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# CRUISE REPORT

RRS *James Clark Ross*
Cruise JR50
July 2000

R.D. Larter

Completed 26/7/2000

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# RRS James Clark Ross
multibeam installation

A & P Tyne  Wallsend
June / July 2000

British
Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

## Contents

## Figures



## Plates



## Tables

# 1. SUMMARY

Cruise JR50 comprised trials of new scientific equipment installed on RRS *James Clark Ross* during the summer refit. These trials mainly consisted of Sea Acceptance Tests of the new multibeam echo sounder and sub-bottom profiler, the purchase and installation of which was funded by an award from the Joint Infrastructure Fund. The cruise also provided an opportunity to test pre-existing echo sounding systems following refitting of transducers, and to prove the newly-installed NOAA Scientific Computing System.

The Sea Acceptance Tests were successful and demonstrated that the new EM120 multibeam echo sounder can provide higher resolution sea-floor imagery than any other multibeam system presently in operation on a civilian vessel. Following the cruise there were some minor issues to resolve before the new sonar systems could be accepted, but these were second order problems which mainly related to some of the ancillary equipment. The fact that these systems worked so well from the outset is a tribute to the hard work, skill and dedication of everyone working for Kongsberg Simrad, BAS Technical Services, Burness Corlett & Partners, and A & P Tyne Ltd who was involved in their installation.

## 2. LIST OF PERSONNEL

### *2.1 Scientific and Technical (21)*

| | | |
|---|---|---|
| R.D. Larter | BAS | Chief Scientist |
| R.A. Livermore | BAS | Geophysicist |
| L. Vanneste | BAS | Geophysicist |
| J. Evans | BAS | Sedimentologist/Marine Geologist |
| P. Morris | BAS | Geophysicist/Database Manager |
| A.P. Cunningham | BAS | Geophysicist |
| C. O'Cofaigh | Bristol University | Sedimentologist/Marine Geologist |
| J. Taylor | Bristol University | Geophysicist |
| D.M. Blake | BAS | Head of Technical Services |
| S.F. Bremner | BAS | Head of ETS (Mechanical Engineer) |
| M.O. Preston | BAS | ETS (Electronic Engineer) |
| J.K. Summers | BAS | Manager of ITS (Computer Engineer) |
| B.J. Lamden | BAS | ITS (Computer Engineer) |
| A.T. Barker | BAS | ITS (Computer Engineer) |
| P.C.D. Lens | BAS | ITS (Computer Engineer) |
| J. Dyberdal | Kongsberg | TOPAS Engineer |
| M. Krangsas | Kongsberg | TOPAS Engineer |
| S.-I. Solum | Kongsberg | TOPAS Engineer |
| G.F. Skogen | Kongsberg | Swath Bathymetry Engineer |
| K. Aasekjer | Kongsberg | Swath Bathymetry Engineer |
| N.J. Roberts | BAS | Paramedic |

### *2.2 Ship's Officers (13)*

| | |
|---|---|
| C.R. Elliott | Master |
| R.C. Paterson | Chief Officer |
| D.B.G. Gooberman | 2nd Officer |
| P. Heslop | 3rd Officer |
| J.W. Summers | Deck Officer |
| D.J. Cutting | Chief Engineer |
| W.R. Kerswell | 2nd Engineer |
| R.A. Coe | 3rd Engineer |
| S.J. Eadie | 4th Engineer |
| C.A. Waddicor | Radio Officer |
| S.A. Wright | Deck Engineer |
| N.E. Thomas | Electrical Engineer |
| K.R. Olley | Catering Officer |

### *2.3 Crew (15)*

| | | | |
|---|---|---|---|
| G. Stewart | Bosun | C.R. Pratley | Senior Steward |
| D.O. Williams | Bosun's mate | T.N. Dixon | Steward |
| P.I. Clarke | Seaman | F. Hardacre | Steward |
| J.J.M. McGowan | Seaman | J. Newall | Steward |
| J.A. Baker | Seaman | | |
| M.A. Blaby | Seaman | | |
| J.P. Kennedy | Seaman | | |
| S.F. Smith | Motorman | | |
| M.A. Robinshaw | Motorman | | |
| R.W. Fox | Chief Cook | | |
| D.P. McLean | 2nd Cook | | |

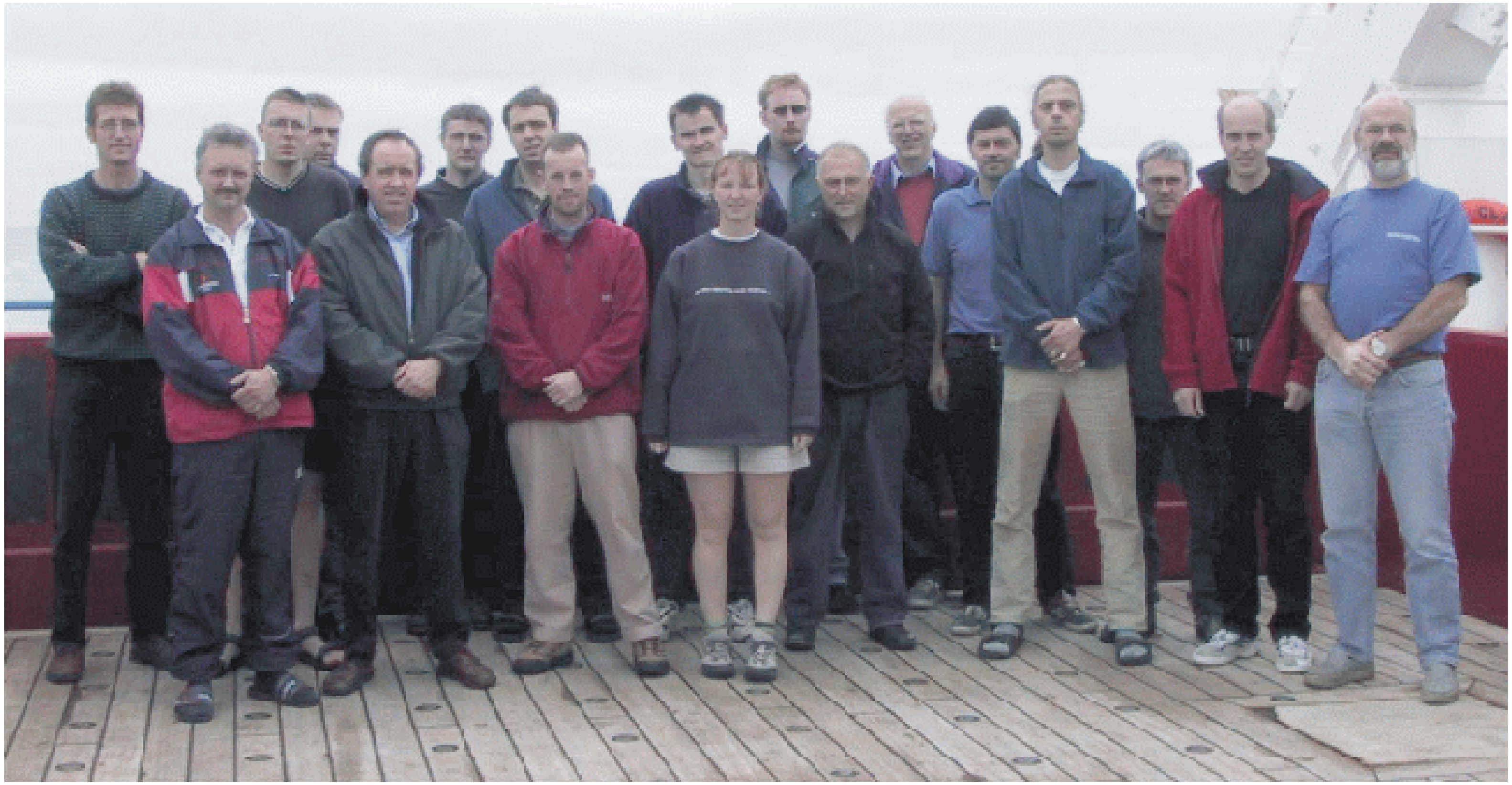


Plate 1. JR50 Scientific and Technical Party

M. Krangsas    S.-I. Solum    K. Aasekjer    P. Morris
J.K. Summers    A.T. Barker    J. Evans    C. O'Cofaigh    S.F.Bremner    R.A. Livermore    P.C.D. Lens
G.F. Skogen    D.M. Blake    J. Taylor    L.E. Vanneste    M.O. Preston    R.D. Larter    J. Dyberdal

Not on photograph: A.P. Cunningham, B.J. Lamden

## 3. TIMETABLE OF EVENTS

July 2000

13 RRS *James Clark Ross* leaves dry dock after refit and transducer installation.

14 Harbour Acceptance Trials and commissioning of new sonar systems.

15-18 Mobilisation of equipment for subsequent Arctic cruise (JR51).

19 Ship departs from A&P Tyne at 13:30 GMT and engine trials are carried out offshore from the Tyne.

20 Passage to Faeroe-Shetland Channel (FSC). Start logging dat from Shipboard Three-Component Magnetometer and EA500 echo sounder at 20:00.

21 First short, uncalibrated EM120 multibeam echo sounder test line along slope on southeastern flank of FSC, then first Sound Velocity Profiler (SVP) deployment. Carry out noise and interference tests on EM120 and TOPAS sub-bottom profiler while heading NNE across FSC, then second SVP station, first XBT deployment and EM120 calibration manoeuvres near northwestern flank of FSC.

22 Passage to Aegir Ridge. EM120 Tx stopped during first part of passage to allow monitoring of Seapath system. On arrival at Aegir Ridge, carry out third SVP station on. Commence EM120 trial survey. Deploy two more XBTs (one failed to log).

23 Continue EM120 trial survey, deploying fourth XBT and stopping for fourth SVP station.

24 Complete EM120 trial survey, then run TOPAS trial lines in axial trough of Aegir Ridge. Commence passage to Bodø, continuing operation of EM120 and TOPAS.

25 Continue passage to Bodø into strong headwind. Kongsberg Simrad personnel hold training courses on EM120 and TOPAS operation.

26 Arrive Bodø at 14:00 GMT.

## 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 EA500 (Bridge navigational echo sounder)
Kongsberg Simrad EK500 (biological echo sounder)
Kongsberg Simrad sonar synchronisation unit

### *4.2 Potential Field Equipment*

2 x Shipboard three-component magnetometers

### *4.3 Sound velocity profiling systems*

2 x Sound velocity probes
XBTs
Acoustic Doppler Current Profiler (ADCP )
Thermosalinograph

### *4.4 Navigation*

Trimble 4000DS GPS receiver
Skyfix differential GPS demodulator (input to Trimble receiver)
Ashtech G24 GPS+GLONASS receiver
Leica MX 400
2 x Ashtech G12
Ashtech 3D GPS receiver
Seapath (input to EM120 and TOPAS)
TSS300 heave, roll and pitch sensor
Chernikeeff Aquaprobe Mk5 electromagnetic speed log
Sperry doppler speed log
Gyro

### *4.5 Data Logging*

NOAA Scientific Computer System (SCS) system

### *4.6 Winches*

CTD wire on 10-ton traction winch (for sound velocity profiler deployment)

## 5. INTRODUCTION

The main purpose of Cruise JR50 was to carry out Sea Acceptance Tests of new sonar systems and ancillary equipment which had been installed on RRS *James Clark Ross* (JCR) during the preceding few weeks. The purchase and installation of the new sonar systems was funded by an award from the Joint Infrastructure Fund (ref. GR3/JIF/02) to the University of Bristol, which resulted from a consortium bid by scientists from the University of Bristol, BAS, and the University of Oxford. Following a multiple tender exercise the new systems were purchased from the Norwegian company Kongsberg Simrad. These systems are a deep-water multibeam echo sounder (EM120) with 1°x1° acoustic beams, and a parametric sub-bottom profiler (TOPAS). As JCR is regularly required to operate in areas of dense sea ice and in areas where the draught of the vessel is of critical importance, the transducers had to be recessed into the ship in such a way that the covering windows were flush with the hull. The size of the transducer arrays combined with the fact that JCR is an ice-strengthened vessel presented a major engineering challenge.

