RRS James Clark Ross

JR99 Cruise Report

Acoustic equipment trials
Rosemary Bank
NE Atlantic

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Cruise Report

RRS *James Clark Ross*

Cruise JR99

August 2003

Equipment trials (swath bathymetry, TOPAS sub-bottom profiling, SSU, magnetometers)

Rosemary Bank, NE Atlantic

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with contributions from Peter Morris, Rob Larter, Jim Fox, Pete Lens and Doug Willis

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JR99 CRUISE REPORT CONTENTS

Front cover photo by Tony Mulcahy
Back cover photo by Mike Gloistein

1. Introduction and objectives

JR99 was intended as a commissioning, calibration, trials and training cruise between the summer refit and the vessel sailing for the Antarctic. It was an opportunity for new ITS, ETS and GSD staff to become familiar with the ship-fitted equipment; this necessarily involved carrying out a realistic survey in deep water. Specific objectives included the following:

1. Calibrate the EM120 multibeam echo sounder for pitch and roll
2. Establish the operational limits of the EM120 and TOPAS sub-bottom profiler in rough weather
3. Check performance of the Simrad Synchronisation Unit (SSU)
4. Test towed magnetometer in stand-alone mode
5. Review performance of on-board scientific systems and carry out general maintenance
6. Install and test new version of Scientific Computer System (SCS) software

The previous cruise demobilised, and JR99 commenced, in Cork. In addition to the BAS participants, we had a Dynamic Positioning engineer and a multibeam engineer from Kongsberg Simrad on board for a day of equipment trials. After returning to Cork so that these two could leave the ship, the ship sailed north past the west coast of Ireland to the main work area of Rosemary Bank, northwest of Scotland. This had been chosen as a suitable survey target in UK waters, with varied topography including depths from about 300 m to 2000 m. It is a large volcanic seamount at least partly of Late Cretaceous age (Morton *et al.* 1995). The bank is surrounded by contourite sediments, sculpted into drifts and waves by a complex system of bottom currents (Roberts *et al.* 1974, Masson *et al.* 2002). Five days were spent surveying Rosemary Bank, including 8 hours hove-to waiting on weather and 10 hours steaming at 4-5 knots head to wind in a gale. On the way back to Immingham we made a diversion to run one survey line in the northern Rockall Trough. We also acquired swath bathymetric data over the Hebrides shelf to the Pentland Firth, as the area around the isle of Rona is quite poorly charted.

References

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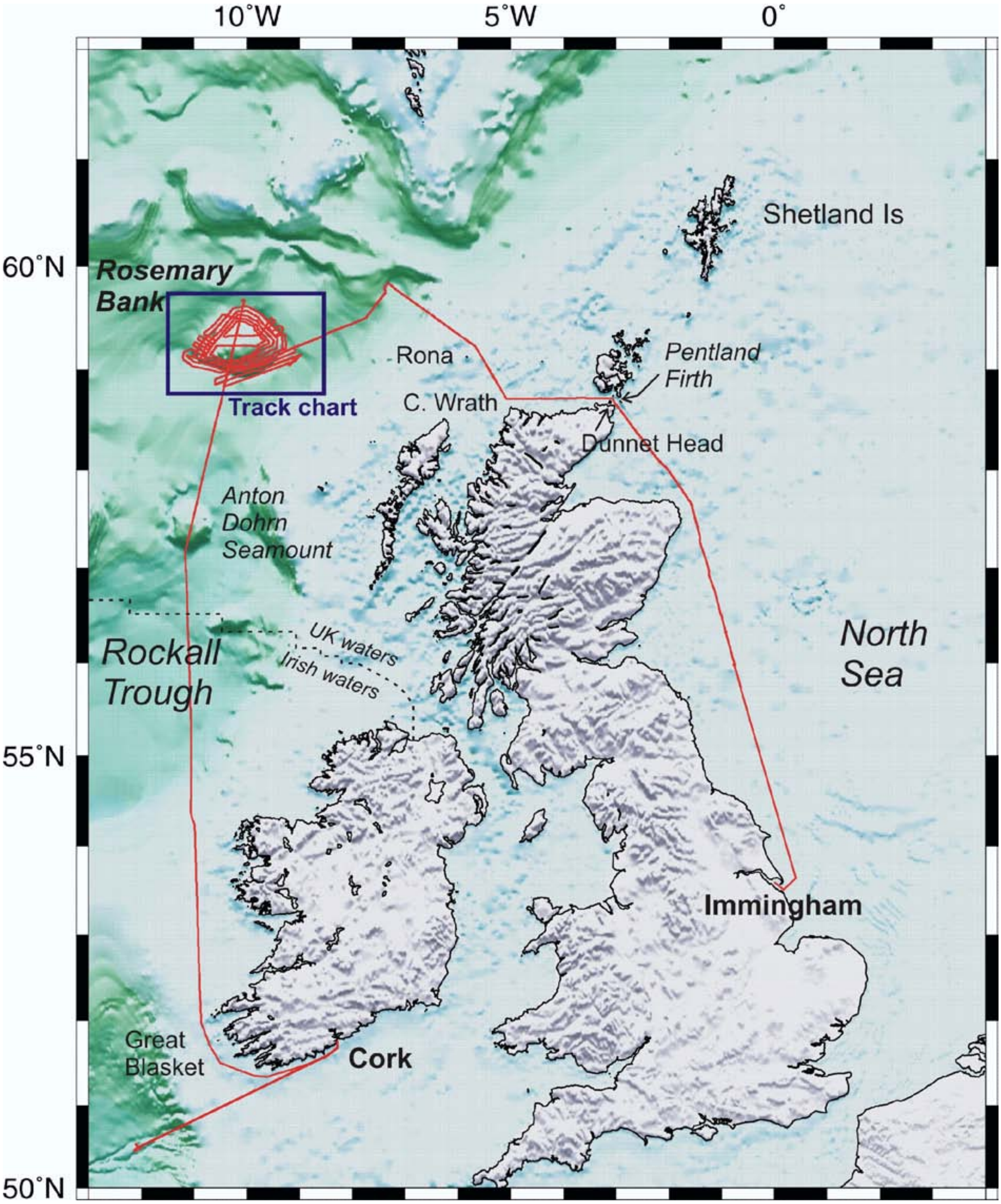
Morton, A.C., Hitchen, K., Ritchie, J.D., Hine, N.M., Whitehouse, M. & Carter, S.G. 1995. Late Cretaceous basalts from Rosemary Bank, northern Rockall Trough. *J. geol. Soc.* **152**, 947-952.

Roberts, D.G., Hogg, N.G., Bishop, D.G. & Flewellen, C.G. 1974. Sediment distribution around moated seamounts in the northern Rockall Trough. *Deep-Sea Res.* **21**, 175-184.

Fig. 1. Track chart of cruise JR99.



10˚W
5˚W
0˚
60˚N
55˚N
50˚N
Rosemary Bank
Track chart
Shetland Is
Rona
Pentland Firth
C. Wrath
Dunnet Head
Anton Dohrn Seamount
UK waters
Irish waters
Rockall Trough
North Sea
Immingham
Great Blasket
Cork

2. Narrative

(all times local, i.e. Z-1)

The scientific party arrived in Cork in the early afternoon of Friday August 15th (except for Doug Willis, who remained on board from the previous cruise). On August 16th a Dynamic Positioning hardware engineer from Kongsberg Simrad attended the ship. The only mobilisation necessary for JR99 was to position the magnetometer reel (newly fitted with handles to assist in deployment) on the starboard side of the aft deck and to wind on the cable. After a safety briefing for all the joining personnel, the ship sailed at 1900 and we had fine views of Cork Harbour in the evening sunshine. Outside the harbour the wind was light to moderate westerly.

Sun 17 th Aug

We required deep water to trial the EM120, so headed for the eastern end of Porcupine Seabight. Arriving at 50° 34'N, 11° 44'W (nearly 2000 m of water), we stopped at 0800 for four hours of Dynamic Positioning trials. While on station we began testing the EM120, TOPAS and the SSU. The echo sounders were working correctly but the SSU was not; it appeared to set the EA500, rather than the EM120, as the "master" in the EA&EK&EM group. In practice this meant that correct spacing of the trigger pulses for each instrument depended on having the correct water depth range set on the bridge EA500 display, plus a large EA500 add-on time to allow the EM120 to complete its ping cycle. Unfortunately nothing could be done to resolve this problem as the Kongsberg Simrad engineer on board was not an SSU specialist, and the ship carries no spares for the SSU.

After satisfactory completion of Dynamic Positioning trials, the ship moved off station and an XBT cast was made for sound velocity input to the EM120. The Sound Velocity Probe had already been found to be non-functional. We then carried out a preliminary roll calibration of the EM120 (another calibration will be done when we can record data in UK waters). Calibration involves sailing at 10 knots along a line 5 km long, turning and covering the line in the opposite direction. We also repeated the procedure on a line at right angles to the first. The roll correction was determined as 0.57 degrees; this can be input to the EM120 Installation Parameters. We had an early demonstration of the effects of leeway on swath data quality when attempting to repeat one of the calibration lines at 5 knots with the wind on the beam; a force 4-5 southwesterly gave us 8 degrees of leeway and all the starboard beam echoes disappeared.

