RRS JAMES CLARK ROSS
CRUISE REPORT – JR142

North and East Svalbard Margin: Past Ice-Sheet and Slide Activity

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NERC *OCEAN MARGINS LINK AND ESF EUROMARGINS PROGRAMME*

Scott Polar Research Institute
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1. JCR CRUISE JR-142, NORTH AND EAST SVALBARD

1.1 Introduction: Aims and Achievements (Julian Dowdeswell)

The aims of JR-142 were to collect marine geophysical and geological datasets around the Svalbard archipelago and its continental margin in order to investigate several aspects of the dimensions and dynamics of the ice sheet that covered Svalbard and adjacent seas during the last glacial period, about 20,000 years ago. In particular, the glacier-derived sediments that were eroded, transported and delivered to the ice-sheet margin during this period hold a key to reconstructing the former flow pattern and dimensions of the ice sheet. Debris delivered by fast-flowing ice, occupying cross-shelf troughs and fjords, was important in supplying most full-glacial and deglacial sedimentation to the upper slope. A major slide, Hinlopen Slide, is present north of one such trough, Hinlopen Trough. The links between ice-sheet dynamics, sediment flux and slope instability on this furthest north part of the continental margin of north-west Europe were an important scientific focus for the cruise. The work, funded by the UK NERC, is part of a broader scientific programme under the ESF project *Euromargins*.

The study area for JR142 was the continental shelf and slope north and north-west of Svalbard, and the north-western Barents Sea to the north-east and east of the archipelago. The ship tracks of the cruise are shown in Figures 1.1 and 1.2. We used a combination of marine geophysical and geological methods, reported below, to investigate the sea floor and shallow sub-surface stratigraphy north and east of Svalbard. The main datasets acquired on cruise JR-142 during 25 science days, from 28 July to 21 August 2006, were:

- TOBI 30 kHz side-scan sonar imagery, swath bathymetry and TOPAS data from an extensive area of the huge Hinlopen Slide, on the continental slope north of Svalbard.
- Swath and TOPAS data, and cores, from Hinlopen Trough, from Nordporten to the scar marking the uppermost part of Hinlopen Slide.
- Swath and TOPAS data from the Yermak Plateau and adjacent slope, north-west of Svalbard, including imagery of very deep iceberg scour marks and current-produced channels.
- Swath and TOPAS data, and cores, from the Kvitøya Trough, from its trough mouth and the adjacent upper slope to Erik Eriksen Strait east of Nordaustlandet.
- Swath and TOPAS data from Olga Strait, between Edgeøya and Kong Karls Land.
- Swath and TOPAS data, and cores, from Hartogbukta, adjacent to the modern 8,000 km^2 ice cap of Austfonna on Nordaustalndet.
- Opportunity-based geophysical data from the western Norwegian-Svalbard margin, Barents Sea and Bear Island Trough during passage to and from UK to Svalbard.

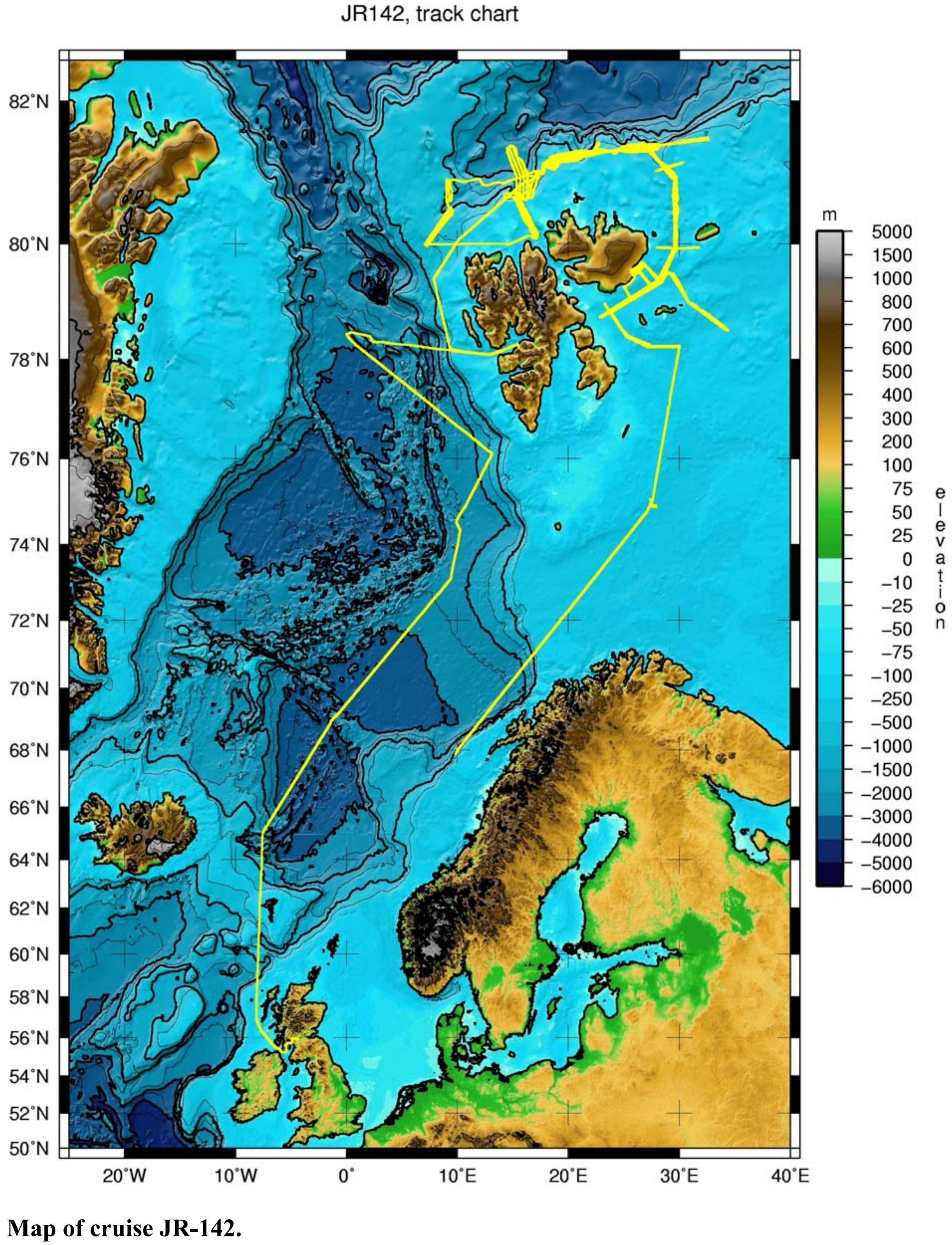

Fig. 1.1. Map of cruise JR-142.

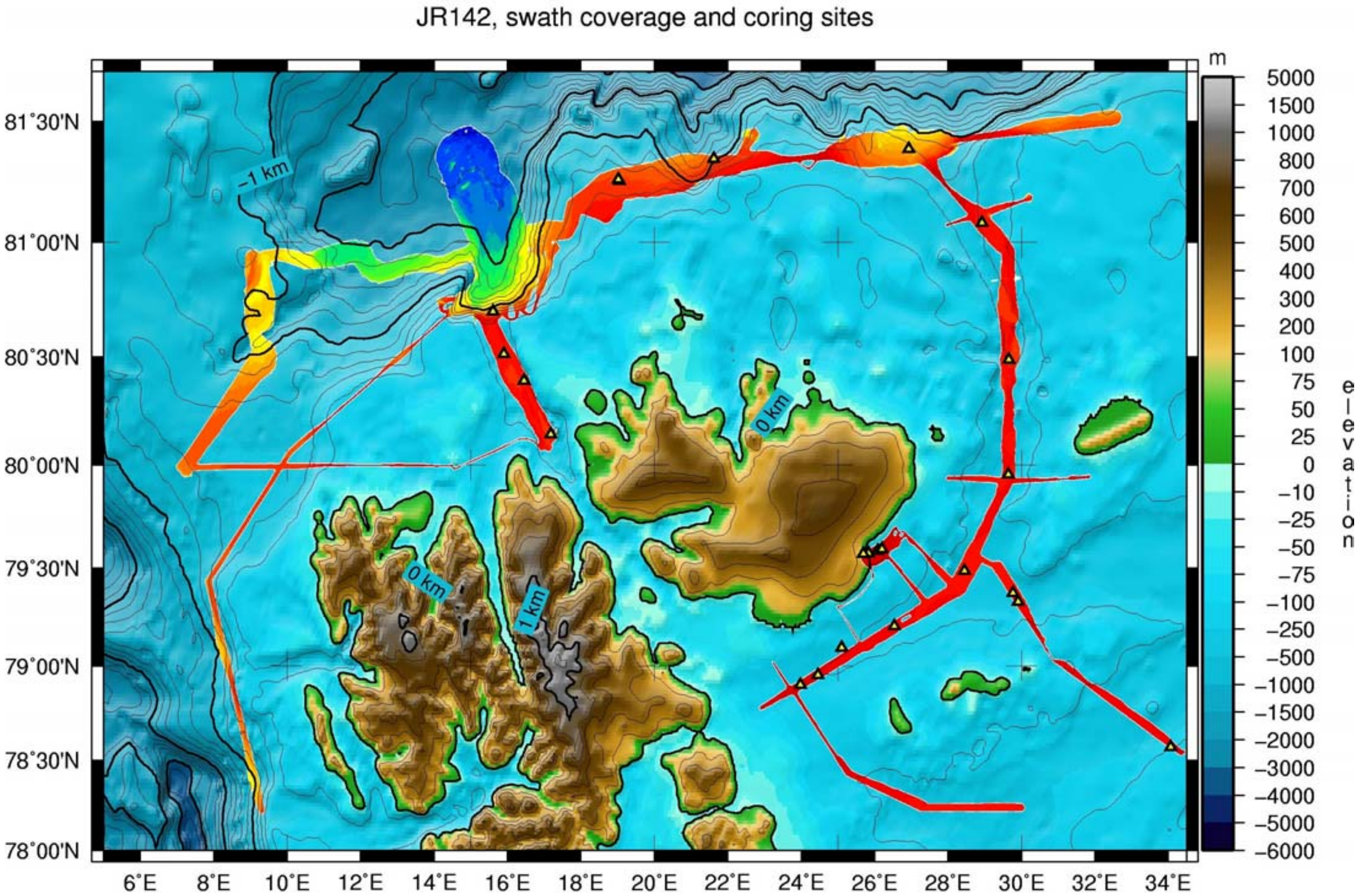

Fig. 1.2. Map of JR-142 cruise tracks around Svalbard, including swath data coverage and the locations of the 23 sites at which gravity cores were acquired (triangles; latitudes and longitudes of core sites are in Section 4.2)

1.2 CRUISE PARTICIPANTS

Officers and Crew

Graham Chapman	Master
Robert Paterson	Chief Officer
Calum Hunter	2nd Officer
Douglas Leask	3rd Officer
Chris Handy	3rd Officer
John Summers	Deck Officer
Charles Waddicor	ETO (Comms)
David Cutting	Chief Engineer
Gerry Armour	2nd Engineer
Tom Elliott	3rd Engineer
Steve Eadie	4th Engineer
Simon Wright	Deck Engineer
Nicholas Dunbar	ETO (ENG)
Hamish Gibson	Purser
George Stewart	Bosun
Marc Blaby	Bosun's Mate
Derek Jenkins	SG1
Lester Jolly	SG1
Christopher Solly	SGI
John MacLeod	SG1
Cliff Mullaney	SG1
Mark Robinshaw	MG1
Sidney Smith	MG1
Duncan MacIntyre	Chief Cook
Glen Ballard	2nd Cook
Cliff Pratley	Senior Steward
Jimmy Newall	Steward
Kenneth Weston	Steward
Derek Lee	Steward

