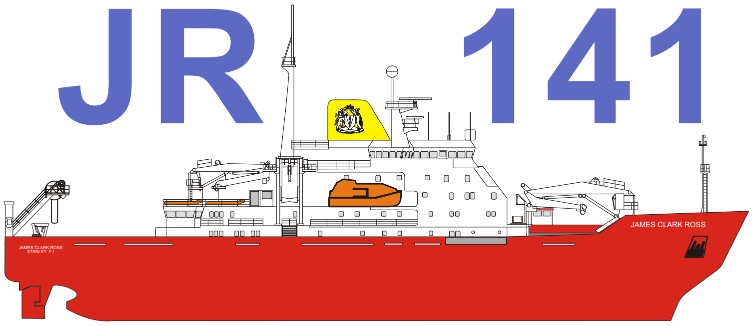
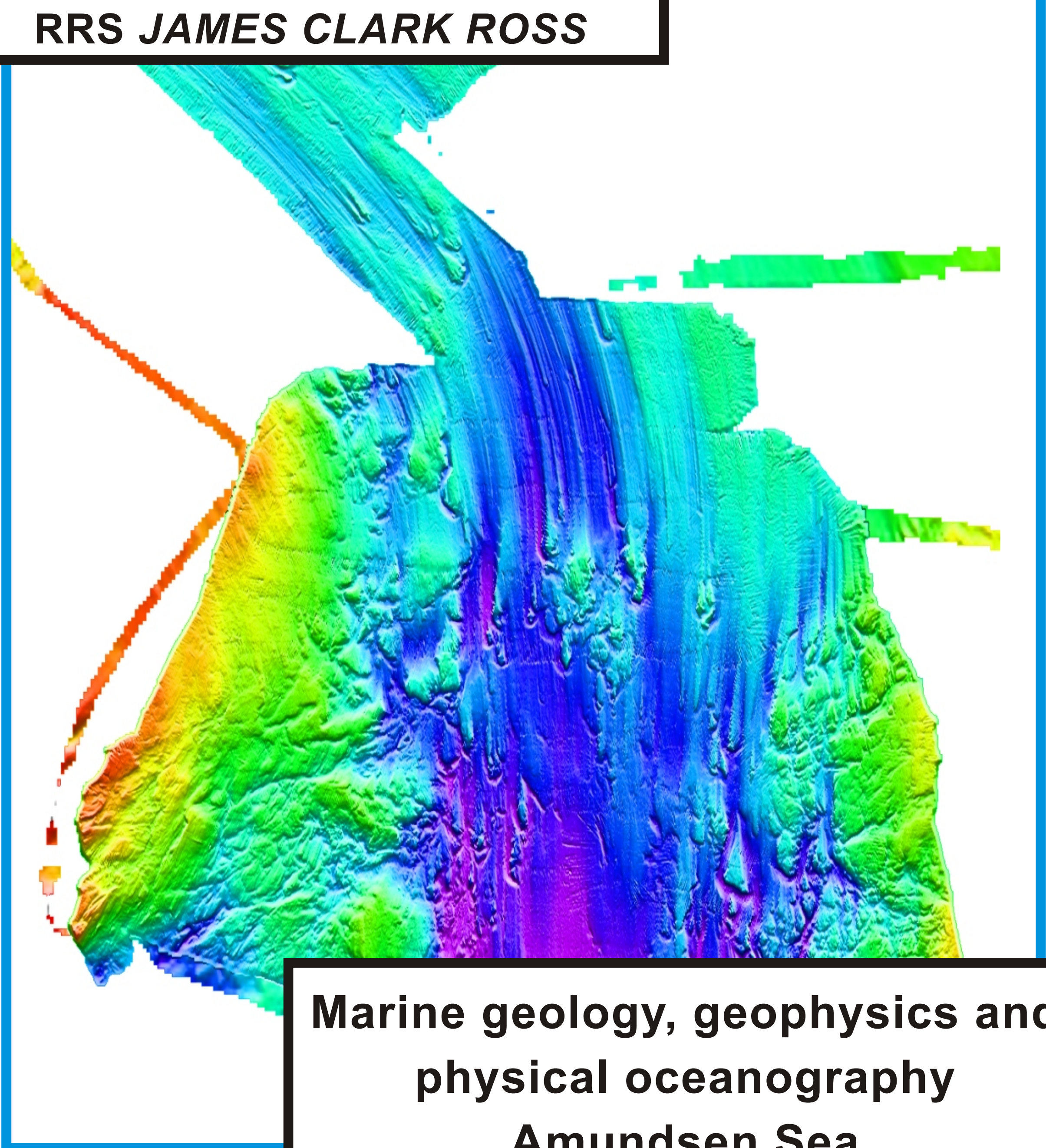
BAS Ref.: JR141 Copy No:

CRUISE REPORT

JR 141



RRS *JAMES CLARK ROSS*



Marine geology, geophysics and physical oceanography
Amundsen Sea
January – February 2006

BAS Ref.: JR141 Copy No:

CRUISE REPORT

RRS *James Clark Ross*

Cruise JR141

January to February 2006

Multibeam echo sounding, TOPAS sub-bottom profiling,
high-resolution airgun seismic profiling, sediment coring, conductivity-temperature-depth casts and acoustic Doppler current profiling

Continental shelf and slope in the Amundsen Sea

R.D. Larter
with contributions from C.P. Brett (BGS), T.J. Deen, C.-D. Hillenbrand, J. Robst,
D.R. Shoosmith and J.A. Smith

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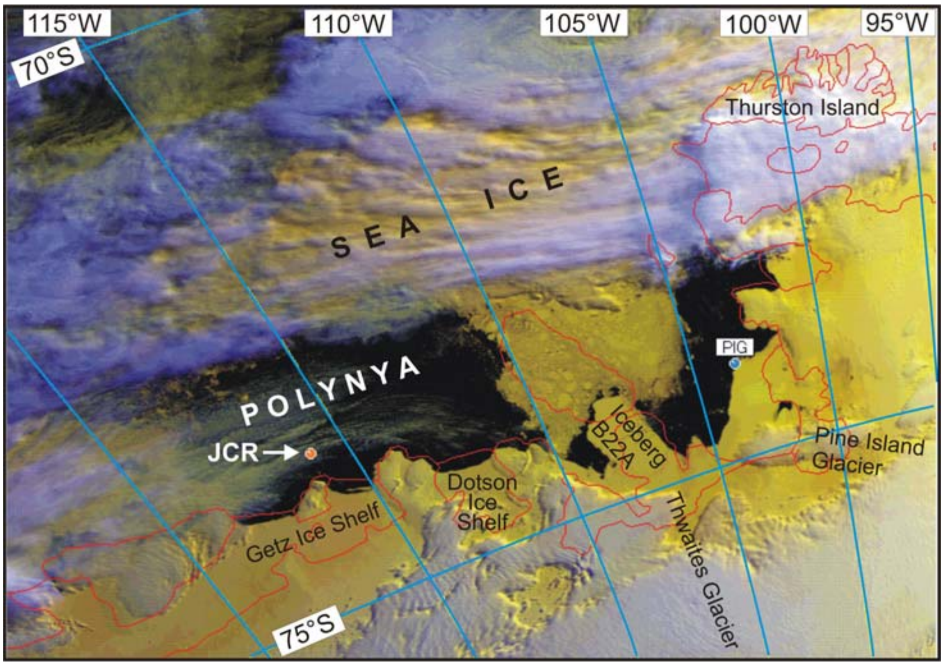


Frontispiece: ice conditions in the Amundsen Sea, (a) as seen from space (top, Dartcom satellite image, 1506 on 28th January 2006) showing the polynya north of the Dotson and Getz ice shelves, and (b) from the ship (~0500 on 11th February near core station VC453 on the outer continental shelf.

Back cover: The JCR Rescue boat in choppy conditions at the front of the Getz Ice Shelf

Contents

Figures

Tables

1. SUMMARY

The data and samples collected on cruise JR141 will ….

TO BE WRITTEN

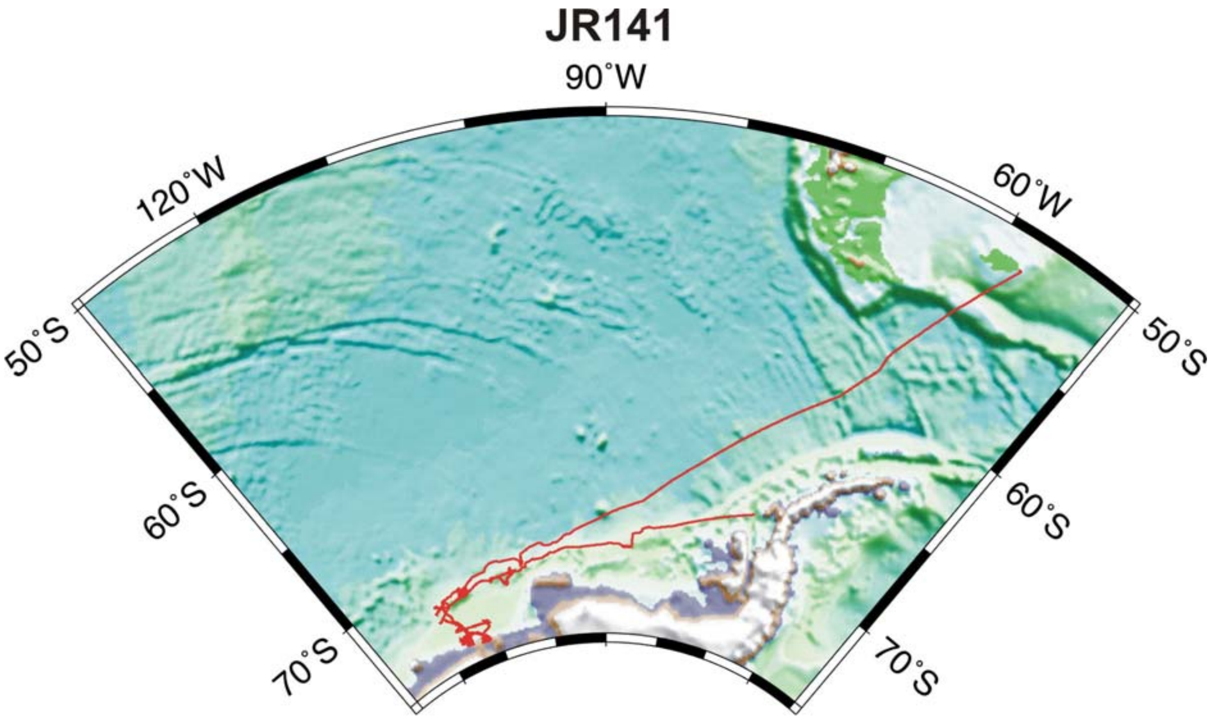


Fig. 1. Track of RRS *James Clark Ross* during cruise JR141 (red) overlaid on shaded-relief display of predicted bathymetry of Smith & Sandwell (north of 72°S; Science, **277**, 1956–1962, 1997). Bathymetry south of 72°S is from ETOPO5 global elevation database (http://www.ngdc.noaa.gov/mgg/global/global.html) and Antarctic topographic data is from the Antarctic Digital Database (http://www.add.scar.org). A larger scale track chart is included as a fold out at the back of this report.