Both the EM120 and TOPAS systems are designed primarily for operation in oceanic water depths, and therefore to conduct rigorous tests it was necessary to go to an area with water depths greater than 3000 m. The nearest area to the Tyne, where the systems were installed, with such deep water is in the Norwegian Sea (Figs 1 and 2). Furthermore, the working areas for the following cruise were further north in the Norwegian-Greenland Sea, so carrying out the Sea Acceptance Tests between the Tyne and Bodø minimized the time spent on passage. Fortuitously, the area which these considerations dictated we go to is also of considerable geological interest, containing a fossil spreading ridge which was part of the plate boundary between Europe and North America until about 25 million years ago.

In addition to testing the EM120 and TOPAS systems themselves, the Sea Acceptance Tests also involved trials of a range of ancillary systems provided as part of the contract with Kongsberg Simrad. These included the Seapath vessel motion monitoring system, the sonar synchronisation unit, the sound velocity profiling system, and software for post-processing EM120 and TOPAS data. It was also necessary to test the performance of pre-existing echo sounding systems on the vessel, the transducers for which had been removed during the installation of the new systems and subsequently refitted. The degree to which the pre-existing and new sonar systems would interfere with one another, both with an without sequencing, also required evaluation. Finally the cruise provided an opportunity to test both the newly-installed NOAA Scientific Computing System, and a novel approach to real-time monitoring of variations in acoustic velocity of surface water.

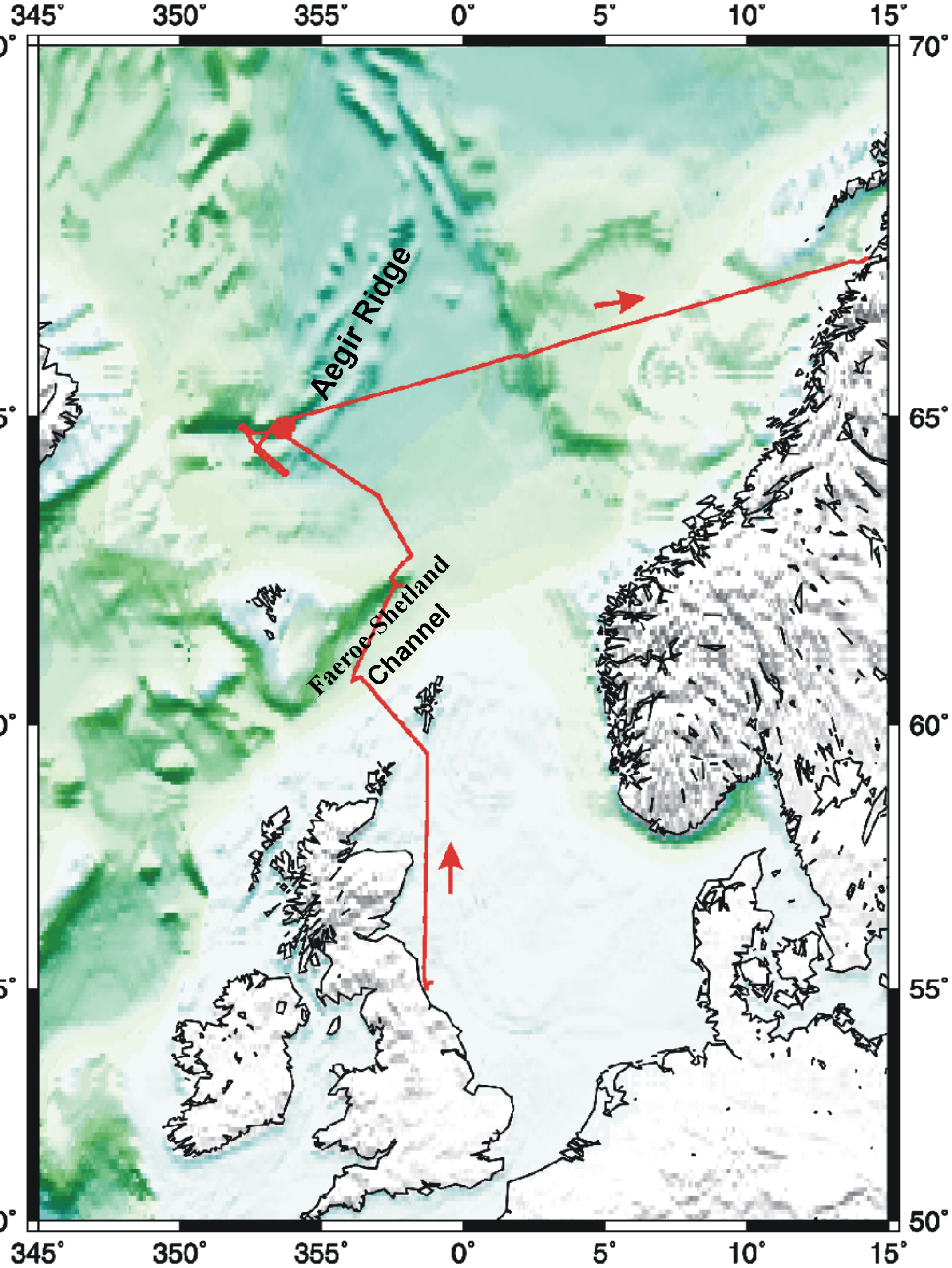



Fig 1. JR50 cruise track overlaid on shaded-relief display of regional bathymetry.

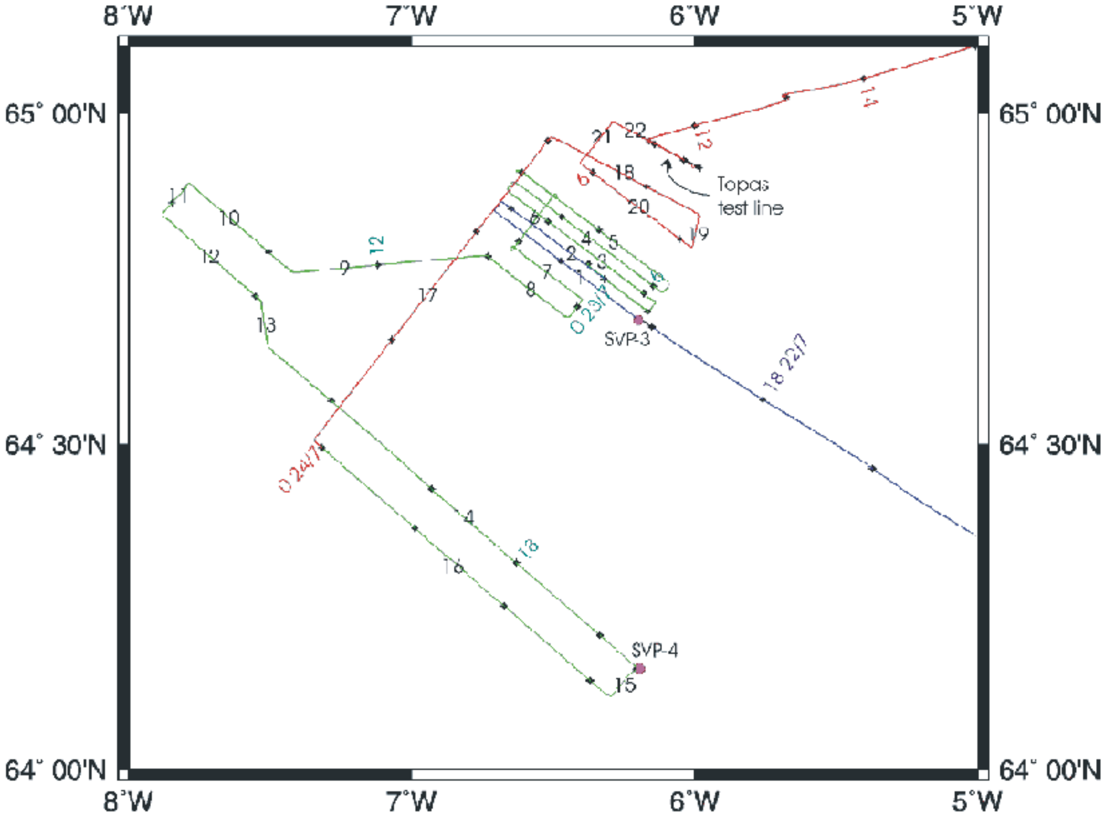



Fig 2. Detailed track chart showing sonar Sea Acceptance Test surveys in the Aegir Ridge area. Annotations in blue and red indicate time and date. Numbers annotated in black on cruise track are survey line numbers as listed in Table 1.

# 6. EQUIPMENT PERFORMANCE

## *6.1 EM120 Multibeam Echo Sounder* (RDL)

### *6.1.1 Introduction*

During JR50 the Kongsberg Simrad EM120 multibeam echo sounder was operated for the first time on RRS *James Clark Ross*. This system is the first EM120 to be delivered with 1°x1° acoustic beam widths, and will provide UK marine scientists with the opportunity to image the deep ocean floor at unprecedented resolution. It is to be hoped that maximum advantage will be taken of this opportunity, particularly during the year or two before other research vessels are equipped with equivalent systems. The EM120 was successfully used to collect high-resolution sea-floor imagery during JR50 (Fig. 3).

### *6.1.2 EM120 Data Acquisition*

The EM120 transmits acoustic pulses at frequencies between 11.25–12.75 kHz from a 7.7 m-long transducer array aligned fore-aft and mounted flush with the hull. Each pulse spreads out to form a fan of acoustic energy which is just 1° wide in the along-track direction. The transmit fan is split into several individual sectors with independent active electronic beam steering to compensate for vessel roll, pitch and yaw. This places all soundings on a "best fit" to a line perpendicular to the survey line, thus ensuring uniform coverage of the sea floor. The acoustic energy returning from the sea floor is detected by a 7.4 m-long transducer array aligned across the vessel and mounted flush with the hull. This array samples the returning energy as 191 acoustic beams each just 1° wide and with a combined angular coverage of up to 150°. The angular coverage sector and beam pointing angles may be fixed by the operator or set to vary automatically with depth according to the achievable coverage (the achievable angular coverage decreases with increasing water depth). The detected acoustic data are passed from a Tranceiver Unit (on the Tween Deck), via an Ethernet connection, to workstation **em120-101** (hostid 80b8f161, in the UIC room). This workstation was connected to the LAN via a separate Ethernet card. Towards the end of JR50, EM120 data were logged directly to an internal hard disk on **em120-101**, and then copied to a separate RAID system, to prevent the local disk from filling to capacity. This configuration was chosen to prevent the interruption of EM120 data logging in the event of the workstation hosting the RAID being rebooted, or any other problem with that machine or the RAID.