Scientists

Julian Dowdeswell (PSO)	SPRI
Jeff Evans	SPRI
Kelly Hogan	SPRI
Ruth Mugford	SPRI
Riko Noormets	SPRI
Colm Ó Cofaigh	Durham
Lee Fowler	TOBI Team, UKORS
Duncan Matthew	TOBI Team, UKORS
David Turner	TOBI Team, UKORS
Mark Preston	BAS
Doug Willis	BAS

SPRI	Scott Polar Research Institute, University of Cambridge
Durham	Department of Geography, Durham University
UKORS, NOC	TOBI Team, National Oceanography Centre, Southampton

1.3 CRUISE NARRATIVE (Julian Dowdeswell)

Friday 28 July, day 1
JCR arrived in Longyearbyen, Svalbard, at 10.00, mooring at the coaling terminal. The scientific party for JR142 boarded the ship and began mobilisation of TOBI and other equipment. The ship left Longyearbyen at 15.15, sailing west along Isfjorden and then northward in light airs. Mountains of Prins Karls Foreland visible in the distance under canopy of clouds.
Noon position: 78 14.6 N 015 32.6 E (alongside Coal Pier in Longyearbyen, Svalbard)

Saturday 29 July, day 2
Sailing northward to area of Hinlopen Slide, encountering ice over the study site. Calm and foggy. Proceeded eastward to 81º'30N, 32º30'E
Noon position: 80 24.5 N 012 26.1 E

Sunday 30 July, day 3
Part of day in ice. Calm and foggy. Polar bear sighted at dinner time. Swam away leaving dead seal. Approached area of Hinlopen Slide again but ice still over it, precluding TOBI operations in this area at present.
Noon position: 81 26.4 N 028 18.3 E

Monday 31 July, day 4
Fog and calm all day. Encountered band of ice in morning and saw one polar bear to port. Turned south towards the strait between Nordaustlandet and Kvitøya in afternoon. No ice in the Kvitøya trough.
Noon position: 81 21.2 N 22 43.3 E

Tuesday 1 August, day 5
Sailing southwards towards Erik Eriksen Strait, with no sea ice present. Fog meant we did not see either Austfonna or Kvitøya as we passed south between them in morning. Completed first southward track of about 20 hours, and turned north in Erk Eriksen Strait shortly after midday. Parts of Austfonna and Kong Karls Land visible in afternoon, together with about six icebergs calved from its seaward margin. Light wind from north in evening dispersing fog.
Noon position: 78 49.2 N 023 15.1 E

Wednesday 2 August, day 6
Passed between Storøya and Kvitøya about 00.00. Melt features on Kvitøyjokulen clearly visible. Headed north to 81 in winds rising to Force 4 with slight swell. Turned southward again about 11.00 and in early pm saw two polar bears far from land. One was swimming, the other appeared to be floating inert. Good view of Storøya and its ice cap, with Austfonna behind in afternoon and of Kong Karls Land and Barentsøya in evening. Several icebergs sighted, including some with dirt bands.
Noon position: 80 54.2 N 029 34.8 E

Thursday 3 August, day 7
Arrived at Isispynten on east coast of Nordaustlandet am. Commenced a swath and TOBI survey of area from Isispynten to Hartogbukta, looking at recent deposits revealed by retreat of the ice cliffs of Austfonna and possible surging. TOBI in water from 18.00 to 21.00, towed at about 20 m depth with useful side-scan data acquired. Calm and sunny setting looking towards ice cliffs and interior of Austfonna. A walrus sighted pm.
Noon position: 79 38.5 N 027 00.1 E

Friday 4 August, day 8
Swath and TOPAS in Hartogbukta, and three cores. Closest approach to ice cliffs about 600 m. Cliffs 10-20 m high in general. Weather calm and clear am, clouding over but remaining calm pm.
Noon position: 79 35.2 N 026 04.3 E

Saturday 5 August, day 9
Left Hartogbukta about 02.00 for the main SW to NE swath line in Erik Eriksen Strait. Excellent views of Barentsøya, Kapp Payer and Kong Karls Land during day, with Edgeøya and Wilhelmøya in the distance. Swath and coring during the day, with four gravity cores obtained.
Noon position: 78 54.0 N 023 58.5 E

Sunday 6 August, day 10
Swath in Hartogbukta overnight, then to Erik Eriksen Strait and a line of swath, TOPAS and cores taken to the north. Passed 15 nm west of Andree’s last camp on the western tip of Kvitøya pm, then to trough mouth by late evening. Weather light winds and high pressure with cloud pm.
Noon position: 79 37.8 N 028 58.1 E

Monday 7 August, day 11
Swath and coring overnight. Clear morning with wind force 3. Passed tabular iceberg, probably derived from Franz Josef Land, where floating ice margins make the release of such bergs possible. TOBI launched at 16.30 in force 4 conditions, to begin survey of Hinlopen Slide. This will take about 5-6 days, depending on weather and sea-ice conditions.
Noon position: 81 15.7 N 020 17.2 E

Tuesday 8 August, day 12
TOBI survey continues, working east to west across Hinlopen Slide. Wind rising to force 5 during day then falling slowly, with snow showers.
Noon position: 81 00.0 N 016 09.6 E

Wednesday 9 August, day 13
TOBI survey continues, working north to the northernmost limit of the survey on Hinlopen Slide. Band of ice encountered in late afternoon meant that the final 4 km of the northernmost leg could not be completed. Saw tabular iceberg in the pack. Winds light throughout the day with sun and snow showers.
Noon position: 81 06.2 N 015 46.0 E

Thursday 10 August, day 14
TOBI survey of Hinlopen Slide continues in fine weather with calm or very light winds. Clear views of northern Nordaustlandet, Phippsøya and Asgaardfonna in NE Spitsbergen. Saw whales pm.
Noon position: 80 50.3 N 015 38.2 E

Friday 11 August, day 15
Half way point in cruise. TOBI survey of Hinlopen Slide continues in fine weather. Wind force 2-4 during day.
Noon position: 80 50.8 N 015 19.7 E

Saturday 12 August, day 16
TOBI survey of Hinlopen Slide completed at 21.00 after encountering ice at north end of survey area earlier in the day. Recovery completed in force 6 winds gusting to force 7. Began swath work in Hinlopen Trough, in clearing weather with excellent views to northern Nordaustlandet and the north coast of Spitsbergen.
Noon position: 81 08.3 N 016 00.9 E

Sunday 13 August, day 17
Swath work and coring in Hinlopen Trough. Four cores taken and several lines of swath data. Winds force 3 to force 6, with more shelter close to Nordporten, the northern entrance to Hinlopen Strait.
Noon position: 80 23.5 N 016 26.2 E

Monday 14 August, day 18
Completed survey of Hinlopen Trough overnight. Passed walrus colony on island of Moffen am on passage to Yermak Plateau. Swath lines over area of deep iceberg scours on Yermak Plateau for rest of the day in light winds.
Noon position: 79 59.9 N 010 57.1 E

Tuesday 15 August, day 19
Yermak Plateau survey area completed overnight. Interesting current-related channels seen in deeps as well as large iceberg scours. Passage then to east, with ice causing several deviations to the south. Swath survey of scour marks east of TOBI area in rising winds from the NW, bring ice down into the survey area.
Noon position: 80 56.4 N 14 49.9 E

Wednesday 16 August, day 20
Moving along northern Svalbard shelf edge, but NW winds blowing sea ice into the survey area. Several deviations from course due to ice. Winds force 5-6. Eventually decide to head southwards due to adverse ice conditions.
Noon position: 81 09.5 N 028 39.5 E

Thursday 17 August, day 21
Overnight swath survey of area between Storøya and Kvitøya shows clear lineations in sea floor and will help define width of former ice stream. During day acquired further swath and TOPAS data from Hartogbukta in calm to light winds.

Noon position: 79 38.2 N 026 39.1 E

Friday 18 August, day 22
Overnight began eastward swath and TOPAS survey across Erk Erikson Strait and passed Abeløya, the most easterly island of Kong Karls Land. Working across trough that leads to Franz Victoria Trough in the Russian zone in light winds with slight swell. Turned north-west again at our furthest east, 34 30'E.
Noon position: 78 37.0 N 033 44.2 E

Saturday 19 August, day 23
Continued swath mapping area east of Kong Karls Land and took two cores in the morning. Then returned SW down Erik Eriksen Strait in light winds but overcast conditions in afternoon. Among icebergs calved from Bråsvellbreen in evening, with good view of this ice front and Sorporten, the southern entrance to Hinlopen Strait.
Noon position: 79 22.5 N 029 46.0 E

Sunday 20 August, day 24
Swath mapping and TOPAS in Olga Strait, between Edgeøya and Kong Karls Land throughout the day with light winds and overcast skies.
Noon position: 78 24.5 N 025 31.0 E

Monday 21 August, day 25
Completed survey of Olga Strait by about 04.00 and proceeded south into the Barents Sea with the end of the scientific activity on the cruise. Final short swath survey of fluted sea floor on north side of Bear Island Trough in evening.
Noon position: 76 55.8 N 28 55.7 E

Tuesday 22 August, day 26
Crossing Bear Island Trough on passage to UK. Weather foggy by very light winds.
Noon position: 73 21.1 N 22 53.2 E

Wednesday 23 August, day 27
On passage to UK, passing Lofoten Islands, north Norway. Winds up to force 4-5 in afternoon.
Noon position: 69 31.2 N 13 19.2 E

Thursday 24 August, day 28
On passage to UK, passing Trondheim and oil platforms of Asgard field en route. Weather fine and winds light.
Noon position: 65 04.3 N 05 51.8 E

Friday 25 August, day 29
On passage to UK, in North Sea. Cruise dinner in evening after drinks on deck.
Noon position: 60 21.1 N 03 12.4 E

Saturday 26 August, day 30
On passage to UK, in North Sea. Calm conditions.

Noon position: 55 52.9 N 01 14.8 E

Sunday 27 August, day 31
Docked in Immingham, UK, after passing through the locks on the morning tide.

2. GEOPHYSICAL OPERATIONS – SWATH AND TOPAS

(Jeffrey Evans, Kelly Hogen, Ruth Mugford, Riko Noormets and Colm Ó Cofaigh)

2.1 EM120 Multibeam Swath Bathymetry System

The Kongsberg-Simrad EM120 multibeam swath bathymetry system was operated throughout the cruise. Angular coverage was set to "Manual" and beam spacing was set to "Equidistant". The beam angle used varied according to sea conditions, water depth and sea-bed type but was generally between 64-68 degrees. During surveys, overlap between individual swath lines was achieved by means of the Helmsman's Display on the bridge, which the Bridge Officer used to adjust the ship's course and maintain a reasonable degree of overlap (10%) between lines. Limited post-processing of the EM120 data (gridding and data filtering) was carried out using the Kongsberg-Simrad NEPTUNE post-processing software. In general the EM120 worked well throughout the cruise, although some problems were encountered in triggering from the SSU. Where the system lost the sea-bed from time to time the most useful method was to use the "Force Depth" command with a depth slightly less than the true seabed. Restricting the maximum and minimum depths to a tight range around the true seabed depth was also useful as well as reducing the angle of the beams.

