EBS-2A		1006.48	208.3	0.3	on deck	-3
12/03/2008 20:34	-71.17659	-109.87101	BIO6-EBS-2A		1014.38	208.48	0.3	off bottom	1106
12/03/2008 20:09	-71.17597	-109.86454	BIO6-EBS-2A		1040.78	208.65	0.8	end trawl	1601
12/03/2008 19:59	-71.17517	-109.85647	BIO6-EBS-2A		1046.86	208.97	0.3	start trawl	1601
12/03/2008 19:49	-71.17495	-109.85415	BIO6-EBS-2A		1020.36	209.29	0.4	on bottom	1096
12/03/2008 19:28	-71.17441	-109.8488	BIO6-EBS-2A	104	1084.33	205.59	0.3	in water	-2
12/03/2008 07:56	-71.33363	-109.96667	BIO6-EBS-3F			356.75	0.1	on deck	-6
12/03/2008 07:43	-71.33411	-109.96665	BIO6-EBS-3F		481.79	356.44	0.3	off bottom	499
12/03/2008 07:32	-71.33502	-109.96659	BIO6-EBS-3F		478.87	356.67	0.8	end trawl	729
12/03/2008 07:22	-71.33782	-109.96628	BIO6-EBS-3F		476.27	356.82	0.3	start trawl	729
12/03/2008 07:16	-71.33831	-109.96626	BIO6-EBS-3F		475.85	356.5	0.3	on bottom	462
12/03/2008 07:03	-71.33903	-109.96614	BIO6-EBS-3F	98	483.14	356.8	0.3	in water	-5
12/03/2008 06:51	-71.33911	-109.9661	BIO6-EBS-3E		476.06	356.61	0.2	on deck	-1
12/03/2008 06:38	-71.33957	-109.96604	BIO6-EBS-3E		472.25	356.82	0.4	off bottom	501
12/03/2008 06:26	-71.34056	-109.96591	BIO6-EBS-3E		477.19	356.96	1	end trawl	730
12/03/2008 06:16	-71.34332	-109.9655	BIO6-EBS-3E		484.03	357.2	0.3	start trawl	730
12/03/2008 06:11	-71.34381	-109.96539	BIO6-EBS-3E		477.38	356.74	0.3	on bottom	465
12/03/2008 05:58	-71.34459	-109.96529	BIO6-EBS-3E	97	476.89	356.81	0.2	in water	-6
12/03/2008 05:35	-71.34473	-109.96521	BIO6-EBS-3D		476.39	356.26	0.1	on deck	-1
12/03/2008 05:22	-71.3452	-109.96518	BIO6-EBS-3D		472.93	356.18	0.3	off bottom	491
12/03/2008 05:10	-71.3462	-109.96509	BIO6-EBS-3D		480.87	356.55	1	end trawl	730
12/03/2008 05:00	-71.34894	-109.96478	BIO6-EBS-3D		476.75	356.33	0.2	start trawl	730
12/03/2008 04:54	-71.34943	-109.96469	BIO6-EBS-3D		479.49	356.35	0.2	on bottom	464
12/03/2008 04:41	-71.35026	-109.96466	BIO6-EBS-3D	96	480.98	356.59	0.2	in water	-8
12/03/2008 04:07	-71.34258	-110.01913	BIO6-EBS-3C		478.08	355.98	0.3	on deck	-9
12/03/2008 03:54	-71.34367	-110.01914	BIO6-EBS-3C		479.98	355.65	0.3	off bottom	499
12/03/2008 03:43	-71.34464	-110.01912	BIO6-EBS-3C		481.85	355.96	1	end trawl	730
12/03/2008 03:33	-71.34734	-110.01908	BIO6-EBS-3C		488.64	355.75	0.3	start trawl	730
12/03/2008 03:27	-71.34783	-110.01908	BIO6-EBS-3C		481.67	355.69	0.4	on bottom	463
12/03/2008 03:14	-71.3489	-110.01908	BIO6-EBS-3C	95	478.2	355.81	0.3	in water	-7
12/03/2008 02:35	-71.33585	-110.01328	BIO6-EBS-3B			356.8	0.3	on deck	-6
12/03/2008 02:22	-71.33688	-110.01325	BIO6-EBS-3B		483.19	356.91	0.3	off bottom	500
12/03/2008 02:10	-71.33794	-110.01327	BIO6-EBS-3B		482.15	356.8	1	end trawl	729
12/03/2008 02:00	-71.34072	-110.01325	BIO6-EBS-3B		477.66	356.83	0.3	start trawl	729
12/03/2008 01:54	-71.3412	-110.01325	BIO6-EBS-3B		478.06	356.32	0.3	on bottom	464
12/03/2008 01:41	-71.34223	-110.01323	BIO6-EBS-3B	94	478.44	356.49	0	in water	-4
12/03/2008 01:32	-71.34226	-110.01322	BIO6-EBS-3A		480.95	356.52	0.3	on deck	-1
12/03/2008 01:20	-71.3433	-110.01325	BIO6-EBS-3A		480.2	356.25	0.3	off bottom	494
12/03/2008 01:08	-71.34438	-110.01328	BIO6-EBS-3A		478.14	356.62	1	end trawl	729
12/03/2008 00:58	-71.34713	-110.01329	BIO6-EBS3A		481.11	356.36	0.3	start trawl	729
12/03/2008 00:52	-71.34761	-110.01328	BIO6-EBS-3A		477.53	356.38	0.4	on bottom	465
12/03/2008 00:40	-71.34858	-110.01331	BIO6-EBS-3A	93	475.04	354.17	0.3	in water	-4
10/03/2008 19:12	-73.99139	-107.38415	BIO5-EBS-3F		540.09	122.06	0	on deck	
10/03/2008 18:54	-73.99085	-107.38645	BIO5-EBS-3F		538.96	121.85	0.3	off bottom	574
10/03/2008 18:44	-73.99033	-107.38886	BIO5-EBS-3F		536.85	121.65	0.8	end trawl	800
10/03/2008 18:34	-73.98849	-107.39645	BIO5-EBS-3F		543.05	122.12	0.3	start trawl	800
10/03/2008 18:29	-73.98821	-107.39762	BIO5-EBS-3F		542.72	122.06	0.4	on bottom	536
10/03/2008 18:18	-73.98775	-107.39964	BIO5-EBS-3F	85		121.34	0.2	in water	-5