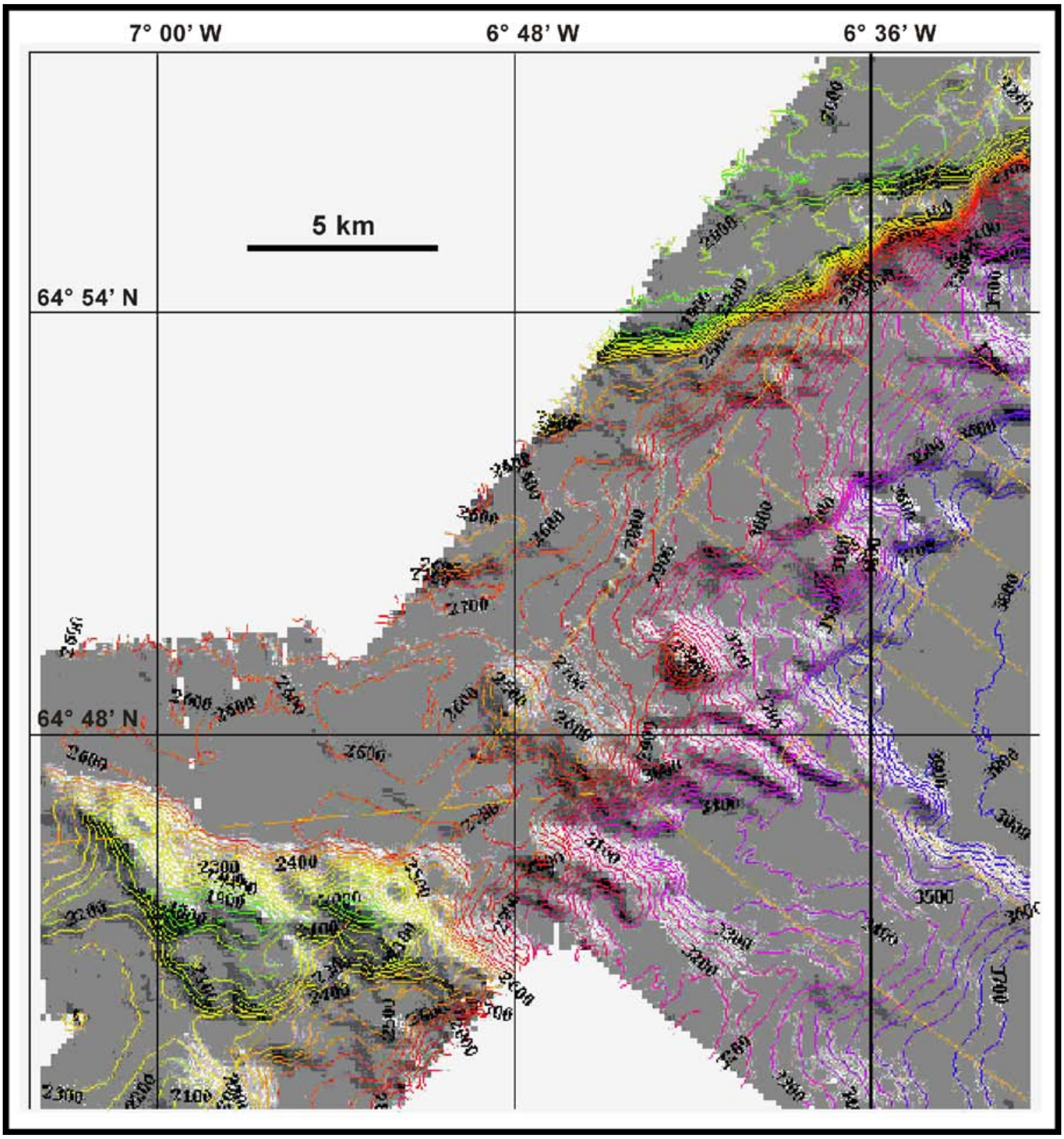



Fig.3. Shaded-relief and contour display of bathymetric data collected with the EM120 system during part of the Sea Acceptance Test survey, post-processed by Kongsberg Simrad personnel using Neptune software.

Plate 2. EM120 and TOPAS operation centre in forward starboard corner of the Underway Instrumentation and Control (UIC) room. This space was previously a dark room.

*6.1.3 EM120 Operation and Performance*

The EM120 system was first operated, for a brief period, on 21st July on a track along the slope on the southeastern flank of the Faeroe-Shetland Channel. A single swath of multibeam echo sounder data was recorded on the approach to Sound Velocity Profiler (SVP) station 1a (Table 2). At this time no calibration of roll, pitch or heading offset had been carried out, and no information about water velocity structure had been entered into the system. As a result the depths recorded along this swath are unreliable. Nevertheless, a shaded-relief display of the data on this swath showed that, even prior to any calibration, the EM120 was able to resolve small channels in water depths of 800–900 m (Fig. 4). These channels had previously been imaged using the TOBI deep-towed sonar and are known to be 50–250 m wide and up to 40 m deep. No further data were collected in this area because there were some initial difficulties in operating the SVP, and it was decided that we would continue on passage while these were resolved.

A successful SVP deployment (SVP station 2) was carried out near the northwestern flank of the Faeroe-Shetland Channel later the same day. After downloading the SVP data to the EM120 operator station (workstation **em120-101**), data were collected along several short tracks for system calibration. Evaluation of data from these tracks and subsequent reversed tracks in the Aegir Ridge area (tracks 2, 2a and 2b in Table 1) resulted in a final estimate of roll offset of 0.30°, and final estimates of pitch and heading offsets of 0.00°. As expected, the calibration tracks indicated no position time delay, since GPS was used for navigation and time stamping of data.

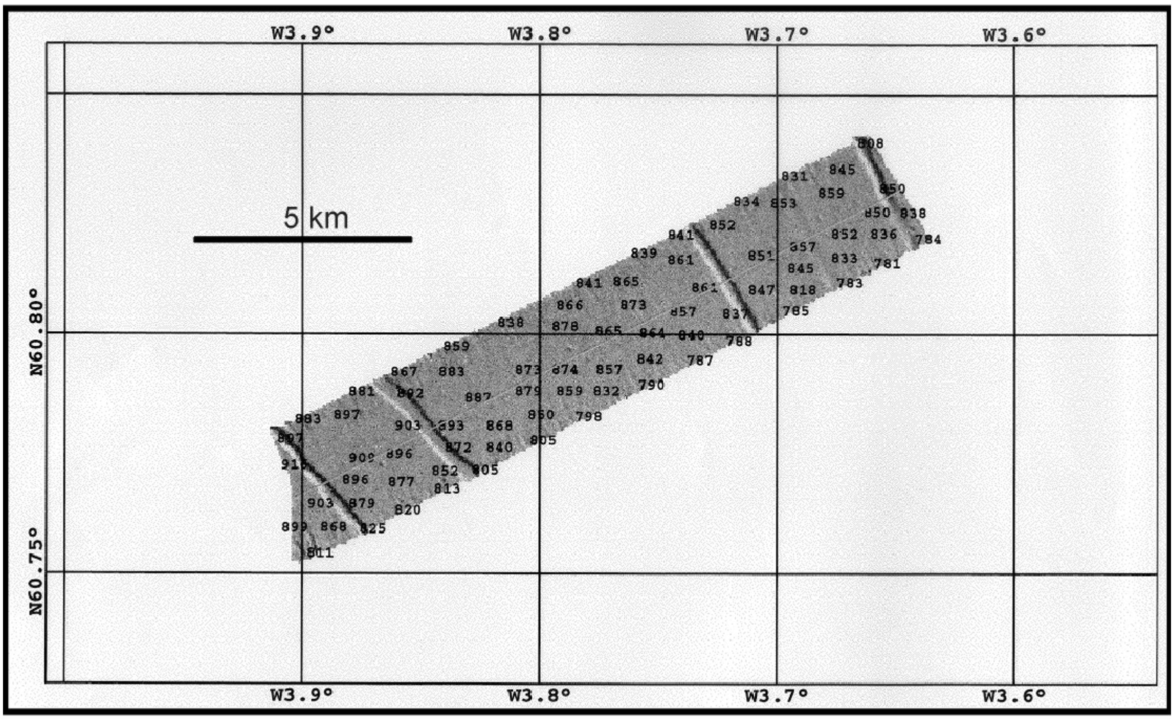



Fig. 4. Shaded-relief display of a single swath of bathymetric data collected with the EM120 system in the Faeroe-Shetland Channel prior to calibration.

Earlier on 21st July, measurements were made of the noise levels recorded by the EM120 at different speeds, both with and without the EA500 and TOPAS systems in operation. Measurements were made at 4, 6, 8, 10 and 12.5 knots. An interesting result of these measurements is that ambient noise levels were lower at 10 knots than at either 8 or 12.5 knots, and only very slightly higher than at 6 knots. This suggests that the optimum speed for collecting high quality multibeam echo sounder data on JCR, while maintaining a fairly rapid rate of progress, is about 10 knots.

The main Sea Acceptance Test survey in the Aegir Ridge area commenced shortly after 2100 on 22nd July (Figs 1 and 2). A SVP deployment (SVP station 3) was carried out immediately before the start of the survey, and the measured water velocity structure was used during the survey to correct for beam refraction effects. The first five survey lines were run at a spacing of 2 km (see Fig. 2 and Table 1), less than one quarter of the achievable swath width over the 3800 m-deep axial trough of the Aegir Ridge. This permitted verification that depths determined from beams near the edge of the swath were consistent with those measured directly beneath the vessel. These first five lines were run at 10 knots. Subsequently it was not possible to increase speed because of dense fog. The fog eventually cleared at 1250 on 23rd July, at the start of line 10, and this and subsequent EM120 survey lines were run at 12 knots.

The only significant problem encountered during the survey was when a reboot of the post-processing workstation (**em120-102**) crashed both the EM120 and TOPAS operator stations at 0010 on 23rd July. This occurred because the operator stations were initially configured to log data directly to the RAID system, which is attached to the post-processing workstation. As a result of this experience a different workstation network arrangement has been implemented for future cruises (see above section and section 6.4.3).

An observation relevant to any possible environmental impact of the EM120 and TOPAS systems is that a pod of six killer whales passed within half a mile of the post side of the vessel between 1410–1415 on 23rd July, near the start of line 12, when both systems were operating. It is interesting to note that they did not choose to avoid such a close approach to the ship.

## ***6.2 Neptune, Poseidon and MB-System Software*** (RDL)

The Kongsberg Simrad **Neptune** software provides facilities for post-processing of bathymetric data collected by multibeam echo sounders. It includes tools for cleaning and filtering of navigation data, analysis and correction of depth data, tidal height adjustment, automated data cleaning based on statistical rules, manual editing, and export of processed sounding data.

The Kongsberg Simrad **Poseidon** software provides facilities for post-processing of acoustic amplitude ("sidescan") data collected by multibeam echo sounders. It includes tools for editing and interpolation of sidescan data, compensation for range-dependent amplitude variations, mosaicing, and export of processed sidescan data.

Both **Neptune** and **Poseidon** were installed on workstation **em120-102** (hostid 80c05482, in the UIC room). As evaluation of the data collected during JR50 constituted a key element of the Sea Acceptance Tests, it was agreed that all processing of multibeam echo sounder data during the cruise would be carried out by Kongsberg Simrad personnel. **Neptune** was used to produce interim bathymetric charts of the Aegir Ridge area while the Sea Acceptance Test survey was still in progress (Figs 5 and 6). This demonstrated that charts showing preliminary processed data can be produced using **Neptune** within half an hour of completing data acquisition. **Poseidon** was not used extensively during JR50, but a number of people from BAS Geological Sciences Divisions and the University of Bristol attended **Neptune** and **Poseidon** training courses shortly before the cruise and are familiar with operation of both software packages.