The EM120 system performed well most of the time with the exception being in very shallow water when SSU triggering of the EM120 and TOPAS resulted in dropouts in swath coverage. The ITS and ETS worked to solve this problem during the cruise and this is still on-going. This problem was worked around by manual triggering of swath and TOPAS. As on previous cruises where the EM120 was used in pack ice (e.g. JR84 and JR104), it was found that when the ship was moving through the ice the swath signal deteriorated significantly. Leeway when wind is on the beam is a well known cause of poor quality in swath data and this occurred on few occasions. Due to the generally light winds on the cruise, this was a problem on only a very few occasions. However, the signal returns in only a few metres of open water. The EM120 acquisition parameters used are described in Appendix 7.1.

2.2. TOPAS Sub-Bottom Profiler

The TOPAS system was used extensively throughout the cruise and generally performed very well. As in the case of the EM120, sea ice affects the TOPAS signal quite badly. It results in many high amplitude signals resulting in dark traces across the record. In heavy sea ice this can have the result of obliterating any meaningful data. In water depths of less than 1000 m we ran TOPAS using a Burst mode whereas in depths greater than this we used the Chirp (see Appendix 1 for TOPAS acquisition parameters).

2.3 EPC Chart Recorder

The EPC chart recorder worked without any problems throughout the cruise. TOPAS input to the EPC chart recorder was on Channel A. The settings used were: 0.5 second sweep; 0 delay; threshold 1/3 of a turn clockwise from the minimum setting; trigger level 0; gain generally about 8; sweep direction from left to right; print polarity +/- (centre setting). Chart settings: scale lines: on; take-up: on; mark/annotate: off (centre setting); chart drive: internal (centre setting), LPI was generally set to 75; contrast setting: centre. Ten-minute time marks and EM120 depths were automatically plotted on the paper roll.

2.4 Expendable Bathythermograph (XBT) System

Seventeen XBT casts were made during JR-142 (see Table 2.1 and Map in Fig. 2.1) of which 3 were T5 dep water probes which record to water depths of 1830 and 14 were T7 shallow water T7 probes that record to water depths of 760 m. Sound velocity profiles (SVP) obtained from the XBT deployments were input to the EM120 and used in the relevant surveys. The XBT system on the James Clark Ross worked well throughout the cruise. Individual SVP profiles were calculated from the XBT data by the system software, assuming a constant salinity. Salinity values were obtained from the Oceanlogger display (located in the UIC), and input to the XBT system software manually. The files (calculated sound velocity profiles) generated by the XBT system software were transferred to the multibeam data processing workstation, and the data then imported into the multibeam data acquisition system across the network.

Table 2.1. Locations at which XBTs were taken (see Figure 2.1 for map)

Probe Type	Latitude (Degrees decimal or degrees minutes)	Longitude (Degrees decimal or degrees minutes)	Water depth (m)	Salinity (psu)	Filename (.RDF)	asvp filename (.asvp)
T 7	78 08.92	10 39.57	254	33.45	T7_00040	20060728_191108
T 7	81 07.32	17 54.33	415	31.60	T7_00041	20060729_161850
T 7	81 26.37	28 40.50	247	32.95	T7_00042	20060730_094038
T 5	81 26.65	26 43.64	1037	30.34	T5_00043	20060731_144649
T 7	81 18.43	27 28.54	245	31.90	T7_00044	20060731_162512
T 7	79 15.84	27 03.40	292	33.69	T7_00045	20060801_162858
T 7	79 19.42	27 20.42	325	33.67	T7_00046	20060802_195116
T 7	79 32.45	25 42.28	128	33.48	T7_00047	20060803_205529
T 7	79 18.50	27 39.64	289	33.68	T7_00048	20060806_064527
T 7	81.33531	21.67593	490	33.66	T7_00049	20060807_083647
T 5	81.12229	15.72048	1650	32.65	T5_00050	20060809_103618
T 5	81 11.27	14 51.74	2208	31.76	T5_00052	20060811_193534
T 7	80 08.53	17 15.74	497	34.15	T7_00053	20060813_192406
T 7	79 59.50	08 03.24	512	35.02	T7_00054	20060814_122418
T 7	78 56.71	31 35.48	210	33.75	T7_00055	20060818_160109
T 7	78 54.42	24 13.00	199	33.66	T7_00056	20060819_183040
T 7	79 09.67	29 07.69	192	34.02	T7_00057	20060821_085327
T 7	75 38.62	27 58.61	253	34.32	T7_00058	20060821_161038
T 7	73 45.41	24 01.02	443	35.03	T7_00059	20060822_073333
T 7	71 55.46	19 06.08	312	35.03	T7_00060	20060822_190124
T 5	70 07.68	14 42.99	2498	34.95	T5_00061	20060823_062505

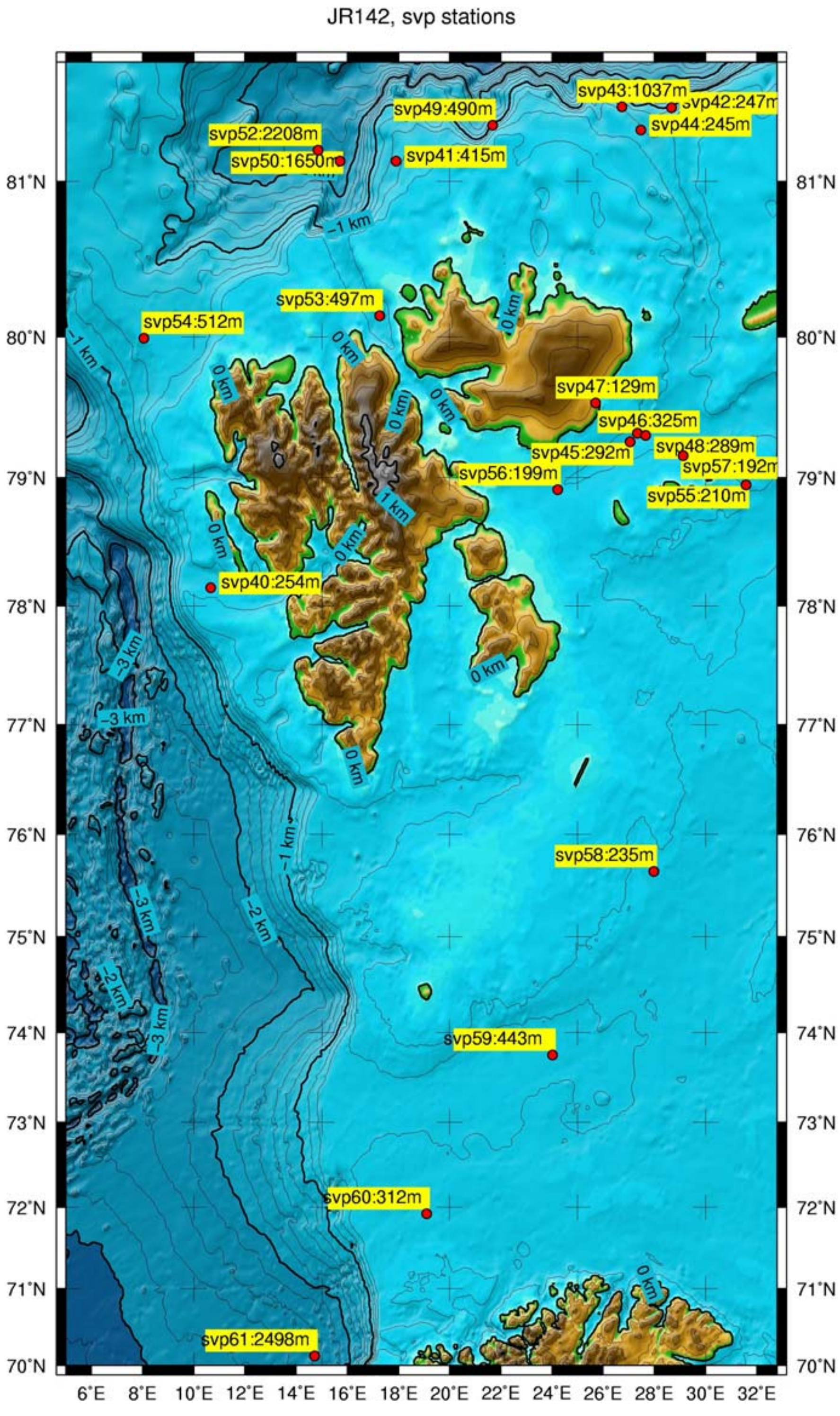

Fig. 2.1. The locations of XBTs taken during cruise JR-142.

2.5 Oceanlogger

The Oceanlogger was operated during JR-142 in order to monitor changes in surface water characteristics that affect sound propagation, and to measure surface water salinity values for calculation of SVP's from XBT data.

3. GEOPHYSICAL OPERATIONS – TOBI SIDE-SCAN SONAR

(TOBI Team: Duncan Matthew, Lee Fowler, David Turner)

Fig. 3.1. The deployment of the TOBI vehicle from the stern of the JCR off Svalbard.

3.1 System Description

TOBI - Towed Ocean Bottom Instrument - is Southampton Oceanography Centre's deep towed vehicle. It is capable of operating in 6000m of water. The maximum water depth encountered during the TOBI surveys during this cruise was around 2500m.

Although TOBI is primarily a sidescan sonar vehicle a number of other instruments are fitted to make use of the stable platform TOBI provides. For this cruise the instrument complement was:

1. 30kHz sidescan sonar with swath bathymetry capability (Built by IOSDL)
2. 8kHz chirp profiler sonar (Built by IOSDL/SOC)
3. Three-axis fluxgate magnetometer. (Ultra Electronics Magnetics Division MB5L)
4. CTD (Falmouth Scientific Instruments Micro-CTD)
5. Pitch & Roll sensor (G + G Technics ag SSY0091)
6. Gyrocompass (S.G.Brown SGB 1000U)
7. Light backscattering sensor (WET labs LBSS)

A fuller specification of the TOBI instrumentation is given in ***TOBISPEC_JR142.doc***.

An Autohelm ST50 GPS receiver provides the TOBI logging system with navigational data. An MPD 1604 9 tonne instrumented sheave provides wire out, load and rate information both to its own instrument box and wire out count signals to the logging system. The instrumented sheave is an optional extra if such an item is not available on chosen ship. If available, on the ship, then the wire out is recorded on the ship's own data network.

The TOBI system uses a two-bodied tow system to provide a highly stable platform for the on-board sonars. The vehicle weighs 2.5 tonnes in air but is made neutrally buoyant in water by using syntactic foam blocks. A neutrally buoyant umbilical connects the vehicle to the 600kg depressor weight. This in turn is connected via a conducting swivel to the main armoured coaxial tow cable. All signals and power pass through this single conductor.

The deck electronic systems and the logging and monitoring systems were set up in the JCR's U.I.C. room on the port side. The TOBI replay computer was mounted on spare bench space in the U.I.C. room, starboard side. As TOBI has been used previously on the ship, mobilisation of the major components was easily accomplished.