2. LIST OF PERSONNEL

2.1 Scientific and Technical (15)

R.D. Larter	BAS	Chief Scientist
C.-D. Hillenbrand	BAS	Marine Geologist
T.J. Deen	BAS	Marine Geophysicist
R.A. Livermore	BAS	Geophysicist/Data Manager
J.A. Smith	BAS	Sedimentologist
D.R. Shoosmith	BAS	Physical Oceanographer
D. Pozzi-Walker	Open University	Physical Oceanographer
P.J. Cooper	BAS	AME (Electronic Engineer)
J. P. Robst	BAS	ICT (Computing Engineer)
C.P. Brett	BGS	BGS Team Leader
D.H. Baxter	BGS Marine Operations	Mechanical Engineer
N.C. Campbell	BGS Marine Operations	Mechanical Engineer
D.J. Smith	BGS Marine Operations	Instrumentation Engineer
D.G. Wallis	BGS Marine Operations	Instrumentation Engineer
D. P. Farrance	BASMU	Doctor

BAS = British Antarctic Survey; BASMU = BAS Medical Unit; AME = BAS Antarctic & Marine Engineering Section; ICT = BAS Information Communications Technology Section; BGS = British Geological Survey

2.2 Ship's Company (30)

M.J.S. Burgan	Master	C.D. Lang	Bosun
A.R. Liddell	Chief Officer	D.J. Peck	Bosun's Mate
P.I. Clarke	2nd Officer	A.M. Bowen	Seaman
J.L. Cox	3rd Officer	K.E. Chappell	Seaman
J.W. Summers	Deck Officer	G.A. Dale	Seaman
Z. Brockman	Deck Cadet	K.J. Holmes	Seaman
E.F. Doig	Deck Cadet	I. Raper	Seaman
D.E. Anderson	Chief Engineer	A.I. Macaskill	Motorman
C. Smith	2nd Engineer	B.D. Smith	Motorman
J.S. Stevenson	3rd Engineer	A.A. Huntley	Chief Cook
T. Balfe	4th Engineer	J.E. Lee	2nd Cook
M.E.P. Gloistein	Radio Officer	L.J. Jones	Senior Steward
S.A.Wright	Deck Engineer	N.R. Greenwood	Steward
A.K. Rowe	Electrical Engineer	G. Raworth	Steward
R.J. Turner	Purser	M. Weirs	Steward

3. TIMETABLE OF EVENTS

January 2006

8 Embarkation of part of scientific party, crew changeover and loading of BGS winch and containers at Mardones Pier, Punta Arenas.

9 Embarkation of three more members of scientific party. RRS *James Clark Ross* departs from Punta Arenas at 1200 local time (1500Z).

10 Passage to Falkland Islands.

11 Arrive at FIPASS at 0800 local time (1100Z) and commence mobilisation for JR141.

12 Complete mobilisation.

13 Ship visited by BAS Director and VIP party. RRS *James Clark Ross* departs from FIPASS at 1040 local time (1340Z) and anchors in Port William to carry out emergency drills. Weigh anchor and start passage to Amundsen Sea at 1400Z. Deploy magnetometer at 2230Z.

14 Crossing Drake Passage, collecting multibeam echo sounding, TOPAS and magnetic data continuously.

15 Continuation of Drake Passage crossing and trial CTD.

16-17 Passage along continental rise west of Antarctic Peninsula, collecting multibeam echo sounding, TOPAS and magnetic data continuously.

18 Passage through Bellingshausen Sea, passing close to Peter I Island, collecting multibeam echo sounding, TOPAS and magnetic data continuously.

19 Recover magnetometer at 1313Z. Coring on upper slope and shelf edge at 103° 16’W – 103° 19’W.

20 Transit westwards and reconnaissance along intended CTD transect across outer shelf trough between 112° 45’W and 114° 17’W, collecting survey data along route.

21 Coring, multibeam echo sounder survey and TOPAS survey in outer shelf trough area, and second reconnaissance along intended CTD transect across trough.

22 One CTD, coring, multibeam echo sounder survey and TOPAS survey in outer shelf trough area, then transit westwards to begin search for route through sea ice to polynya, collecting survey data along route. Coring on outer shelf at 117° 07’W.

23 Slow transit southwards through sea ice until 1750Z. Coring and one CTD in polynya.

24 Coring north of Martin Peninsula Dotson Ice Shelf, reconnaissance along eastern edge of polynya, then start seismic profile, heading west.

25 Seismic profiling, collecting multibeam echo sounder and TOPAS data along profiles.

26 Seismic profiling, multibeam echo sounding and TOPAS survey along front of Getz Ice Shelf, coring, then CTD transect along front of Getz Ice Shelf.

27 Complete CTD transect, multibeam echo sounding and TOPAS survey north of Getz Ice Shelf, deploy boat party to attempt (unsuccessful) to recover sample from outcrop on coast of Martin Peninsula.

28 Coring, multibeam echo sounding survey and TOPAS survey north of Getz Ice Shelf.

29 Multibeam echo sounding and TOPAS survey north of Getz Ice Shelf, Martin Peninsula and Dotson Ice Shelf.

30 Multibeam echo sounding and TOPAS survey, and coring, north of Dotson Ice Shelf.

31 Coring, dredging, multibeam echo sounding survey and TOPAS survey north of Dotson Ice Shelf.

February 2006

1 Coring, multibeam echo sounding and TOPAS survey north of the Martin Peninsula and Getz Ice Shelf.

2 Multibeam echo sounding and TOPAS survey, and coring, in main mid-shelf trough north of Getz Ice Shelf, then slow transit northwards through sea ice.

3 Drifting with pack, unable to make progress.

4 Slow transit northwards through sea ice, then multibeam echo sounding and TOPAS survey, coring and one CTD on outer shelf.

5 Multibeam echo sounding and TOPAS survey, and coring on the upper slope north of Getz Ice Shelf.

6 Transit eastward, collecting survey data along route, then coring in outer shelf trough.

7 Seismic profiling over outer shelf trough, coring on upper slope, then CTD transect across trough.

8 Transit eastward, collecting survey data along route, then coring, multibeam echo sounding and TOPAS survey over grounding zone wedge near 108°W.

9 Multibeam echo sounding and TOPAS survey, and coring, in outer shelf trough around 106°W.

10 Seismic profiling eastward along outer shelf from 108° 29.2’W.

11 Coring and one CTD on shelf and upper slope near 105°W, then transit eastward, collecting survey data along route.

12 Transit eastward along Bellingshausen Sea continental slope, collecting survey data along route.

13 One CTD, coring, then multibeam echo sounding and TOPAS survey in outer part of Belgica Trough and on Belgica Trough Mouth Fan.

14 Passage to Rothera, collecting survey data along route.

15 RRS *James Clark Ross* arrives at Rothera at 0800 local time (1100Z).

4. LIST OF SCIENTIFIC EQUIPMENT USED

4.1 Echo Sounders

Kongsberg Simrad EM120 multibeam echo sounder
Kongsberg Simrad TOPAS PS018 sub-bottom profiler
Kongsberg Simrad EA600 (Bridge navigational echo sounder)
Kongsberg Simrad sonar synchronisation unit (SSU)
10 kHz Precision Echo Sounder and 10 kHz pinger (used when CTD altimeter failed)

4.2 Coring equipment and winches

BGS 6 m vibrocorer and deep-water winch
Duncan and Associates box corer (300 mm square box)
30-tonne traction winch and CLAM wire monitoring system

4.3 Seismic profiling equipment

Bolt 600B airguns and airgun control system (provided by BGS)
SIG hydrophone streamer (provided by BGS)
Coda DA200 seismic data recording system (provided by BGS)
Hamworthy compressors

4.4 Potential Field Equipment

Shipboard three-component magnetometer (STCM)
SeaSpy towed Overhauser magnetometer

4.5 Oceanographic instruments

Seabird Conductivity-Temperature-Depth (CTD) system
Autosal
RDI 75 kHz Acoustic Doppler Current Profiler (ADCP)
Thermosalinograph (part of BAS Oceanlogger)
Expendable bathythermograph probes (XBTs, types T5 and T7)

4.6 Navigation

Seapath (input to EM120 and TOPAS)
Skyfix differential GPS demodulator (input to Seapath receiver)
Furuno GP-32 GPS receiver
Ashtech G24 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

4.7 Data Logging

NOAA Scientific Computer System (SCS) system

5. INTRODUCTION

Cruise JR141 collected data for two research projects funded through the BAS five-year (2005–2010) core research programme *Global Science in the Antarctic Context* (GSAC). Most time on the cruise was allocated to collect marine geological and geophysical data for the *Quaternary West Antarctic Deglaciations* (QWAD) project, which is part of the GSAC component programme *Glacial Retreat in Antarctica and Deglaciation of the Earth System* (GRADES). Two days were allocated to collect oceanographic data for the *Forcings from the Ocean, Clouds, Atmosphere and Sea Ice* (FOCAS) project, which is part of the GSAC component programme *Antarctic Climate and the Earth System* (ACES).

MORE TO BE ADDED –

Explain why equipment had to be collected from Punta Arenas then mobilised in Stanley.

Brief scientific background, with references.