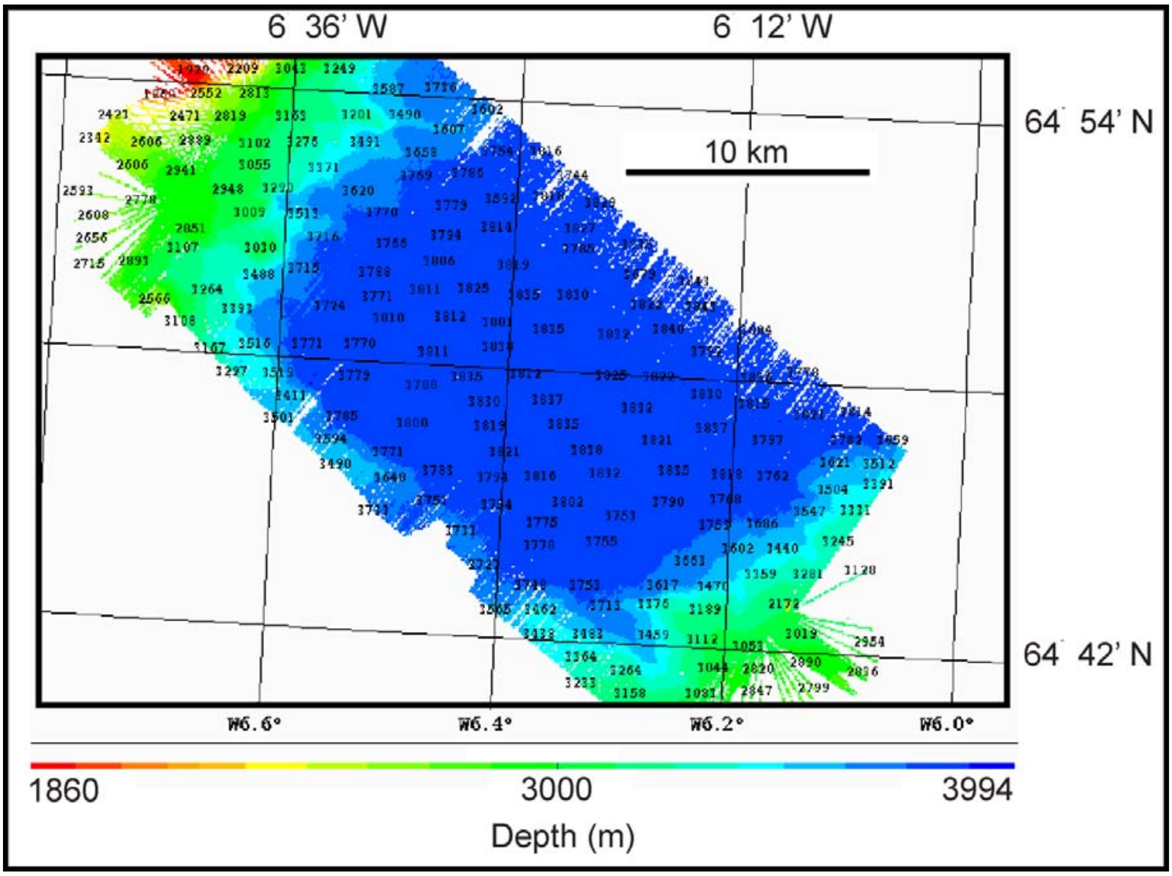



Fig. 5. Bathymetric map of the southwestern tip of the Aegir Ridge axial rift, produced by processing EM120 data from lines 1–5 using Neptune software while the survey was still in progress.

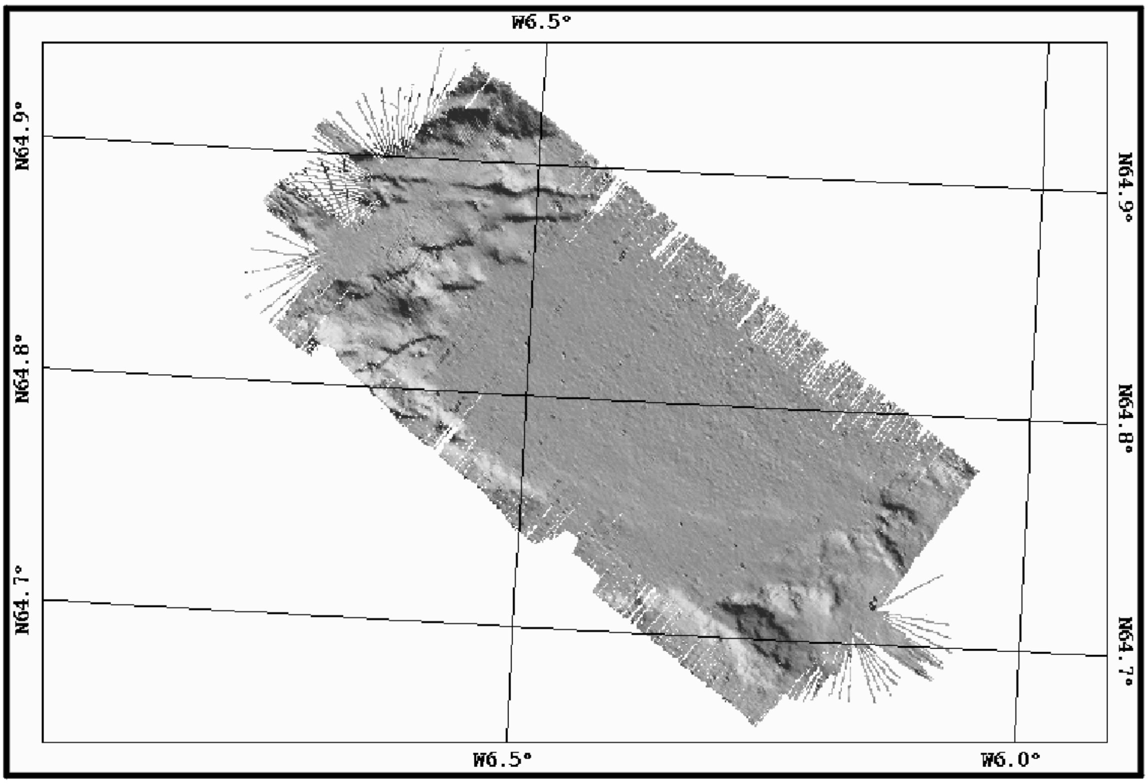



Fig. 6. Shaded-relief display of the Aegir Ridge bathymetric data shown in Figure 5, also produced using Neptune software while the survey was still in progress.

**MB-System** is a public domain software package for processing swath sonar data written by Dr. D.W. Caress (Monterey Bay Aquarium Research Institute) and Dr. D.N. Chayes (Lamont Doherty Earth Observatory of Columbia University). For further information, including instructions on how to obtain source code and install this software see:
http://www.mbari.org/~caress/MB-System_intro.html
During JR50 **MB-System** was installed on workstation **jruf** (hostid 80a1326c) and was used to process Hydrosweep multibeam echo sounder data which had been collected in the Aegir Ridge region on R/V *Maurice Ewing* in 1990. These data were obtained on CD-ROM from the National Geophysical Data Centre, Boulder, Colorado, with the approval of the data collector, Dr. P.R. Vogt (Naval Research Laboratory, Washington, D.C.). During the cruise Roy Livermore sent a sample of EM120 data to Dr. D.W. Caress, and he sent back a software patch to enable MB-System to read these data (mbsys_simrad2.h).

### *6.3 TOPAS Sub-Bottom Profiler and Post-Processing Software* (APC)

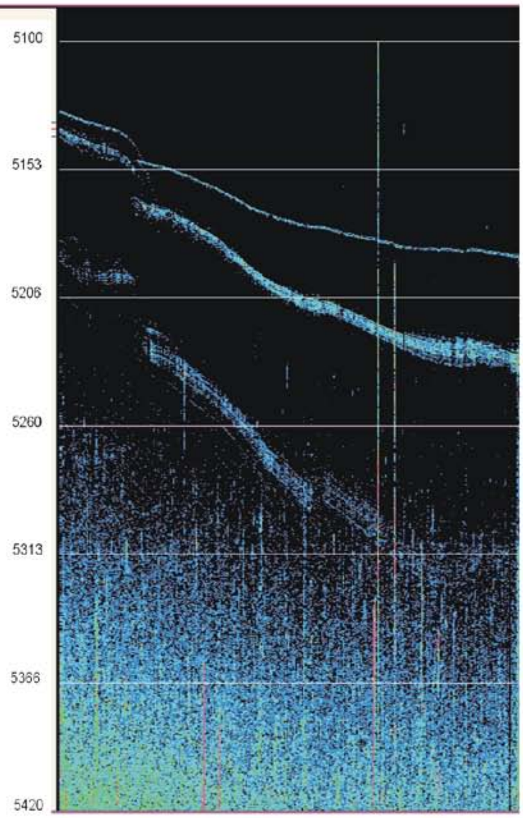
#### *6.3.1 Introduction*

During JR50, the Kongsberg Simrad TOPAS sub-bottom profiler was operated for the first time on RRS *James Clark Ross*. TOPAS was successfully used to collect high-resolution sub-bottom profiles on passage and test tracks (Figs 7 and 8), and during periods of EM120 multibeam survey.

#### *6.3.2 TOPAS Data Acquisition*

The TOPAS system transmits and receives acoustic pulses via an array of 64 hull-mounted transducers, and uses effects of non-linear propagation and interference in the water column to generate a variety of signatures, including Ricker and zero-phase 'burst' wavelets and swept-frequency chirps. Each 'ping' is recorded with attitude data supplied by a vertical reference unit, and navigation data provided by the Seapath system. The attitude data are used to compute and apply phase adjustments to the signals from each of the 64 transducers in order to steer the transmitted and recorded signal. During periods of EM120 survey, the TOPAS transmission was synchronised with that of the multibeam system to prevent interference. However, TOPAS data were also collected using higher ping rates on passage and test tracks. The recorded acoustic data were passed via analogue and real-time processors to workstation **topas** (hostid 80c56df9). The real-time processor is housed in an enclosure fitted above the workstation in the UIC room, and is connected to it via a dedicated ethernet connection. Kongsberg Simrad engineers recommend the use of a dedicated ethernet because of the high data transfer rates achieved during survey. The logging workstation was connected to the LAN via a separate Ethernet card. Towards the end of JR50, TOPAS data were logged directly to an internal hard disk on **topas**, and then copied to a separate RAID system, to prevent the local disk from filling to capacity. This configuration was chosen to prevent the interruption of TOPAS data logging in the event of the workstation hosting the RAID being rebooted, or any other problem with that machine or the RAID.

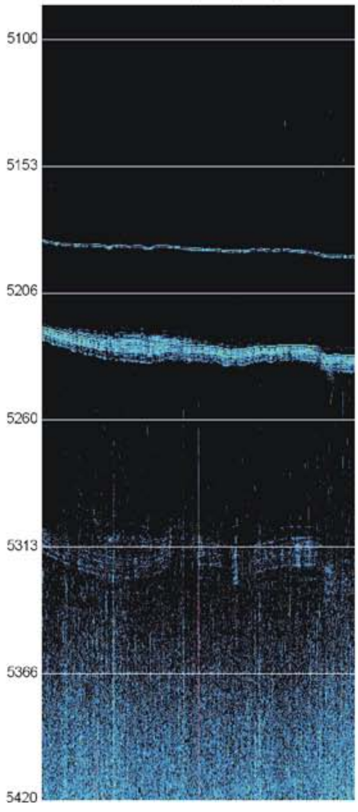
(a) TOPAS test: burst, single ping, 10 kts



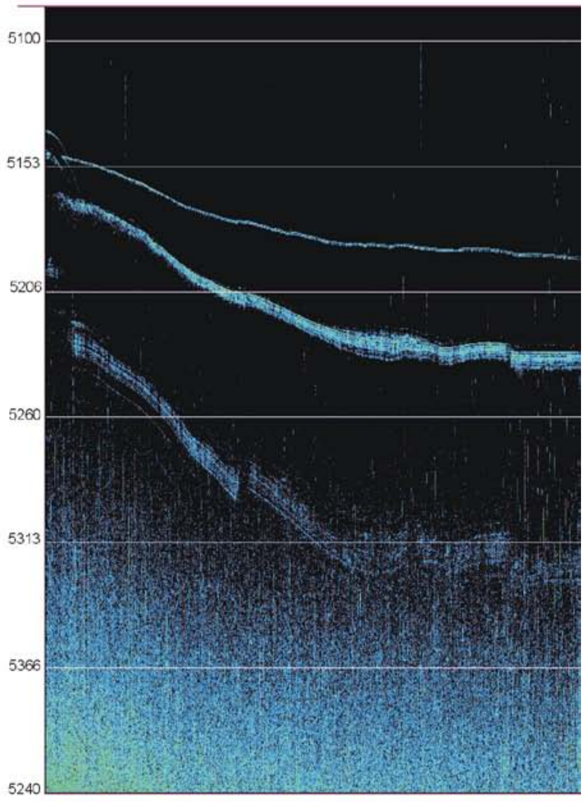

## TOPAS Burst Pulse

Fig. 7. TOPAS sub-bottom profiles collected using 'burst' transmission pulse during repeated runs along line 22:
(a) single ping mode at 10 kts,
(b) multiple ping mode at 6 kts,
(c) multiple ping mode at 10 kts.