3.2 TOBI Deployments and Watch Keeping

The James Clark Ross is equipped with a wide stern mounted hydraulic 'A' frame that allows TOBI to be deployed and recovered in an athwartships position. This gives good control of the vehicle during these operations. A block on the articulated arm of the 'A' frame was used for deploying and recovering the TOBI vehicle. The main sheave was used for deploying and recovering the depressor weight and towing the complete system during the survey. No problems were encountered during any of the launch or recovery operations, which is a very great credit to the deck crews involved.

TOBI was launched and recovered a total of 2 times during the cruise. The times are listed below along with relevant comments:

Deployment	Start time/day	End time/day	Comments
1	16:03:54/215	19:00:00/215	Shallow water run / test run.
2	14:49:54/219	18:29:58/224	Main survey area.

The M-O disks used and their relevant numbers, files and times are listed in the file ***JR142_2006_MO_Record.doc***.

TOBI watch keeping was split into three, four-hour watches repeating every 12 hours. Watch keepers kept the TOBI vehicle flying at a height of ideally 400m above the seabed by varying wire out and/or ship speed. Ship speed was usually kept at 2.5knts over the ground with fine adjustments carried out by using the winch. As well as flying the vehicle and monitoring the instruments watch keepers also kept track of disk changes and course alterations.

The bathymetry charts of the work area comprised of previously surveyed blocks and EM120 runs prior to deployment. Both of these helped immensely when flying the vehicle.

3.3 Instrument Performance

These are real time observations of the instrumentation performance. A more detailed engineering analysis, involving the data collected, will home in on problem areas highlighted by these observations.

Vehicle

Pre-survey tests revealed a problem with the CTD causing no and/or incorrect data strings, comprising of CTD and gyro readings, reaching the logging and digital display computers. A bench test of the CTD unit revealed that it was in an incorrect mode. The mode was changed to the required setting and the correct data stream was observed. The CTD was re-attached to the vehicle which was then powered up and the data strings were now correct.

Run 1 was short (3 hours) and the vehicle performed well for such a shallow area, 220 – 240 meters water depth. Run 2 was the primary work area comprising of 5 days survey time in water depths of 100 – 2500 metres.

During the 2 runs the vehicle performed well apart from a number of remote 'reboots' of the CTD/Gyro interface and occasional 'power cycling' of the vehicle to get the CTD/Gyro data stream back online. Further into the run it was found that only remote 'reboots' of the CTD /gyro interface with adequate wait times to restart precluded any need to 'power cycle'. This allowed the sonar data stream to continue and only the CTD/gyro data to be incorrect for such short (2 – 3 minute) periods.

There were two (2) instances of 'loss of trigger pulses' towards the end of Run#2, a very rare occurrence, which produced gaps in the data files due to corrupted files. The vast majority of the data in the effected files were successfully recovered.

The umbilical and electrical swivel performed well with no down time.

Profiler

The system preformed well although the altitude tracking had to be turned off and entered in manually. This was due to the large number of multiple echoes inherent in shallow water work which confused the auto tracking algorithm.

Sidescan

The system performed well with excellent records of slopes and debris flow.

Magnetometer

The unit worked well throughout the cruise. The output did lock up (frozen display values) when a power cycle was conducted too quickly. A few minutes of power down to allow voltages to fully fall solved this. No calibration of the magnetometer in the vehicle was undertaken although there should be enough data within the survey to carry one out post cruise.

Gyro

The unit performed well with the data stream only being corrupted when the CTD locked up. The system returned to normal once the CTD had been correctly rebooted.

CTD – FSI Serial No. 1426-09nov98

For the majority of the cruise the CTD worked well once the system was set to the right mode during the initial deck test. During the survey the unit had to be rebooted 38 times. This had the effect of freezing the CTD and gyrocompass readings until the CTD could be fully rebooted. Due to time pressure and the ability to reboot the unit remotely it was decided not to recover the vehicle to try one of the other spares. A full assessment of this unit, in and out of the vehicle, will be done back at NOC.

Pitch/Roll

This unit performed well for the whole cruise.

LSS

The light scattering sensor was used throughout the cruise. Although the data was not required on this cruise it is available in the TOBI data files.

Swath bathymetry

The unit performed well with only occasional periods of the port side being washed out at the far range. From observations, in this cruise, it could be seen that there is a good 1.5km range for the starboard swath with approximately 1km for the port side.

Deck Unit

The system proved very reliable in operation throughout the cruise. A voltage of 320V was used to power the vehicle with a current of approximately 300mA.

Instrumented Sheave. Not required on this cruise, JCR had the facilities in place and wire out data made available in a text file.

Winch – TOBI Portable. Not required on this cruise, JCR had a fully operational deep tow winch with an inner coaxial cable for power, communication and data streams.

Data Recording and Display

Data from the TOBI vehicle is recorded onto 1.2Gbyte magneto-optical (M-O) disks. One side of each disk gives approximately 16 hours 9 minutes of recording time. All data from the vehicle is recorded along with the ship position taken from the TOBI portable GPS receiver. Data was recorded using TOBI programme LOG.

As well as recording sidescan and digital telemetry data LOG displays real-time slant range corrected sidescan and logging system data, and outputs the sidescan to a Raytheon TDU850 thermal recorder. PROFDISP displays the chirp profiler signals and outputs them to a Raytheon TDU850. DIGIO9 displays the real-time telemetry from the vehicle – magnetometer, CTD, pitch and roll, LSS – plus derived data such as sound speed, heading, depth, vertical rate and salinity.

LOG, PROFDISP and DIGIO9 are all run on separate computers, each having its own dedicated interface systems.

Data recorded on the M-O disks were copied onto CD-ROMs for archive and for importation into the portable (NOC), available on board, image processing system (PRISM).

On M-O disk 961 – TOBI.DAT the wrong date was recorded. This was corrected on a turn and from disk 961 – TOBIA.DAT onwards the date is correct. It was noted that RUN#1, four days prior, had the correct day.

M-O disk 967 suffered from corrupted files during a period of two (2) losses of the main 4 second system trigger pulses. The files were recovered but with a loss of 54 minutes and 10 seconds of data. This loss was during a long 180 degree turn and zigzag route, to avoid ice sheets, which took the vehicle track within a previously covered line. The loss of data is therefore reduced in importance.

The Logging PC will be investigated back at base for any reoccurrence of this anomaly.

3.4 Deliverable Items

- Copies of M-O data discs on CD-ROM plus associated document files, numbered 960 – 968.
- Real Time thermal printout of raw sidescan (only Time Varied Gain T.V.G. applied).
- Real Time thermal printout of raw non-motion compensated profiler (made available but not generally looked at).
- Replayed thermal printout of motion compensated profiler data.

Summary

The system performed well, overall, with some excellent sidescan imagery. The system will be reviewed, in light of the reported faults, back at NOC in preparedness for next year's cruise program. The most likely candidate is the CTD unit as most of the reboots and power cycling revolved around getting it restarted.

Reference and Contacts

TOBI technical reference: 'TOBI, a vehicle for deep ocean survey', C. Flewellen, N. Millard and I. Rouse, Electronics and Communication Engineering Journal April 1993.
e-mail: dlrm@noc.soton.ac.uk
url: http://www.noc.soton.ac.uk

M-O Number	File Name	Time/ Day START	Time/ Day STOP	Comments / Run #	Raw S/Scan Roll #	Corrected Profiler Roll #
960	TOBI.DAT	16:03:54 / 215	19:00:00 / 215	Run #1	1	1
961	TOBI.DAT TOBIA.DAT	14:49:54 / 216(219) 23:32:08 / 219	23:29:06 / 216(219) 07:01:46 / 220	Run #2 Logging stopped on a 180 deg. turn to reset date 216->219 Vehicle on turn between WP1 -> WP2	2	2
962	TOBI.DAT TOBIA.DAT TOBIB.DAT	07:01:50 / 220 19:08:44 / 220 21:36:36 / 220	19:05:52 / 220 21:35:16 / 220 22:34:24 / 220	Run#2 Power recycle Power recycle Power recycle	2	3
963	TOBI.DAT TOBIA.DAT	22:50:50 / 220 08:46:24 / 221	08:42:56 / 221 11:07:26 / 221	Run#2 Power recycle	2	4

	TOBIB.DAT	11:17:18 / 221	15:12:58 / 221	Power recycle		
964	TOBI.DAT	15:13:02 / 221	07:22:04 / 222	Run#2	2	5
965	TOBI.DAT TOBIA.DAT	07:22:08 / 222 18:38:54 / 222	18:36:32 / 222 23:31:40 / 222	Run#2 Power recycle Power recycle	2	6
966	TOBI.DAT	00:09:18 / 223	16:18:18 / 223	Run#2	2	7
967 Damaged files recovered to this one. Reordered on CD	TOBI.DAT TOBIA.DAT TOBIB.DAT TOBIC.DAT TOBIA.DAT TOBIB.DAT	Damaged Damaged 07:18:38 / 224 16:18:26 / 223 16:18:26 / 223 07:18:38 / 224	Damaged Damaged 09:20:44 / 224 06:24:52 / 224 06:24:52 / 224 09:20:44 / 224	Run#2 Repair of files TOBI.DAT TOBIA.DAT Files on CD reordered to mirror this update Last 5 pings are corrupted One ping lost on disk change	2	8
968	TOBI.DAT	09:20:52 / 224	18:29:58 / 224	Run#2 **End Survey**	2	9

4. GEOLOGICAL OPERATIONS

4.1 Deployment and Operation of Gravity Corer
(Dave Turner, Lee Fowler, Duncan Matthew)

NMFD Personnel:	Dave Turner, Duncan Matthew, Lee Fowler
No. Cores Taken:	23

Seabed Coring System – Gravity Core

The Gravity Core System consists of a 1000kg bomb (weight), 3m core barrels with liners, a core catcher and cutter. The 3m core barrels can be joined together to give a 6m coring system. The deployment system consists of a coring bucket, davit and the use of the ships Stbd 'A' frame, coring winch and warp. The warp is secured to the core bomb using a 5t swivel.

The core bucket, complete with the core bomb and barrel(s) is moved from the inboard position to the deployment position over the side of the ship, using the core bucket hydraulic ram and system davit. From this position the locking gate on the bucket is released and the system is rotated from the horizontal to the vertical using the davit. In the vertical position the core bucket is secured by the gate locking mechanism, and the bomb to bucket retaining chain is removed. The ship's 'A' frame and winch lift the core bomb and barrel(s) from the bucket and the system is lowered into the water.

At approximately 50 meters from reaching the seabed the winch is stopped to allow the corer to settle in the water column for a few minutes. The winch then proceeds at a speed of approximately 60m/min until the corer hits the seabed. This is indicated with the load on the wire significantly dropping off, or visually, with the sheave block 'kicking' back. The core wire is then paid out a further 10 to 15 meters. The winch then starts to haul at approximately 10m/min until the corer has left the bottom, this is indicated by a slight 'pullout' tension on the cable monitoring system, or again visually, by the sheave block. Once off the bottom the system is brought to the surface for recovery. Haul and veer speeds through the water column will be determined by the capabilities of the ships winch system, but generally around 60m/min.

Recovery is the reverse of the deployment.