6. NARRATIVE

TO BE WRITTEN

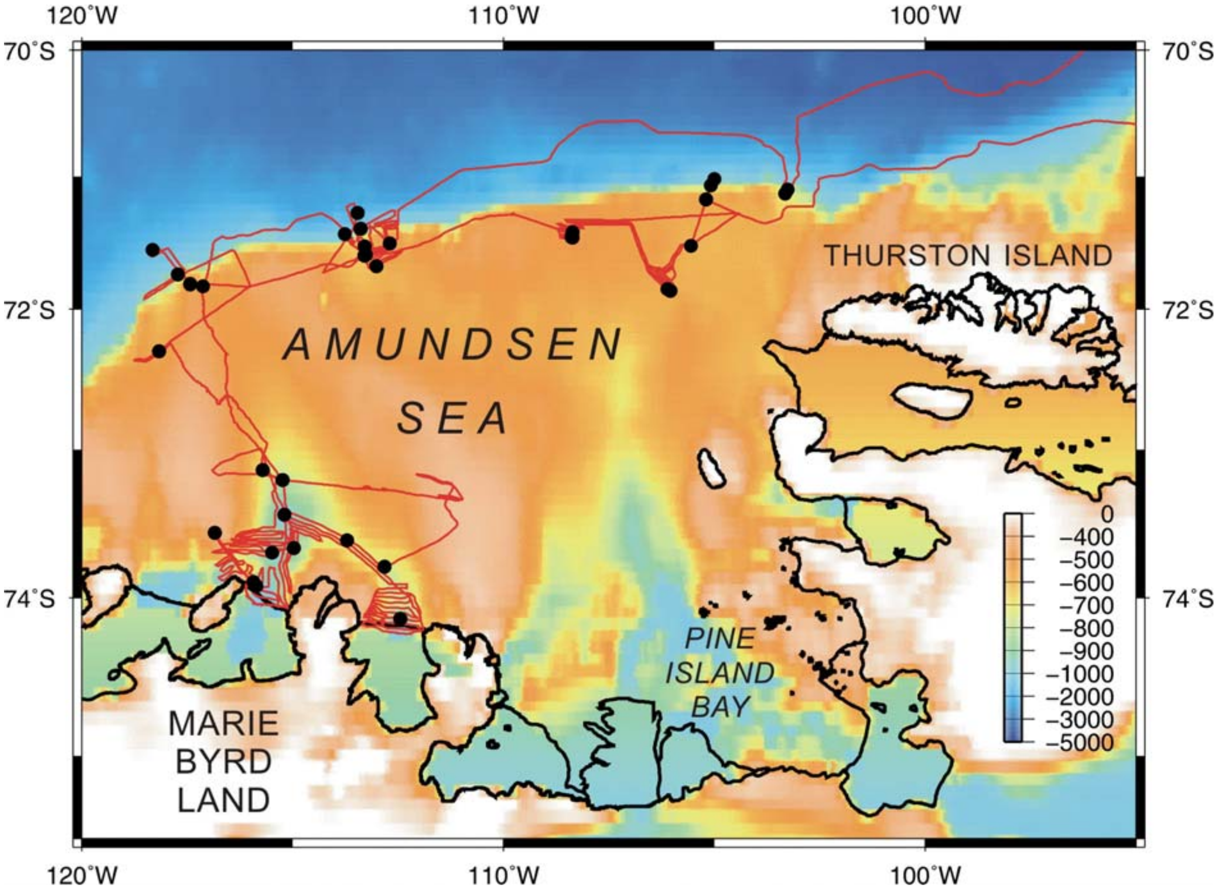


Fig. Nar1. Track of RRS *James Clark Ross* in the Amundsen Sea during cruise JR141 (red) overlaid on regional bathymetry and subglacial topography compiled by Frank Nitsche (Lamont Doherty Earth Observatory, Columbia University, USA). Core sites are marked by black dots.

7. PRELIMINARY RESULTS

7.1 EM120 Swath Bathymetry and TOPAS Investigations

7.2 Seismic Reflection Profiling

7.3 Box coring

Claus-Dieter Hillenbrand

Box coring during JR141 recovered three different types of surface sediments in the study area. On the continental slope and on the outer shelf surface sediments (assumed to be Holocene in age) consist of brown foraminiferal mud and foraminiferal ooze (BC395, BC398, BC401, BC403, BC431, BC433, BC435, BC437, BC439, BC442, BC443, BC446, BC448, BC451, BC455, BC456, BC459). The foraminiferal assemblage is dominated by the planktonic species *Neogloboquadrina pachyderma* sin. The foraminiferal carbonate found in these sediments will be used for AMS ^{14}C dating. Gravel grains and cobbles lay on top of the foraminifera-bearing sediments (Fig. **BC2**).

Fig. **BC2**: Photo of box corer BC437 (outer shelf of Pine Island Bay). Surface sediment: foraminiferal mud. Note the high abundance of pebbles and gravel grains, which are partly coated by manganese (visible by the brown and black colors).

Fig. **BC3**: Photo of box corer BC435 (shelf edge in western Amundsen Sea). Surface sediment: foraminiferal mud. Note the high abundance of pebbles and gravel grains partly coated by manganese and high concentration of benthic animals (e.g. brittle stars, brachiopods, bryozoans).

The gravels and cobbles, which are interpreted as dropstones, are often covered with thin manganese coatings pointing to sedimentation rates less than 1 cm/kyr. The occurrence of silt- and clay-sized particles within the foraminifera-bearing units supports the idea that these deposits represent condensed units rather than residual sediments. Only the high concentration of benthic animals at site BC435 (Fig. **BC3**) located at the shelf break in the western Amundsen Sea suggests that the deposition of foraminiferal mud there also resulted from current-induced winnowing.

Dark brown, reddish brown and olive diatom-bearing muds and diatomaceous muds were found on the inner shelf north of the Dotson and the eastern Getz Ice Shelves (BC407, BC409, BC410, BC412, BC416, BC421, BC423, BC426, BC429 Fig. **BC4**). The surface sediments at most of these sites lack coarse-grained terrigenous detritus. Holocene sedimentation rates there are assumed to be significantly higher than at the sites where foraminifera-bearing sediments were recovered. The only purely terrigenous sediments were found at site BC420 north of the Dotson Ice Shelf (mud) and at site BC431 on the outer shelf in the western Amundsen Sea (sandy mud; Fig. **BC5**).

Fig. **BC4**: Photo of box corer BC426 (inner shelf NNW of Martin Peninsula). Surface sediment: reddish brown, diatom-bearing mud.

At most box corer sites the contents of biogenic material decrease downcore in the sediments underlying the foraminifera- and the diatom-bearing top layers. These sediments, which often contain significant amounts of terrigenous sand and gravel, were probably deposited at the transition from the last glacial to the present interglacial period. At site BC431, the sandy mud is underlain by a dark grayish brown, homogenous diamicton (Fig. **BC5**). This sedimentary succession is interpreted as an iceberg turbate resulting from iceberg scouring, which is documented by numerous iceberg furrows visible in swath images from that area.

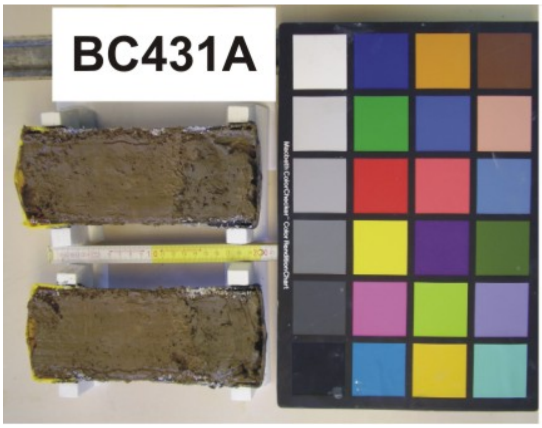


Fig. **BC5**: Photo of split subcore A of box core BC431 (outer shelf in western Amundsen Sea). Core top is to the left. Sediments: 0-14 cm: dark grayish brown, moderately bioturbated sandy mud; 14-19 cm: dark gray brown, homogenous diamicton.

8. EQUIPMENT PERFORMANCE

8.1 EM120 Multibeam Echo Sounder

8.1.1 EM120 operational performance

8.1.2 EM120 raw file to MB conversion

Jeremy Robst

The program mbcopy (part of the mb suite) is used to convert the EM120 raw files to MB format. Occasionally (once on JR134 and once on JR141) mbcopy will leave large gaps in the output. Further investigation (using the -v option to get the number of output records) showed that mbcopy often misses the occasional few pings.

I investigated the mbcopy source code and found the reason for these gaps. An EM120 raw file consists of a number of records or datagrams, each preceded by a 4 byte length field. Immediately after the length field are two bytes, a start of datagram identified (always 02h) and a byte identifying the datagram type (e.g D (044h) for depth datagrams – the datagrams the MB suite generally uses).

In January 2004 Kongsberg Simrad introduced a new datagram type f (066h) to replace their older F (046h) datagram. The f/F datagrams record the raw range and beam angle data.

The MB suite has not yet (as of version 5.0.7) been updated to decode the f datagram. When the mbcopy program encountered an f datagram in the EM120 raw file it assumed the file was corrupt and proceeded to scan the rest of the file byte by byte until it found something that looked like the start of a known datagram. Sometimes it would succeed and sometimes it would find a sequence of bytes in the middle of an f datagram that it tried to decode. This would generally result in invalid output data and mbcopy would stop processing the file at this point; resulting in gaps in the MB format files.

I modified the mbcopy source code (actually the mbio library code used by all the MB suite) so that when an f datagram is encountered the program uses the length information and skips directly to the start of the next datagram and continues reading the EM120 raw file. This allows mbcopy to generate MB format files containing all the datagrams it knows how to handle and removes the gaps from the MB output.

I recompiled mbcopy and put the modified version in /nerc/packages/mb/5.0.7/bin (the original is saved as mbcopy.org) so doing a ‘setup mb’ and using it normally uses the modified mbcopy.

8.2 TOPAS Sub-Bottom Profiler

8.3 Single Beam Echo Sounders

8.3.1 EA600

8.3.2 Precision Echo Sounder (PES)

8.4 Seismic Reflection Profiling System

8.4.1 System Description and Operations

Colin Brett

Source: An array of 5 x 40 cu.in. Bolt 600B airguns with waveshape kits and time break solenoids. Routinely, up to four guns were fired simultaneously, keeping the fifth gun as a ready spare. The number of guns used was varied with water depth, with a minimum of two being used in the shallower areas. The firing rate was 6 seconds throughout. Gun synchronisation was achieved by monitoring the time break solenoids and manually adjusting as required. This introduced a short time delay into the system of approximately 35 msec and thus the sea-bed return time was not an absolute measurement of depth. The airgun array was towed at a depth of approximately 1.5m, 20m astern of the vessel from a point inboard of the port trawl post. Air was supplied by the vessel’s inbuilt compressors.

Fig. S1. The array of five Bolt 600B airguns on the aft deck prior to deployment.