(b)
TOPAS test: burst, multiple ping, 6 kts



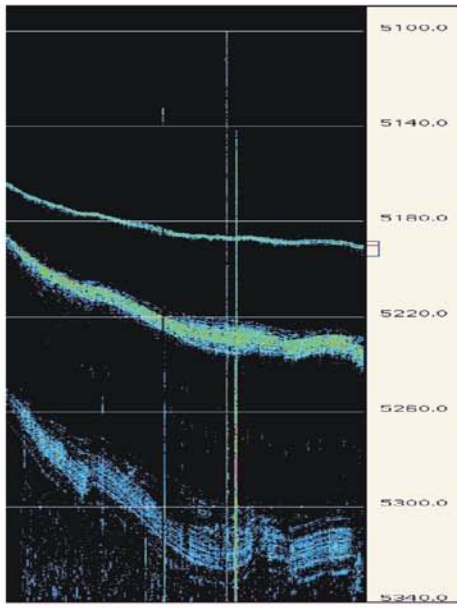

(c)
TOPAS test: burst, multiple ping, 10 kts



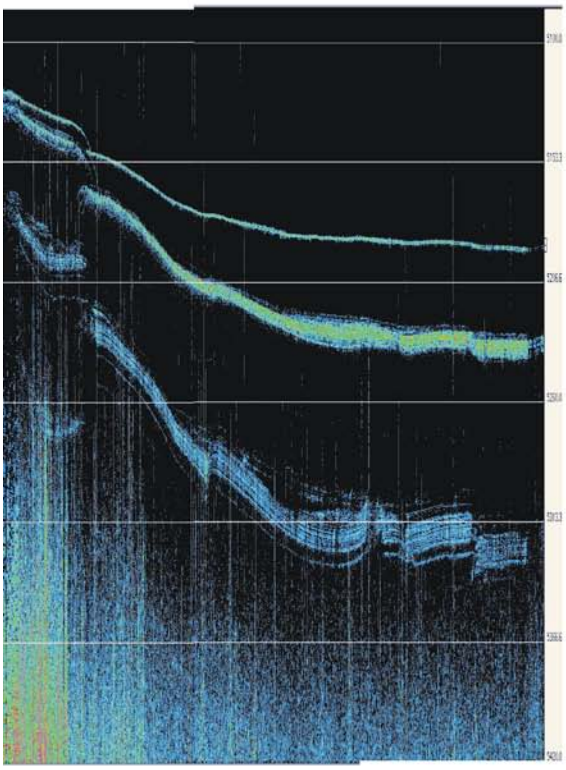
# TOPAS Chirp Pulse

Fig. 8. TOPAS sub-bottom profiles collected using 'chirp' transmission pulse during repeated runs along line 22:
(a) single ping mode at 10 kts,
(b) multiple ping mode at 6 kts,
(c) multiple ping mode at 10 kts.

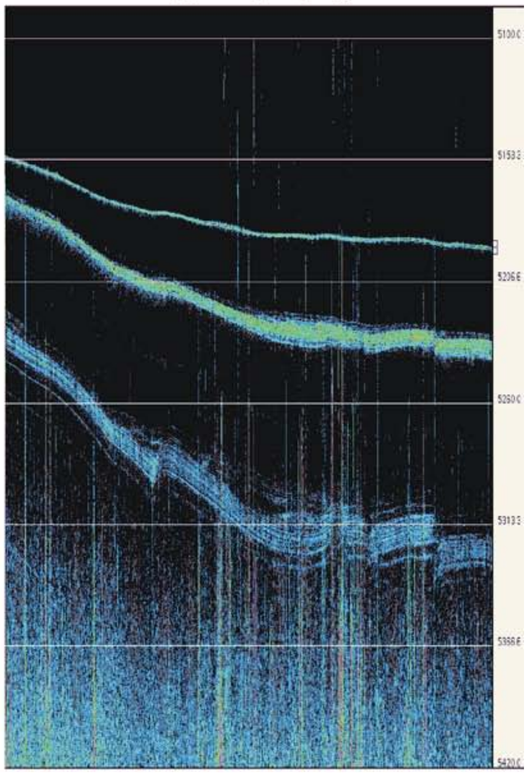
(a) TOPAS test: chirp, single ping, 10 kts




(b)
TOPAS test: chirp, multiple ping, 6 kts



(c)
TOPAS test: chirp, multiple ping, 10 kts



### *6.3.3 TOPAS Post-Processing Software.*

TOPAS software (version 2.1, release date 15/6/00) was also mounted on workstation **jruf** (hostid 80a1326c) to enable post processing of the recorded data. Kongsberg Simrad engineers reported 'no significant' problems with the installation of the software, or incompatibilities with the LAN. The TOPAS package and accompanying AVS graphics software were licensed using 'Flexlm' software, which requires installation of a separate license key. The license key consists of an ASCII file containing encrypted information which includes the hostid and nodename of the parent workstation. During installation, environment variables describing paths for the TOPAS and licensing software, and data logging directories, were set in the TOPAS user .cshrc file.

TOPAS software includes algorithms for gain recovery, automatic gain control, bandpass filtering, deconvolution and the generation of complex trace attributes. These procedures were used during JR50 to generate a real-time display of processed data. The software also provides a facility to replay, process and display recorded data. However, version 2.1 does not provide any means to output processed data to a digital data file. Hence, data processed during JR50 could only be displayed on the workstation console or the real-time plotter attached to the acquisition system. It is recommended that future software versions have the capability to export processed data to output files. The TOPAS package also includes a program 'TOPAS2Segy' to convert TOPAS data files to SEG–Y format, although the format of the output files remains untested by us.

### *6.3.4 TOPAS Operation and Performance*

During operation, it was necessary to periodically adjust the recording gain and delay with variations in water depth. Recording gains were typically set between 6 and 24 dB, and delays were set so that the recording window tracked the sea floor. Kongsberg Simrad engineers suggested that, in future, it would be possible to trigger recording using a two-way-time based on the centre beam depth provided by the EM120. This could greatly reduce the need for user intervention during future passage legs. During JR50, the length of the recording window varied in time according to the sampling rate, but the number of recorded samples was fixed at 8000 per trace. The system provides a real-time display of the recorded data using the 'raw trace' display option. Kongsberg Simrad engineers suggested that the logged data would clip if the amplitude of the recorded trace exceeded that of the display window, and it is important to check this regularly during operation. Processed traces were also displayed on the workstation console, and plotted on Waverley and EPC plotters attached to the system. The recorded acoustic, attitude and navigation data were written to disk using a system-specific disk format.

During JR50, no significant sources of instrumental or mechanical noise were identified in the TOPAS data. However, cultural noise associated with the maintenance of the ship was recorded on test profiles (collected to assess the effectiveness of different transmitted pulses). The recorded signal also deteriorated badly during turns due to aeration under the hull. Similar effects have been observed in data obtained with the 3.5 kHz system previously installed on the ship.

### *6.4 Networking of Sonar Workstations* (BJL)

There are three Sun Ultra5 workstations associated with the EM120 and TOPAS systems: **em120-101** for EM120 operation and logging; **topas** for TOPAS operation and logging; and **em120-102** for post processing. All three workstations are on the ship's193.61.88 network and have their system clocks synchronised to the clock on the NOAA Scientific Computer System (which in turn is synchronised to GPS time from the Trimble 4000DS receiver). See appendix 1 for details relating to these workstations.

#### *6.4.1 EM120 Logging Software*

This software writes to three directories on the logging system: **raw**, **proc**, and **shared**. The contents of these directories need to be made available to the Neptune and Poseidon packages (these packages also use a fourth directory: **xyz**). It is therefore necessary to copy files across to the **em120-102** RAID system.

If available disk space on the logging system drops below 50MB then logging will automatically stop. Space can be recovered by deleting older files from the **raw** and **proc** directories.

The **shared** directory contains velocity profiles and can be selectively cleared out at the end of a cruise but the **1500.asvp** file **must** be retained at all times.

New EM120 **raw** files are started at a set interval. This interval is configurable and 30 minutes is recommended.

The logging software is run from the **em120** user ID.

### *6.4.2 TOPAS Logging Software*

Like the EM120 system the TOPAS data files, stored in **/data**, need to be copied to the **em120-102** RAID system and older files deleted to make room for logging. There is no need to retain files between logging sessions.

The logging software is run from the **topas** user ID.

### *6.4.3 Data Logging and Backup Arrangements*

It was initially thought that it might be possible to log both the EM120 and TOPAS data directly to the RAID system. However, after an incident when a reboot of **em120-102** crashed both logging workstations simultaneously, it was felt safer to log the data to the local disks on the **em120-101** and **topas** machines and copy the files to the RAID system later. For the next cruise a system has been implemented using a program 'rsync' which automatically copies new data from the local disks to the RAID every minute.

Provided that a copy of the **raw**, **proc**, and **shared** directories (for EM120) and **/data** (for TOPAS) are kept on the RAID, it is not necessary to backup the local **em120-101** and **topas** disks regularly. However, it is wise to do this from time to time to aid recovery from system disk failure. Since data is copied to the **em120-102** RAID system, this will need routine daily backups.

### *6.5 Sound Velocity Profiling System* (MOP)

#### *6.5.1 Instrumentation*

Sound velocity profiles are required for calibration of the Kongsberg Simrad EM120. The instrument supplied by Kongsberg Simrad for this purpose is the Applied Microsystems Svplus Sound Velocity Profiler (SVP). This is a multi-parameter, self-contained, intelligent instrument, which measures sound velocity, temperature and pressure. The system has an on board power supply, which can either be dry cell or rechargeable Nicad 'D' cells. Data communications and power on / off are achieved through two water proof connectors mounted on the end of the case. The sensors are mounted at the opposite end to the connectors. Programming is achieved using a PC. BAS Information Technology Section provided a rugged laptop for this purpose.

The system is supplied with a choice of software for programming the instrument and all necessary plugs and cables. The instrument is housed in an aluminium alloy pressure case, with an integral sensor cage. The housing is hard-anodised for durability and corrosion resistance. In addition to this a stainless steel crash frame was also supplied to provide added protection during deployments.

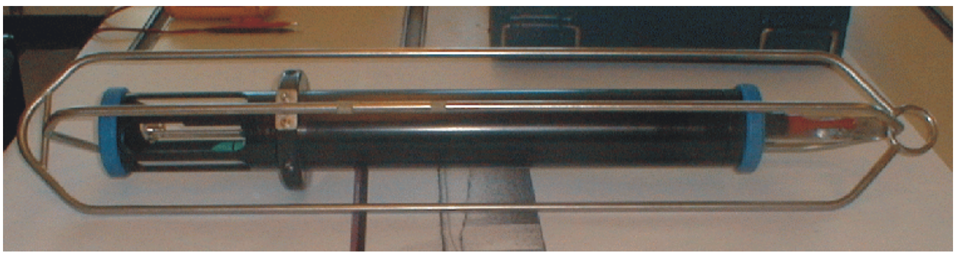


Plate 3. The SVplus sound velocity probe.