At 1800, with the calibration runs complete, we increased speed and headed back to Cork Harbour.

Mon 18th Aug

The ship stopped in the outer harbour off Spike Island and the two departing Kongsberg Simrad personnel were transferred to the launch *Bryan J* just after 0900 on Monday August 18th. A very scenic voyage past the SW and west coasts of Ireland (including the Fastnet Rock) was enjoyed for the remaining daylight hours, in a fresh westerly wind, sunshine and good visibility. An Atlantic swell slowed the ship's speed, but once round Great Blasket we were able to maintain 11.5 knots.

Tues 19th Aug

The ship continued north and entered UK waters at 2008 on Tuesday. We had been running the EM120 and TOPAS, without recording data, earlier that day, though the SSU was so unwell we were not receiving many data. Logging commenced at 2045 (1945Z) and we experimented with SSU settings, internal and external triggers for an hour. Overnight we turned TOPAS off and left the EA500 and EM120 on the SSU, controlled by the EA500 having a chart scale of 0-3000 m and 100% add-on time. This gave one ping approx every 7 seconds. As an experiment this setup was left unattended overnight. It was not considered necessary to set complete scientific night watches, and over most nights the UIC room was unmanned from midnight to 0600.

Wed 20th Aug

The weather continued fine overnight and the EM120 had recorded data along the complete track, including the steep slopes either side of Anton Dohrn Seamount. This is very encouraging for the potential of acquiring data when only one EM120 operator is available for a cruise. We began the survey of Rosemary Bank with a SSW-NNE line run at 12 knots across the shallowest charted depth of 311 m (we obtained a least depth of 470 m). The ship slowed for an XBT cast in 1400 m of water on the north side of the bank, then returned along the same track at 10 knots for a pitch calibration. The calibration procedure revealed a zero pitch offset. A second roll calibration was done on the two lines in relatively deep water on the north side, revealing a roll offset of 0.57 degrees.

As we approached the southern edge of the work area, available weather information indicated west to southwest winds for the next 2 days, with force 6-7 forecast for sea area Rockall. Accordingly the ship headed ENE along what was planned as the first of a series of parallel ENE-WSW lines. Meanwhile some hardware diagnostics were carried out on the SSU and a fault was traced in one board (for which we do not have a spare). By the end of the line the wind had backed to SSW and TOPAS was suffering from dropouts in the quartering sea. After the turn we could no longer hold the desired course of 250° at the achievable speed of 6-7 knots without making excessive leeway. Visibility was poor with rain. Although TOPAS was still yielding good data, EM120 data were of very poor quality with many dropouts. The echo sounders were therefore turned off and the ship returned to the eastern end of the second survey line to heave to for the rest of the night.

Thurs 21st Aug

Overnight the wind moderated slightly and veered to SW, so at 0600 we were able to return quickly to the start of the second ENE-WSW line and maintain 8-9 knots along it. Turning at the far end the ship made about 7° of leeway and some of the EM120 starboard (leeward) beam echoes were dropping out. The return track, downwind at 10 knots, yielded good to excellent EM120 data, though TOPAS suffered from dropouts with the ship corkscrewing slightly. During the early evening the wind increased from a steady force 6-7 to force 8 gusting 10, with a maximum gust of 58 knots. The most difficult conditions (combination of wind and a short, steep sea) occurred at the start of the fourth track, when we struggled to get any return at all from the EM120. We found that running it on internal trigger with a narrow beam angle of 30° and a depth range only 200 m either side of the seabed usually found the bottom echo, though it was still necessary to stop and re-start the sounder every few minutes. By about 8 pm conditions had eased to the extent that the ship was making 4-5 knots without slamming into the sea, we were able to increase the EM120 beam angle to 50° and acquire quite presentable data on both the swath and TOPAS.

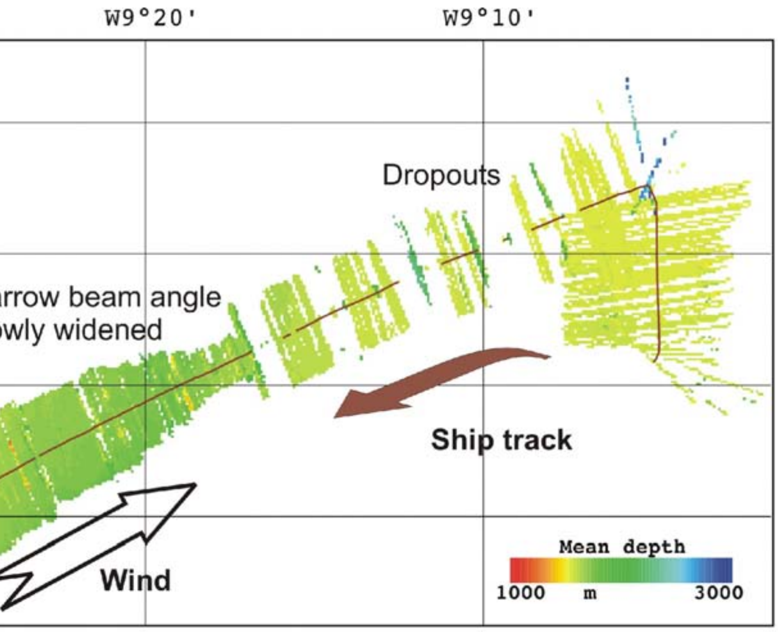
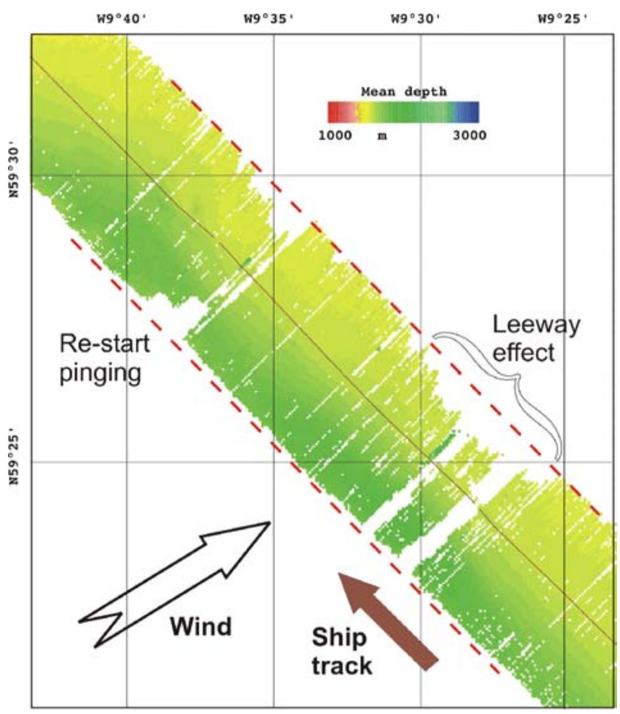


Figure 2. Poor-quality swath data acquired while the ship was head to wind in a gale. Frequent dropouts occurred in very gusty wind conditions and a short, steep sea. As conditions inproved slightly we were able to widen the beam angle from 20° to 50° and obtain acceptable data.

Fri 22nd Aug

The ship continued officially hove-to all night; the wind slowly veered to WNW so the track gradually diverged from the planned WSW line (see track chart). Quite fortuitously, this was exactly along the southern edge of the gently domed top of Rosemary Bank. At the end of the line the wind was moderating, and a second XBT was done at 0830. By then it was considered acceptable to turn the ship without excessive rolling, and we were able to resume the survey with another WSW-ENE track. In the early afternoon, having reached the southeastern corner of the bank, it was time to investigate the northern part. Waypoints were picked along the "moat" as identified from the GEBCO bathymetry grid; in practice this mainly took us slightly outboard of the deepest part of the moat. While heading northwest in steadily improving weather, we streamed the towed magnetometer. Deployment speed is 4 knots. The ship speeded up gradually to 6, 8 and 10 knots so that we could note the effect of leeway; as expected, the starboard (leeward) beam echoes dropped out at low speeds with the wind on the port beam.



The magnetometer was not sending any data so it had to be recovered while the fault was traced to a poor cable connection at the outboard end; on redeployment it worked perfectly. We continued surveying around the north and west sides of Rosemary Bank.

Figure 3. Effect of leeway on quality of swath data. In only a moderate wind on the beam, low ship speed (4 knots) results in 6-7° of leeway and frequent dropouts. At 6 knots and 3° of leeway, loss of signal is observed on the downwind side.

At 8-10 knots and negligible leeway, data quality is good.