System Performance:

The coring system worked well for the majority of the cruise with one minor incident reported (See attached near miss report). The minor equipment failure meant that the ships mid-ships crane had to be deployed to aid the recovery of the coring system, which in turn took a little longer to get the corer secured ready for sampling. This procedure did not affect the coring sample or generate a significant amount of science down time. Equipment repairs were carried out with no complications, or loss of time to the science program.

Near Miss Report JR142

National Marine Facilities Division (NMFD) Gravity Core System.

Date & Time:	17-08-06, 14:17 hrs GMT
Position:	Lat 79.593166N, Lon 26.192966E
Weather conditions:	Sea State 1-2 Wind Speed approx 12-14 knts
Ships location of incident:	Stbd Side
NMFD operators at time of incident:	Dave Turner and Lee Fowler

Description of the event:

The Core bomb (weight) and barrel had been recovered into the core bomb cradle, and secured with its chain over the top. The Core bomb and barrel were then rotated from the vertical position to the horizontal, using the system davit. The core bomb bucket was then secured horizontally using the locking gate mechanism.

The bucket, complete with the bomb and the barrel then proceeded to move inboard using the bomb bucket hydraulic ram and system davit. This process was stopped prior to reaching the inboard position, realizing that the core barrel had not been washed down yet.

The hydraulic ram and system davit was then reversed, as with any deployment, to move the bomb bucket and barrel outboard again.

As the hydraulic ram reached the outer end of its stroke, the fixings on the inboard end of the ram gave way, releasing the ram and allowing the bomb bucket to swing over the side. The bucket was secured from swinging any further by its own pivot points.

To recover the situation the mid-ships crane was deployed and a strop secured to the bomb bucket. The bucket, complete with the core bomb and barrel was then lifted, slewed inboard, and secured into its inboard position. The two bolts used for the transportation and lifting of the bucket were then put into place locking the system inboard in the absence of the hydraulic ram. The removal of the barrel and core sample was then carried out in the usual manner.

On the inspection of the failure afterwards, it was found that the inboard fixing studs (4 off), to the hydraulic ram had failed due hidden excessive corrosion on the under side of the hydraulic ram mounting point. The securing studs had originally been welded to the under side of the fixing plate, but due to the corrosion had pulled out when the hydraulic ram had extended.

To return the coring system to an operational status the stud holes were cleaned out, and the hydraulic ram secured to the plate using 4 off M12 x 40 st/st bolts.

The system was then fully tested for operational use.

4.2 Cores Acquired
(Jeffrey Evans, Colm Ó Cofaigh, Kelly Hogan)

Twenty-three gravity cores were obtained during the cruise (Table 4.1, Fig. 1.2). The maximum recovery obtained was 310 cm. The cores were cut into metre-long sections, capped off and sealed, and stored in the JCR refrigerators at about 4°C. They were freighted to the BOSCORF core store at NOC, Southampton, to undergo detailed laboratory analyses.

Table 4.1 Locations of gravity cores taken on JR-142

Core Number	Latitude (Degrees decimal or degrees minutes)	Longitude (Degrees decimal or degrees minutes)	Water depth (m)	Core Recovery (cm)	Core Catcher/ Core Cutter
JR142 - GC1	79.57500	25.03900	97	0	yes
JR142 - GC2	79.57400	25.83800	96	42	yes
JR142 - GC3	79.57005	25.69271	90	15	yes
JR142 - GC4	78.90160	23.97580	178	155	yes
JR142 - GC5	78.95323	24.44935	205	140	yes
JR142 - GC6	79.09550	25.09550	223	183	yes
JR142 - GC7	79.20524	26.53834	259	204	yes
JR142 - GC8	79.48700	28.43900	344	248	yes
JR142 - GC9	79.95442	29.64900	317	129	yes
JR142 - GC10	80.48599	29.64889	443	223	
JR142 - GC11	81.08190	28.92710	359	167	
JR142 - GC12	81.38795	26.93711	813	255	
JR142 - GC13	81.34880	21.62560	532	310	
JR142 - GC14	80 23.460	16 26.450	352	266	yes
JR142 - GC15	80 30.740	15 54.040	345	210	
JR142 - GC16	80 42.000	15 36.500	728	80	
JR142 - GC17	80 08.680	17 10.870	462	219	
JR142 - GC18	81 15.542	19 02.929	460	169	yes
JR142 - GC19	81 15.848	19 01.261	550	189	yes
JR142 - GC20	79.59317	26.19297	144	220	
JR142 - GC21	78.56885	34.06115	212	100	26
JR142 - GC22	79 19.926	29 54.017	302	111	19
JR142 - GC23	79 22.554	29 46.030	306	222	

Fig. 4.1. Gravity coing operations from the starboard side of the JCR in Hartogbukta, Nordaustlandet, eastern Svalbard.

5. SOME PRELIMINARY DATA: PAST ICE-SHEET AND SLIDE ACTIVITY ON THE NORTH AND EAST SVALBARD MARGIN

(J.A. Dowdeswell, J. Evans, K. Hogan, R. Mugford, R. Noormets, C. Ó Cofaigh)

The Svalbard archipelago was covered by part of an extensive Eurasian Ice Sheet about 20,000 years ago. The history of the western margin of the ice sheet is relatively well known. The aim of cruise JR-142 (Fig. 1.1) was to investigate several aspects of the dimensions and dynamics of the ice sheet north and east of Svalbard, and the glacier-derived sediments that were delivered to these areas, using marine geophysical and geological methods. Streamlined sedimentary landforms and bedrock on the continental shelf, imaged with swath bathymetry (Fig. 5.1), indicate the direction of past ice flow and show that ice extended to the shelf break north of Svalbard, and flowed north and north-east into the Kvitøya and Franz Victoria troughs from an ice centre located in the NW Barents Sea. An ice stream drained through Hinlopen Trough (Fig. 5.2) in successive glacial cycles to deposit a sedimentary fan north of Svalbard. A huge slide on the upper slope in this area has produced a major slide scar and the downslope deposition of large intact blocks, which were imaged using the TOBI 30 kHz side-scan sonar system (Fig. 5.3). The keels of icebergs calved from the ice-sheet margin scoured the sea floor to depths of over 600 m on the outer shelf (Fig. 5.4). Close to the ice cliffs of the 8,000 km^2 Austfonna, the largest modern ice cap in the Eurasian Arctic, successive ice advance and retreat over the past few decades has produced a series of superimposed submarine landforms which were also imaged (Fig. 5.5). Similar landforms are exposed on the small island of Isispynten, adjacent to our study area (Fig. 5.5). These investigations allow the reconstruction of the form, flow and retreat of the last ice sheet to cover Svalbard and adjacent seas.

We thank the Master, Officers and Crew of the RRS *James Clark Ross* for excellent support throughout Cruise JR-142, July-August 2006. The work was funded by a UK NERC Grant.

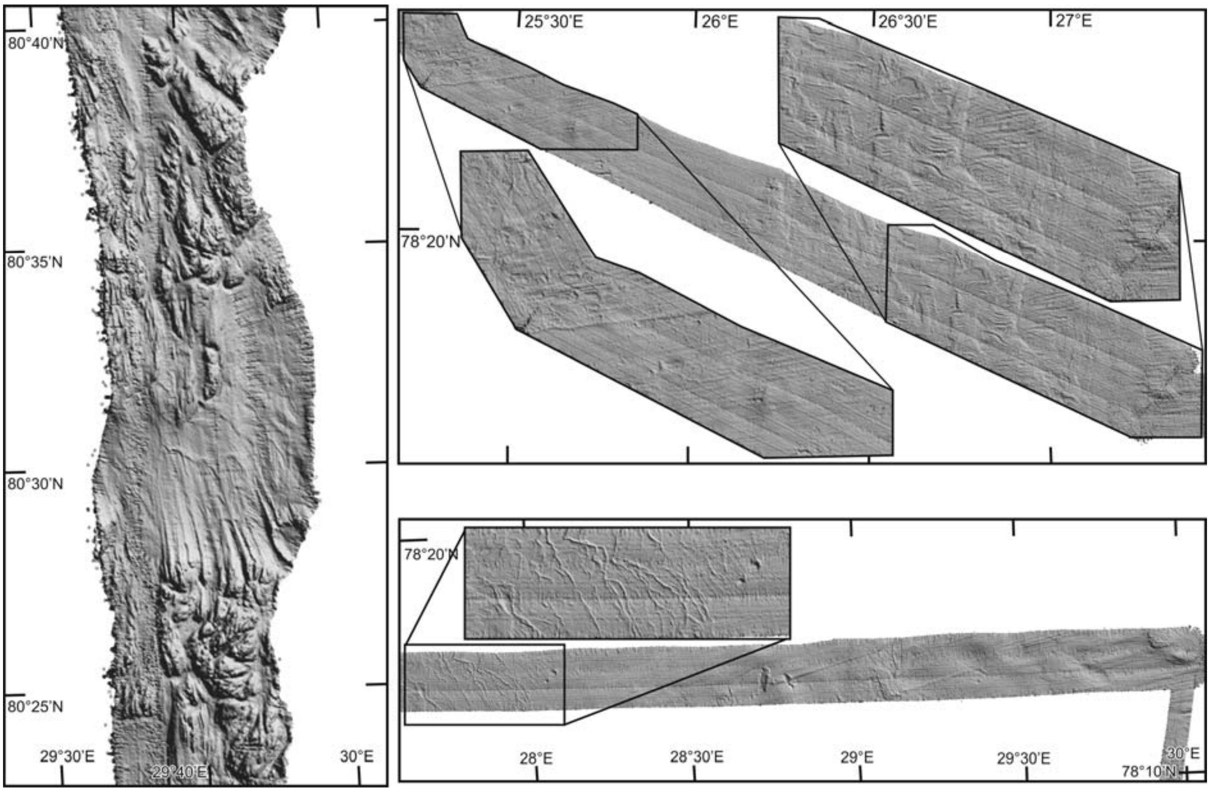

Fig. 5.1. Swath imagery from east of Svalbard: the Kvitoya Trough (left) and Olga Strait on the right. Note the streamlined sedimentary and bedrock features on the left and the series of submarine ridges on the right.