A second instrument was purchased as a back up, as the profiles are an essential part of the EM120 operation. This was supplied direct to BAS from the Applied Microsystems UK agent, Ocean Scientific. The second unit is identical to the one supplied by Kongsberg Simrad, with the exception that one has rechargeable batteries, the other Alkaline 'D' cells.

*6.5.2 SVP Operation*

For the purposes of the trials cruise it was decided that the traction winch and the CTD wire would be used to deploy the system. Although not ideal the arrangement was effective.

Plate 4. Deployment of the sound velocity probe using the CTD wire and midships gantry. This was a temporary arrangement, as a dedicated winch is being installed for deployment of the probe on future cruises.

The two software packages provided with the instrument are called Total System Software V1.67 and Procomm. According to the manual the software requires a Windows 95 or DOS operating system. The rugged laptop provided was running on NT. For the purposes of the trials NT was removed and DOS 6.22 was installed. After installing the Total System Software the instrument was programmed for a trial deployment. It was decided that the first deployment should be 1000 metres. The instrument was interrogated after the deployment and although there appeared to be a large file no data could be seen. A second shallow drop was completed with similar results. After considerable investigation it was discovered that with the sample rate set to 10Hz, the SVP would turn itself off and start a new file if the instrument was dipped and then raised from the water by sea swell. This has the affect of nesting the data within the main file. The system allows this to be done up to 10 times. By setting the sample rate to 1Hz it is possible to make it unlikely that the SVP will start a sub-file as the instrument would have to be lifted out of the water for more than 10 seconds.

Further deployments were successfully completed (Table 2) and data was transferred via the serial port on the laptop to the **em120-101** workstation. Mark Preston and Alex Cunningham have written a list of instructions for carrying out this procedure.

#### *6.5.3 Conclusions*

The SVP is a very robust and appears to be a reliable instrument. The software and documentation, however, is rather vague in some areas. Kongsberg Simrad have recently developed a routine for programming the SVP and downloading the data directly to the EM120 operating station (i.e. **em120-101** workstation on JCR). This procedure appears to be quite straightforward but as yet is undocumented, although training has been provided. Kongsberg Simrad have been tasked to provide adequate documentation.

#### *6.5.4 Future Improvements*

In future the SVP will be deployed from a dedicated hydraulic winch which will be situated on the port side, forecastle deck and will replace the 3.5 kHz towfish deployment winch. This installation will be completed when the vessel returns to Grimsby after the JR51 Arctic cruise. Data transfer will be via a dedicated serial cable through the computer room port bulkhead to the **em120-101** workstation. It is envisaged that the SVP will be permanently connected to the winch cable. Communications will be achieved through a waterproof plug and socket arrangement on the port bulkhead with a suitable cable to the SVP.

### ***6.6 Seapath Vessel Motion Monitoring System*** (PM)

This is the GPS based instrument which provides position, and directional data for the swath system. It uses two antennae 2.5 m apart on a horizontal beam. This is mounted near the top of the main mast; a site with excellent sky visibility in all directions. The instrument is also linked to the MRU (motion reference unit) installed in the Gravity Meter Room, which measures heave, roll and pitch.

In general the instrument has worked well but there have been a few periods when poor satellite availability have meant that although it has been able to provide a reasonable ships position the relative accuracy of the positions from the two receivers has been insufficient to provide a reliable direction measurement. This is a potentially serious situation as the swath system needs this direction for correct operation. The ships Ashtech 3D GPS system which works in a similar way drops out quite frequently on Antarctic cruises, often for significant periods of time. The ships gyro has now been linked into the system and this should start providing an emergency direction reading within 2 seconds of any GPS dropout. No further problems have been noted but a close eye should be kept on the unit during the next season.

### *6.7 Kongsberg Simrad Sonar Synchronisation Unit* (DMB)

The operating frequencies of the EM120 multibeam and TOPAS are adjacent to the centre frequencies of the existing echo sounder, affording potential for interference and cross modulation. As part of the multibeam and TOPAS package, a Sonar Synchronisation Unit (SSU) was specified to sequence gate systems with similar transmit frequencies and avoid interference.

The Kongsberg Simrad SSU was not fully effective during trials and further work will be necessary between BAS and KS. For the equipment combinations with similar frequencies:

- The EA500 navigation echo sounder is significantly impacted by the EM120 multibeam. The bottom depth measurement is not reliable and the echogram display is impacted by noise and spurious traces. It was agreed that for navigation purposes, the EM120 helmsman display would be used for depth measurement when the multibeam is operating. The multibeam will not normally be used in depths of less than 200 metres unless specifically agreed with the ship's Master. The EA500 works normally when the multibeam is not transmitting.

- The TOPAS has a limited impact on the operation of the EK500. Although bottom depths can be measured on the EK500, the TOPAS transmission does cause interference on the echogram. The EK500 works normally when the TOPAS is not transmitting. As it is very unlikely that the TOPAS and EK500 will be used concurrently, the interfence generated by the TOPAS is not considered to be a significant issue of concern.

- The EK500 is not significantly impacted by the EM120 and can operate concurrently with the multibeam.

- The 10 KHz PES is affected by the EM120 multibeam with significant noise on the echogram, although bottom depth measurements are still possible.

### *6.8 Pre-Existing Echo Sounders* (DMB)

#### *6.8.1 Introduction*

The RRS *James Clark Ross* was fitted with echo sounders at build, to support a range of applications:

- Kongsberg Simrad EA500 for navigation
- Kongsberg Simrad EK500 for fish studies
- Acoustic Doppler Current Profiler (ADCP)
- IOS 10 kHz Precision Echo Sounder (PES) for general purpose scientific applications
- IOS 3.5 kHz sub-bottom profiler (SBP) for sediment studies

During the installation of the EM120 multibeam and TOPAS SBP, the transducers for the existing echo sounders were removed to avoid damage. Before departure for trials the transducers were re–installed in the ship's hull, with the exception of the IOS 3.5 kHz SBP, and electrical connections re-made.

### *6.8.2 Operation of Existing Echo Sounders*

During sea trials, the existing echo sounders were powered and checked to determine whether they operated effectively. All systems acquired and displayed data although the full effectiveness of the ADCP will require further interpretation.

The opportunity was taken to initiate the permanent installation of the EK500 to improve system reliability and reduce the chance of equipment damage. A console to house the system will be installed upon arrival of the ship at Grimsby.

The long term future of the 10 KHz PES needs to be determined once the EM120 multibeam is in routine operation.

## ***6.9 Sound Velocity Monitor*** (ATB)

A system has been developed which constantly monitors the speed of sound in the water beneath the hull. This system was developed to enable operators of the EM120 multibeam system to make informed decisions about when changes in surface water conditions are great enough to merit measurement of a new sound velocity profile. The system relies on sea-surface temperature, temperature at thermosalinograph intake and conductivity from the OceanLogger pc. This information is logged on the SCS system and then sent via TCP/IP sockets to the remote display PC in the UIC room.

Using the thermosalinograph temperature and conductivity we can calculate salinity. Then using salinity and sea-surface temperature it is possible to calculate sound velocity.

The sound velocity system works out a 5 minute average and writes this to a plain text file.

Java Source Code containing salinity and velocity calculations is included in appendix 2.

### *6.10 XBT System* (MOP)

The XBT system has been updated and improved recently; the deck unit replaced by a dedicated card in a PC and the DOS software replaced with a windows 3.11 package. It should be noted that the software is not Y2K compliant, however this did not seem to affect operation. The system worked well and three successful XBT profiles were recorded (Table 3).

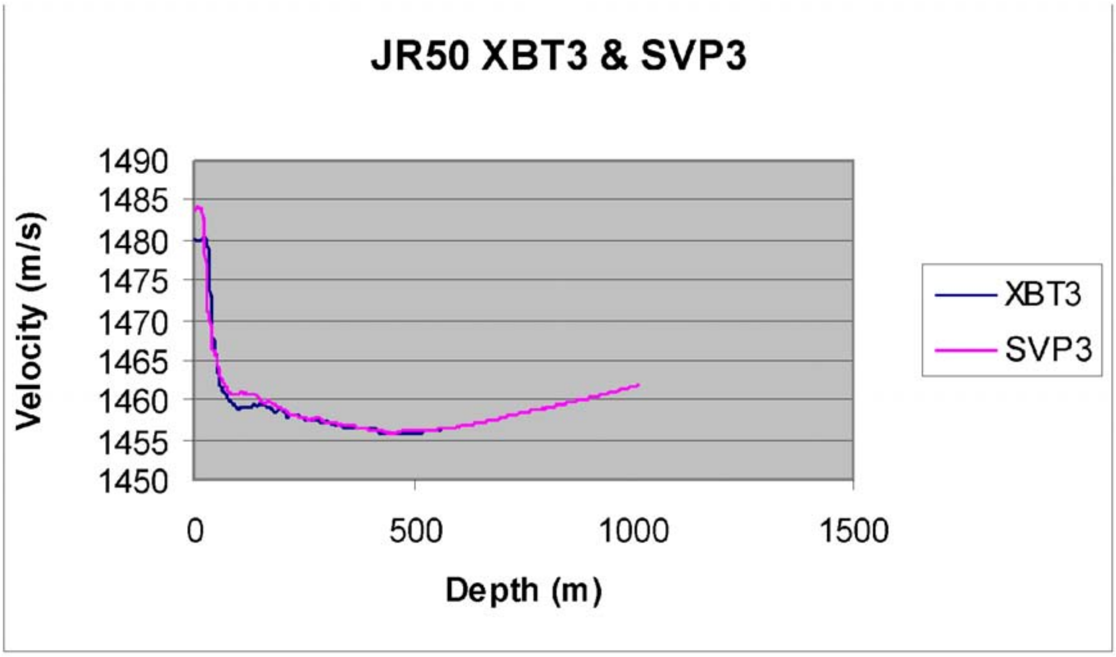



Fig. 9. Comparison of sound velocity profile from SVP station 3 with that derived from XBT station 3 assuming constant salinity. Surface water salinity measured by the thermosalinograph was used in the calculation of sound velocity from the XBT data. The two stations are 20 km apart (see Tables 2 and 3), but the velocity estimates differ by less than 4 m/s throughout the common depth range.

A good correlation between post-processed sound velocity from the XBT and the sound velocity measurements made with the SVplus was found (Fig. 9), leading to the possibility that XBTs might be used for the multibeam sound velocity calibration on occasions when it is not feasible to stop to use the SVP.

It should also be noted that past experience has shown that the XBT card in the PC is very sensitive to its physical installation in the PC. When it fails to function this can usually be traced to the card not being exactly in line with the motherboard connector in the PC.

### *6.11 Shipboard Three-Component Magnetometers* (PM)

Only the newer of the two STCM's on the ship was working at the start of the voyage; the older one having been declared electrically unsafe. This problem was soon corrected by adding a suitable earth lead. After updating the software the old STCM then logged to the NOAA system without problems. The new STCM, however, produced a Level A output which the NOAA system could not handle. As a suitable compiler was not available with which to modify the software, the data from this instrument had to be logged separately, using a specially written Java program.

No calibration turns were carried out during the cruise but it was found possible to use data from two periods when the ship was turning frequently to calculate two rough sets of calibration constants. One of these appeared to give much better compensation than the other and was used to correct all of the data..

As on recent cruises the old STCM is still giving far better quality data than the new one, which should be remounted elsewhere. The top of the foremast could be an excellent site if it was possible to run a suitable cable to that position.

## *6.12 Navigation Systems* (LEV)

The navigational systems on board comprised:

### *6.12.1 Trimble 4000DS GPS Receiver*

This was the principal scientific navigation unit and operated in differential location mode. The differential corrections were derived from a Racal Skyfix unit via an Inmarsat feed and applied in real time by the GPS receiver. The position fixes calculated by the GPS unit were logged to the NOAA Scientific Computing System (SCS).