<u>Sat 23rd Aug</u>

The whole of the next day was spent sailing clockwise round Rosemary Bank in ever-decreasing circles. The wind continued to drop and in calmer seas we increased ship speed to 12 knots. The swath data revealed some very interesting volcanic features including west-facing terraces at the western end, and a number of small parasitic cones on the eastern half of the bank (fig 4). Late in the evening we began a 5-hour TOPAS survey of a sediment wave field on the western side of the bank.

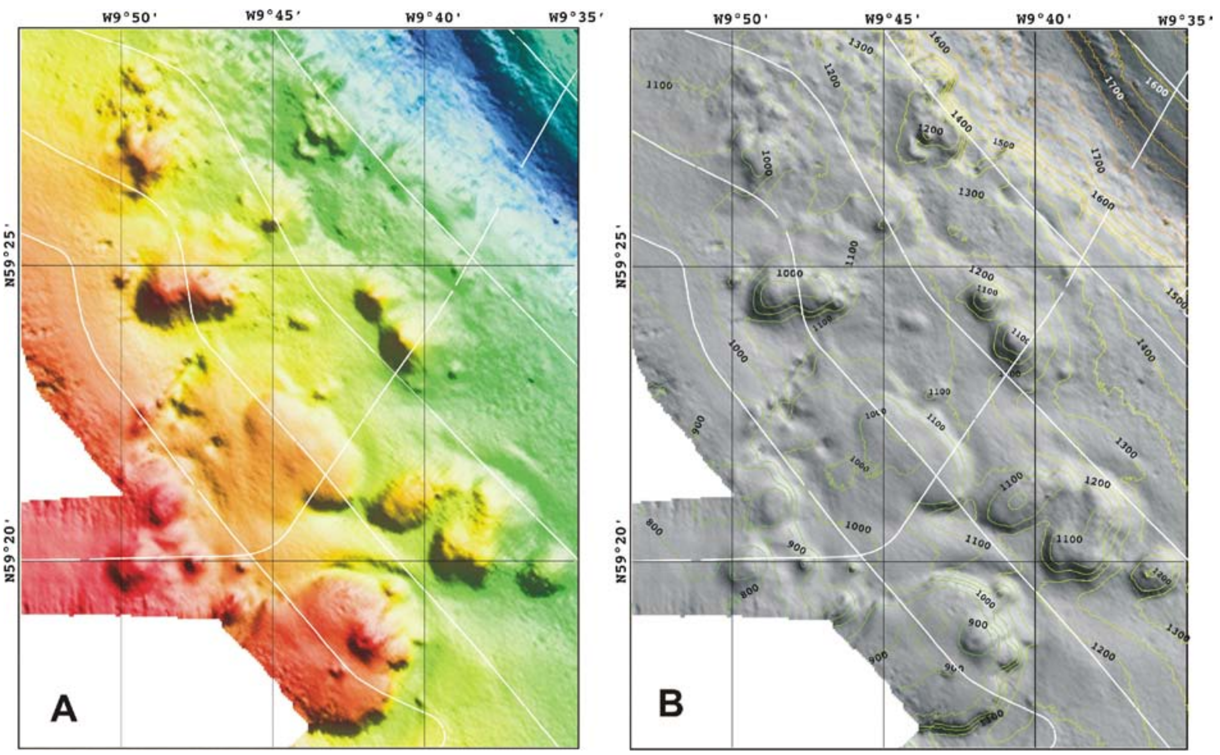
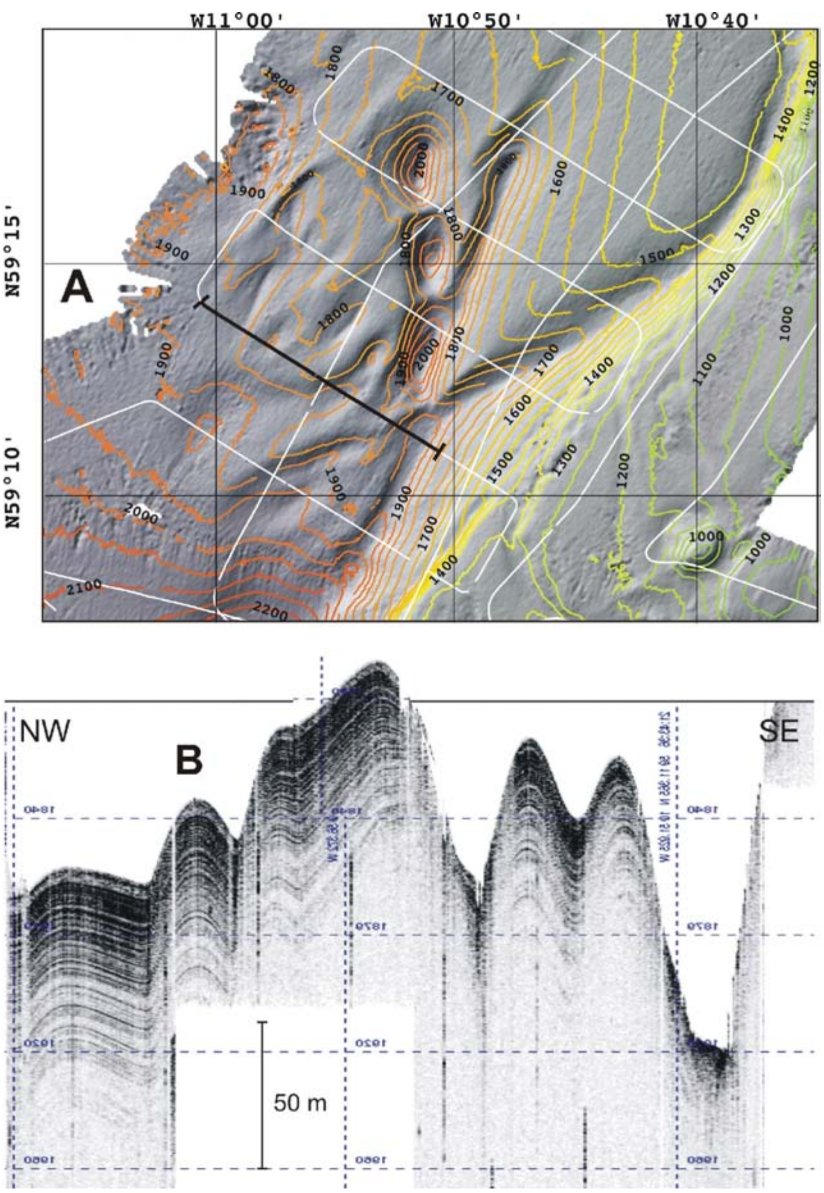


Figure 4. Small parasitic volcanoes on the eastern side of Rosemary Bank. A shows a colour shaded-relief view, B shows a greyscale shaded-relief view with contours at 50 m intervals. Sun illumination from the northeast. Ship track in white.

Figure 5. Sediment waves at the western end of Rosemary Bank.



5A shows a greyscale shaded-relief view with contours at 50 m intervals. Sun illumination from NW, ship track in white.

Black line indicates TOPAS profile in Fig. 5B.

<u>Sun 24th Aug</u>

The last day of survey of Rosemary Bank included two east-west lines where we identified the shallowest depths of 316 and 348 m, and a second sediment wave survey of the northeastern section of the moat. The weather was calm and foggy; although there are no ice hazards here, the ship did run over a length of fishing tackle in the morning, luckily without fouling the propellor. At this point the towed magnetometer was recovered.

The perspective view of Rosemary Bank (fig. 6, compiled from all the JR99 survey data and gridded using GMT), clearly shows the gently-domed shape of the seamount and the moat around its base. The volcanic edifice appears to be gently tilted down to the east, with scarps some 40 m high (?edges of lava flows) near the western edge. Parasitic cones 100-150 m high are abundant in the area of complete swath coverage and may cover most of the top of the bank. Their age is not known but they appear to protrude through most of the sediment cover, so may be substantially younger than the late Maastrichtian borehole age obtained by

Morton et al. (1995). Concave sections of the slope down into the moat at the SW corner are interpreted as large slide scars.

Thick sediments surround the bank and have been reworked into waves and sheet-like drifts by bottom currents. The deep current flow pattern is not known in detail, but the slope current which flows NE along the Hebrides Slope is assumed to be deflected westwards along Wyville-Thompson Ridge and then southwards towards Rockall Trough (fig. 1), so that Rosemary Bank is almost encircled by an anticlockwise gyre (Masson et al. 2002). The moat attains its greatest depth at the SW corner of the bank (2300 m, with a steep slope 850 m high on the north side) but is subdued farther north. Sediment waves are restricted to a small area just west of the bank (fig. 5) though buried waves also occur outboard of the moat on the east side. TOPAS sub-bottom penetration commonly exceeds 50 m and the parallel, laterally continuous reflectors indicate the sediments are fine-grained contourites or hemipelagites.