10/03/2008 18:01	-73.98768	-107.39994	BIO5-EBS-3E		540.75	135.89	0.2	on deck	-5
10/03/2008 17:44	-73.98687	-107.4019	BIO5-EBS-3E		541.91	136.12	0.3	off bottom	573
10/03/2008 17:34	-73.98598	-107.40284	BIO5-EBS-3E		538.58	135.97	0.9	end trawl	800
10/03/2008 17:24	-73.98329	-107.40456	BIO5-EBS-3E		542.26	135.94	0.3	start trawl	800
10/03/2008 17:19	-73.98286	-107.40483	BIO5-EBS-3E		535.78	136.37	0.3	on bottom	536
10/03/2008 17:06	-73.98189	-107.40617	BIO5-EBS-3E	84	537.38	136.05	0.3	in water	-8
10/03/2008 16:55	-73.98181	-107.40637	BIO5-EBS-3D		537.78	135.76	0.2	on deck	-7
10/03/2008 16:40	-73.98109	-107.40832	BIO5-EBS-3D		542.55	136.25	0.3	off bottom	579
10/03/2008 16:30	-73.98041	-107.41007	BIO5-EBS-3D		544.97	136.39	1	end trawl	801
10/03/2008 16:20	-73.97816	-107.4159	BIO5-EBS-3D		547.27	136.99	0.3	start trawl	801
10/03/2008 16:15	-73.97782	-107.41677	BIO5-EBS-3D		550	136.92	0.3	on bottom	544
10/03/2008 16:04	-73.97704	-107.4188	BIO5-EBS-3D	83		136.65	0.3	in water	-11
10/03/2008 15:23	-73.98564	-107.38669	BIO5-EBS-3C		541.13	136.75	0.4	on deck	-9
10/03/2008 15:09	-73.9846	-107.38895	BIO5-EBS-3C		539.97	136.67	0.3	off bottom	580
10/03/2008 14:59	-73.98395	-107.39035	BIO5-EBS-3C		539.89	136.52	2.7	end trawl	800
10/03/2008 14:49	-73.98152	-107.39665	BIO5-EBS-3C		547.63	136.53	0.8	start trawl	800
10/03/2008 14:44	-73.98102	-107.39772	BIO5-EBS-3C		544.01	136.79	1.5	on bottom	534
10/03/2008 14:32	-73.98078	-107.39859	BIO5-EBS-3C	82	548.24	136.81	0	in water	-8
10/03/2008 14:07	-73.98092	-107.40005	BIO5-EBS-3B		543.7	136.48	0.2	on deck	-9
10/03/2008 13:52	-73.98004	-107.40813	BIO5-EBS-3B		545.28	136.68	21	off bottom	567
10/03/2008 13:42	-73.97922	-107.40435	BIO5-EBS-3B		545.76	136.4	0.9	end trawl	800
10/03/2008 13:32	-73.97693	-107.41019	BIO5-EBS-3B		551.7	136.78	0.3	start trawl	800
10/03/2008 13:27	-73.97655	-107.41105	BIO5-EBS-3B		554.39	137.05	0.3	on bottom	545
10/03/2008 13:16	-73.97693	-107.41019	BIO5-EBS-3B	81	551.7	136.78	0.3	in water	-6
10/03/2008 12:58	-73.97582	-107.41297	BIO5-EBS-3A		555.08	136.76	0	on deck	-6
10/03/2008 12:44	-73.97483	-107.41545	BIO5-EBS-3A		554.26	137.24	0.2	off bottom	568
10/03/2008 12:34	-73.97415	-107.4172	BIO5-EBS-3A		553.97	137.17	0.9	end trawl	800
10/03/2008 12:23	-73.97193	-107.42287	BIO5-EBS-3A		568.68	137.35	0.3	start trawl	800
10/03/2008 12:19	-73.97161	-107.42369	BIO5-EBS-3A		567.77	136.85	0.3	on bottom	559
10/03/2008 12:07	-73.97081	-107.42567	BIO5-EBS-3A	80	569.76	137.14	0.3	in water	-3
09/03/2008 23:27	-73.89156	-106.27538	BIO5-EBS-2B		1132.41	126.6	0.3	on deck	-5
09/03/2008 22:59	-73.88999	-106.28113	BIO5-EBS-2B		1126.76	126.8	0.3	off bottom	1173
09/03/2008 22:42	-73.88885	-106.28526	BIO5-EBS-2B		1126.82	126.85	0.9	end trawl	1551
09/03/2008 22:32	-73.88686	-106.29237			1152.69	126.64	1.1		1551
09/03/2008 22:26	-73.88646	-106.29387	BIO5-EBS-2B		1148.13	126.1	0.3	start trawl	1551
09/03/2008 22:17	-73.88595	-106.29571	BIO5-EBS-2B		1125.76	126.48	0.4	on bottom	1108
09/03/2008 21:56	-73.88469	-106.30021	BIO5-EBS-2B	73		126.44	0.3	in water	-4
09/03/2008 21:39	-73.88449	-106.30097	BIO5-EBS-2A		1118.69	126.01	0.2	on deck	-21
09/03/2008 21:12	-73.88294	-106.3065	BIO5-EBS-2A		1112.14	126.25	0.1	off bottom	1103
09/03/2008 20:49	-73.88211	-106.30944	BIO5-EBS-2A		1113.97	126.76	1.2	end trawl	1502
09/03/2008 20:39	-73.88016	-106.31654	BIO5-EBS-2A		1045.85	126.8	0.6	start trawl	1502
09/03/2008 20:30	-73.87964	-106.31846	BIO5-EBS-2A		1052.18	127.65	0.2	on bottom	1035
09/03/2008 20:09	-73.87843	-106.32288	BIO5-EBS-2A	72	1047.91	127.74	0.5	in water	-14
09/03/2008 09:04	-74.12406	-105.81275	BIO5-EBS-1B		1555.97	112.69	0.4	on deck	-11
09/03/2008 08:29	-74.12222	-105.82084	BIO5-EBS-1B		1450.07	117.14	0.2	off bottom	1486
09/03/2008 07:51	-74.12017	-105.82975	BIO5-EBS-1B		1480.5	116.66	1	end trawl	2250
09/03/2008 07:41	-74.11842	-105.83757	BIO5-EBS-1B		1477.13	116.24	0.3	start trawl	2250
09/03/2008 07:24	-74.1175	-105.84145	BIO5-EBS-1B		1473.06	112.26	0.4	on bottom	1433
09/03/2008 06:51	-74.11702	-105.84403	BIO5-EBS-1B	67	1469.71	118.19	0.1	in water	-8
09/03/2008 06:16	-74.12274	-105.81031	BIO5-EBS-1A		1492.54	112.01	0.3	on deck	-11
09/03/2008 05:40	-74.12112	-105.81945	BIO5-EBS-1A		1490.73	106.89	0.3	off bottom	1516