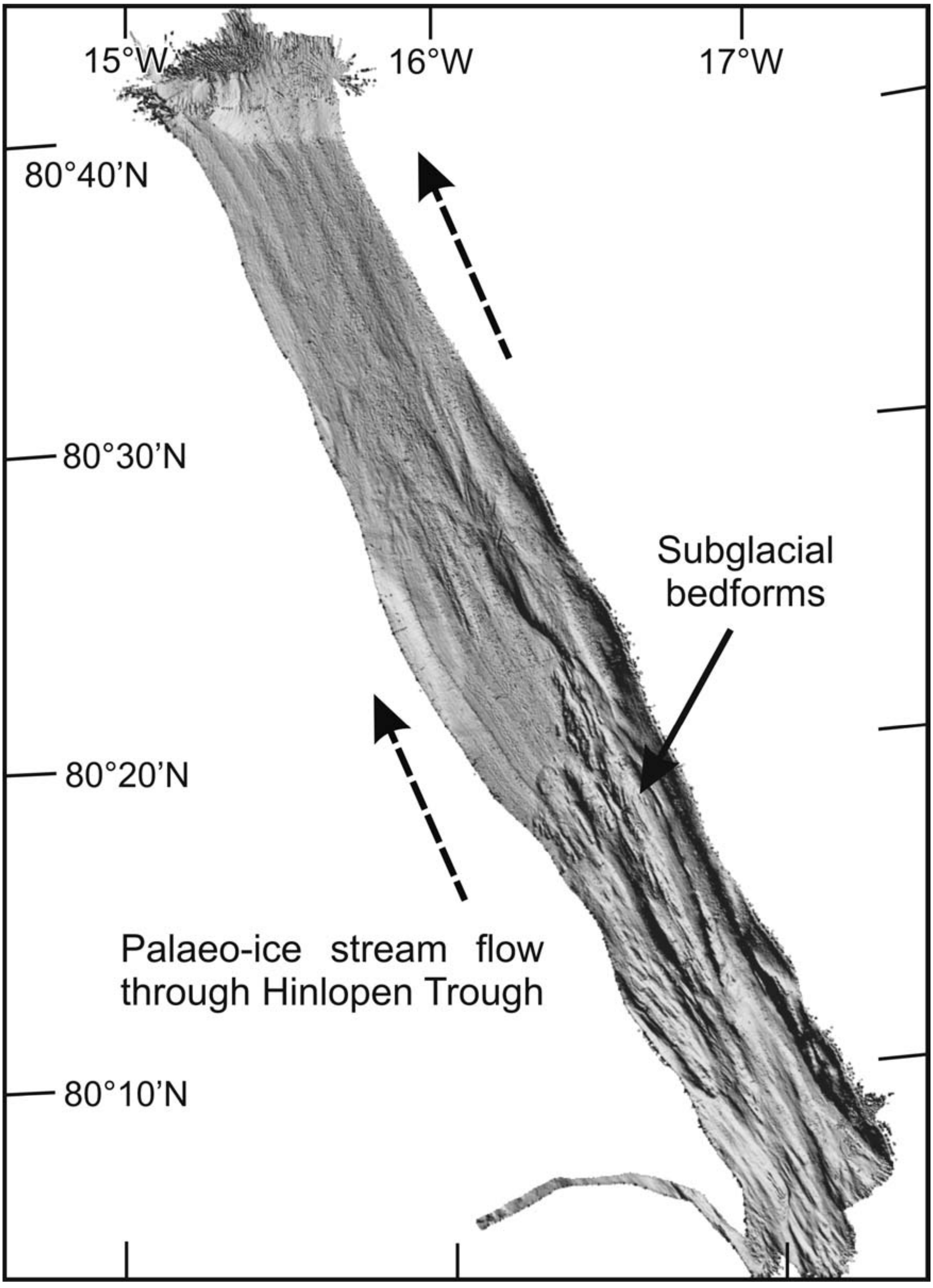

Fig. 5.2. Swath bathymetric imagery of Hinlopen Trough north of Svalbard. The trough is about 70 km long.

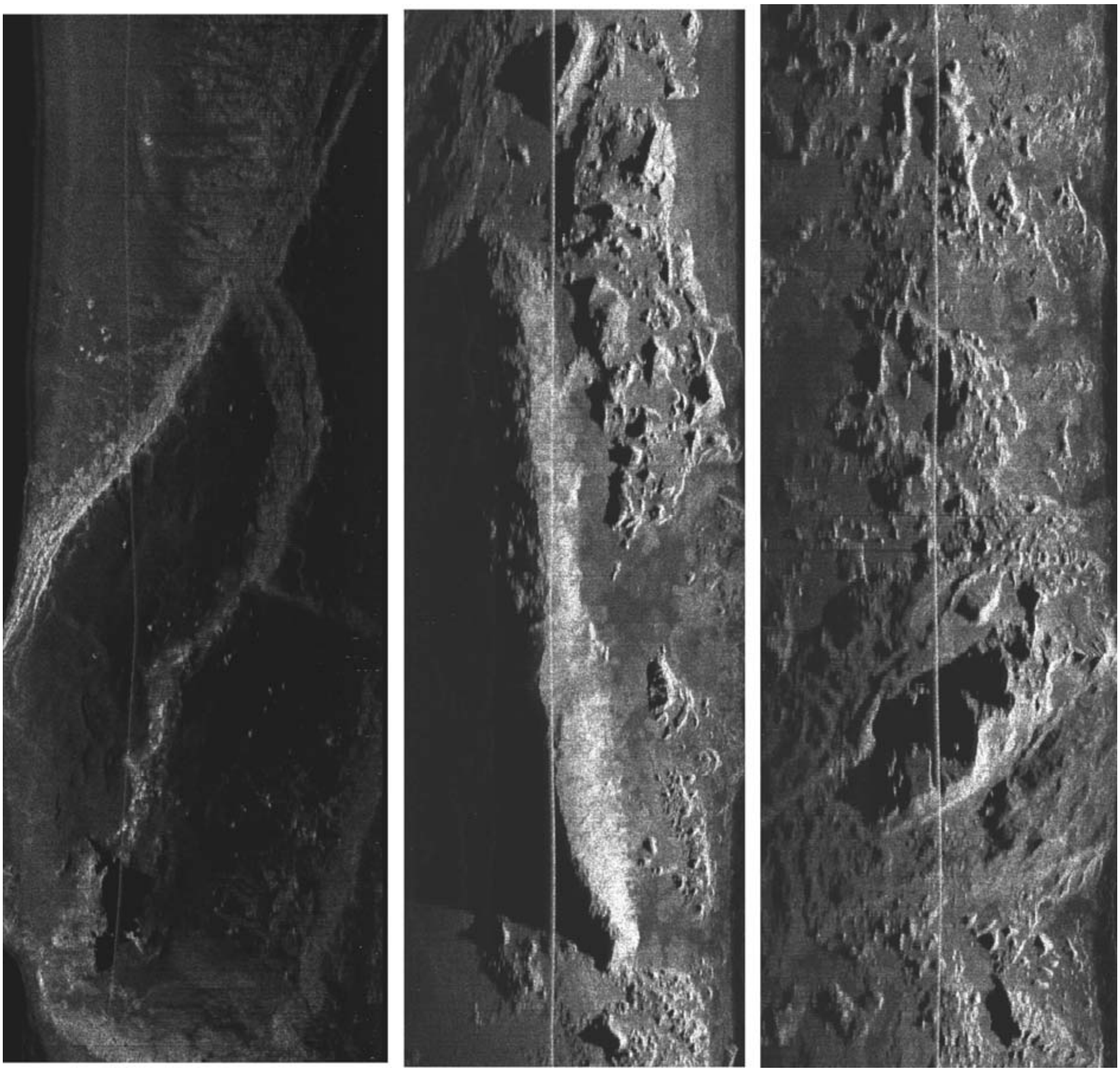

Fig. 5.3. Parts of the huge Hinlopen Slide, imaged by TOBI side-scan sonar. Each block of data is about 4 km across.

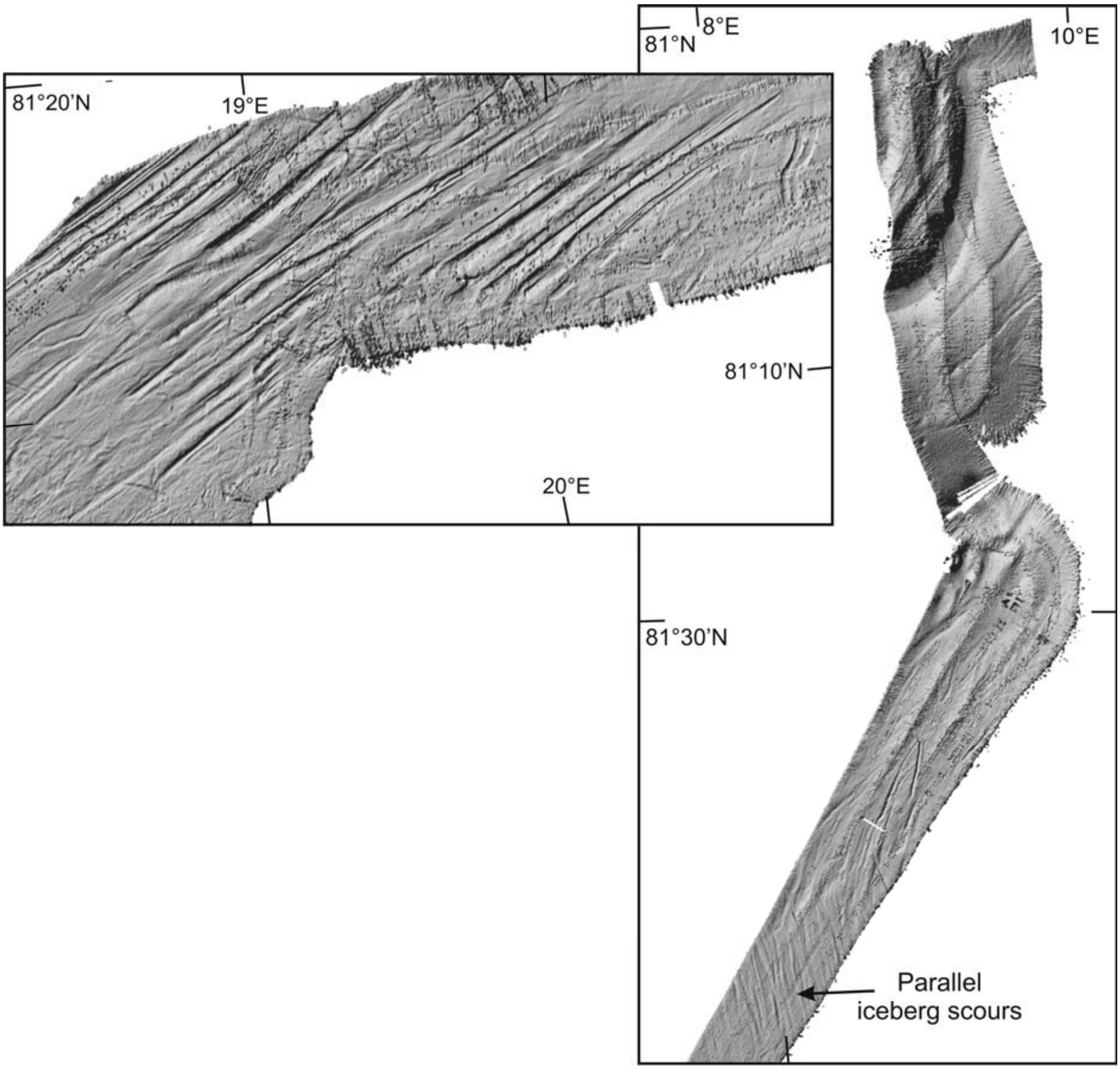

Fig. 5.4. Swath image of large iceberg scour marks on the sea floor in 500-600 m of water north and west of Svalbard on the Yermak Plateau. Note also the moat produced by the strong Spitsbergen Current in the right-hand image.