Hydrophone: Four channel S.I.G (Services et Instruments de Geophysique) summed to give a single channel 31.5 m active length. The hydrophone had 64 x SIG18 hydrophone elements at 0.5 m spacing, with 16 elements per channel and 4 m-long stretch sections at the front and rear of the streamer. A depth sensor at the head of the streamer was monitored in the laboratory and tow depth was continuously displayed. One feature of the design of this hydrophone was that the tow cable is enclosed in an air filled tube, with a vent open to the water at the outboard end. The tow depth was controlled from the laboratory by pumping air in (shallower) or letting air out (deeper). A tow depth of approximately 1.5 m was used throughout. The hydrophone was towed through the starboard aft fairlead, with the head of the active section approximately 30m astern of the vessel. On occasion of increased sea – ice risk (Line S113) it was moved to tow from a point inside the starboard arm of the main stern gantry. Despite being nearer the vessel’s wake it did not appear to introduce excessive noise. The summing amplifier used was a recently developed BGS unit, which also incorporated low pass (20 Hz) and anti-alias (800 Hz) filters.

Fig. S2. Deployment of the S.I.G. hydrophone streamer.

Recording: CODA DA200 four channel digital recording and processing system. The data was recorded on a hard drive disk in CODA format with a sampling interval of 0.33 msec, record length of 4 seconds and bandpass filter of 20-800Hz. The start of recording was delayed in deep water to permit a minimum of 2 seconds (TWTT) of data below the sea bed. The CODA system also received a navigation data string from the navigation processor, and logged position on each shot. On completion of each operational window, data was converted to SEGY format for supply to BAS for post processing.

The system initially suffered from a series of trigger jumps of approximately 20 msec. Unfortunately the cause of these could not be identified and eliminated but the frequency of occurrence was reduced considerably (to several hours) by adjusting the earthing arrangements. All jumps were noted and they can be eliminated in post processing.

On-line processing: In addition to the recording described above, the CODA system was also used to process the data on-line and to produce a real-time hard copy output on an ULTRA 120 thermal printer. Processes applied were time varied gain (TVG), time varied filtering (TVF) and trace mixing. Both TVG and TVF were applied from the sea bed, which was tracked automatically. A 1.4 second record length was normally used for the on-line hard copy, with a delay adjusted to give an optimum record in the prevailing water depth. On line S113, going down the continental slope, a record length of 2 seconds was displayed. This on-line processed data was also supplied as .tif files.

Operations: A total of nine seismic lines (S106 – S114 inclusive) were run (Table 3). These were carried out in three separate periods of operations totalling 67.8 hours.

8.4.2 *Data acquired and on-board processing*

Tara Deen

Nine seismic lines were acquired in the following locations:

BAS056-S106: Short line across a bank to the north of the Bear Peninsula, aborted due to trigger problems.

BAS056-S107: Approximately east-west line, to the north of the Bear Peninsula. Line ended to permit rebooting of the CODA acquisition system.

BAS056-S108: Approximately east-west line, to the north of the Bear Peninsula. Line ended to permit rebooting of the CODA acquisition system.
BAS056-S109: Approximately east-west line, perpendicular to the main trough in front of the Getz ice front.
BAS056-S110: Across the western flank of the trough in front of the Getz ice front.
BAS056-S111: Approximately north-south line, shots down the trough towards the Getz ice front.
BAS056-S112: Attempt at an east-west transect along the outer shelf of the NW Amundsen Sea, aborted due to ice.
BAS056-S113: Approximately north-south line, running from the shelf of the NW Amundsen Sea, onto the slope.
BAS056-S114: Along-shelf line, parallel to the slope, intersecting two pre-existing seismic lines to enable correlation between lines.

1.6 Gb of seismic data were acquired in total, in seg-y format. Only basic processing was undertaken onboard, involving the application of delays where required to compensate for trigger delays introduced by the equipment during acquisition. Minimal processing of the data will be required due to the high quality of data during acquisition.

8.5 BGS Vibrocorer

Colin Brett

The BGS vibrocorer consisted of a steel open structure frame with electro-hydraulic winch retraction, seabed penetration monitoring unit, vibrator motor and subsea transformer. It was capable of coring soft and unconsolidated sediment formations up to a depth of 6m below seabed in up to 2000 m of water. Guillotine closure below the core barrel was also effected during recovery of the equipment from the seabed. The overall dimensions of the coring rig were 7.7 m high with a 5.5 m span at the extremities of the feet, with a weight in air of 4.0 tonnes. The core barrel had an outer diameter of 102mm and had a clear polycarbonate liner of 83 mm inner diameter. The core was retained in the liner and was normally cut into 1m lengths after recovery.

The system was supplied complete with a combined signal/power/hoist umbilical winch. This was electro-hydraulically operated from it’s own power pack and was controlled by a remote control located in the winch control area in the UIC. The remote control included a line meter display. A special sheave was also supplied and mounted on the main stern gantry for deployment. Once on the seabed the vibrocorer was operated from a control container located on the after deck. The operation was computer controlled and penetration information was logged electronically for each site. This data was also supplied to Dr Hillenbrand.

The system was deployed as requested during the period from 19th January to 13th February inclusive. A total of 39 core attempts were made, and 35 of them resulted in acceptable core recovery. The remaining 4 attempts were two repeat attempts at each of two locations, one yielding a small bag of recovered material and the other nothing. At this latter site it was evident that the coring rig had fallen over on both attempts due to the irregular seabed. This resulted in some damage to the deployment cable, which was cut back and re-terminated. This was carried out during a planned long period of swath bathymetry operations and no coring time was lost. At one site (VC419) the retract system failed to operate and the vibrocorer was recovered with the barrel fully extended but with good core recovery of 4.7m. The fault was traced to the control relay bottle on the coring rig and this was changed for the spare whilst the vessel was carrying out a box core at the same location and, again, no coring time was lost. The unit was subsequently repaired and remained as the spare. Over the 39 sites a total of approximately 131m of core were recovered.

Fig. VC1. Deployment of BGS vibrocorer at site VC394 near the continental shelf edge in the eastern Amundsen Sea.

8.6 Box Corer

Claus-Dieter Hillenbrand

8.6.1 Operations

During JR141 a box corer (box dimensions 30x30x95.5-97.5cm) was deployed at 27 sites in order to recover undisturbed surface sediments. With the exception of two sites (BC401, BC456), at least surface sediment samples were collected at each box coring site. The coring locations and core recoveries are given in Table 1 and the locations are also shown on a large-scale fold-out track chart at the back of this report.

The box corer frame was fixed to the deck on the starboard side and the corer was deployed via the mid-ships gantry. With the spades tensioned, the corer was lifted out of its frame and moved over the rail. The security bolt was removed from the trigger mechanism by pulling on a rope fixed to it. The box corer was lowered at 60 m/min down to ca. 30-40 m above the seafloor and was veered at ca. 20 m/min into the seabed. Haul speed was typically 70 m/min.

Issues:

At the first box core site (BC395) the box corer triggered only at the second attempt because of too little freedom of movement between the bar from which the box corer was supported and the hook of the trigger unit. The connection of two 4 ¾ tonne shackles to the strut solved this problem by increasing the sensitivity of the trigger mechanism (see cruise report for JR104).

A common problem during the box corer deployments on JR141 (sites BC410, BC433, BC442, BC446, BC448, BC451, BC455) was that the box corer fell over on the seabed, and was probably dragged a couple of metres across the seafloor at the beginning of the hauling. As a consequence, the whole block of recovered sediment within the box toppled, and often only a surface sediment sample could be taken at these sites (Fig. **BC1**). This problem was most evident during times of considerable swell.

Another, inevitable problem arising during box coring on JR141, particularly at sites from the outer shelf and continental slope, was that the spades of the box corer didn’t close properly because cobbles and pebbles had jammed the closure mechanism (sites BC395, BC401, BC421, BC456, BC459). In these cases, large amounts or even all of the recovered sediment was lost during hauling, and the box corer had to be deployed for a second time.

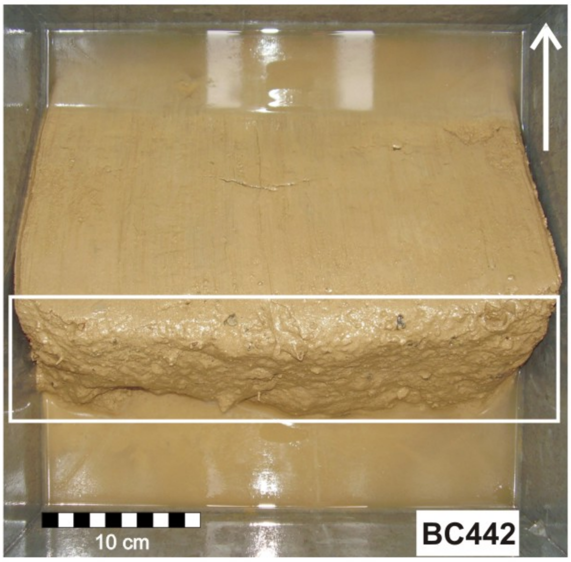


Fig. **BC1**: Example of recovered sediment in a box corer which had fallen over (site BC442). The arrow indicates the direction of the toppling of the corer, and the rectangular box marks the original sediment surface.

8.6.2 Sampling procedures

After the recovery of the box corer, most of the seawater was removed from the box using a rubber tube (diameter: 1 cm) as a siphon. After estimating the penetration depth and measuring the core recovery, photographs of the sediment surface were taken, lithology, sedimentary structures and sediment colour were described, and the presence of dropstones and benthic organisms was recorded. Sampling procedures included recovery of the uppermost centimetre of the sediment column (using a garden hoe) for geochemical, granulometric, micropalaeontological and mineralogical investigations, which will be carried out in the laboratories at BAS.

Up to seven (normally three) plastic liners (ca. 85x8 cm) were pushed into the sediment, closed with yellow plastic caps and pulled out of the sediment recovering sub-cores of up to 45 cm length. The plastic liners were then closed at the bottom with black plastic caps, which had been perforated with a single small hole.

The rest of the sediment was emptied by opening the spades and discarded. The sub-cores were cleaned and the empty liner above the sediment surface was cut off using a hacksaw. In order to reduce contamination of the sediment with plastic swarf, a cardboard disc (diameter 8 cm) was temporarily placed on top of the sediment surface during the cutting, and removed afterwards. After the shortening, the plastic caps were taped, and the length of the sub-cores was measured. The sub-cores were labelled and stored onboard JCR together with the surface sediment samples at temperatures of 4° C and -20° C, respectively (one sub-core from each site).

Issues

The draining of the seawater took a considerable amount of time. In order to avoid the freezing of the seawater within the box corer on deck during future cruises (at temperatures cooler than during JR141) the draining process should be accelerated by the synchronous use of several tubes. The use of a single rubber tube with a larger diameter (>1 cm) is not recommended, because it is likely to make the sucking of the seawater more difficult or even impossible.