09/03/2008 05:05	-74.11971	-105.82841	BIO5-EBS-1A		1486.8	106.47	0.4		2249
09/03/2008 05:04	-74.11962	-105.82882	BIO5-EBS-1A		1486.13	106.51	1	end trawl	2250
09/03/2008 04:54	-74.11822	-105.83776	BIO5-EBS-1A		1478.92	105.55	0.2	start trawl	2250
09/03/2008 04:38	-74.11757	-105.84202	BIO5-EBS-1A		1471.57	106.97	0.3	on bottom	1445
09/03/2008 04:06	-74.11696	-105.84584	BIO5-EBS-1A	66	1465.81	106.76	0.1	in water	-9
07/03/2008 16:48	-74.39385	-104.75535	BIO4-EBS-3F		511.06	109.42	0.3	on deck	-5
07/03/2008 16:35	-74.39334	-104.75868	BIO4-EBS-3F		508	115.72	0	off bottom	512
07/03/2008 16:18	-74.3925	-104.75964	BIO4-EBS-3F		522.55	114.42	1	end trawl	753
07/03/2008 16:08	-74.39	-104.76392	BIO4-EBS-3F		517.91	114.59	0.4	start trawl	753
07/03/2008 16:03	-74.38964	-104.7645	BIO4-EBS-3F		523.14	114.81	0.3	on bottom	534
07/03/2008 15:52	-74.38948	-104.76483	BIO4-EBS-3F	58		114.63	0	in water	-7
07/03/2008 14:33	-74.40057	-104.75012	BIO4-EBS-3E		521.89	106.15	0.2	on deck	-4
07/03/2008 14:19	-74.39953	-104.75191	BIO4-EBS-3E		517.96	106.43	0.3	off bottom	544
07/03/2008 14:06	-74.39847	-104.75372	BIO4-EBS-3E			102.8	1	end trawl	764
07/03/2008 13:56	-74.39603	-104.75793	BIO4-EBS-3E		515.55	102.96	0.2	start trawl	764
07/03/2008 13:51	-74.39564	-104.75862	BIO4-EBS-3E			102.85	0.3	on bottom	497
07/03/2008 13:39	-74.3954	-104.75905	BIO4-EBS-3E	57	516.18	103.22	0.1	in water	-10
07/03/2008 13:22	-74.39535	-104.75903	BIO4-EBS-3D			103.18	0.4	on deck	-13
07/03/2008 13:07	-74.39428	-104.76105	BIO4-EBS-3D		502.65	102.89	0.2	off bottom	520
07/03/2008 12:54	-74.3933	-104.7628	BIO4-EBS-3D		507.12	103.82	1	end trawl	761
07/03/2008 12:44	-74.39088	-104.76726	BIO4-EBS-3D			102.03	0.3	start trawl	761
07/03/2008 12:39	-74.39051	-104.76792	BIO4-EBS-3D		505.81	101.92	0.3	on bottom	510
07/03/2008 12:29	-74.39038	-104.76815	BIO4-EBS-3D	56		96.71	0	in water	4
07/03/2008 10:29	-74.40226	-104.62498	BIO4-EBS-3C		486.99	114.57	0.3	on deck	-8
07/03/2008 10:16	-74.40153	-104.62724	BIO4-EBS-3C			95.48	0.1	off bottom	490
07/03/2008 09:53	-74.40078	-104.62991	BIO4-EBS-3C			112.34	1	end trawl	750
07/03/2008 09:43	-74.39878	-104.63655	BIO4-EBS-3C		505.16	112.45	0.5	start trawl	750
07/03/2008 09:39	-74.39848	-104.63748	BIO4-EBS-3C			112.21	0.3	on bottom	543
07/03/2008 09:23	-74.39745	-104.64036	BIO4-EBS-3C	55		112.37	0.3	in water	-6
07/03/2008 05:26	-74.40556	-104.60154	BIO4-EBS-3B			97.17	0.3	on deck	-4
07/03/2008 05:13	-74.40484	-104.60463	BIO4-EBS-3B		516.43	97.37	0.3	off bottom	519
07/03/2008 05:00	-74.40409	-104.6077	BIO4-EBS-3B		508.53	97.53	0.9	end trawl	750
07/03/2008 04:50	-74.40232	-104.61505	BIO4-EBS-3B		495.97	97.87	0.4	start trawl	750
07/03/2008 04:45	-74.402	-104.61633	BIO4-EBS-3B		495.06	97.94	0.3	on bottom	483
07/03/2008 04:31	-74.40122	-104.61957	BIO4-EBS-3B	54		98.28	0.2	in water	-3
07/03/2008 04:11	-74.40109	-104.62019	BIO4-EBS-3A			91.95	0.3	on deck	-4
07/03/2008 03:56	-74.4004	-104.62327	BIO4-EBS-3A		491.37	87.18	0.1		495
07/03/2008 03:42	-74.40009	-104.62462	BIO-EBS-3A		489.65	87.16	1	end trawl	760
07/03/2008 03:32	-74.39845	-104.63215	BIO4-EBS-3A		504.29	86.91	0.5	start trawl	760
07/03/2008 03:27	-74.39818	-104.63342	BIO4-EBS-3A		508.04	86.81	0.3	on bottom	532
07/03/2008 03:11	-74.39731	-104.63746	BIO4-EBS-3A	53	527.1	87.01	0.3	in water	1
06/03/2008 14:02	-74.35953	-104.7243	BIO4-EBS-1B		1416.26	117.06	0.3	on deck	-17
06/03/2008 13:27	-74.35865	-104.73444	BIO4-EBS-1B		1415.52	116.96	0.3	off bottom	1408
06/03/2008 13:01	-74.358	-104.74252	BIO4-EBS-1B		1415.58	117.72	1	end trawl	2102
06/03/2008 12:51	-74.35721	-104.752	BIO4-EBS-1B		1415.86	117.49	0.3	start trawl	2100
06/03/2008 12:38	-74.35689	-104.75592	BIO4-EBS-1B		1467.81	117.76	0.3	on bottom	1399
06/03/2008 12:08	-74.3562	-104.76447	BIO4-EBS-1B	47	1412.49	121.2	0	in water	-8
06/03/2008 11:43	-74.36247	-104.71863	BIO4-EBS-1A		1411.43	111.97	0.3	on deck	-14
06/03/2008 11:09	-74.36168	-104.7287	BIO4-EBS-1A		1411.29	111.8	0.3	off bottom	1418
06/03/2008 10:44	-74.36108	-104.73653	BIO4-EBS-1A		1413.5	111.73	1	end trawl	2098
06/03/2008 10:33	-74.35975	-104.74595	BIO4-EBS-1A		1414.29	111.86	0.3	start trawl	2098