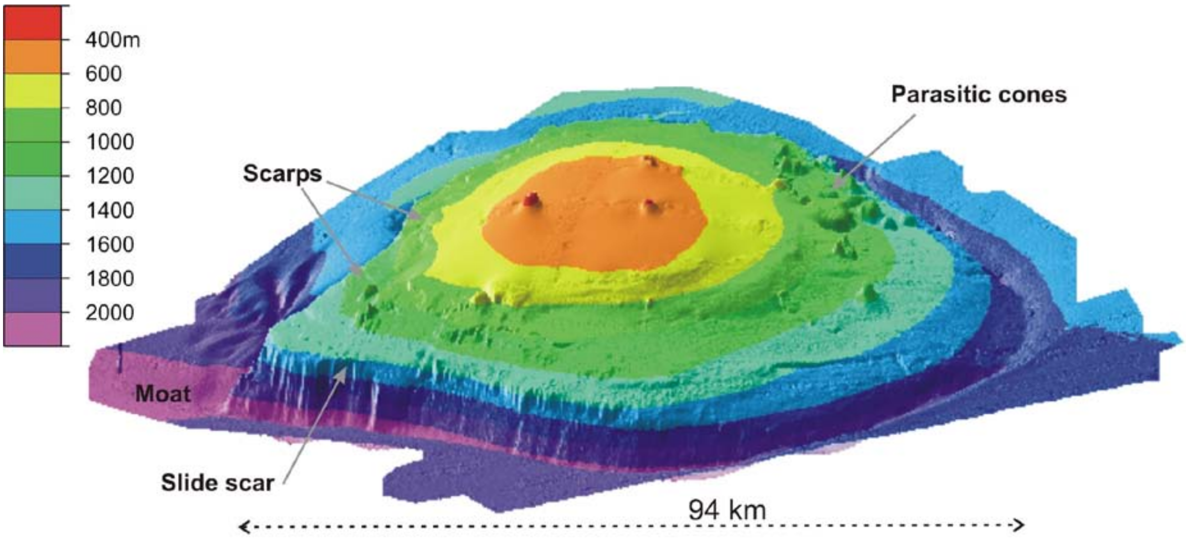


Fig 6. Perspective view of Rosemary Bank from south.

Mon 25th Aug

The final science task was a short (25 mile) TOPAS line over an area of pockmarks and mounds in the northern Rockall Trough, requested by Dr D G Masson (SOC). The ship slowed down after leaving Rosemary Bank so as to arrive at the start of the line at 0500 on Monday 25th August, thus missing the Bank Holiday traffic. The line was completed and course was set for Rona and the Pentland Firth. In beautiful weather (fine and clear with a light northeasterly wind) we made the passage from Cape Wrath to Dunnet Head, with magnificent views of the northern Scottish hills from Foinaven to Ben Loyal. We continued to record EM120 data from the Isle of Rona to just past Dunnet Head, for navigational purposes. The end-of-cruise dinner was held this evening.

Tues 26th Aug

The final day of passage was spent gridding, plotting and backing up data and writing reports. A speed of only 9 knots had to be maintained for timely arrival at Immingham, and the ship stopped twice for work on the bow thruster. We carried out two STCM calibrations, before and after moving the “new STCM” to the position of the old STCM, i.e. just behind the funnel. SCS logging ceased at 1600 and all the cruise data were backed up.

Wed 27th Aug

The Humber pilot came aboard at Spurn Head at 0730 and two hours later the ship was locking in to Immingham. We secured to no. 2 berth at 1010.

3. Equipment Report

3.1. EM120 Multibeam Echo Sounder

This instrument worked well throughout the cruise, except when overcome by bad weather. The present version of the software seems more stable than the version we had on JR71. We did not experience a single crash or any instance of the display hanging up. Pitch calibration revealed a zero offset, and two roll calibrations yielded an offset of +0.57degrees. A short guide to calibration was written by Rob Larter. We identified a question of whether roll and pitch offsets should be cumulative, i.e. should the offsets be set to zero in the installation parameters window before a new calibration is performed?

Four surveys were logged:

JR99_1 from 56° 30'N to the north side of Rosemary Bank (2 days, 342.5 km)
JR99_2 survey of Rosemary Bank (5 days, 1855.4 km)
JR99_3 from Rosemary Bank to the continental shelf edge (0.5 day, 199.9 km)
JR99_4 from the shelf edge to just SE of Duncansby Head (0.3 day, 244.6 km)

Total 2642.4 line km.

The data from survey JR99_2 were cleaned using BinStat (part of the Neptune processing software), with additional manual editing of the poor-quality data acquired during bad weather.

3.2. TOPAS

The TOPAS sub-bottom profiler worked very well throughout the cruise, suffering dropouts only in the worst of weather when neither the EM120 nor the EA500 could see the bottom at all. We ran it in Chirp mode during surveys 1, 2 and 3 and in Burst mode in the shelf survey 4. It was externally triggered from the SSU except during the two sediment wave surveys, when it was put on a 4 second manual trigger. Normally we recorded a 400 ms trace length at a sample rate of 10,000 Hz, but for the sediment wave surveys the sample rate of 20,000 Hz necessitated a shorter trace length of 240 ms (and frequent delay changes). It would be extremely useful to be able to record a longer trace length at high sample rates.

Delay can be controlled a) manually by the watchkeeper, b) in tracking mode or c) externally using the centre-beam depth from the EM120. In good weather we found externally controlled delay was satisfactory, but when the EM120 is regularly missing returns the TOPAS delay gets lost and is slow to readjust. Tracking mode works well on a flat or gently sloping seabed, but not on steep slopes. If TOPAS is left running unattended it will not always be able to follow the seabed.

For the processed trace on the screen, time-variable gain can also be manually, tracking or externally controlled. We used it in tracking mode most of the time.

A Waverley thermal linescan recorder was used for the chart output (the EPC having died at the end of last season). The scientists on board preferred this to the EPC as it takes up much less bench space, the chart roll is a more manageable size and it is easy to change time annotation and the print parameters such as scaling. A new EPC was put in place at the end of the cruise.

3.3 Simrad Synchronisation Unit (SSU)

After various previous reports of misbehaviour, this was examined. The main fault was found to be that the SSU is ignoring the RTS signal coming from the EM120 when it finishes processing a ping. This means the calculated time is wrong. The red horizontal line on the screen which shows the EM120 is busy is complete fiction and seems to be fixed at about 3 secs. The RTS signal was traced and found to be good all the way to the timer card in the SSU (output from D/I board is fine). This is either a hardware fault or a software fault which has not been identified before. The practical solution we adopted was to use a large time add-on on the EA500 setting, of more than 100% (varies with depth). This gives the EM120 time to finish each ping cycle. Kongsberg Simrad were contacted about this, with no result by the end of the cruise.

The dependence of the SSU on the EA500 is not a good situation. Scientific survey work is heavily reliant on an instrument on the bridge for the timing of the SSU. A better alternative would be to have the SSU depth value coming from the EM120. This is currently not possible without SSU software modification by Kongsberg Simrad. Fitting of the EA600 with a slave unit in the UIC would also solve this situation; this is due next refit.

E-mail to Kongsberg Simrad from Jim Fox:

Our SSU can be used to synchronise four echo sounders; EA500, EM120, TOPAS and EK60. The software version is 2.30.

Fault description:

The EM120 is set up to send an 'RTS' signal when it has finished processing ping data and is ready for the next ping. This signal is getting to the SSU but the SSU is ignoring it. The SSU is showing a green line on the EM120 trace well before the EM120 has finished processing and before the RTS signal line has changed state. As a result, calculated timings are going astray and synchronisation is failing. We are currently bypassing this by using manually changed fixed times or using time add-ons but this is not optimal.

Please see an attached picture for an example of the display. Here we have EA500 and EM120 in the same group but with 150% add-on onto EA500. TOPAS is in a separate group. All are set to calculated. By using the EA500 add-on, we allow the EM120 to finish processing. As you can see, the red line on the EM120 is far too short for this depth of water (depth as shown under 'TOPAS'). The way the red line begins a fraction of a second before the EM120 transmit pulse is also strange.

I have traced the EM120 RTS signal all the way to the output of the line drivers on the D/I card inside the SSU where it is good and as it should be (i.e. it clearly shows a change of state for the length of time we calculate the EM120 needs to process each ping data). As can be seen from the .ini file, channel 2 carries the RTS signal. The red LED on the D/I card lights when it should and the output from the LM339 comparator is good.

On disconnecting the RTS signal from the D/I board, absolutely no change was observed on the SSU display trace - timings were unaffected showing that the RTS signal is not affecting the SSU behaviour in any way.

I also tried setting EM120 FinishActiveHigh=0 (it should be 1) in the SSU.INI file and this had no effect, either.

I tried using the older version of the software (v2.20) and this showed exactly the same problem with the red line length for the EM120. To me this indicates a fault with the timer card.

3.4 Sound Velocity Probe and XBT

The SVP is faulty and needs repair. Comms are OK, but a raw ADC value of zero appears on every sensor channel.

The XBT cable was replaced with a new one. Three T5 casts were made, the profiles edited and used to generate sound velocity profiles for the EM120. The cable suffers if it is carelessly coiled on deck; ETS plan to provide a small storage drum for it.