At sites with high core recovery (e.g. BC407), too low recovery (e.g. BC435), and with sandy to gravelly sediments (e.g. BC455), no sub-core or only the upper part of the sediment column could be recovered by the sub-coring method described above. At the corresponding sites, sub-cores had to be taken in two sections (BC421), or only sediment surface samples could be collected.

The contamination of the sediment surface in the sub-cores with plastic swarf during the shortening of the liners could not completely be avoided, even though several counter-measures had been taken. The contamination prevents determination of the radiocarbon reservoir effect on bulk organic matter by AMS ^{14}C dating of surface sediment from these sub-cores (this applies to the core tops of the vibro-cores as well). The use of a tube cutter for the clean cut of plastic liners is recommended for future cruises.

8.7 Dredging Rig

A standard UKORS dredging rig, consisting of a dredge bag, pipe dredge, heavy chain, 3-tonne weak link and bag-strangling wire, was used at one site (DR193; Table 2) in the trough north of the Dotson Ice Shelf on 31st January. When recovered the bag and pipe were both full of muddy sediment and clasts ranging in size up to large cobbles (Fig. D1). The clasts comprised a diverse range of lithologies and were probably mostly glacial erratics (Fig. D2). However, a few clasts of white granite with freshly broken surfaces and are interpreted as having been *in situ* (Fig. D3).

Fig. D1. Dredge bag and pipe dredge recovered at site DR193.

Fig. D2. Clasts recovered in DR193.

Fig. D3. Granite clast with freshly broken surfaces recovered in DR193 and interpreted as having been *in situ*.

8.8 Cable Logging and Monitoring (CLAM) System

8.9 Conductivity Temperature Depth (CTD) System

8.10 Seawater sampling for Nd isotope analysis

James Smith

8.9.1 Introduction

Several recent studies have indicated that floating ice shelves and the downstream parts of major ice streams in the Amundsen Sea sector of the West Antarctic Ice Sheet (WAIS) have thinned by 5.5 m yr-1 over the past decade (Rignot and Jacobs 2002; Shepherd et al., 2002, 2004; Payne et al., 2004). It has been suggested that such rapid thinning is a direct consequence of intrusions of warm Circumpolar Deep Water (CDW) (Payne et al., 2004; Shepherd et al., 2004). However, at present there exists no long-term record of CDW flow in this region so it remains difficult to put the recent changes in perspective and judge their long-term significance. The absence of a long-term record of CDW in this region and elsewhere on the western side of the Antarctic Peninsula largely reflects the lack of a reliable proxy for detecting the presence or absence of CDW in the marine geological record.

One objective of JR141 was to collect seawater samples from various depths and locations in the Amundsen Sea in order to determine whether different ocean water masses, specifically CDW, have distinct Nd-isotope signatures. If we can demonstrate that CDW has a distinct Nd-isotope signature then we will analyse the Nd-isotope signature of benthic foraminifera (which directly records the Nd-isotope signature of the water) from sediment cores in order to reconstruct the presence/absence of CDW in the Amundsen Sea during the late Quaternary. Analyses of seawater samples will be undertaken at the Department of Earth Sciences, University of Bristol in collaboration with Dr. Derek Vance.

8.9.2 Seawater sampling and filtering

Ten seawater samples were selected for Nd-isotope analysis (**Table N**). The location of each sample was determined on the basis of temperature-salinity information obtained from the SeaBird 911plus CTD. We specifically targeted regions of CDW and modified-CDW masses in order to test whether CDW has a distinctive Nd-isotope signature. Other seawater samples include winter water and ice shelf melt water and will be used to determine end-member values.

Water samples were drawn into 4 litre acid-washed Nalgene® from the niskin bottle (10 litre) array on the SeaBird 911plus CTD carousel. Water samples were then filtered, under vacuum, through 0.45 μm cellulose membrane filter papers to remove inorganic and organic particulates. Filter papers were retained for diatom analysis. The filtering equipment consisted of a Buckner funnel attached to the top opening of the conical filter flask. This was connected with rubber tubing via an aspirator to the uncontaminated seawater tap to create a vacuum.

N.B. TABLE OF SAMPLE LOCATIONS TO BE INSERTED

8.11 Acoustic Doppler Current Profiler

8.12 Expendable Bathythermograph (XBT) System

8.13 Oceanlogger

8.14 Magnetometers

8.15 Navigation Systems

The navigational systems on board comprised:

8.15.1 Seapath System

This combined differential GPS and motion reference unit provides navigational data for the Kongsberg Simrad EM120 multibeam and TOPAS sub-bottom profiler systems. The differential corrections were derived from a Racal Skyfix unit via an Inmarsat feed and applied in real time by the GPS receiver Data from this unit were logged onto both the Kongsberg Simrad systems and the NOAA SCS.

8.15.2 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 Scientific Computing System (SCS).

8.15.3 Ashtech GG24 GPS/GLONASS Receiver

This was operated throughout the cruise and is known to produce fixes that are more accurate than those of the standalone (i.e. non-differential) GPS receivers. The position fixes calculated by this system were logged to the NOAA SCS.

8.15.4 Ashtech G12 GPS System

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

8.15.5 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.

8.16 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 JR141:

<u>Stream name</u> <u>Data Source</u>

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

9. ACKNOWLEDGEMENTS

We thank all of 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 Jerry for indulging our ambition to work in areas of dense ice cover, and to Andy, Paul, and Jo for successfully navigating our way through them. 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 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. We thank Dave the Doctor for compiling the web diaries and assisting with collection of swath bathymetry and TOPAS data, in addition to his normal duties.

BGS team, John Summers, Simon Wright and deck crew – TO BE ADDED

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
AFI	Antarctic Funding Initiative
AMS	Accelerator Mass Spectrometer
BAS	British Antarctic Survey
BASMU	British Antarctic Survey Medical Unit
CLAM	Cable Logging And Monitoring system
CTD	Conductivity-Temperature-Depth
ETS	Engineering Technology Section
FIPASS	Falkland Islands Port And Storage System
GPS	Global Positioning System
ITS	Information Technology Section
JCR	RRS *James Clark Ross*
MCS	Multi-Channel Seismic
MODIS	MODerate resolution Imaging Spectroradiometer
MSGL	Mega-Scale Glacial Lineations
NOAA	U.S. National Oceanic and Atmospheric Administration
PES	Precision Echo Sounder
SCS	Shipboard Computing System
SSU	Sonar Sequencing Unit
STCM	Shipboard Three-Component Magnetometer
TOPAS	TOpographic PArametric Sonar
SVP	Sound Velocity Probe
UIC	Underway Instrumentation and Control room
WAIS	West Antarctic Ice Sheet
XBT	Expendable Bathythermograph

11. CRUISE STATISTICS

Total cruise duration (1040/013–0800/046) 32.9 days

Time on passage	
a) north of 70° 30'S on way to Amundsen Sea	6.0 days
b) north of 69° on way to Rothera	1.0 days
Time in working areas	25.9 days

Vibro and box coring	days
CTD stations	days
Total station time	**days**

Waiting on weather/ice/mechanical problems Negligible

Underway data collection in study area	**days**
during which:	
EM120	days
TOPAS	days
STCM	days
Towed magnetometer	days
Oceanlogger	days

Average underway (i.e. excluding station time) speed in study area was kts (km/hr).
About X days of underway data collection were on the continental shelf and uppermost continental slope (mean water depth m), while the other X days were on the middle continental slope (mean water depth m). Assuming EM120 swath fan 120°, mean swath widths were ~ km and ~ km in these areas, respectively. Thus, area covered by EM120 multibeam data was $\sim^2$ on the shelf and uppermost slope, and ~ km^2 on the middle slope, so **total area covered by EM120 data in study area was ~ km^2**.

Underway data collection on passage	**days**
during which:	
EM120	days
TOPAS	days
STCM	days
Towed magnetometer	days
Oceanlogger	days

Average speed on passage was kts (km/hr).
Assuming mean water depth m and EM120 swath fan 120°, swath width ~ km,
so **area covered by EM120 data on passage ~ km^2**.
Therefore, **total area covered by EM120 data during cruise ~ km^2**.

Data volumes recorded:	
EM120 raw	Gigabytes
EM120 processed	Gigabytes
TOPAS	Gigabytes
SCS	Gigabytes
Total	**Gigabytes**

12. RECOMMENDATIONS

1. The draining of the seawater from the box corer took a considerable amount of time. In order to avoid the freezing of the seawater within the box corer on deck during future cruises (at temperatures cooler than during JR141) the draining process should be accelerated by the synchronous use of several tubes.

2. The use of a tube cutter for the clean cut of plastic liners is recommended for future cruises.

Table 1. Core stations (complied by CDH)