06/03/2008 10:19	-74.35908	-104.74936	BIO4-EBS-1A		1414.42	111.57	0.3	on bottom	1403
06/03/2008 09:48	-74.35833	-104.75842	BIO4-EBS-1A	46	1401.53	125.83	0.3	in water	-5
05/03/2008 23:21	-74.49155	-104.32118	BIO-4-EBS-2B			130.9	0	on deck	-8
05/03/2008 22:54	-74.49107	-104.32266	BIO-4-EBS-2B			136.14	0.3	off bottom	1127
05/03/2008 22:37	-74.48992	-104.32624	BIO-4-EBS-2B			131.53	1	end trawl	1600
05/03/2008 22:27	-74.4878	-104.3329	BIO-4-EBS-2B			132.73	0.3	start trawl	1600
05/03/2008 22:18	-74.48722	-104.3347	BIO-4-EBS-2B			139.96	0.3	on bottom	1105
05/03/2008 21:57	-74.48692	-104.33576	BIO-4-EBS-2B	41		140.32	0	in water	8
05/03/2008 21:38	-74.4869	-104.3358	BIO-4-EBS-2A			130.42	0	on deck	-9
05/03/2008 21:10	-74.48655	-104.33685	BIO-4-EBS-2A			130.89	0.3	off bottom	1163
05/03/2008 20:52	-74.48541	-104.34043	BIO-4-EBS-2A			131.68	1	end trawl	1601
05/03/2008 20:42	-74.4831	-104.345	BIO-4-EBS-2A			131.65	0.3	start trawl	1601
05/03/2008 20:34	-74.48248	-104.3461	BIO-4-EBS-2A			131.83	0.3	on bottom	1161
05/03/2008 20:12	-74.48204	-104.34747	BIO-4-EBS-2A			131.63	0	in water	0
05/03/2008 19:12	-74.4805	-104.23253	BIO-4-EBS-2A	40	1169.05	121.03	0.1		-16
04/03/2008 11:10	-71.78585	-106.19234	BIO-3-EBS-1C			84.85	0.3	on deck	-8
04/03/2008 10:56	-71.78585	-106.19613	BIO-3-EBS-1C			84.7	0.3	off bottom	568
04/03/2008 10:48	-71.78585	-106.19822	BIO-3-EBS-1C			85.26	0.3		800
04/03/2008 10:46	-71.78584	-106.19862	BIO-3-EBS-1C			85.34	1	end trawl	800
04/03/2008 10:36	-71.7858	-106.20758	BIO-3-EBS-1C		568.08	85.72	1.2	start trawl	800
04/03/2008 10:31	-71.78579	-106.20936	BIO-3-EBS-1C			85.4	0.3	on bottom	559
04/03/2008 10:17	-71.78581	-106.21302	BIO-3-EBS-1C	32		85.55	0.3	in water	0
04/03/2008 10:01	-71.78677	-106.21601	BIO-3-EBS-1B			325.7	0.3	on deck	-9
04/03/2008 09:46	-71.78797	-106.21571	BIO-3-EBS-1B			325.82	0.3	off bottom	567
04/03/2008 09:38	-71.78864	-106.21537	BIO-3-EBS-1B			325.7	0.3		800
04/03/2008 09:36	-71.78885	-106.21531	BIO-3-EBS-1B			325.78	1	end trawl	800
04/03/2008 09:26	-71.79152	-106.21394	BIO-3-EBS-1B		577.67	326.38	0.3	start trawl	800
04/03/2008 09:21	-71.79192	-106.21374	BIO-3-EBS-1B			325.4	0.3	on bottom	565
04/03/2008 09:07	-71.79296	-106.21238	BIO-3-EBS-1B	31		304.44	0.4	in water	-5
04/03/2008 08:39	-71.79149	-106.23128	BIO-3-EBS-1A		574.9	305.49	0	on deck	-12
04/03/2008 08:24	-71.79227	-106.22829	BIO-3-EBS-1A			306.01	0.3	off bottom	576
04/03/2008 08:16	-71.79267	-106.22676	BIO-3-EBS-1A			305.75	0.3		800
04/03/2008 08:14	-71.79295	-106.22621	BIO-3-EBS-1A			305.16	1	end trawl	800
04/03/2008 08:04	-71.79492	-106.22048	BIO-3-EBS-1A		576.25	305.3	0.4	start trawl	800
04/03/2008 08:00	-71.79504	-106.21933	BIO3-EBS-1A	30		305.74	0.3	on bottom	571
04/03/2008 07:44	-71.79151	-106.29502			582.07	330.32	0	in water	-8

D) Typical EM120 and Topas Parameter Settings

EM120 Acquisition Parameters

MBES screen, "EM120 Runtime Menu"
Ping Mode: Auto
Sector Coverage
Max Port Angle: 50–68°
Max Starboard Angle: 50–68°
Angular Coverage: Auto
Beam Spacing: Equidistant
Pitch stabilization: On
Yaw stabilization: On , in 'Re Filtered Heading' mode
Min Depth: used to constrain depth when in ice or using TOPAS chirp Tx on fixed cycle
Max Depth: used to constrain depth when in ice or using TOPAS chirp Tx on fixed cycle

Sound Speed Profile
Current Sound Profile: jr179_xbt??.asvp or jr179_ctd???.asvp
Sound Speed at Transducer:
From: Profile
Sensor Offset: 0.0 m/s
Filter: 60 s

Filtering
Spike Filter Strength: Medium
Aeration: On
Sector Tracking: On
Slope: On
Interference: Off
Range Gate: Normal
Absorption Coefficient
Absorption (dB/km): 1.00
Seabed Imaging
TVG Crossover (deg) 6

TOPAS Acquisition Parameters

TOPAS was used in 'chirp' transmission mode throughout the cruise because this suppresses much of the persistent 100 Hz noise, which is evident in the raw trace display and has been a problem in data collected using 'burst' transmission mode on previous cruises.