3.5 Magnetometers

3.5.1 Towed Magnetometer

The Marine Magnetics towed Overhauser magnetometer performed well during its first Antarctic season when it was logged to the SCS system. On cruise JR99 the opportunity was taken to operate it in stand alone mode in case it needs to be run from a vessel where no central data logging facility is available. The standard logging software (Sealink) which comes with the magnetometer has the facility to log both the magnetometer and a GPS nmea input. This configuration had been tried briefly on the 2002 trials cruise and seemed to work reasonably, though it ‘fell over’ too frequently for comfort. This time a much longer test was undertaken.

There were initial problems in starting up the magnetometer. These were probably due to the connector between the magnetometer and towing cable not being done up correctly, though all other cable connections were rechecked as the cable had been removed from the reel prior to the cruise so that handrails could be added to the reel drum. These made a great difference when spooling the cable in and out. With the connections correctly made the magnetometer performed very well, and continued to put out a very clean signal for the time during which it was deployed.

The Sealink software runs on a PC (a Toshiba Laptop in the present case). The GPS and magnetometer signals arrive via two separate serial ports and are recorded into two files. There is an option to add position information from the GPS string on to the magnetometer data string before it is written to disk.

The GPS aerial was taped to the deck rail on the port side above the UIC room. Data were recorded for most of the cruise. In general the setup seemed stable and only seemed to fall over when the computer was ‘woken up’ to see what was on its screen (which blanks out after a time). If the Sealink program was restarted immediately only a minimal amount of data was lost. The program never fell over during the night when it was undisturbed.

The magnetometer was deployed for about two days and ran smoothly. Interestingly the Sealink program did not seem to crash so often when being woken up with both GPS and magnetometer recording, as with GPS alone.

The only serious problem identified was that the GPS positions recorded on to the magnetometer string were incorrect, and did not correspond to the GPS positions being recorded in the GPS file. They were about a degree greater and rather erratic, though when plotted out the shape of the track recorded was similar in shape to the true ship’s track. The GPS readings are interpolated in some way to match the magnetometer samples and this process was obviously not working properly.

This is a nuisance and will be investigated, but is not critical to stand alone operation of the instrument. There is the option to place manual file markers into the magnetometer file, and a few of these added per day at known times would provide an adequate link between the magnetometer and GPS files.

3.5.2 STCM (Shipboard Three Component Magnetometer)

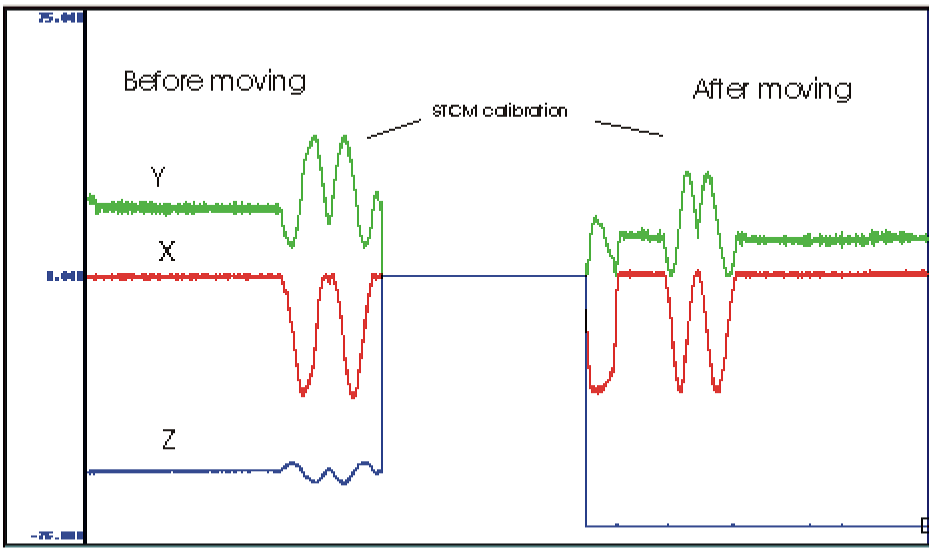
There are two STCM instruments active on the ship, generally referred to as the old and new STCMs. The old model was mounted on the rail of the monkey island behind the funnel, the new one was on the rail on the navigating bridge deck. In the past the old STCM has been somewhat less noisy than the new one, and this has been thought to result from its better location. At the start of JR99 the old instrument was found to be performing badly, the end of the vertical tube containing the sensors was broken and had been roughly repaired with insulating tape, and the readings were ridiculously high and occasionally dropping out. The situation cannot have been helped by the fact that the instrument had been used as a convenient pole to support someone's television aerial. The new instrument was operating normally (i.e. noisily).

The old instrument was taken down and checked over by the ETS engineers but it proved impossible to repair. The power supply was replaced, which prevented the signal dropping out, but large/spurious values remained. Analogue Devices 6B12 ADC modules used appear to have different gains - configuration software should be obtained and the behaviour of these modules verified. New modules should also be bought as there are no spares on board.

On the last day of the cruise it was decided to transfer the new STCM sensor to the superior position on the monkey island formerly occupied by the old one. When this had been done the Z (vertical) channel gave a very high (? saturated) constant signal (fig. 7, below) and in the time available it was not possible to identify the cause of this.

Thus there is thus currently no useable STCM on the JCR. Whilst the availability of a towed magnetometer reduces the need for an STCM somewhat, it is not always practical or desirable to tow a fish and the three component instrument provides a useful backup. Steps should be taken to restore one of the instruments to proper working order.

New STCM



3.6 Other instrumentation (from J W Fox)

3.6.1 USW and ocean logger

Flow meter: Air continues to get trapped. Needs a big flush out every couple of days (open the main valve at very top) to get rid of air.
Seawater temperature: Noisy as usual. Should be replaced/ calibrated really. History is unknown, but possibly not calibrated since ship was built.
Thermosalinograph: Found not to be including sound velocity on output string. Configured to do this using laptop. Oceanlogger software should be amended to set configuration of O/P string at start of comms.

3.6.2 Precision Echo Sounder

The ancient PC, which was dying, was replaced with a P5 and a new flat screen monitor fitted. The ADC card was transferred from the old PC. The PES itself appears to be working normally (it was used on JR98).

3.7 Scientific Computer System

The following is extracted from the ITS cruise report.

The SCS was upgraded from v3.0 to v3.3. Upgrades from NOAA consist of a replacement to the AllSCS directory. This directory contains binaries, documentation, basic and java applications and other ships config files. Both the main and backup servers were updated. If a serious problem is found with v3.3 then we can revert to v3.0
BAS receives the SCS software from NOAA under the auspices of a UK/US government MOU. The software was provided at no charge; we have free software but with no guaranteed right to support. BAS is not entitled to source code and any software updates are best endeavours by NOAA. For planning purposes it is important to note that SCS 3.4 and SCS 4.0 are going to phase out Windows NT support.
There are some issues with non-functionality: *Merge SCS data* , Message Builder v18, SCSLog=, the file SCSDLL.DLL required to make WebDisplay work.
The source code would be very useful to tailor some parts of the software. We're particularly interested in shortening the delay for the colour changes to yellow and red in the Real Time Display. Currently 5 minutes for yellow, 30 minutes to red.
We require a copy of the file WORLD_BIN.MAP so that we can create coastlines etc.
The derived sensors are a good idea.. We would like a realtime display of ships leeway; i.e. the difference between ships heading and course made good. This figure affects the output from our multibeam echosounder so would be good to see it at a glance.

3.8. Other IT matters

A Ghost backup/restore system was installed on all the data prep room PC's and the instrumentation PC's (except CLAM and EK500).
The network was examined with a Fluke network analyser. Several problems were identified and fixed including duplicate IP addresses, half duplex uplinks, damaged patch cables and incorrect labelling of wires. Documentation is on http://www.jcross/its/doc/network/Network_Structure.htm

4. Summary of Operational Limits for EM120 and TOPAS

Two effects degrade the received signal on both these systems: aeration under the hull, and leeway. Aeration problems in rough weather are common to all echo sounders, but the leeway effect has been particularly noticed on the EM120 as it can occur in only moderate sea states.

"Rough weather" does not have an exact definition because the sea state produced by a strong wind depends on for how long it has been blowing, how constant are wind direction and speed, and on large-scale bottom topography. A steady force 7 from one direction in a deep-ocean area may allow acceptable data acquisition if the vessel is rolling and pitching moderately, while a gusty and veering wind of the same average strength at the edge of the continental shelf (short, steep sea) will wipe out the signal completely. Basically if the ship feels comfortable and is not making much leeway, the EM120 should work, albeit with a reduced beam angle of 40-50°.