Gear	Station No.	Date	Start (UTC)	At seafloor (UTC)	End (UTC)	Location	Latitude (deg/min)	Longitude (deg/min)	Water depth (m)	Core Recovery (m)
VC	394	01/19/2006	19:20	19:38	20:17	upper continental slope NW of Thurston Island	71°05.9565´S	103°16.0931´W	770	3.88
BC	395	01/19/2006	21:48	22:00	22:15	shelf break NW of Thurston Island	71°07.8764´S	103°19.1819´W	578	0.01
VC	396	01/21/2006	02:38	02:50	03:21	outer shelf E of western trough	71°30.5996´S	112°42.0014´W	446	3.71
VC	397	01/21/2006	06:08	06:28	07:13	upper continental slope offshore from western trough	71°24.0065´S	113°23.3635´W	918	ca. 0.2
BC	398	01/21/2006	07:40	08:02	08:23	upper continental slope offshore from western trough	71°24.0055´S	113°23.3610´W	918	0.295
VC	399	01/21/2006	08:43	09:01	09:45	upper continental slope offshore from western trough	71°23.9763´S	113°23.3608´W	918	0.00
VC	400	01/21/2006	22:34	22:48	23:25	outer shelf within western trough	71°35.6470´S	113°16.1539´W	624	2.565
BC	401	01/21/2006-01/22/2006	23:50	00:04	00:19	outer shelf within western trough	71°35.6386´S	113°16.1493´W	624	0.00
VC	402	01/22/2006	03:30	03:44	04:17	outer shelf within western trough	71°31.8992´S	113°17.3587´W	622	0.41
BC	403	01/22/2006	05:44	05:57	06:10	outer shelf within western trough	71°35.9489´S	113°17.1989´W	619	0.135
VC	404	01/22/2006	08:34	09:04	09:49	upper continental slope offshore from western trough	71°26.3266´S	113°46.1156´W	992	4.92
VC	405	01/22/2006-01/23/2006	23:38	23:48	00:21	outer shelf in western Amundsen Sea	71°49.6936´S	117°07.2083´W	468	0.575
VC	406	01/23/2006	20:32	20:49	21:30	inner shelf NNW of Martin Peninsula	73°12.7588´S	115°14.3880´W	814	5.765
BC	407	01/23/2006	21:43	22:01	22:20	inner shelf NNW of Martin Peninsula	73°12.7589´S	115°14.3880´W	815	0.465
VC	408	01/24/2006	05:29	05:46	06:28	trough on inner shelf NNE of Bear Peninsula	73°47.7069´S	112°49.0531´W	787	3.68
BC	409	01/24/2006	06:45	07:03	07:19	trough on inner shelf NNE of Bear Peninsula	73°47.7072´S	112°49.0515´W	787	0.395
BC	410	01/26/2006	20:52	21:03	21:14	inner shelf NNW of Wright Island	73°34.014´S	116°50.7558´W	370	0.195
VC	411	01/26/2006	21:30	21:40	22:22	inner shelf NNW of Wright Island	73°34.0181´S	116°50.7542´W	370	3.325
BC	412	01/27/2006-01/28/2006	23:47	00:10	00:32	inner shelf N of eastern Getz Ice Shelf	73°55.3764´S	115°51.4175´W	1128	0.455
VC	413	01/28/2006	00:40	01:04	02:00	inner shelf N of eastern Getz Ice Shelf	73°55.3765´S	115°51.4262´W	1129	0.00
VC	414	01/28/2006	02:37	03:04	03:49	inner shelf N of eastern Getz Ice Shelf	73°55.3969´S	115°51.4931´W	1127	0.00
VC	415	01/28/2006	04:30	05:08	05:47	inner shelf N of eastern Getz Ice Shelf	73°53.7464´S	115°55.8676´W	918	4.34
BC	416	01/30/2006	20:10	20:30	20:50	inner shelf north of Dotson Ice Shelf	74°08.1664´S	112°27.0827´W	893	0.28
VC	417	01/30/2006	21:00	21:21	22:04	inner shelf north of Dotson Ice Shelf	74°08.1664´S	112°27.0827´W	891	1.73

VC	418	01/31/2006	04:15	04:31	05:12	inner shelf north of Dotson Ice Shelf	73°58.2363´S	112°13.2496´W	739	4.335
VC	419	01/31/2006	16:46	17:05	17:59	inner shelf north of Dotson Ice Shelf	74°08.4965´S	112°51.3838´W	806	4.795
BC	420	01/31/2006	18:33	18:50	19:08	inner shelf north of Dotson Ice Shelf	74°08.4964´S	112°51.3973´W	806	0.365
BC	421	02/01/2006	05:33	05:50	06:08	trough NNE of Bear Peninsula	73°37.0764´S	113°42.5584´W	833	0.48
VC	422	02/01/2006	04:23	04:42	05:17	trough NNE of Bear Peninsula	73°37.0764´S	113°42.5588´W	833	5.76
BC	423	02/01/2006	10:10	10:32	10:53	trough NW of Bear Peninsula	73°26.8264´S	115°11.8816´W	1073	0.41
VC	424	02/01/2006	10:58	11:24	12:03	trough NW of Bear Peninsula	73°26.8165´S	115°11.8838´W	1073	5.37
VC	425	02/02/2006	00:16	00:37	01:17	N of eastern Getz Ice Shelf	73°42.1764´S	115°29.1620´W	1020	5.085
BC	426	02/02/2006	03:19	03:38	03:56	NNW of Martin Peninsula	73°40.1436´S	114°58.6902´W	978	0.465
VC	427	02/02/2006	04:05	04:25	04:36	NNW of Martin Peninsula	73°40.136´S	114°58.682´W	978	5.635
VC	428	02/02/2006	15:09	15:25	16:05	shelf N of eastern Getz Ice Shelf	73°08.5493´S	115°42.2624´W	758	4.945
BC	429	02/02/2006	16:20	16:38	16:55	shelf N of eastern Getz Ice Shelf	73°08.5012´S	115°42.1820´W	765	0.405
VC	430	05/02/2006	02:23	02:35	03:06	outermost shelf in western Amundsen Sea	72°18.27´S	118°09.82´W	512	4.52
BC	431	05/02/2006	03:18	03:30	03:42	outer shelf in western Amundsen Sea	72°18.2739´S	118°09.8306´W	512	0.135
VC	432	05/02/2006	17:01	17:20	18:00	upper slope in western Amundsen Sea	71°44.5969´S	117°43.5940´W	857	5.885
BC	433	06/02/2006	00:27	01:01	01:31	upper slope in western Amundsen Sea	71°33.5167´S	118°18.8746´W	1722	ca. 0.2
VC	434	05/02/2006-06/02/2006	22:26	23:03	00:10	upper slope in western Amundsen Sea	71°33.5170´S	118°18.8732´W	1722	4.15
BC	435	06/02/2006	05:09	05:32	06:09	vicinity of shelf edge in western Amundsen Sea	71°48.9872´S	117°25.8023´W	466	0.11
VC	436	06/02/2006	06:18	06:29	06:58	vicinity of shelf edge in western Amundsen Sea	71°48.8173´S	117°26.0122´W	466	5.965
BC	437	06/02/2006	15:47	16:04	16:20	outer shelf in western Pine Island Bay trough	71°36.0507´S	113°17.7403´W	616	0.46
VC	438	06/02/2006	16:26	16:39	17:06	outer shelf in western Pine Island Bay trough	71°36.0507´S	113°17.7287´W	616	1.26
BC	439	06/02/2006	17:16	17:36	17:51	outer shelf in western Pine Island Bay trough	71°36.0507´S	113°17.7335´W	616	0.36
VC	440	06/02/2006	17:58	18:12	18:45	outer shelf in western Pine Island Bay trough	71°36.0492´S	113°17.7462´W	616	0.705
VC	441	06/02/2006	20:55	21:09	21:40	western PIB trough	71°40.7969´S	113°00.4738´W	608	4.615
BC	442	06/02/2006	21:53	22:07	22:23	western PIB trough	71°40.7877´S	113°00.4608´W	608	0.375
BC	443	07/02/2006	11:33	12:10	12:44	mid-slope offshore from western PIB trough	71°16.8878´S	113°27.6410´W	1789	0.285
VC	444	07/02/2006	12:54	13:34	14:38	mid-slope offshore from western PIB trough	71°16.8878´S	113°27.6409´W	1789	2.485
VC	445	08/02/2006	20:17	20:29	21:03	seaward of grounding-zone wedge on outer shelf in PIB	71°25.5966´S	108°21.3254´W	507	3.69
BC	446	08/02/2006	21:22	21:36	21:50	seaward of grounding-zone wedge on outer shelf in PIB	71°25.5967´S	108°21.3253´W	506	0.335

VC	447	08/02/2006	22:53	23:04	23:25	on top of grounding-zone wedge on outer shelf in PIB	71°28.0966´S	108°21.5259´W	488	2.62
BC	448	08/02/2006-09/02/2006	23:44	23:59	00:11	on top of grounding-zone wedge on outer shelf in PIB	71°28.0967´S	108°21.5357´W	488	0.105
VC	449	09/02/2006	01:55	02:06	02:41	on top of grounding-zone wedge on outer shelf in PIB	71°27.7066´S	108°23.6456´W	488	3.275
VC	450	09/02/2006	14:48	15:00	15:30	NNE outer shelf in PIB	71°51.9376´S	106°02.4410´W	568	3.95
BC	451	09/02/2006	15:44	15:58	16:14	NNE outer shelf in PIB	71°51.9380´S	106°02.4502´W	568	0.205
VC	452	09/02/2006	16:44	16:58	17:27	NNE outer shelf in PIB	71°51.2077´S	106°06.4308´W	583	3.92
VC	453	11/02/2006	05:35	05:48	06:15	broad trough NNE outer shelf in PIB	71°31.5878´S	105°33.1593´W	587	2.175
VC	454	11/02/2006	09:52	10:18	11:09	slope offshore from PIB in eastern Amundsen Sea	71°01.0625´S	104°59.5918´W	1269	4.445
BC	455	11/02/2006	12:15	12:40	12:59	slope offshore from PIB in eastern Amundsen Sea	71°04.0671´S	105°04.7870´W	807	0.28
BC	456	11/02/2006	14:49	15:02	15:18	shelf edge in eastern Amundsen Sea	71°10.5406´S	105°11.5063´W	538	0.00
VC	457	11/02/2006	15:22	15:33	16:12	shelf edge in eastern Amundsen Sea	71°10.5369´S	105°11.5162´W	538	1.325
VC	458	13/02/2006	05:17	05:31	06:02	outer shelf in Belgica Trough, Bellingshausen Sea	70°36.3077´S	86°15.1841´W	676	4.71
BC	459	13/02/2006	06:54	07:08	07:21	outer shelf in Belgica Trough, Bellingshausen Sea	70°36.3077´S	86°15.1813´W	676	0.285

Table 2. Dredge station

			At seafloor				Off seafloor						
Station No.	Date	Start (UTC)	Time (UTC)	Latitude (deg/min)	Longitude (deg/min)	Water Depth (m)	Time (UTC)	Latitude (deg/min	Longitude (deg/min	Water depth (m)	End (UTC)	Location	Remarks
DR193	01/31/2006	13:40	14:16	74°09.3´S	112°50.0´W	670	15:00	74°09.3´S	112°50.8´W	599	15:17	North of Dotson Ice Shelf	Recovered possible in situ granite and a variety of erratics

Table 3. CTD stations (compiled by DRS)