Parasource Menu
Level: 85%
Ping interval: 0 ms (enables external, SSU trigger) or 4500 – 6500 ms
Pulseform: Chirp
Chirp start frequency (Hz): 1500

Chirp stop frequency (Hz):	5000
Length (ms):	10 or 15

Acquisition Menu

Ch_no:	0
Speed of sound (m/s):	1520 (changed to 1500 on day 077)
Sample rate:	20000 Hz
Trace length (ms):	400
Gain:	18 – 36 dB
Filter:	1.00 kHz
Delay:	Manual or External

Processing Menu

Channel no:	0			
Filter:	ON			
	Low stop: 1200		Low pass:	4800
	High pass: 1700		High stop:	5200
Processing (deconvolution):	DECONV			
	Filter factor (ppm): 1			
Swell:	ON			
	Threshold: 60%			
	# traces: 1			
TVG:	MAN			
	Slope: 30 – 45 dB (mostly 45)			
	Start point: Manual or Tracking or External at different times			
Dereverb:	OFF			
Stacking:	OFF			
AVC:	OFF			
Scale (%):	700 – 2000 (mostly 700)			
Attribute:	INST.AMP			

LOG/Replay Menu

Medium:	DISK
Rate (ms):	1000
Channel:	0
File size (Mb)	10

E) ADCP

Command File JR161 OS75 Narrow Band without Bottom Tracking

```
;------------------------------------------------------------------------------\
; ADCP Command File for use with VmDas software.
;
; ADCP type:     75 Khz Ocean Surveyor
; Setup name:    default
; Setup type:    low resolution, Long range profile(Narrowband)  1000 m
;
; NOTE:  Any line beginning with a semicolon in the first
;        column is treated as a comment and is ignored by
;        the VmDas software.
;
; NOTE:  This file is best viewed with a fixed-point font (e.g. courier).
; Modified Last: 28August2005
;-----------------------------------------------------------------------------/

; Restore factory default settings in the ADCP
cr1

; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE:  VmDas sends baud rate change command after all other commands in
; this file, so that it is not made permanent by a CK command.
cb611

; Set for narrowband single-ping profile mode (NP), sixty five (NN) 16 meter bins (NS),
; 8 meter blanking distance (NF), 390 cm/s ambiguity vel (WV)

; Switch Narrowband ON  NP1
NP1
nn65
ns1600
nf0800


; Switch Broadband  OFF  WP0

WP000
WN065
WS800
WF0200

WV390

; Disable single-ping bottom track (BP),
; Set maximum bottom search depth to 1200 meters (BX) (decimeters)
BP00
BX12000


; output velocity, correlation, echo intensity, percent good
WD111100000

; One and a half seconds between bottom and water pings
TP000150

; Two seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas Communication options
TE00000200

; Set to calculate speed-of-sound, no depth sensor, external synchro heading
; sensor, no pitch or roll being used, no salinity sensor, use internal transducer
; temperature sensor
EZ1020001

; Output beam data (rotations are done in software)
EX00000
```

; Set transducer misalignment (hundredths of degrees)
EA6008

; Set transducer depth (decimeters) [= 6.3 on JCR]
ED00063

; Set Salinity (ppt) [salinity in transducer well = 0]
ES0

; Set Trigger In/Out [ADCP run through SSU]
; CX1,3

; save this setup to non-volatile memory in the ADCP
CK

Command File   JR161 OS75 Narrow Band with Bottom Tracking

```
;----------------------------------------------------------------------------\
; ADCP Command File for use with VmDas software.
;
; ADCP type:     75 Khz Ocean Surveyor
; Setup name:    default
; Setup type:    low resolution, Long range profile(Narrowband)  1000 m
;
; NOTE:  Any line beginning with a semicolon in the first
;        column is treated as a comment and is ignored by
;        the VmDas software.
;
; NOTE:  This file is best viewed with a fixed-point font (e.g. courier).
; Modified Last: 28August2005
;----------------------------------------------------------------------------/

; Restore factory default settings in the ADCP
cr1

; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE:  VmDas sends baud rate change command after all other commands in
; this file, so that it is not made permanent by a CK command.
cb611

; Set for narrowband single-ping profile mode (NP), sixty five (NN) 16 meter bins (NS),
; 8 meter blanking distance (NF), 390 cm/s ambiguity vel (WV)

; Switch Narrowband ON  NP1
NP1
nn65
ns1600
nf0800


; Switch Broadband  OFF  WP0

WP000
WN065
WS800
WF0200

WV390

; Enable single-ping bottom track (BP),
; Set maximum bottom search depth to 1200 meters (BX) (decimeters)
BP01
BX12000


; output velocity, correlation, echo intensity, percent good
WD111100000

; Two seconds between bottom and water pings
TP000150

; Three seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas Communication options
```

```
TE00000300

; Set to calculate speed-of-sound, no depth sensor, external synchro heading
; sensor, no pitch or roll being used, no salinity sensor, use internal transducer
; temperature sensor
EZ1020001

; Output beam data (rotations are done in software)
EX00000

; Set transducer misalignment (hundredths of degrees)
EA6008

; Set transducer depth (decimeters) [= 6.3 on JCR]
ED00063

; Set Salinity (ppt) [salinity in transducer well = 0]
ES0

; Set Trigger In/Out [ADCP run through SSU]
; CX1,3

; save this setup to non-volatile memory in the ADCP
CK
```