As documented by Willis et al. on cruise JR84 (pdf appended to this report), leeway angles of greater than 8-10° will result in severe data dropouts on the downwind side of the ship's track. Leeway angles of 4-7° will result in some loss of data. This is obvious during data acquisition from the real-time screen display of each ping. The *amount of leeway* is the difference between the ship's heading and the course made good (available on the VMS monitor in the UIC room). If there is a set (bridge will advise) in the same direction as the wind, the sideways movement of the ship through the water is less than the apparent sideways movement across the seabed. If the set is opposite to the wind it makes the problem worse.

The problem is also worse the slower the ship is going, e.g. if required to steam at 4-5 knots towing seismic equipment. In sea states of 5 or more it is advisable to choose courses which run up- or downwind. For example during JR99 we obtained 13 hours' worth of acceptable data on August 21-22 while the ship was steaming at 5 knots head to wind in a gale. If up-wind or downwind courses take the ship away from the work area, you may as well stop until the weather improves.

Loss of signal resulting from sideways movement of the hull will also be observed on all echo sounders when the ship is turning rapidly, e.g. when coming on station.

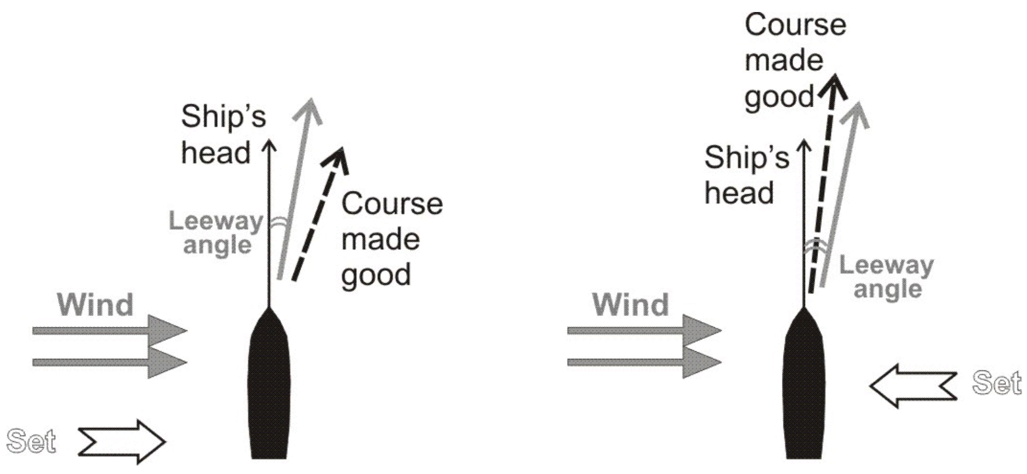


Fig. 7. Leeway affects the EM120 when the ship is pushed sideways through the water by the wind. GPS displays include the ship's heading and the course made good. The ship can also be set sideways by a current. If set and wind are in the same direction, the leeway is less than the difference between heading and CMG, i.e. the data are degraded less badly than you might expect. Conversely if the set is pushing the ship up into the wind things will be worse.

5. Quick Guide to EM120 Calibration

1. Kongsberg Simrad recommends calibration of the EM120 before every survey. To carry out a calibration you need a fairly smooth, flat area (for roll calibration) and a steep slope or step (for pitch and time delay calibration).

2. For calibration purposes it is best if the whole of each calibration line is logged as a single line. Usually we have the system configured to automatically start a new 'line' every 30 minutes, so change this by selecting the pull-down 'Options' menu on the EM120 control system, clicking on 'User Preferences', and then changing the appropriate parameter in the dialogue box that appears.

3. For roll calibration, collect data along a line approximately 5 km (3 miles) long over a smooth, flat area and then return along the same line in the opposite direction. Stop and then restart logging at the end of each line to increment the line number. Any speed is OK, but 10 kts usually provides the optimum compromise between data quality and speed.

4. For pitch and time delay calibration, collect data along a line approximately 5 km (3 miles) perpendicular to a steep slope (5–20 degrees) or a feature such as a step, small seamount or sharp change in sea-floor gradient. Return along the same line at the same speed in the opposite direction, then go along the line again in the original direction at half the speed of the first two lines. Stop and then restart logging at the end of each line to increment the line number.

5. Start Neptune (click middle mouse button on background) on the data processing workstation. The 'Select Survey' dialogue box appears: select the calibration survey.

6. The 'Neptune Survey Control' window appears, and should include a map showing the calibration survey lines. Select the two roll calibration lines (hold SHIFT key down while clicking on each one), then select the pull-down 'Processing' menu, and click on 'Offsets'.

7. The 'Calibrate' window appears, showing the selected lines. Select the pull-down 'View' menu in this window, then click on 'Show/hide'. Check the 'Points' and 'Rectangles' boxes in the dialogue box that appears, then click on 'Apply'. This will show the swath width and depths on the calibration lines.

8. Select the pull-down 'Edit' menu in the 'Calibrate' window, then click on 'New line'. Draw one or more lines perpendicular to the survey lines across the full width of the swath by holding down the right-hand mouse button.

9. Select the two roll calibration lines (hold the SHIFT key down while clicking on each one), then select the pull-down ‘Edit’ menu and click on ‘Roll calibration’. Right click on one of the cross lines that were drawn in step 8.

10. The ‘Roll calibration’ window appears. Adjust the corridor width as preferred by changing the parameter on the left of the window. Adjust the roll correction value to get the best fit between the two profiles. Note down your estimate of any correction required so that you can apply it in the ‘Installation Parameters’ menu on the EM120 control system later.

11. Close the ‘Calibrate’ window and return to the ‘Neptune Survey Control’ window. Select the pitch and time delay calibrations lines, then select the pull-down ‘Processing’ menu, and click on ‘Offsets’.

12. Repeat steps 7 through 10, but this time the lines you draw in step 8 should be parallel to the survey lines, and you should click on ‘Pitch calibration’ in the pull-down ‘Edit’ menu in step 9. In the ‘Pitch calibration’ window, first compare two lines collected in the same direction at different speeds to check for any time delay. Depth errors due to time delay increase with increasing vessel speed. Next compare two lines collected in opposite directions at the same speed to estimate the pitch correction. Depth errors on a constant gradient slope due to pitch calibration error increase with increasing depth. Note down your estimate of any correction required so that you can apply it in the ‘Installation Parameters’ menu on the EM120 control system later.

13. Remember to reset the automatic line number increment time in ‘Options’ > ‘User Preferences’ on the EM120 control system.

14. Add your estimated corrections to the existing values in the ‘Installation Parameters’ menu on the EM120 control system, and then replace the existing values. To find the ‘Installation Parameters’ menu select the ‘MBES’ workspace, then in the ‘EM120 Runtime Menu’, select the ‘Show’ pull-down menu and click on ‘Installation Parameters’. Calibration corrections are entered as ‘Offset angles’ in the ‘Motion sensor’ box (pitch and roll), and as ‘Position delay’ in the ‘Positioning systems’ box (time delay).

I think any corrections determined from a calibration survey must be additive to any corrections that were already applied when the survey was carried out, but we need to check this.

6. Crew List

Scientific Party

Dr Carol J. Pudsey	Principal Scientist
Dr Peter Morris	Geophysics database manager
Dr Rob Larter	Geophysicist
Mr Alex Tate	Geology database manager/geophysicist
Mr Jim Fox	Electronics engineer
Mr Aidan O'Hare	Electronics engineer
Mr Pete Lens	Computer support
Mr Doug Willis	Computer support
Mr Dave Prentice	Computer support
Mrs Doris Woo	Computer support

Ship's company

Jerry Burgan	Master	Dave Peck	Bosun's Mate
David Gooberman	Chief Officer	Martin Bowen	Seaman
Dave King	2nd Officer	Kelvin Chappell	Seaman
Paul Clarke	3rd Officer	George Dale	Seaman
Mike Gloistein	Radio Officer	Ian Raper	Seaman
Duncan Anderson	Chief Engineer	Kevin Holmes	Seaman
Colin Smith	2nd Engineer	Angus Macaskill	Motorman
Jim Stevenson	3rd Engineer	Bruce Smith	Motorman
Tom Elliott	4th Engineer	William Hume	Chief Cook
Keith Rowe	Electrician	William Hyslop	2nd Cook
Nick Dunbar	Electrician	Lee Jones	Senior Steward
Doug Trevett	Deck Engineer	Nick Greenwood	Steward
Hamish Gibson	Catering Officer	Graham Raworth	Steward
		Michael Weirs	Steward

7. Acknowledgements

First of all we are grateful to David Blake for sponsoring the cruise. Thanks to Karen Ellis and Julia Fear for organising our travel, and the agents for shoreside arrangements (Clyde Shipping in Cork and Sutcliffes in Grimsby/Immingham). By marine geoscience standards this was a relatively simple cruise, with no ice and only a bit of weather to contend with, and in an area which had a reasonable chart. Nevertheless, things do not automatically go smoothly without someone making them go that way, so we are as ever grateful to Captain Jerry and his team for running a trouble-free and contented ship. On the technical side, particular thanks to Jim Fox for his efforts with the SSU; maybe one day Kongsberg Simrad will take our technical support seriously.