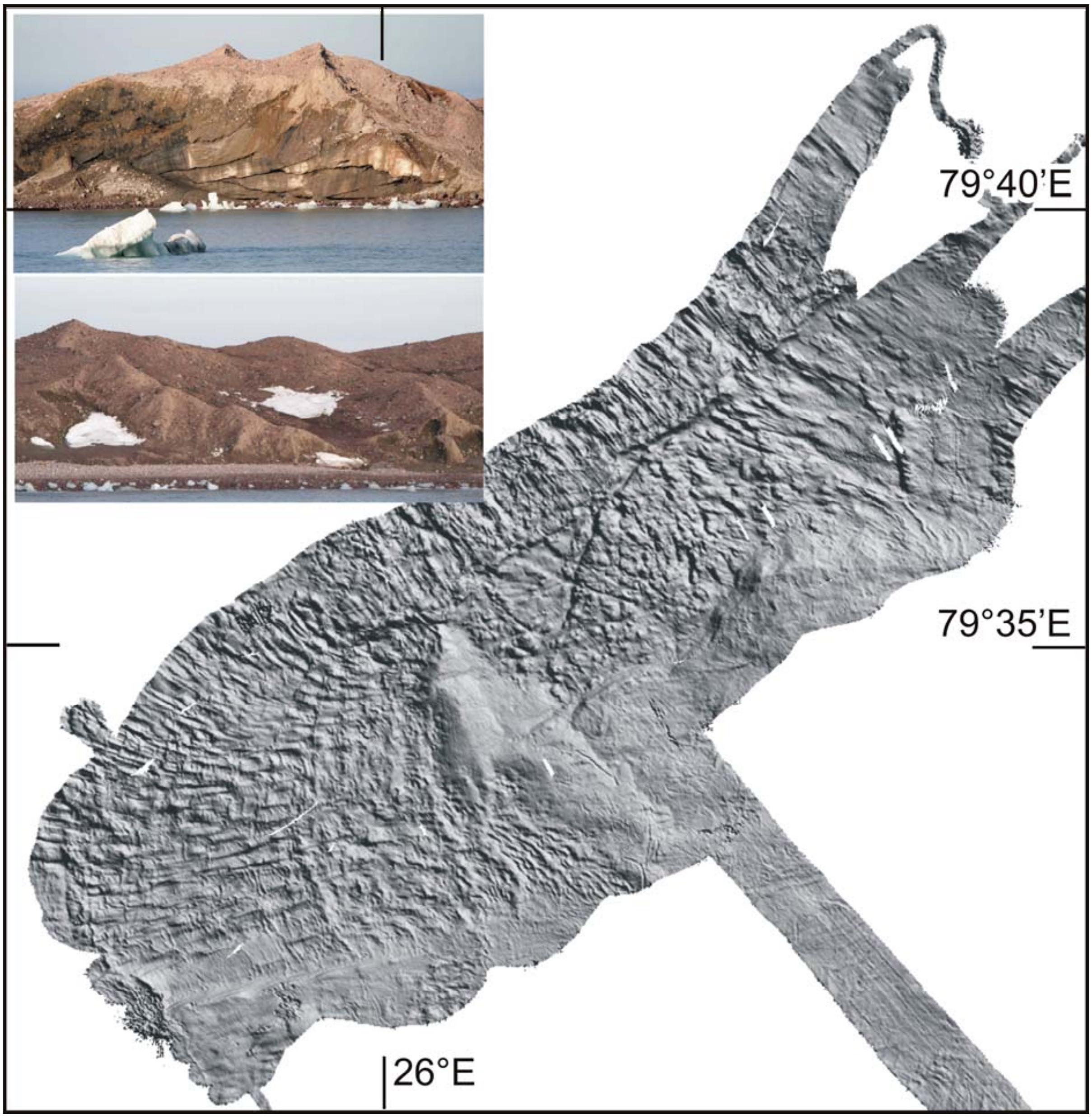

Fig. 5.5. Swath imagery of submarine landforms produced within a few kilometres of the modern ice cap of Austfonna. Sediment ridges and a section of thrusted ice exposed on Isispynten, adjacent to Austfonna, can been seen in the inset. The ridges are about 10 m high.

6. TESTS ON BACKSCATTER VALUES DERIVED FROM THE EM120 (R. Noormets)

In some of the earlier swath data collected aboard JCR, abrupt changes in backscatter (BS) levels have been observed. The cause for these “jumps” is not fully understood.

During the JR142 cruise, series of tests were conducted with the aim of clarifying the origin of the BS fluctuations and to investigate the possibilities for improving the quality of BS data collected with the EM120.

The tests included:

1. Calculating and implementing new acoustic energy absorption profiles appropriate for local conditions using echosounder and water column parameters readily available on JCR.
2. Examining the effect of different factory preset operation modes on the output BS levels.

1: A new absorption profile was calculated based on the equations given in the EM120 operator’s manual using the following parameters measured on the vessel: pH, temperature, salinity, sound velocity. Absorption coefficients in the new profile were locally up to 30% different from those in the “standard” one used before. Deviations were greatest in the upper (shallower) end of the profile.
The original absorption profile file in Neptune $SHAREHOME directory was renamed from “absorption.coef.EM120” to “absorption.coef.EM120.original” and the newly calculated profile was copied to that directory and named “absorption.coef.EM120”.
The effect of implementing the new absorption profile is difficult to assess at this time as this requires testing in well controlled conditions, and preferably repeating survey lines over previously known seabed types. Theoretically, improvement in returned backscatter levels should be expected.

2: During normal data collecting, the EM120 is run in automatic mode, which ensures ‘optimum’ bottom detection in full ocean range. The automatic mode consists of 5 factory preset ping modes, each of which is designed for optimum bottom detection in different depth and bottom conditions. These ping modes (Very shallow, Shallow, Medium, Deep and Very deep) feature a set of various parameters, such as maximum range, swath angle, pulse length etc. When underway, the EM120 switches between the ping modes automatically, based on the outcome of a series of bottom detection tests that it performs continuously on the incoming swath data.

We started the testing with an assumption that the abrupt changes in backscatter levels observed in several earlier datasets (e.g. Bellingshausen Sea) may have been the result of the automatic switching from one ping mode to the next. Testing was conducted under normal data collecting procedures during TOBI-survey, i.e. with vessel speeds around 2-4 kn.

One typical example of the effect of mode switching has been summarized in the figures below. In this case, the vessel was proceeding from north to south, i.e. from deeper to shallower water (max depth 1163 m, min depth 599 m), and the ping mode changed from "Deep" to "Medium" (Fig. 6.1).

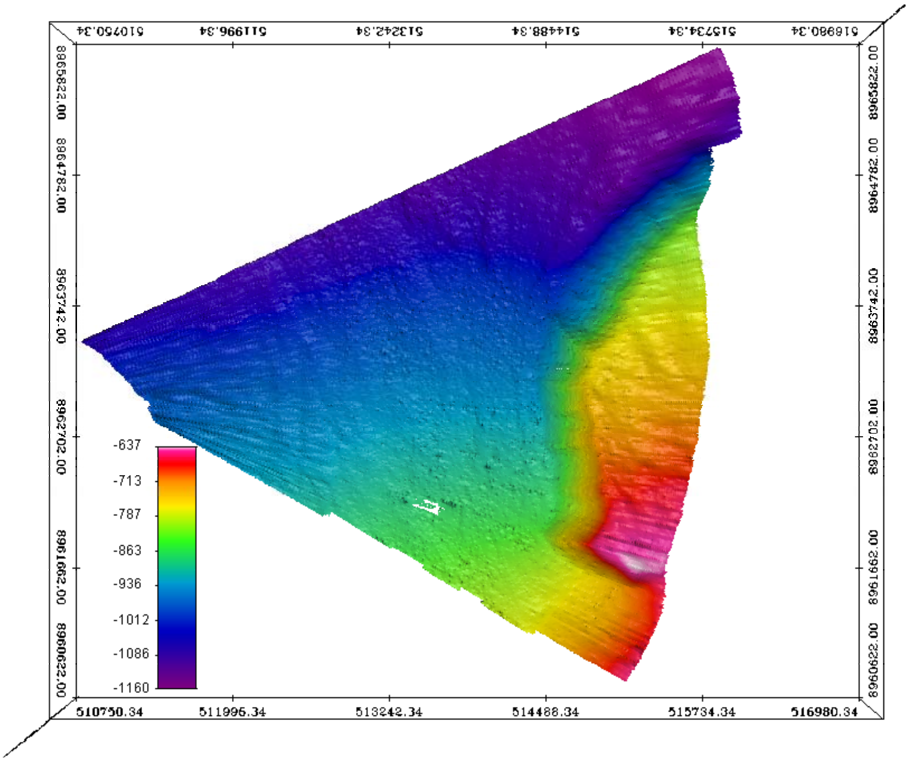

Fig.6.1. Shaded bathymetry (illumination from west) of the test site (line 0372 between 0511 and 0607). Switching from Deep to Medium ping mode occurred in the middle of the test area.

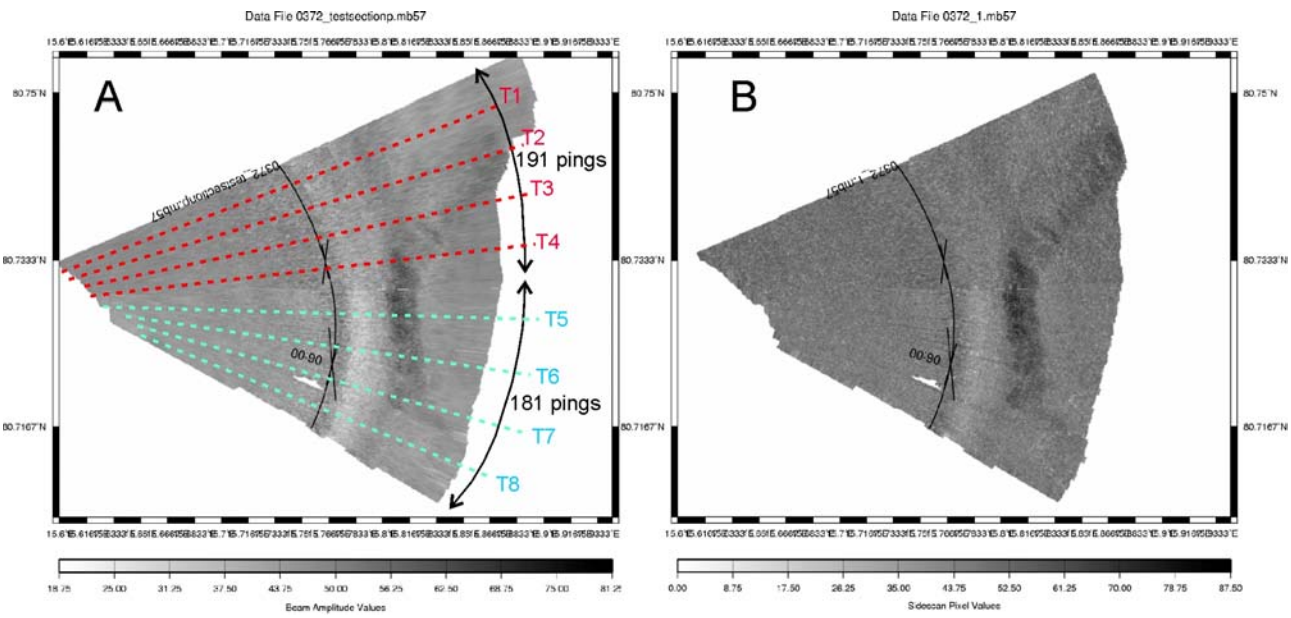

Fig.6.2. Raw amplitude (A) and side-scan (B) records from the same dataset consisting of 372 pings of swath data. Applied processing includes removal of beams with failed bottom

detection and correcting for BS variation due to grazing angle. Also, the BS values have been compensated for attenuation due to cross-track slope of the seabed. Amplitude values along transects T1-T8 have been graphed in Fig.6.3.