### *6.12.2 Ashtech GG24 GPS/GLONASS Receiver*

This was operated throughout the cruise and is known to produce fixes which are more accurate than those of the standalone (i.e. non-differential) GPS receivers. It was not connected to the NOAA SCS.

### *6.12.3 Ashtech G12 GPS System*

This dual redundant GPS setup is available for dynamic positioning of the ship. This facility was not used on JR50.

### *6.12.4 Leica MX 400 GPS Receiver*

This was the primary navigation system used by the bridge. The data from this differential GPS were logged onto a navigation PC on the bridge but not by the NOAA SCS.

### *6.12.5 Ashtech 3D GPS and TSSHRP Systems*

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

#### *6.12.6 Seapath System*

This combined differential GPS and motion reference unit provides the navigational data for the Kongsberg Simrad EM120 multibeam and TOPAS sub-bottom profiler systems (see also section 10). The data were logged by the Kongsberg Simrad systems but not by the NOAA SCS. An input from the Racal Skyfix unit was added on the afternoon of 21st July (day 203), so after this the system operated in differential location mode.

#### *6.12.7 Track Planning*

A 106 km-long track between a pair of waypoints during the trials revealed a difference between the methods being used for determining the intended track by the EM120 software and the SysOps system on the Bridge. The position of the track midway between the two waypoints calculated by the two systems showed a discrepancy of more than 100 m. We suspect that this difference resulted from the SysOps being set up to use Mercator projection for track planning (i.e. tracks are rhumb lines) and the EM120 operating on a UTM projection. It is recommended that the EM120 track planning software should be configured to operate on the same projection as the SysOps at the start of future cruises.

### ***6.13 NOAA Shipboard Computing System (Data Logging System)*** (ATB)

The ABC data logging system on the RRS *James Clark Ross* has been replaced this summer with a Windows NT based logging 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 Compaq server featuring RAID disk tolerance. The SCS package has worked well throughout the JR50 trials. One of the advantages of the SCS system is the ability to use workstations around the ship as remote displays for the real time data. Currently we have two remote displays, these are located in the UIC room and the

Main Lab. Another advantage of the SCS software is the ability to distribute data over the network using industry standards such as TCP/IP sockets.

The 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 using NFS. A process on the Level C reads the data in and writes to the Level C database. The Level C is being used primarily to allow scientists to use existing routines to extract the data.

The SCS system cannot log some old Level A applications. These are the winch, gyro and new_stcm. The solution for this has been to develop some Java applications onboard which can interface to the Level A's and log the data directly to the Compaq server. The ADCP currently logs directly to the Level C.

A data monitor program for the winch, gyro and new_stcm has been developed which allows real time monitoring of data being logged by the Java applications. The DataMon program has three status levels, green means that the instrument has sent data in the last 30 seconds, yellow denotes no data received for 30 seconds and red denotes that no data has been received for the last minute.

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. With this NTP system in place we can ensure that the time stamping of data between the SCS system and the new sonar systems is consistent.

## 7. RECOMMENDATIONS

The following is a list specific recommendations arising from section 6 of this report:

1. When minimising the ambient noise recorded by the EM120 is more important than maximising rate of progress, the optimum ship speed appears to be about 10 knots.

2. Kongsberg Simrad must be reminded that they have promised to provide an upgrade to the TOPAS post-processing software which includes the capability to export processed data to digital files.

3. Kongsberg Simrad should be encouraged implement a real-time link between the TOPAS and the EM120 so that the former can use the centre beam depth from the latter to make its recording window track the sea floor.

4. During cruises when the EM120 and TOPAS are operated, either separately or together, daily backups must be made from the RAID system hosted by the post-processing workstation.

5. To minimise the likelihood of the Sound Velocity Profiler concealing data in sub-files a sample rate of 1 Hz is recommended.

6. Kongsberg Simrad must be reminded that they have promised to provide documentation for the procedure for downloading Sound Velocity Profiler data directly to the EM120 operating station.

7. There were some intervals when the GPS input to the Seapath system did not provide reliable heading information. The Seapath performance should be monitored closely on forthcoming cruises.

8. Kongsberg Simrad must be reminded that further work is required to improve the performance of the Sonar Synchronisation Unit.

9. When the EM120 is operating the EA500 single-beam echo sounder should be switched off and depth measurements provided by the EM120 helmsman display should be used for navigational purposes. The EM120 should not normally be used in water depths of less than 200 m unless specifically agreed with the ship's Master.

10. The long term future of the 10 kHz Precision Echo Sounder should be reassessed once the EM120 multibeam is in routine operation. There may still be a role for it in monitoring and communicating with acoustic pingers and beacons, many of which operate at 10 kHz.

11. The sensors for the new STCM should be remounted elsewhere. The top of the foremast could be an excellent site if it was possible to run a suitable cable to that position.

12. At the start of cruises on which the EM120 is to be used it is important to check that the survey planning tools in the EM120 operating software are configured to operate on the same projection as the SysOps system.

**Table 1. Survey Lines - Aegir Ridge Region**

| Line | Year | Month | Day | Start | | | | End | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Hour | Min | Lat | Lon | Hour | Min | Lat | Lon |
| 1 | 2000 | 7 | 22 | 21 | 7 | 64.69008 | -6.19999 | 22 | 45 | 64.85260 | -6.70431 |
| 2 | 2000 | 7 | 22 | 22 | 54 | 64.86590 | -6.67531 | 0 | 10 | 64.73333 | -6.26431 |
| 2a | 2000 | 7 | 23 | 1 | 25 | 64.71078 | -6.19434 | 1 | 57 | 64.76743 | -6.36900 |
| 2b | 2000 | 7 | 23 | 2 | 5 | 64.76847 | -6.37209 | 2 | 45 | 64.70323 | -6.15800 |
| 3 | 2000 | 7 | 23 | 2 | 55 | 64.72098 | -6.15665 | 4 | 24 | 64.88159 | -6.65584 |
| 4 | 2000 | 7 | 23 | 4 | 33 | 64.89301 | -6.62452 | 6 | 0 | 64.74011 | -6.14613 |
| 5 | 2000 | 7 | 23 | 6 | 15 | 64.74784 | -6.09969 | 7 | 52 | 64.91360 | -6.61780 |
| 5a | 2000 | 7 | 23 | 8 | 5 | 64.90365 | -6.58584 | 8 | 22 | 64.87241 | -6.49030 |
| 6 | 2000 | 7 | 23 | 8 | 29 | 64.87632 | -6.49903 | 9 | 5 | 64.79577 | -6.64080 |
| 7 | 2000 | 7 | 23 | 9 | 13 | 64.79732 | -6.63273 | 9 | 55 | 64.72000 | -6.39800 |
| 8 | 2000 | 7 | 23 | 10 | 8 | 64.69354 | -6.45236 | 11 | 0 | 64.78525 | -6.73005 |
| 9 | 2000 | 7 | 23 | 11 | 0 | 64.78525 | -6.73005 | 12 | 45 | 64.76062 | -7.41819 |
| 10 | 2000 | 7 | 23 | 12 | 45 | 64.76062 | -7.41819 | 13 | 48 | 64.89401 | -7.79075 |
| 11 | 2000 | 7 | 23 | 13 | 48 | 64.89401 | -7.79075 | 14 | 7 | 64.84851 | -7.87878 |
| 12 | 2000 | 7 | 23 | 14 | 7 | 64.84851 | -7.87878 | 15 | 3 | 64.71814 | -7.53270 |
| 13 | 2000 | 7 | 23 | 15 | 3 | 64.71814 | -7.53270 | 15 | 23 | 64.64932 | -7.50809 |
| 14 | 2000 | 7 | 23 | 15 | 23 | 64.64932 | -7.50809 | 19 | 25 | 64.16033 | -6.21084 |
| 15 | 2000 | 7 | 23 | 20 | 25 | 64.15495 | -6.20645 | 20 | 45 | 64.11478 | -6.29289 |
| 16 | 2000 | 7 | 23 | 20 | 45 | 64.11478 | -6.29289 | 0 | 4 | 64.50364 | -7.34059 |
| 17 | 2000 | 7 | 24 | 0 | 4 | 64.50364 | -7.34059 | 3 | 2 | 64.96320 | -6.51033 |
| 18 | 2000 | 7 | 24 | 3 | 2 | 64.96320 | -6.51033 | 4 | 32 | 64.84752 | -5.98651 |
| 19 | 2000 | 7 | 24 | 4 | 32 | 64.84752 | -5.98651 | 4 | 51 | 64.79892 | -6.01100 |
| 20 | 2000 | 7 | 24 | 4 | 51 | 64.79892 | -6.01100 | 6 | 8 | 64.92456 | -6.40111 |
| 21 | 2000 | 7 | 24 | 6 | 10 | 64.92883 | -6.39924 | 6 | 37 | 64.98493 | -6.29217 |
| 22 | 2000 | 7 | 24 | 6 | 37 | 64.98493 | -6.29217 | 7 | 1 | 64.95709 | -6.15565 |
| 22a | 2000 | 7 | 24 | 7 | 2 | 64.95586 | -6.15000 | 7 | 28 | 64.92281 | -6.00359 |
| 22b | 2000 | 7 | 24 | 7 | 37 | 64.92616 | -6.02109 | 8 | 8 | 64.96356 | -6.18480 |
| 22c | 2000 | 7 | 24 | 8 | 15 | 64.96599 | -6.19555 | 8 | 54 | 64.91973 | -5.99020 |
| 22d | 2000 | 7 | 24 | 9 | 1 | 64.91893 | -5.98828 | 9 | 41 | 64.96722 | -6.20005 |
| 22e | 2000 | 7 | 24 | 9 | 51 | 64.96437 | -6.18883 | 10 | 39 | 64.91908 | -5.98961 |
| 22f | 2000 | 7 | 24 | 10 | 48 | 64.91935 | -5.99143 | 11 | 10 | 64.93847 | -6.07238 |
| 22g | 2000 | 7 | 24 | 11 | 12 | 64.94006 | -6.07961 | 11 | 26 | 64.95152 | -6.12948 |

22a -22g are Topas trial lines only

SVP STATIONS

| Station Number | Julian Day | Date | Latitude | Longitude | Filenames | Data Direction Used | Comment |
|---|---|---|---|---|---|---|---|
| JR50-SVP 1a | 203 | 21-07-00 | 60° | 03° | No files | Not used | Unable to read data from SVP Probe |
| JR50-SVP 1b | 203 | 36727 | 60° | 03° | No files | Not used | Unable to read data from SVP Probe |
| JR50-SVP 1c | 203 | 36727 | 60° | 03° | No files | Not used | Unable to read data from SVP Probe. Solutions at hand for next SVP site. Abandon area with no further SVP testing due to time. |
| JR50-SVP 2 | 203 | 21-07-00 | 62° | 02° | JR530.rw JR530_u.rel | Upgoing | |
| JR50-SVP 3 | 204 | 22-07-00 | 64° | 06° | JR531.rw JR531_u.rel | Upgoing | |
| JR50-SVP 4 | 205 | 23-07-00 | 64° | 06° | JR532.rw JR532_u.rel | Upgoing | |

XBT STATIONS

| Station Number | Julian Day | Date | Latitude | Longitude | Filenames | Comment |
|---|---|---|---|---|---|---|
| JR50-XBT1 | 203 | 21-07-00 | 62° | 02° | t7_01001.rdf<br>t7_01001.edf | |
| JR50-XBT2 | 204 | 22-07-00 | 64° | 06° | | Failed to log |
| JR50-XBT3 | 204 | 22-07-00 | 64° | 06° | t7_01002.rdf<br>t7_01002.edf | |
| JR50-XBT4 | 205 | 23-07-00 | 64° | 07° | t7_01004.rdf<br>t7_01004.edf | |

## APPENDIX 1

## JCR SONAR WORKSTATIONS (BJL)

There are Sun Ultra5 workstations associated with the EM120 and TOPAS systems: **em120-101** for EM120 operation and logging; **topas** for TOPAS operation and logging; and **em120-102** for post processing. All three workstations are on the ship's193.61.88 network.