APPENDIX: Swath Trials conducted on cruise JR84 29th March 2003

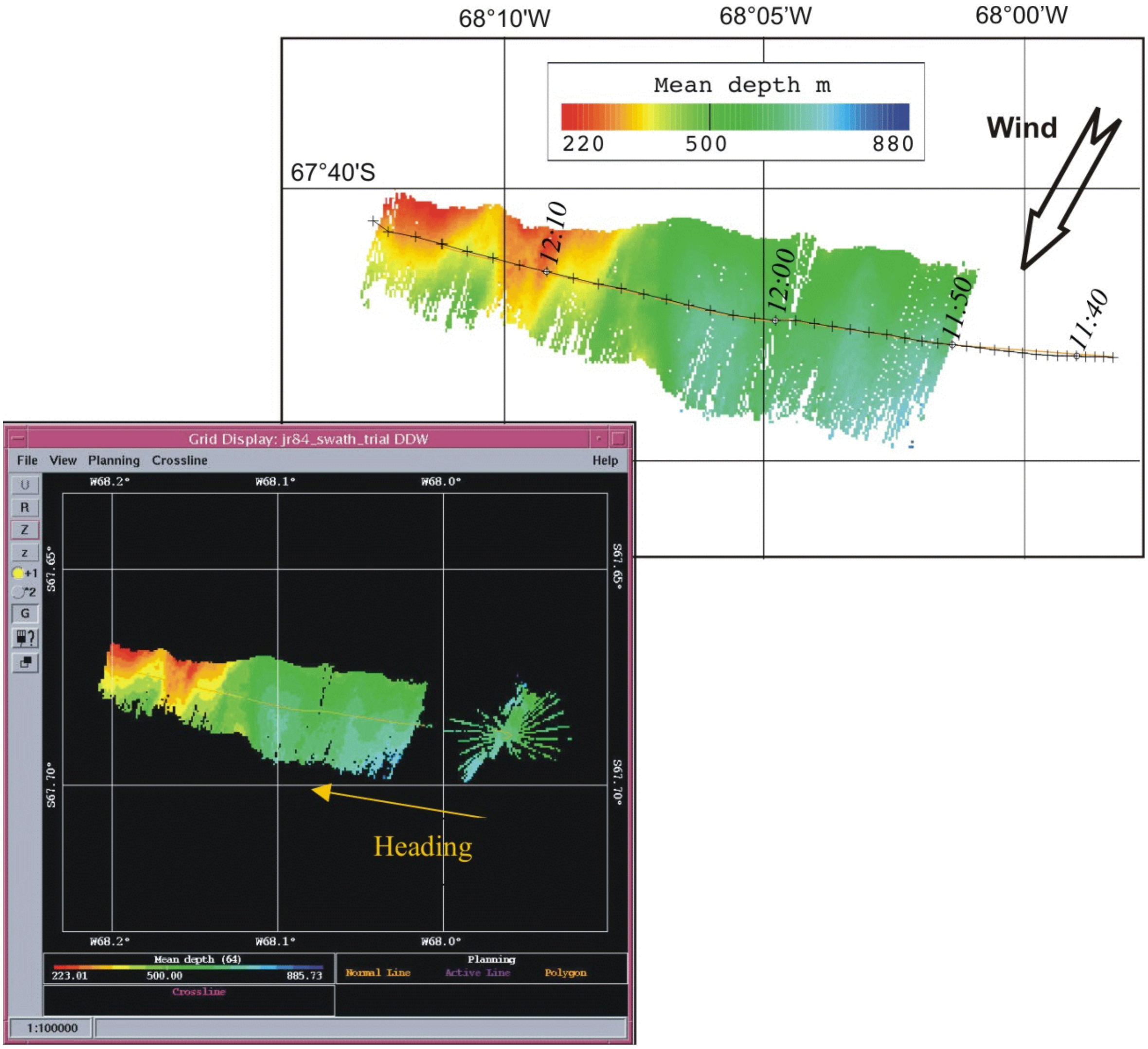
(D. Willis, Captain C. Elliot, J. Dowdeswell, C. O'Cofaigh, J. Evans)

Having noticed problems with the swath when the wind is on the beam, it was decided to perform some sea trials to determine the parameters under which the EM120 suffers from poor performance. For the JR99 cruise report, new figures (white background) have been added to the JR84 document.

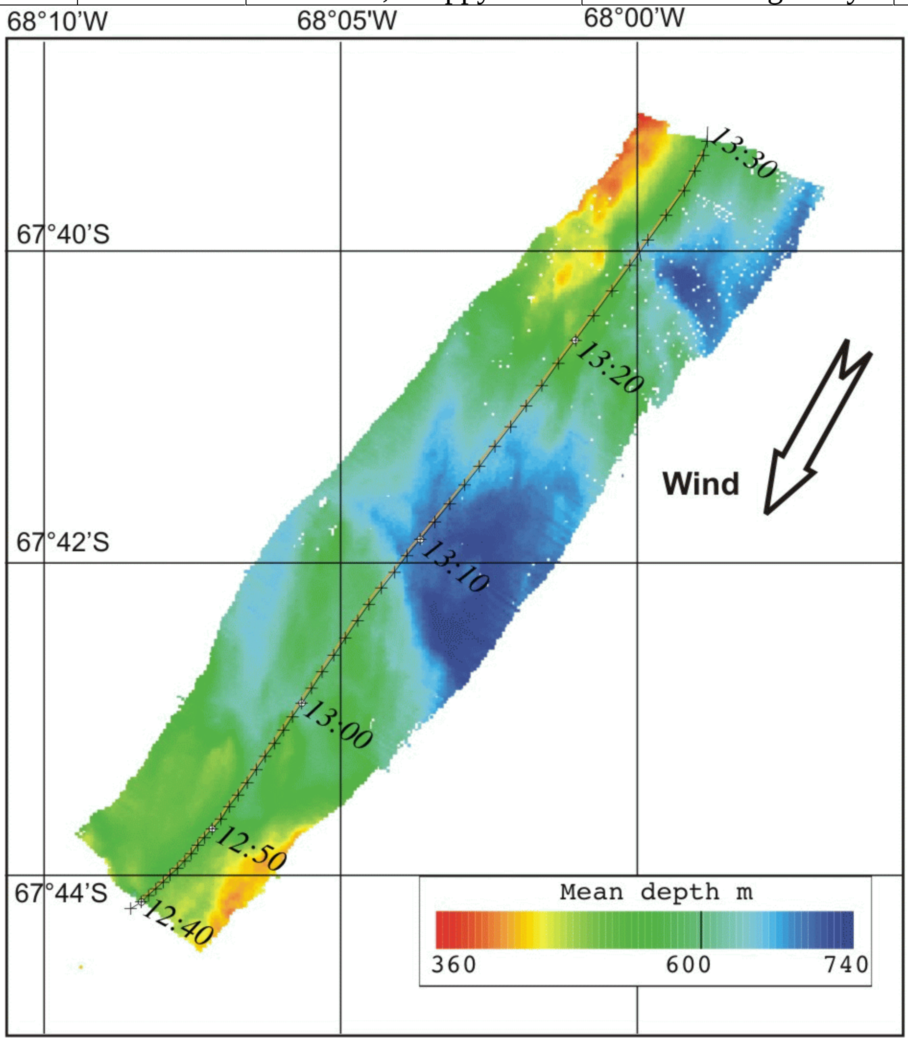
Test Results

The first trial was run at various speeds with the wind at various attitudes to the ship's direction. At each speed an evaluation of the EM120 data quality was made. All times are GMT, speed in knots, wind speed on Beaufort scale.