F) Core Station Table

Gear	Station	Date	Start (UTC)	At seafloor (UTC)	End (UTC)	Location	Latitude (°S)	Longitude (°W)	Water depth (m)	Recovery (m)
TC	466	25/02/2008	21:11	22:00	23:10	Bellingshausen Sea, crest of Drift 4	64° 54'.60	069° 04'.59	2348	1.12
PC	466	25/02/2008	21:11	22:00	23:10	Bellingshausen Sea, crest of Drift 4	64° 54'.60	069° 04'.59	2348	10.45
TC	467	26/02/2008-27/02/2008	23:37	00:25	01:28	Bellingshausen Sea, crest of Drift 6	67° 40'.48	074° 39'.56	2440	1.13
PC	467	26/02/2008-27/02/2008	23:37	00:25	01:28	Bellingshausen Sea, crest of Drift 6	67° 40'.48	074° 39'.56	2440	9.94
GC	468	28/02/2008	23:07	23:24	23:40	Bellingshausen Sea, shelf N' Alexander Island	68° 32'.61	074° 00'.15	672	0.91
GC	469	29/02/2008	00:06	00:24	00:40	Bellingshausen Sea, shelf N' Alexander Island	68° 32'.61	074° 00'.15	672	0
BC	470	29/02/2008	08:25	08:44	09:03	Bellingshausen Sea, shelf N' Alexander Island	69° 05'.18	076° 23'.21	670	0.24
GC	471	29/02/2008	09:52	10:09	10:26	Bellingshausen Sea, shelf N' Alexander Island	69° 05'.19	076° 23'.22	670	2.87
BC	472	04/03/2007	15:27	15:43	15:58	Amundsen Sea outer shelf Pine Island Bay (MSGL)	72° 18'.16	106° 43'.15	702	0.30
GC	473	04/03/2007	16:47	17:01	17:21	Amundsen Sea outer shelf Pine Island Bay (MSGL)	72° 18'.17	106° 43'.15	702	2.09
BC	474	04/03/2007	22:57	23:14	23:28	Amundsen Sea, lineation west of Burke Island	73° 06'.44	107° 02'.89	760	0.21
GC	475	05/03/2008	00:15	00:34	00:50	Amundsen Sea, lineation west of Burke Island	73° 06'.44	107° 02'.89	760	1.055
BC	476	06/03/08	00:03	00:52	01:31	Pine Island Bay inner shelf basin (BIO4, 1000m)	74° 29'.00	104° 25'.00	1120	0.295
BC	477	06/03/08	16:31	17:00	17:25	Pine Island Bay inner shelf basin (BIO4, 1500m)	74° 21'.47	104° 40'.19	1406	0.255
BC	478	07/03/08	17:39	17:58	18:11	Pine Island Bay inner shelf basin (BIO4, 500m)	74° 23'.93	104° 44'.98	507	0.00
GC	479	07/03/08-08/03/08	23:35	00:05	07:55	Pine Island Bay inner shelf, tunnel valley flank	74° 08'.30	105° 44'.40	1453	1.325
BC	480	08/03/08	00:55	01:35	01:57	Pine Island Bay inner shelf, tunnel valley flank	74° 08'.30	105° 44'.40	1452	0.225
GC	481	08/03/08	03:04	03:38	04:02	Pine Island Bay inner shelf, tunnel valley flank	74° 08'.27	105° 44'.59	1452	1.325
BC	482	10/03/08	00:23	00:53	01:17	Pine Island Bay inner shelf (BIO5, 1000m)	73° 53'.50	106° 16'.49	1113	0.220
BC	483	10/03/08	19:56	20:10	20:20	Pine Island Bay inner shelf (BIO5, 500m)	73° 59'.49	107° 23'.05	528	0.45
GC	484	11/03/08	07:09	07:26	07:41	Pine Island Bay mid-shelf, grounding zone wedge	72° 43'.52	107° 17'.64	691	2.04
BC	485	11/03/08	08:07	08:27	08:41	Pine Island Bay mid-shelf, grounding zone wedge	72° 43'.52	107° 17'.64	692	0.32
BC	486	12/03/08	09:05	09:20	09:36	Pine Island Bay outer shelf (BIO6, 500m)	71° 20'.03	109° 58'.0	465	0.10
BC	487	13/03/08	01:08	01:33	01:53	Amundsen Sea upper slope, offshore from PIB (BIO6, 1000m)	71° 10'.78	109° 54'.26	898	0.15
BC	488	13/03/08	16:17	16:49	17:12	Amundsen Sea upper slope, offshore from PIB (BIO6, 1500m)	71° 09'.78	110° 04'.87	1378	0.23
TC	489	15/03/08	12:54	13:57	15:15	Amundsen Sea continental rise, sediment waves	69° 35'.68	117° 58'.93	3281	0.145

Gear	Station	Date	Start (UTC)	At seafloor (UTC)	End (UTC)	Location	Latitude (°S)	Longitude (°W)	Water depth (m)	Recovery (m)
PC	489	15/03/08	12:54	13:57	15:15	Amundsen Sea continental rise, sediment waves	69° 35'.68	117° 58'.93	3281	8.875

BC	490	15/03/08	15:58	17:05	17:55	Amundsen Sea continental rise, sediment waves	69° 35'.68	117° 58'.93	3281	0.16
TC	491	16/03/08	03:46	04:31	05:32	Amundsen Sea continental rise, unnamed Marie Byrd Seamount	71° 09'.00	119° 57'.70	2074	0.69
PC	491	16/03/08	03:46	04:31	05:32	Amundsen Sea continental rise, unnamed Marie Byrd Seamount	71° 09'.00	119° 57'.70	2074	8.94
BC	492	16/03/08	06:37	07:25	08:08	Amundsen Sea continental rise, unnamed Marie Byrd Seamount	71° 09'.00	119° 57'.45	2073	0.17
TC	493	16/03/08	09:20	10:02	10:58	Amundsen Sea continental rise, unnamed Marie Byrd Seamount	71° 07'.84	119° 54'.81	2077	0.935
PC	493	16/03/08	09:20	10:02	10:58	Amundsen Sea continental rise, unnamed Marie Byrd Seamount	71° 07'.84	119° 54'.81	2077	10.39
TC	494	18/03/08	00:10	01:28	02:15	Amundsen Sea, drift crest	70° 02'.93	108° 20'.69	3450	1.13
PC	494	18/03/08	00:10	01:28	02:15	Amundsen Sea, drift crest	70° 02'.93	108° 20'.69	3450	10.41
BC	495	18/03/08	03:15	04:30	05:28	Amundsen Sea, drift crest	70° 02'.92	108° 20'.95	3468	0.52
TC	496	19/03/08	07:15	08:35	10:06	Amundsen Sea, drift flank	69° 13'.80	106° 40'.80	4230	1.13
PC	496	19/03/08	07:15	08:35	10:06	Amundsen Sea, drift flank	69° 13'.80	106° 40'.80	4230	9.37
BC	497	19/03/08	03:15	04:30	05:28	Amundsen Sea, drift flank	69° 13'.81	106° 40'.80	4229	0.17
BC	498	21/03/08	12:20	13:59	15:15	Bellingshausen Abyssal Plain, just to the south of APF	64° 23'.67	107° 03'.14	4985	0.18
TC	499	21/03/08	16:03	17:38	19:15	Bellingshausen Abyssal Plain, just to the south of APF	64° 23'.67	107° 03'.13	4986	0.855
PC	499	21/03/08	16:03	17:38	19:15	Bellingshausen Abyssal Plain, just to the south of APF	64° 23'.67	107° 03'.13	4986	11.27
TC	500	22/03/08	11:39	13:22	15:09	Bellingshausen Abyssal Plain, APF	62° 53'.28	106° 17'.33	5109	0.715
PC	500	22/03/08	11:39	13:22	15:09	Bellingshausen Abyssal Plain, APF	62° 53'.28	106° 17'.33	5109	9.375
TC	501	23/03/08	11:42	13:20	15:01	Bellingshausen Abyssal Plain, APF	60° 32'.08	108° 18'.17	5204	0.705
PC	501	23/03/08	11:42	13:20	15:01	Bellingshausen Abyssal Plain, APF	60° 32'.08	108° 18'.17	5204	11.68
BC	502	23/03/08	20:10	21:51	23:03	Bellingshausen Abyssal Plain, APF	60° 32'.11	108° 18'.14	5205	0.24
TC	503	25/03/08	01:25	03:07	04:48	Bellingshausen Abyssal Plain, Polar Front Zone	61° 14'.72	114° 52'.76	5137	0.295
PC	503	25/03/08	01:25	03:07	04:48	Bellingshausen Abyssal Plain, Polar Front Zone	61° 14'.72	114° 52'.76	5137	10.305
BC	504	25/03/08	05:12	06:58	08:18	Bellingshausen Abyssal Plain, Polar Front Zone	61° 14'.72	114° 52'.76	5137	0.245
TC	505	26/03/08-27/03/08	21:37	23:07	00:13	Amundsen Sea lower continental rise, 'Ponded sediment'	66° 42'.52	106° 11'.97	4756	0.10
Gear	**Station**	**Date**	**Start (UTC)**	**At seafloor (UTC)**	**End (UTC)**	**Location**	**Latitude (°S)**	**Longitude (°W)**	**Water depth (m)**	**Recovery (m)**
PC	505	26/03/08-27/03/08	21:37	23:07	00:13	Amundsen Sea lower continental rise, 'Ponded sediment'	66° 42'.52	106° 11'.97	4756	9.01
BC	506	28/03/08	14:00	15:23	16:28	Bellingshausen Sea, lower continental rise	67° 59'.91	095° 00'.60	4430	0.445
TC	507	28/03/08	17:23	18:46	20:16	Bellingshausen Sea, lower continental rise	67° 59'.91	095° 00'.60	4430	0.64