### *A1.1 em120-101*

Hostid: `80b8f161`

IP Addresses:

```
157.237.14.30  (/etc/hostnames.hme0) to transceiver units
193.61.88.70   (/etc/hostnames.hme1) to JCR main LAN
```

Disk Partioning:

```
Part      Tag    Flag     Cylinders         Size            Blocks
  0       root    wm        0 -  4146        1.99GB    (4147/0/0)   4180176
  1       swap    wu     4147 -  5162      500.06MB    (1016/0/0)   1024128
  2     backup    wm        0 - 17659        8.49GB    (17660/0/0) 17801280
  3 unassigned    wm        0                0         (0/0/0)            0
  4 unassigned    wm        0                0         (0/0/0)            0
  5 unassigned    wm     5163 - 17353        5.86GB    (12191/0/0) 12288528
  6 unassigned    wm        0                0         (0/0/0)            0
  7        var    wm    17354 - 17658      150.12MB    (305/0/0)     307440
```

Mount Points (/etc/vfstab):

```
#device      device        mount     FS  fsck   mount  mount
#to mount to fsck       point     type   pass   at boot   options
#
#/dev/dsk/c1d0s2 /dev/rdsk/c1d0s2 /usr     ufs    1   yes    -
fd -   /dev/fd   fd -   no -
/proc  -   /proc  proc   -   no -
/dev/dsk/c0t0d0s1   -   -   swap   -   no -
/dev/dsk/c0t0d0s0   /dev/rdsk/c0t0d0s0  /   ufs    1   no -
/dev/dsk/c0t0d0s7   /dev/rdsk/c0t0d0s7  /var   ufs    1   no -
/dev/dsk/c0t0d0s5   /dev/rdsk/c0t0d0s5  /data1    ufs    2   yes    -
swap   -   /tmp   tmpfs  -   yes    -
```

```
#em120-102:/data2/em120 - /data2 nfs - yes rw,bg,soft,intr
```

Peripherals:

```
DDS 3 DLT (/dev/rmt/0)
```

Software:

```
em120 logging software
```

### *A1.2 topas*

Hostid: 80c56df9

IP Addresses:

```
172.20.1.199   (/etc/hostnames.hme0) to tranceiver units
193.61.88.72   (/etc/hostnames.hme1) to JCR main LAN
```

Disk Partitioning:

```
Part      Tag    Flag     Cylinders         Size            Blocks
  0       root    wm       0 -  7111        3.42GB    (7112/0/0)   7168896
  1       swap    wm    7112 -  8152      512.37MB    (1041/0/0)   1049328
  2     backup    wm       0 - 16705        8.03GB    (16706/0/0) 16839648
  3 unassigned    wm    8153 - 16705        4.11GB    (8553/0/0)   8621424
  4 unassigned    wu       0                0         (0/0/0)            0
  5 unassigned    wm       0                0         (0/0/0)            0
  6 unassigned    wm       0                0         (0/0/0)            0
  7 unassigned    wm       0                0         (0/0/0)            0
```

Mount Points (/etc/vfstab):

```
#device      device       mount     FS  fsck   mount  mount
#to mount to fsck      point     type   pass   at boot   options
#
#/dev/dsk/c1d0s2 /dev/rdsk/c1d0s2 /usr     ufs    1   yes    -
/proc     -      /proc     proc   -   no -
fd     -      /dev/fd      fd -   no -
swap      -      /tmp      tmpfs  -   yes    -

/dev/dsk/c0t0d0s0 /dev/rdsk/c0t0d0s0 / ufs 1 no -
/dev/dsk/c0t0d0s1 - - swap - no -
/dev/dsk/c0t0d0s3 /dev/rdsk/c0t0d0s3 /data ufs 1 yes -
#em120-102:/data2/topas - /data nfs - yes  rw,bg,soft,intr
```

Peripherals:

```
None
```

Software:

```
topas logging software
```

### *A1.3 em120-102*

Hostid: `80c05482`

IP Addresses:

```
193.61.88.71      (/etc/hostnames.hme0) to JCR main LAN
172.20.1.174      (/etc/hostnames.hme1) to Topas DSP
```

Disk Partitioning:

```
Part      Tag    Flag     Cylinders         Size            Blocks
  0       root    wm        0 -  3862        1.86GB    (3863/0/0)   3893904
  1       swap    wu     3863 -  5163      640.34MB    (1301/0/0)   1311408
  2     backup    wm        0 - 17659        8.49GB    (17660/0/0) 17801280
  3 unassigned    wm        0                0         (0/0/0)            0
  4 unassigned    wm        0                0         (0/0/0)            0
  5 unassigned    wm     5164 - 17354        5.86GB    (12191/0/0) 12288528
  6 unassigned    wm        0                0         (0/0/0)            0
  7        var    wm    17355 - 17659      150.12MB    (305/0/0)     307440
```

Mount Points:

```
#device      device        mount     FS  fsck   mount  mount
#to mount to fsck      point     type   pass   at boot   options
#
#/dev/dsk/c1d0s2 /dev/rdsk/c1d0s2 /usr     ufs    1   yes    -
fd -  /dev/fd   fd -   no -
/proc  -  /proc  proc   -  no -
/dev/dsk/c0t0d0s1   -   -  swap   -  no -
/dev/dsk/c0t0d0s0   /dev/rdsk/c0t0d0s0  /  ufs    1   no -
/dev/dsk/c0t0d0s7   /dev/rdsk/c0t0d0s7  /var  ufs    1   no -
/dev/dsk/c0t0d0s5   /dev/rdsk/c0t0d0s5  /data1    ufs    2  yes    -
```

```
/dev/dsk/c1t0d0s2       /dev/rdsk/c1t0d0s2      /data2  ufs     2       yes     -
swap   -   /tmp   tmpfs  -   yes    -
jruf:/jra1000/lun0/packages/solaris - /nerc/packages nfs - yes ro,bg,soft,intr
jruf:/local0/master/solaris/bin - /nerc/bin nfs - yes ro,bg,soft,intr
jruf:/local0/master/etc - /nerc/etc nfs - yes ro,bg,soft,intr
```

Peripherals:

```
Sun A1000 H/W RAID with approx 100GB usable diskspace mounted on /data2.
DLT700 (/dev/rmt/0).
Topas-DSP (172.21.1.171)
```

Software:

```
Neptune and Poseidon em120 post processing.
Topas post processing.
/nerc/packages/.
```

### *A1.4 Processing Software (on em120-102)*

**Neptune** runs under the **neptune** user ID (passwd **simrad0**).

**Poseidon** runs under the **poseidon** user ID (passwd **simrad0**).

**Topas** runs under the **topas** ID (passwd **topas0**).

Data directories for th s/w are: **/data2/em120** and **/data2/topas**.

The current version of **Topas** requires a DSP. **Topas** also uses its own copy of Uniras installed in /usr/uniras.

### *A1.5 NTP*

All three workstations have their system clocks synchronised to the clock on the SCS Data Acquisition System (which in turn is sychronised to GPS time from the Trimble).

The */etc/inet/ntp.conf* files have the entry **“server ntp-server”** and ntp-server is set in the */etc/hosts* as 193.61.88.60 (the DAS). The **server** keyword ensures the workstations act as NTP clients and ignore any other NTP servers that may be running on the main LAN.

## APPENDIX 2

## SOURCE CODE FOR SOUND VELOCITY MONITOR (ATB)

```
/* Salinity, Velocity source code
   By Andrew Barker 21 May 2000
*/

public class Tools
{

  boolean digit(String intext) // validate digit
  {
     boolean valid=true;
     for(int k=0; k<intext.length(); k++)
     {
        if ((intext.charAt(k)>=45) && (intext.charAt(k)<=57))
        {
           if (intext.charAt(k)==47)
              valid=false;
        }
        else
            valid=false;
     }
     return valid;
   }

   static double CalculateSalinity(double C, double T, double P)
   {

      // Formula taken from OCEANLOG

      double a[] = {0.008,-0.1692,25.3851,14.0941,-7.0261,2.7081};
      double b[] = {0.0005,-0.0056,-0.0066,-0.0375,0.0636,-0.0144};
      double A1,A2,A3,B1,B2,B3,B4,C0,C1,C2,C3,C4;
      A1 = 0.0000207;
      A2 = -0.000000000637;
      A3 = 3.989D-15;
      B1 = 0.03426;
      B2 = 0.0004464;
      B3 = 0.4215;
      B4 = -0.003107;
      C0 = 0.6766097;
      C1 = 0.0200564;
      C2 = 0.0001104259;
      C3 = -0.00000069698;
      C4 = 0.0000000010031;
      double R,RP,RT,result,sum1,sum2,i;
      double temp;
      R = C;
      if (R<=0.0)
         result=0.0;
      else
      {
         R = R * 10.0; // convert Siemens/meter to mmhos/cm
```

```
      R = R / 42.914;
      RP = 1.0 + P * (A1 + P * (A2 + P * A3)) / (1.0 + B1 * T + B2 * T * T + B3 * R + B4 * R *T);
      RT = R / (RP * (C0 + T * (C1 + T * (C2 + T * (C3 + T * C4 )))));
      sum1 = 0.0;
      sum2 = 0.0;
      i=0;
      while (i < 6)
      {
        temp = Math.pow (RT,(i/2.0));
        sum1 = sum1 + a[(int)i] * temp;
        sum2 = sum2 + b[(int)i] * temp;
        i++;
      }
      result = sum1 + sum2 * (T- 15.0) / (1.0 + 0.0162 * (T - 15.0));
    }
    return result;
  }

  static double CalculateSpeedSound(double Lat, double Temp, double Sal, double Depth)
  {
    double Press;
    if (Sal==0)
      Sal = 35; // set salinity if it was defaulted
    if (Lat!=0)
      Lat = Math.toRadians(Lat); // * (3.1415926/180) // Convert degrees to radians
    if (Lat<0)
      Lat = Lat * -1; // make sure latitude is positive

    // First calculate the Pressure term (Press) in decibars from depth in meters
    // This conversion is from Coates, 1989, Page 4.

    Press=1.0052405 * ( 1+ 5.28E-3 * ((Math.sin(Lat))
              * (Math.sin(Lat))))
          * Depth + 2.36E-6 * (Depth * Depth);

    // Then calculate SV according to DelGrosso

    double P1,c0;
    double dltact,dltacs,dltacp,dcstp;
    P1 = Press * 0.1019716;   // to pressure in kg/cm**2 gauge
    c0 = 1402.392;

    dltact = Temp*( 0.501109398873E1 + Temp*(-0.550946843172E-1+ Temp
           *  0.221535969240E-3));

    dltacs  = Sal*(0.132952290781E1
           + Sal* 0.128955756844E-3);

    dltacp  = P1*( 0.156059257041E0 +  P1*( 0.24499868841E-4
            + P1*(-0.883392332513E-8)));
    dcstp   =  Temp*(-0.127562783426E-1*Sal      +
         P1*( 0.635191613389E-2        +
         P1*( 0.265484716608E-7*Temp      +
           -0.159349479045E-5        +
            0.522116437235E-9*P1)     +
```

```
          (-0.438031096213E-6)*Temp*Temp)) +
          Sal*((-0.161674495909E-8)*Sal*P1*P1 +
         Temp*( 0.968403156410E-4*Temp      +
         P1*( 0.485639620015E-5*Sal      +
          (-0.340597039004E-3))));

    double velocity;
    velocity = c0 + dltact + dltacs + dltacp + dcstp;
    return velocity;
  }
}
```