Station no.	Time/date start	Time/date deepest	Time/date end	Latitude S	Longitude W	Water depth (m) (EA600)	Cast length (wire out, m)	Geographical Location	Remarks
000	1708/015	1735/015	1758/015	60° 03.19'	65° 15.29'	3536	1000	Southwest from Drake Passage In outer shelf trough	Trial deployment
001	0113/022	0128/022	0150/022	71° 35.92'	113° 18.06'	619	607	Amundsen Sea shelf-edge trough	Wasn't possible to do whole section
002	2348/023	0008/024	0037/024	73° 23.41'	115° 09.29'	993	983	Amundsen Sea mid-shelf trough, north of Getz Ice Shelf	Opportunistic CTD cast (core location)
003	1931/026	1943/026	2000/026	73° 37.77'	116° 45.10'	383	372	Getz ice shelf - 1	
004	2335/026	2352/026	0017/027	73° 41.89'	116° 33.44'	802	771	Getz ice shelf - 2	Did a core between 003 and 004!
005	0132/027	0151/027	0217/027	73° 47.63'	116° 18.00'	912	878	Getz ice shelf - 3	
006	0304/027	0313/027	0323/027	73° 49.87'	116° 10.95'	292	277	Getz ice shelf - 4	
007	0515/027	0537/027	0608/027	73° 58.90'	116° 05.46'	1019	998	Getz ice shelf - 5	
008	0709/027	0732/027	0805/027	74° 02.19'	115° 55.81'	1226	1186	Getz ice shelf - 6	
009	0857/027	0914/027	0937/027	74° 02.80'	115° 43.96'	808	779	Getz ice shelf - 7	
010	1031/027	1054/027	1126/027	74° 03.14'	115° 30.56'	1155	1129	Getz ice shelf - 8	
011	1733/027	1756/027	1824/027	74° 03.26'	115° 21.19'	1027	1022	Getz ice shelf - 9	
012	1949/027	2007/027	2034/027	74° 03.41'	115° 10.55'	845	807	Getz ice shelf - 10	This station is right in front of a calving ice shelf. The ice front has moved approx. 250m in the last 30 hours.
013	0113/030	0128/030	0149/030	74° 13.25'	111° 56.48'	588	580	Dotson ice shelf - 1 (eastern end)	
014	0258/030	0317/030	0348/030	74° 14.05'	112° 11.61'	986	971	Dotson ice shelf - 2	
015	0451/030	0514/030	0546/030	74° 13.70'	112° 31.53'	1200	1186	Dotson ice shelf - 3	
016	0646/030	0701/030	0728/030	74° 13.04'	112° 51.67'	780	750	Dotson ice shelf - 4	
017	0844/030	0900/030	0923/030	74° 11.61'	113° 12.35'	820	802	Dotson ice shelf - 5	
018	1023/030	1035/030	1058/030	74° 10.49'	113° 20.95'	565	573	Dotson ice shelf - 6 (western end)	
019	0145/036	0157/036	0215/036	72° 18.28'	118° 09.83'	523	511	Outer shelf - slight depression	
020	1744/038	1802/038	1821/038	71° 43.92'	114° 16.81'	474	453	Shelf-edge trough - 1	

021	1919/038	1932/038	1952/038	71° 42.04'	114° 01.75'	552	527	Shelf-edge trough - 2	
022	2058/038	2112/038	2129/038	71° 40.10'	113° 47.41'	587	547	Shelf-edge trough - 3	
023	2226/038	2242/038	2302/038	71° 38.26'	113° 32.72'	625	596	Shelf-edge trough - 4	
024	0017/039	0032/039	0055/039	71° 35.93'	113° 18.03'	631	605	Shelf-edge trough - 5	
025	0147/039	0201/039	0225/039	71° 34.80'	113° 07.07'	636	611	Shelf-edge trough - 6	
026	0305/039	0317/039	0339/039	71° 33.41'	112° 56.10'	567	545	Shelf-edge trough - 7	
027	0438/039	0448/039	0509/039	71° 31.89'	112° 44.99'	437	422	Shelf-edge trough - 8	
028	1404/042	1418/042	1438/042	71° 10.55'	105° 11.51'	549	526	Eastern Amundsen Sea outer shelf	
029	0428/044	0443/044	0511/044	70° 36.52'	086° 14.72'	691	668	Belgica Trough, Bellingshausen Sea	

Table 4. Locations and depths of water samples taken for Nd isotope analysis

Table 5. XBT Stations (compiled by TJD & RDL)

Cast no.	Filename	Time/date	Latitude S	Longitude W	Water depth (m)	Cast length (m)	Serial Number	Geographical Location	Remarks
1	T5_0001	1630/014	55° 38.346'	61° 17.093'	4151	1830.5	314335	Drake Passage	Failed
2	T5_0003	1630/017	66° 42.274'	80° 20.669'	4152	1482.55	314332	W of Antarctic Peninsula	
3	T5_0004	1209/019	70° 26.516'	102° 21.949'	3197	1480	314328	Cont. rise N of Thurston I.	
4	T7_0005	1643/023	72° 48.802'	116° 21.851'	632	632	290728	Mid-shelf N of Wright I.	
5	T5_0006	2027/036	71° 36.709'	118° 19.194'	1624	1624	314334	Continental slope	
6	T5_0007	1424/043	70° 37.445'	93° 59.591'	840	840	314331	Continental slope	

Table 6. Seismic profiles

Line no.	Start time	Start lat S	Start long W	Start depth	End time	End lat S	End long W	End depth	Length	Remarks
S106	024/1705	73° 20.5'	111° 03.5'	291 m	024/1838	73° 19.5'	111° 30.6'	328 m	14 km	Bank N of Bear Peninsula
S107	024/2050	73° 20.6'	111° 01.4'	293 m	025/0349	73° 16.8'	112° 52.0'	486 m	59 km	Bank N of Bear Peninsula
S108	025/0416	73° 16.3'	112° 48.3'	488 m	025/0609	73° 15.9'	113° 15.3'	489 m	14 km	Bank N of Bear Peninsula
S109	025/0703	73° 16.3'	113° 12.1'	486 m	025/2102	73° 09.1'	116° 53.0'	406 m	119 km	Across main trough
S110	025/2121	73° 07.9'	116° 51.7'	415 m	026/0147	72° 59.7'	115° 45.8'	691 m	39 km	Across W flank of trough
S111	026/0148	72° 59.8'	115° 45.5'	690 m	026/1113	73° 41.9'	115° 13.6'	956 m	80 km	Towards Getz Ice Shelf
S112	038/0052	71° 34.1'	112° 30.7'	436 m	038/0352	71° 37.1'	113° 13.1'	628 m	25 km	Across E flank of trough
S113	038/0458	71° 34.9'	113° 21.1'	613 m	038/1004	71° 14.8'	113° 42.5'	2001 m	38 km	Along trough & down slope
S114	041/0946	71° 19.9'	108° 29.2'	487 m	042/0200	71° 17.1'	104° 29.8'	543 m	142 km	Along outer shelf

APPENDIX

Typical Sonar System Parameter Settings

A2.1 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: Manual
- Beam Spacing: Equidistant

Pitch stabilization: On
Yaw stabilization: On when on passage. Off sometimes when making frequent course changes in ice
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: jr141_xbt??.asvp

Sound Speed at Transducer:
- From: Profile
- Sensor Offset: 0.0 m/s
- Filter: 60 s

Filtering
- Spike Filter Strength: Medium
- Aeration: Off
- Sector Tracking: On
- Slope: On
- Interference: Off
- Range Gate: Normal

Absorption Coefficient
- Absorption (dB/km): 1.00

Seabed Imaging
- TVG Crossover (deg) 6

A2.2 TOPAS Acquisition Parameters in < 1000 m Water Depth

Parasource Menu
Level: 100%
Ping interval: 0 ms (this enables external trigger)
Pulseform: Burst
Period: 1 or 2
Secondary frequency: 2800 Hz

Acquisition Menu

Ch_no:	0	
Speed of sound (m/s):	1500	
Sample rate:	20000 Hz	
Trace length (ms):	400	
Gain:	18 – 26 dB	
Filter:	1.00 kHz	
Delay:	Manual	(External tends to cause frequent delay changes, especially when there is ice noise)

Processing Menu

Channel no: 0

Filter: ON

Low stop:	1200	Low pass:	4800
High pass:	1700	High stop:	5200

Processing (deconvolution): OFF

Swell: ON

Threshold: 60%

traces: 1

TVG: OFF or AUTO or MAN (all used at different times)

When MAN used, Slope: 30 – 60 dB

Start point: Manual or Tracking or External

Dereverb:	OFF
Stacking:	OFF
AVC:	OFF
Scale (%):	700 – 1000
Attribute:	INST.AMP

LOG/Replay Menu

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

A2.3 TOPAS Acquisition Parameters in > 1000 m Water Depth

Parasource Menu

Level: 90 – 100%

Ping interval: 4000 – 5000 ms

Pulseform: Chirp

Chirp start frequency (Hz):	1500
Chirp stop frequency (Hz):	5000
Length (ms):	15

Acquisition Menu

Ch_no:	0
Speed of sound (m/s):	1500
Sample rate:	20000 Hz

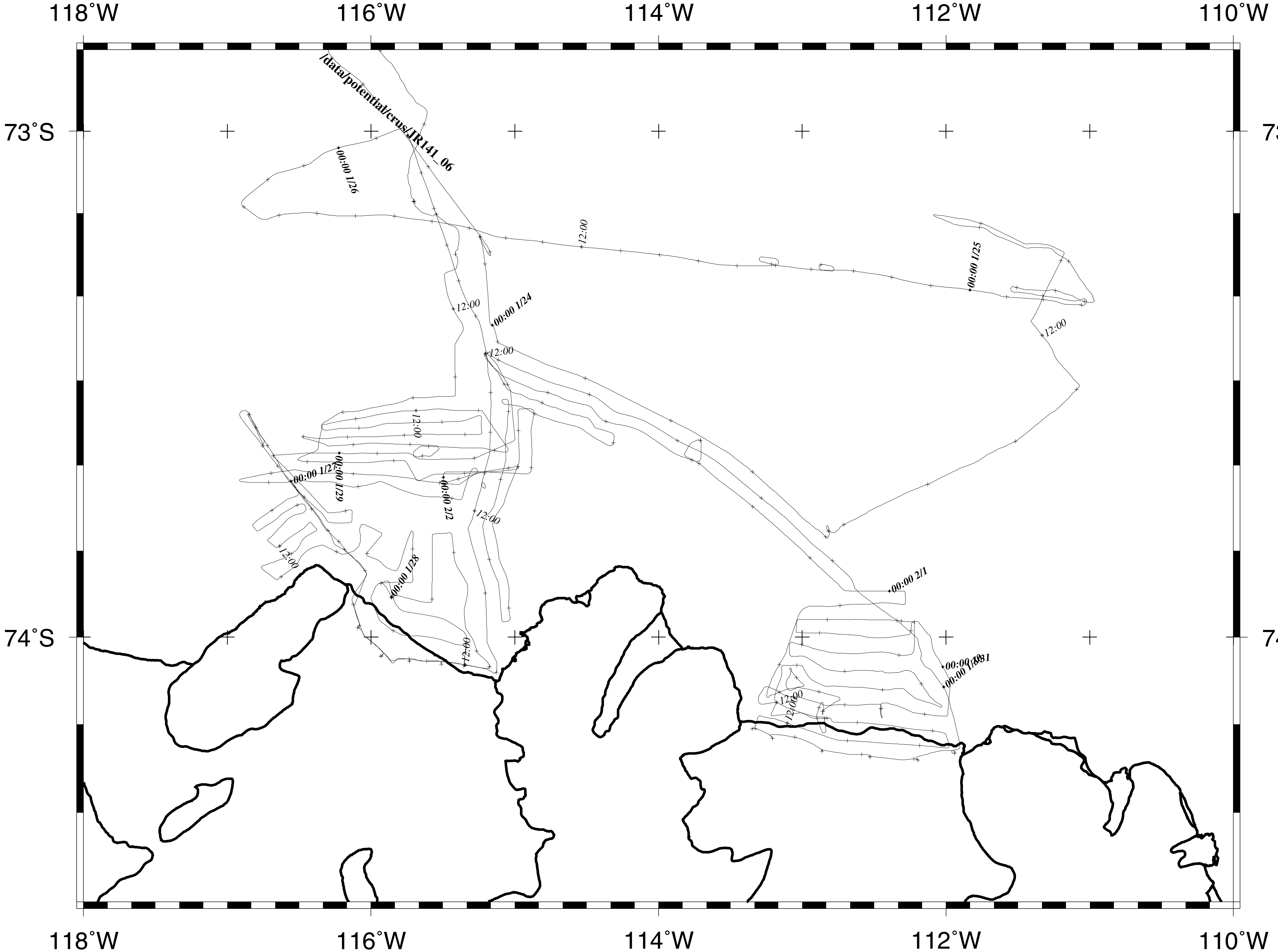
Trace length (ms):	400		
Gain:	21 – 32 dB		
Filter:	1.00 kHz		
Delay:	Manual or External		