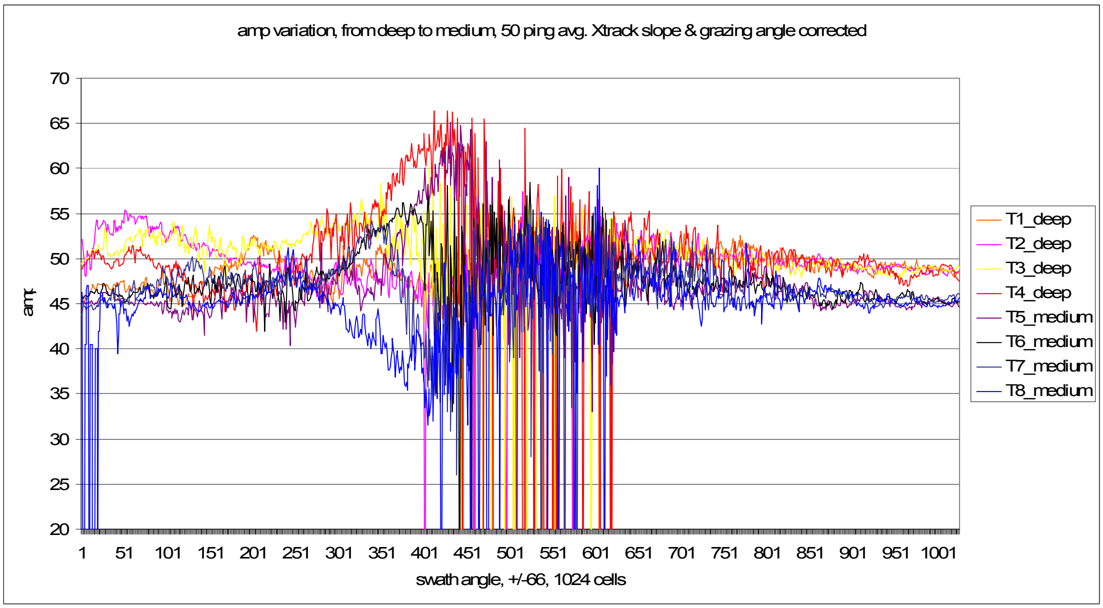

Fig.6.3. Beam amplitude levels sampled at 8 time steps, T1-T8 (for approx. locations see Fig.6.2). Samples T1-T3 and T5-T7 represent 50 ping average values, whereas T4 and T8 are averages of 41 and 31 pings, respectively. The central part of the swath features larger variability due to strong specular reflections. Cells with zero-value result from removal of "bad" bathymetry beams and possibly also from gaps in between beam footprints due to narrow (1x1 degree) beams.

Amplitudes from the portside beams record the nature of the seabed, showing increased values at T3-6 coinciding with the slope in the seabed suggesting a "harder" bottom with stronger reflectivity.
Note clustering of amplitudes from deep and medium ping modes in different levels. This is particularly striking in the outer parts of the swath. The EM120 seems to output approximately 4 dB higher amplitude levels in 'Deep' as compared to those in 'Medium' ping mode.

Although the amplitude and side-scan levels appear rather consistent on the raw (unfiltered) plots due to the abundant random scatter (a thorough visual examination reveals the contact though), some basic post-processing in order to reduce speckles and enhance contrast of the seabed image tends to bring out the ping mode switching rather clearly.

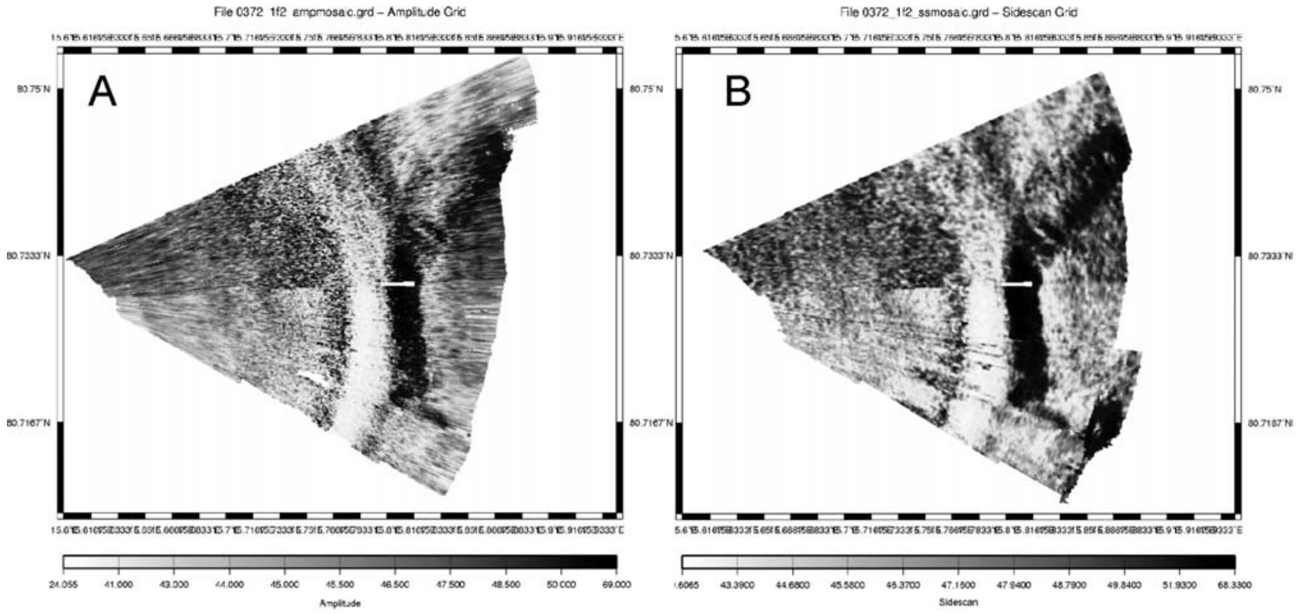

Fig.6.4. Mosaiced amplitude (A) and side-scan (B) records of the same datasets as presented in Fig.6.2. In addition some low-pass filtering has been applied in order to reduce the random scatter and accentuate BS variability associated with seabed character.

This "jump" in BS level was observed only when switching from Deep to Medium ping mode. Switching between Very shallow and Shallow, and Shallow and Medium ping modes did not produce such an abrupt change. This is probably due to the TX pulse length, which changes automatically from 15 ms in Deep mode to 5 ms in Medium, Shallow and Very shallow modes. In order to produce consistent BS maps across c. 0.8-1 km water depth boundary, where the switching between Deep and Medium ping modes tends to take place, the resulting, presumably rather constant, c. 4 dB difference in BS levels, should be corrected for.

7. APPENDICES

7.1 Sonar System Parameter Settings

EM120

MBES screen
Ping Mode: Auto
Sector Coverage

Max Port Angle:	50-70
Max Starboard Angle:	50-70
Angular Coverage:	Manual
Beam Spacing:	Equidistant

Pitch stabilisation:	On
Yaw stabilisation:	Off
Min depth:	Used to constrain depth when bottom is lost
Max. depth:	Used to constrain depth when bottom is lost

Sound Speed Profile
Current Sound Profile: jr104_xbt??.asvp

Sound Speed at Transducer:

From:	Profile
Sensor Offset:	0.0 m/s
Filter:	60s

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

TOPAS Acquisition Parameters

<u><1000 m water depth</u>

Parasource Menu

Level:	100%
Ping Interval:	0 ms (enables external SSU triggering) or 1100-2500 ms (manual triggering).

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: 12 – 36 dB
Filter: 1.00 kHz
Delay: Manual

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)
Slope: (30 – 60 dB slope)
Start point: Manual or Tracking or External
Deverb: 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

<u>>1000 m water depth</u>

Parasource Menu
Level: 90 – 100%
Ping Interval: 2000 – 5000 ms (Manual triggering over rides SSU triggering)
Pulseform: Chirp
Chirp start frequency (Hz): 1500
Chirp stop frequency (Hz): 5000

	Length (ms):		15	
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:	20 – 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)			
	Slope:	(30 – 60 dB slope)		
	Start point:	Manual or Tracking or External		

Deverb:	OFF
Stacking:	OFF
AVC:	OFF
Scale (%):	1000 – 3000
Attribute:	INST.AMP

LOG/Replay Menu

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

A1.3 SSU – Sonar Sequencing Unit

Group: EM & EA, EK, TOPAS

Trigger:	EM120 & EA600:	ON (both systems)
	EK60:	OFF
	TOPAS:	ON

Time usage:	EM120 & EA600:	Calculated (both systems)
	EK60:	OFF
	TOPAS:	Calculated
Time add on:	Not used for any of the systems	

The bridge echosounder (EA600) was run on passive, external trigger, and listened out for the EM120 centre-beam return and used this to calculate depth below the ship. Whenever, the EM120 was not active the EA600 was switched to Active, internal triggering.

7.2 TOBI: Brief Technical Specification

Mechanical

Towing method	Two bodied tow system using neutrally buoyant vehicle and 600kg depressor weight.
Size	4.5m x 1.5m x 1.1m (lxhxw).
Weight	2500kg in air.
Tow cable	Up to 10km armoured coax.
Umbilical	200m long x 50mm diameter, slightly buoyant.
Tow speed	1.5 to 3 knots (dependent on tow length).

Sonar Systems

Sidescan Sonar

Frequency	30.37kHz (starboard) 32.15kHz (port).
Pulse Length	2.8ms.
Ouput Power	600W each side.
Range	3000m each side.
Beam Pattern	0.8 x 45 degree fan.

Bathymetry Sonar

Transmitter	Uses sidescan sonar.
Receiver	6 hydrophone arrays in 2 housings for each side.
Detection	Single and multi-phase.
Range	Up to 3000m each side.

Profiler Sonar

Frequency	6 to 10kHz Chirp.
Pulse Length	26ms.
Output Power	1000W.
Range	>50ms penetration over soft sediment.
Resolution	0.25ms
Beam Pattern	25 degree cone.

Standard Instrumentation

Magnetometer	Ultra Electronics Magnetics Division MB5L.
Range	+/- 100,000nT on each axis.
Resolution	0.2nT.
Noise	+/- 0.4nT.
CTD	Falmouth Scientific Instruments, Micro CTD.
Conductivity	
Range	0 to 65 mmho/cm.
Resolution	0.0002 mmho/cm.
Accuracy	+/- 0.005 mmho/cm.
Temperature	
Range	-2 to 32° Celcius.
Resolution	0.0001° C.
Accuracy	+/- 0.005° C.
Depth	
Range	0 to 7000 dbar.
Resolution	0.02 dbar.
Accuracy	+/-0.12% F.S.
Heading	S.G. Brown SGB 1000U gyrocompass.
Resolution	0.1 degrees.
Accuracy	Better than 1°, latitude < 70°.
Pitch/Roll	Dual Axis Electrolytic Inclinometer.
Range	+/- 20 degrees.
Resolution	0.2 degrees.
Altitude	Taken from profiler sonar.
Range	1000m.
Resolution	1m.

Additional Instrumentation

Light back-scattering sensor	WET labs LBSS
Source	2 x 880nm LEDs
Detector	Solar-blind silicon light detector
Range	~10mg/l
Resolution	0.01% F.S., ~1ug/l