PC	507	28/03/08	17:23	18:46	20:16	Bellingshausen Sea, lower continental rise	67° 59'.91	095° 00'.60	4430	10.80
BC	508	29/03/08	17:06	18:15	19:08	Distal Belgica Trough Mouth Fan, upper continental rise	68° 18'.63	086° 01'.93	3560	0.29
TC	509	29/03/08	19:48	20:56	21:55	Distal Belgica Trough Mouth Fan, upper continental rise	68° 18'.64	086° 01'.93	3559	1.15
PC	509	29/03/08	19:48	20:56	21:55	Distal Belgica Trough Mouth Fan, upper continental rise	68° 18'.64	086° 01'.93	3559	9.89
TC	510	30/03/08	02:58	04:12	05:25	Distal Belgica Trough Mouth Fan, lower continental rise	67° 55'.51	086° 37'.65	3849	0.73
PC	510	30/03/08	02:58	04:12	05:25	Distal Belgica Trough Mouth Fan, lower continental rise	67° 55'.51	086° 37'.65	3849	11.49
BC	511	30/03/08	06:05	07:30	08:32	Distal Belgica Trough Mouth Fan, lower continental rise	67° 55'.51	086° 37'.65	3847	0
BC	512	01/04/08	09:40	10:16	10:38	Bellingshausen Sea, shelf N' Rothschild Island	68° 47'.35	073° 06'.65	1087	0.32
GC	513	01/04/08	11:21	11:41	12:04	Bellingshausen Sea, shelf N' Rothschild Island	68° 47'.35	073° 06'.65	1095	5.325
GC	514	01/04/08	14:16	14:33	14:54	Bellingshausen Sea, shelf N' Rothschild Island	68° 41'.18	073° 04'.42	867	2.90
GC	515	02/04/08	02:31	02:52	03:13	Inner trough in Marguerite Bay	68° 47'.50	069° 53'.04	999	2.29
BC	516	02/04/08	03.33	04:00	04:20	Inner trough in Marguerite Bay	68° 47'.50	069° 53'.03	998	0.275
GC	517	02/04/08	05:05	05:25	05:45	Inner trough in Marguerite Bay	68° 47'.50	069° 53'.03	998	2.885
BC	518	02/04/08	11.04	11:26	11:40	Marguerite Bay	68° 14'.25	070° 12'.22	698	0.19
BC	519	02/04/08	13:06	13:20	13:34	Marguerite Bay	68° 14'.25	070° 12'.21	697	0.17
TC	520	02/04/08-03/04/08	23:20	23:40	00:19	Marguerite Bay, Adelaide Trough	67° 47'.49	068° 05'.05	870	0.42
PC	520	02/04/08-03/04/08	23:20	23:40	00:19	Marguerite Bay, Adelaide Trough	67° 47'.49	068° 05'.05	870	9.955
BC	521	03/04/08	00:56	01:19	01:41	Marguerite Bay, Adelaide Trough	67° 47'.49	068° 05'.04	889	0.31
TC	522	03/04/08	03:39	04:00	04:40	Marguerite Bay, Adelaide Trough	67° 51'.33	068° 12'.28	910	0.41
PC	522	03/04/08	03:39	04:00	04:40	Marguerite Bay, Adelaide Trough	67° 51'.33	068° 12'.28	910	11.72
BC	523	03/04/08	05:00	05:24	05:45	Marguerite Bay, Adelaide Trough	67° 51'.33	068° 12'.28	911	0.29

G Smear Slide List:

Core Number	Smear Slide Depth	logged	assessed	not in logs	Box number
BC476Y	5			/	1
BC476Y	20			/	1
BC479Z	3			/	1
BC479Z	10			/	1
BC479Z	20			/	1
BC482X	5	/			1
BC482X	15	/			1
BC483X	2	/			1
BC483X	20	/			1
BC485	3	/	/		1
BC485	15	/	/		1
BC485	28	/	/		1
BC487X	4	/			1
BC487X	12	/			1
BC488X	5	/			1
BC488X	20	/			1
BC502	0 - 1			/	1
BC504X	29.5			/	1
GC468	5	/	/		4
GC468	25	/	/		4
GC468	65	/	/		4
GC471	0	/	/		4
GC471	2	/	/		4
GC471	7	/	/		4
GC471	50	/	/		4
GC471	85	/	/		4
GC471	100	/	/		4
GC471	120	/	/		4
GC471	185	/	/		4
GC471	230	/	/		4
GC471	277	/	/		4
GC471	160			/	4
GC471 core catcher	-	/	/		4
GC473	2	/	/		4
GC473	25	/	/		4
GC473	40	/	/		4
GC473	50	/	/		4
GC473	80	/	/		4
GC473	170	/	/		4
GC473	2			/	4
GC475	19	/	/	/	4
GC475	40	/	/	/	4
GC475	70	/	/	/	4
GC475	2	/	/		4
GC481	2	/	/		4
GC481	6	/	/		4
GC481	20	/	/		4
GC481	40	/	/		4
GC481	70	/	/		4
GC481	130	/	/		4
GC481	110	/			4
GC481	80	/			4