Processing Menu

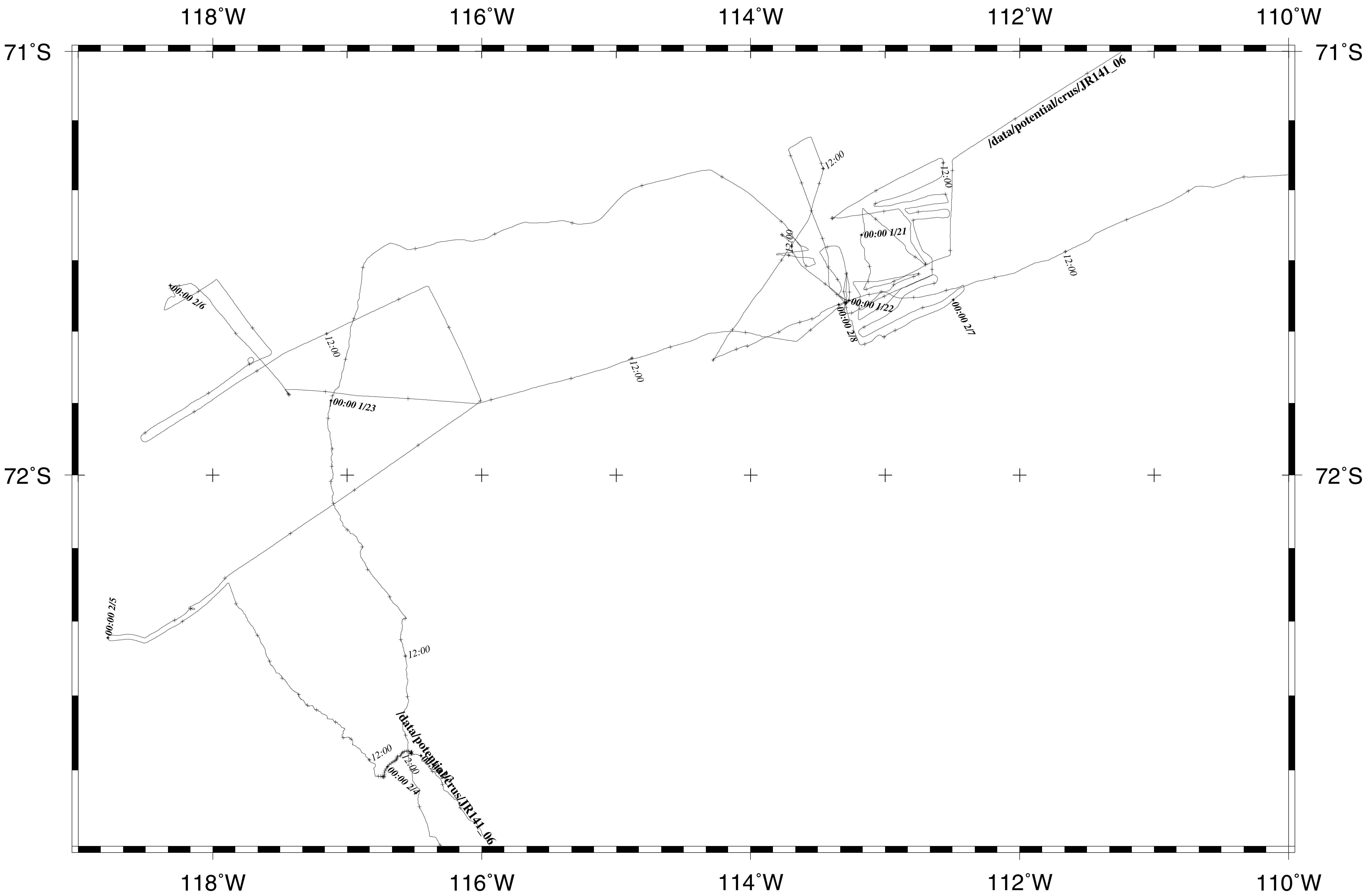
Channel no:	0			
Filter:	ON			
	Low stop: 1200		Low pass:	4800
	High pass: 1700		High stop:	5200
Processing (deconvolution):	DECONV			
	Filter factor (ppm): 1			
Swell:	ON			
	Threshold: 60%			
	# traces: 1			
TVG:	OFF or AUTO or MAN (all used at different times)			
	When MAN used, Slope: 30 – 60 dB			
	Start point: Manual or Tracking or External			
Dereverb:	OFF			
Stacking:	OFF			
AVC:	OFF			
Scale (%):	1000 – 1500			
Attribute:	INST.AMP			

LOG/Replay Menu

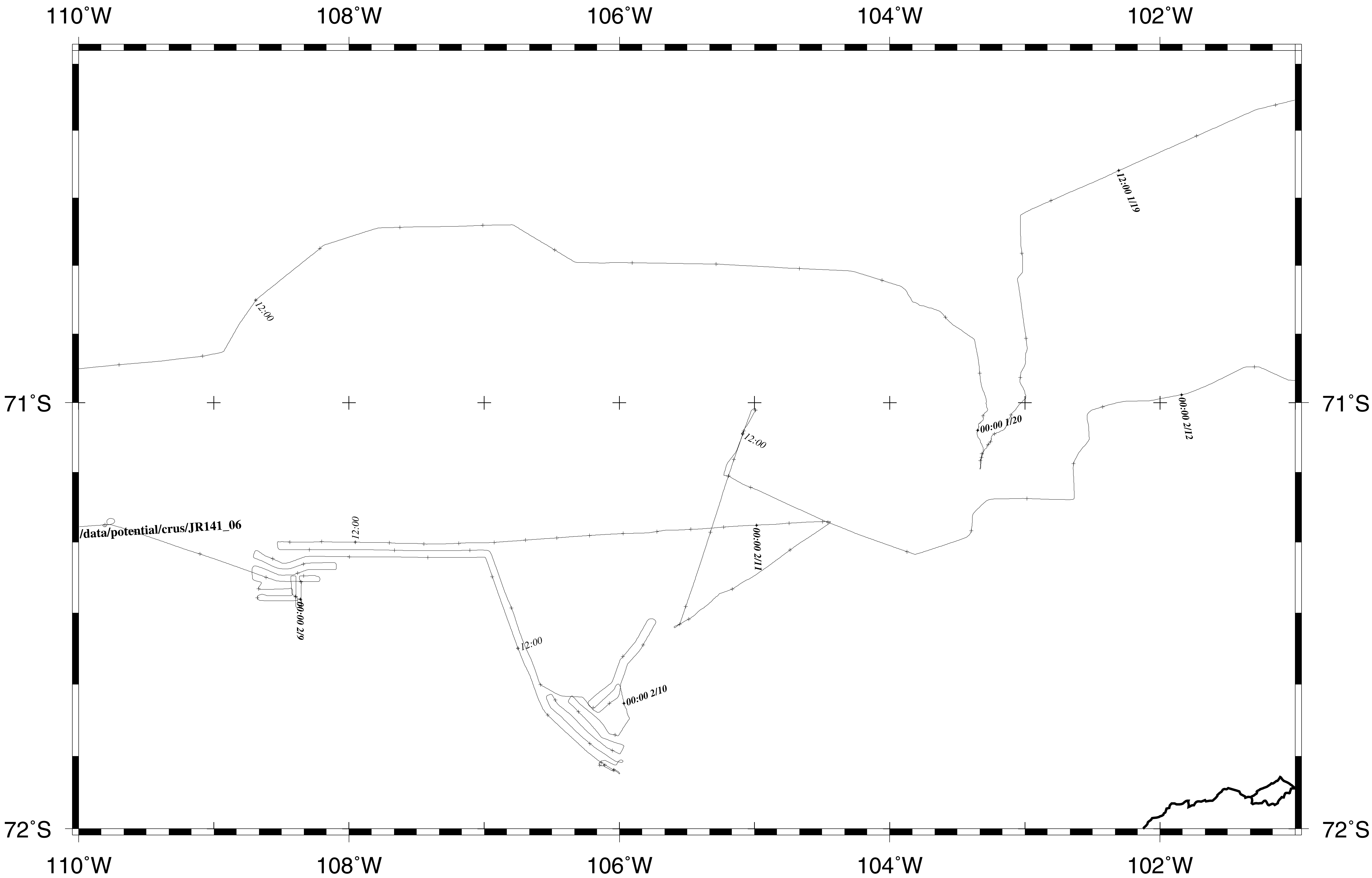
Medium:	DISK
Rate (ms):	1000
Channel:	0
File size (Mb)	10



JR141 tracks (with ticks every hour and annotations every 12 hours) near the Dotson and Getz ice shelves. Coastline and ice fronts shown are from the SCAR Antarctic Digital Database.



JR141 tracks (with ticks every hour and annotations every 12 hours) on the outer continental shelf and upper slope in the central Amundsen Sea.



JR141 tracks (with ticks every hour and annotations every 12 hours) on the outer continental shelf and upper slope in the eastern Amundsen Sea.