GC484 (1 of 2)	5	/	/		4
GC484 (1 of 2)	25	/	/		4
GC484 (1 of 2)	39	/	/		4
GC484 (1 of 2)	60	/	/		4
GC484 (1 of 2)	105	/	/		4
GC484 (1 of 2)	77	/	/		4
GC484 (2 of 2)	25		/	/	4
GC484 (2 of 2)	50		/	/	4
GC484 (2 of 2)	75		/	/	4
GC512	base of a1			/	2
GC512	base of a2			/	2
GC512	base of a3			/	2
GC512	base of b1			/	2
GC512	base of b2			/	2
GC512	top of b3			/	2
GC513	0	missing	missing	missing	missing
GC513	40	/			3
GC513	100	/			3
GC513	138.5	missing	missing	missing	missing
GC513	360			/	3
GC513	420			/	3
GC513	460	/			3
GC513	510	/			3
GC513	160			/	3
GC513	210			/	3
GC513	260			/	3
GC513	310			/	3
GC514	base of a1			/	2
GC514	base of a2			/	2
GC514	base of b3			/	2
GC514	top of a3			/	2
GC515	base of c2			/	2
GC515	base of c3			/	2
GC515	top of c3			/	2
GC515 core catcher	-			/	2
GC517	base of d2			/	2
GC517	base of d3			/	2
GC517	top of d3			/	2
GC517 core catcher	-			/	2
PC466	50	/	/		4
PC466	85	/	/		4
PC466	98	/	/		4
PC466	100	/	/		4
PC466	150	/	/		4
PC466	220	/	/		4
PC466	275	/	/		4
PC466	320	/	/		4
PC466	370	/	/		4
PC466	420	/	/		4
PC466	470	/	/		4
PC466	541	/	/		4
PC466	578	/	/		4
PC466	645	/	/		4
PC466	745	/	/		4

PC466	810	/	/		4
PC466	870	/	/		4
PC466	895	/	/		4
PC466	930	/	/		4
PC466	960	/	/		4
PC466	1000	/	/		4
PC466	1042	/	/		4
PC466	866.5	/	/		4
PC466	890.5	/	/		4
PC466 core catcher	-				4
PC467	2	/			1
PC467	26	/			1
PC467	59	/			1
PC467	83	/			1
PC467	95.5	/			1
PC467	129	/			1
PC467	180	/			1
PC467	230	/			1
PC467	274	/			1
PC467	330	/			1
PC467	360	/			1
PC467	390	/			1
PC467	437	/			1
PC467	487	/			1
PC467	530	/			1
PC467	575	/			1
PC467	600	/			1
PC467	640	/			1
PC467	701	/			1
PC467	735	/			1
PC467	785	/			1
PC467	830	/			1
PC467	898	/			1
PC467	930	/			1
PC467	980	/			1
PC491 core catcher	-	/	/		4
PC494 core catcher	-	/	/		4
PC499	2	/			1
PC499	10	/			1
PC499	24	/			1
PC499	33			/	1
PC499	60	/			1
PC499	549			/	1
PC499	base of B3			/	1
PC499 core catcher	bottom			/	1
PC499 core catcher	top			/	1
PC501	base of 1/12			/	1
PC501	base of 10/12			/	1
PC501	base of 11/12			/	1
PC501	base of 2/12			/	1
PC501	base of 3/12			/	1
PC501	base of 4/12			/	1
PC501	base of 5/12			/	1
PC501	base of 6/12			/	1

PC501	base of 7/12		/	1
PC501	base of 8/12		/	1
PC501	base of 9/12		/	1
PC501 core catcher	-		/	1
PC503	base of a1		/	1
PC503	base of a2		/	1
PC503	base of a3		/	1
PC503	base of b1		/	1
PC503	base of b2		/	1
PC503	base of b3		/	1
PC503	base of c1		/	1
PC503	base of c2		/	1
PC503	base of c3		/	1
PC505	2	/		2
PC505	50	/		2
PC505	150	/		2
PC505	250		/	2
PC505	350		/	2
PC505	390		/	2
PC505	450		/	2
PC505	670		/	2
PC505	730		/	2
PC505	760		/	2
PC505	810		/	2
PC505	840		/	2
PC505	890		/	2
PC507	96		/	1
PC507	298		/	1
PC507	399		/	1
PC507	603		/	1
PC507	705		/	1
PC507	905		/	1
PC507	1006		/	1
PC507	1080		/	1
PC509	base of a1		/	2
PC509	base of a2		/	2
PC509	base of a3		/	2
PC509	base of b1		/	2
PC509	base of b2		/	2
PC509	base of b3		/	2
PC509	base of c1		/	2
PC509	base of c2		/	2
PC509	base of c3		/	2
PC509	top of d2		/	2
PC509 core catcher	-		/	2
PC510	base of a1		/	2
PC510	base of a2		/	2
PC510	base of a3		/	2
PC510	base of b2		/	2
PC510	base of b3		/	2
PC510	base of c1		/	2
PC510	base of c2		/	2
PC510	base of C3		/	2
PC510	base of d1		/	2

PC510	base of d2			/	2
PC510	base of d3			/	2
PC510 core catcher	-			/	2
PC520	base of a2			/	3
PC520	base of a3			/	3
PC520	base of b2			/	3
PC520	base of b3			/	3
PC520	base of c2			/	3
PC520	base of c3			/	3
PC522	base of a3			/	3
PC522	base of b1			/	3
PC522	base of b2			/	3
PC522	base of b3			/	3
PC522	base of c1			/	3
PC522	base of c2			/	3
PC522	base of c3			/	3
PC522	base of d1			/	3
PC522	base of d2			/	3
PC522	base of d3			/	3
PC522	top of d3			/	3
PC522 core catcher	-			/	3
TC466	20	/	/		4
TC466	50	/	/		4
TC466	95	/	/		4
TC466	112	/	/		4
TC494 core catcher	-	/	/		4
TC501 core catcher	-			/	1
TC509	base			/	2
TC509	top			/	2
TC510	top			/	2
TC510 core catcher	-			/	2
TC520 core catcher	-			/	3
TC520 core catcher	-			/	3
TC522 core catcher	-			/	3