Leg 1 – Beam on to wind (Starboard side)					
Time	**Speed**	**Wind**	**Sea State / Swell**	**Remarks**	**EM120 Quality**
1137	4	N7	No Swell, choppy seas	Vessel moving easily	None
1145	6	N7	No Swell, choppy seas	Vessel moving easily roll 2º	None
1153	8	N7	No Swell, choppy seas	Pitching and rolling easily	Poor
1202	10	N7	No Swell, choppy seas	Rolling 3º	Poor
1210	12	N9/10	No Swell, choppy seas	Rolling 3º & pitching easily	Poor to average

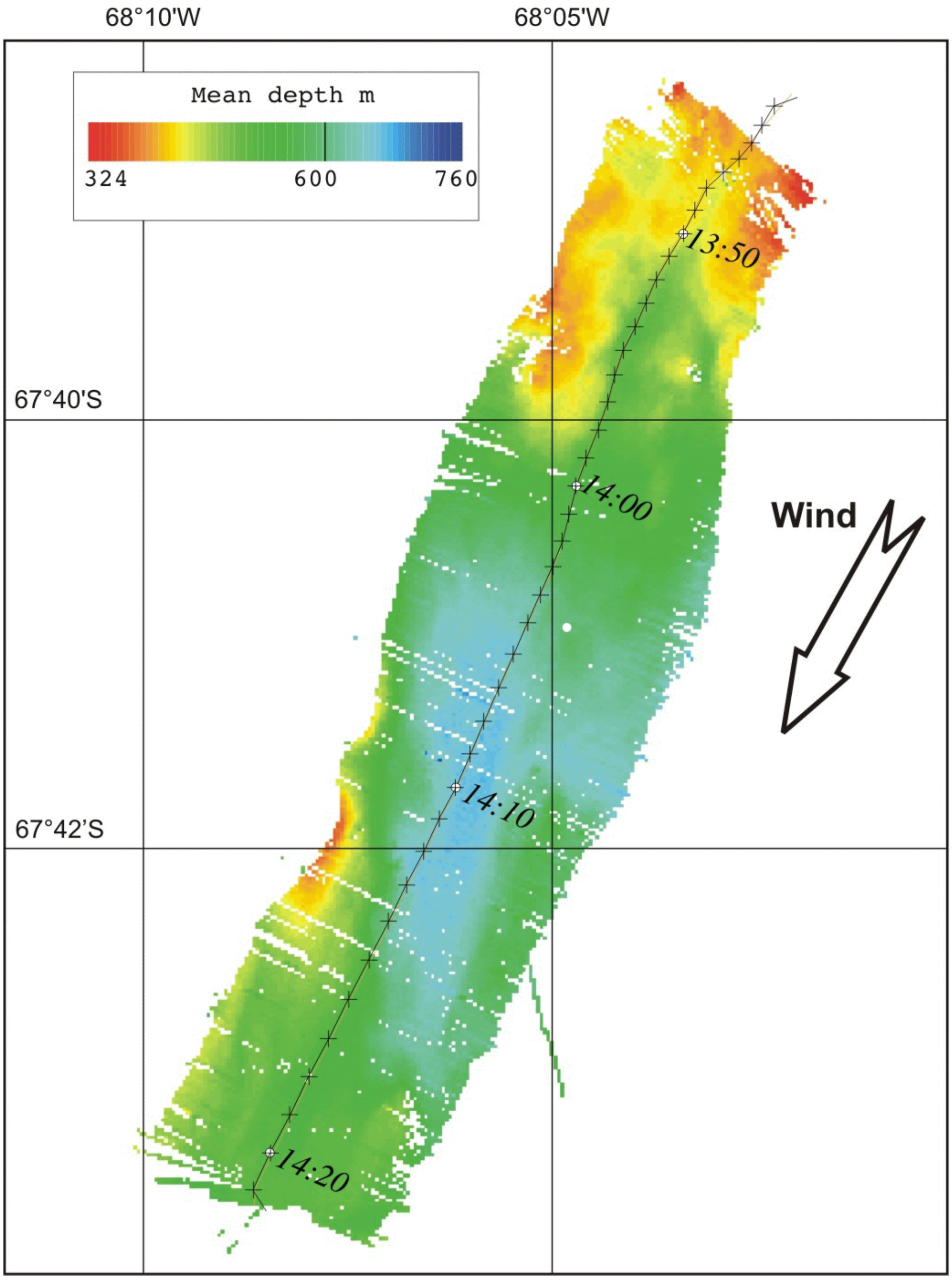


Leg 2 – Head to wind & sea					
Time	**Speed**	**Wind**	**Sea State / Swell**	**Remarks**	**EM120 Quality**
1242	4	NExN7/8	No Swell, choppy seas	Vessel moving easily	Good to excellent
1251	6	NExN7/8	No Swell, choppy seas	Vessel moving easily	Good to excellent
1303	8	NExN8	No Swell, choppy seas	Vessel moving easily	Good to excellent
1312	10	NExN8	No Swell, choppy seas	Vessel moving easily	Good to excellent
1320	12	NNE8	No Swell, choppy seas	Vessel moving easily	Good to excellent



(Incorrect figure in JR84 document)

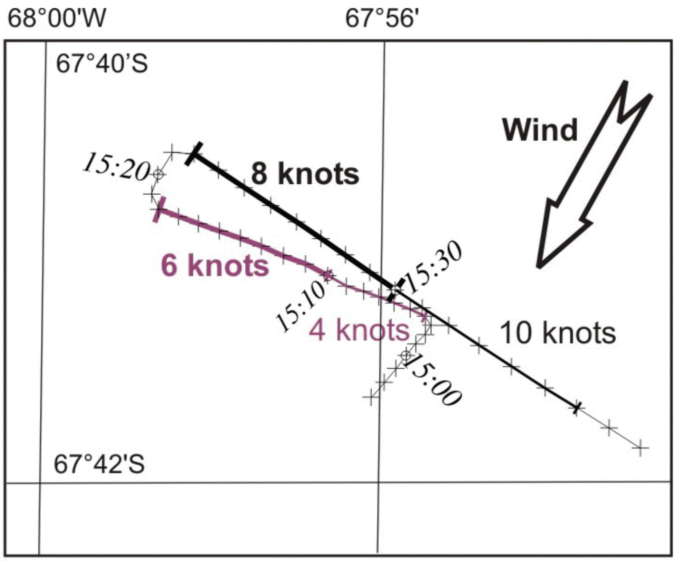
Leg 3 – Following wind & sea					
Time	**Speed**	**Wind**	**Sea State / Swell**	**Remarks**	**EM120 Quality**
1349	6	NNE8	No Swell, choppy seas	Vessel moving easily	Good
1356	8	NNE8	No Swell, choppy seas	Vessel yawing gently	Good
1406	10	NNE8	No Swell, choppy seas	Vessel yawing gently	Good
1415	12	NExN7/8	No Swell, choppy seas	Vessel moving easily	Good

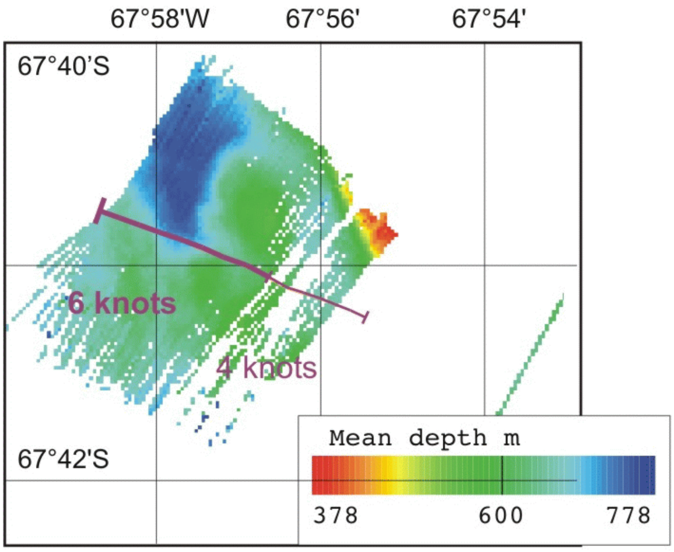


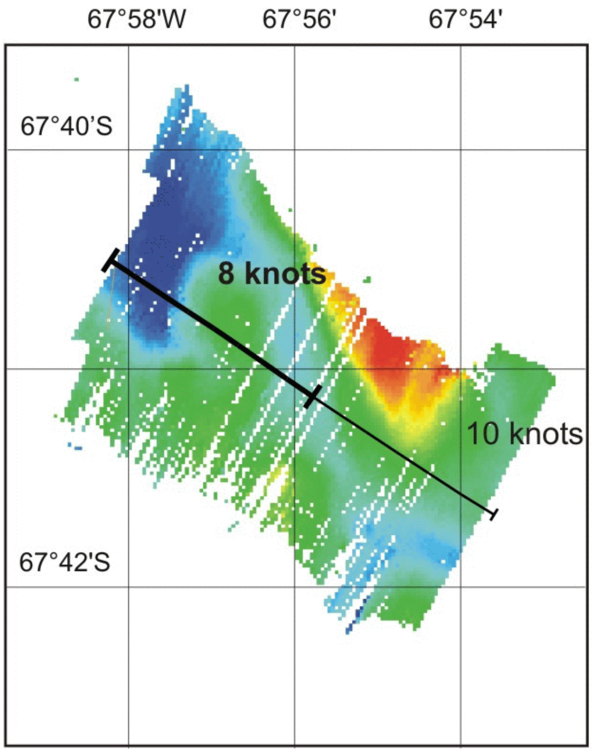
(Incorrect figure in JR84 document)

Second trial was run with the wind on the beam to see what the effect of leeway was on the EM120.

Leg 4 – Beam on to wind					
Speed	**Heading (gyro)**	**Course over ground (true)**	**Wind**	**Sea State / Swell**	**EM120 Quality**
4	300˚	292T	20º & 35Kn	Rough sea no swell	None to poor
6	300˚	292T	20º & 35Kn	Rough sea no swell	None to poor
8	120˚	124T	20º & 35Kn	Rough sea no swell	None to poor
10	120˚	124T	20º & 35Kn	Rough sea no swell	None to average



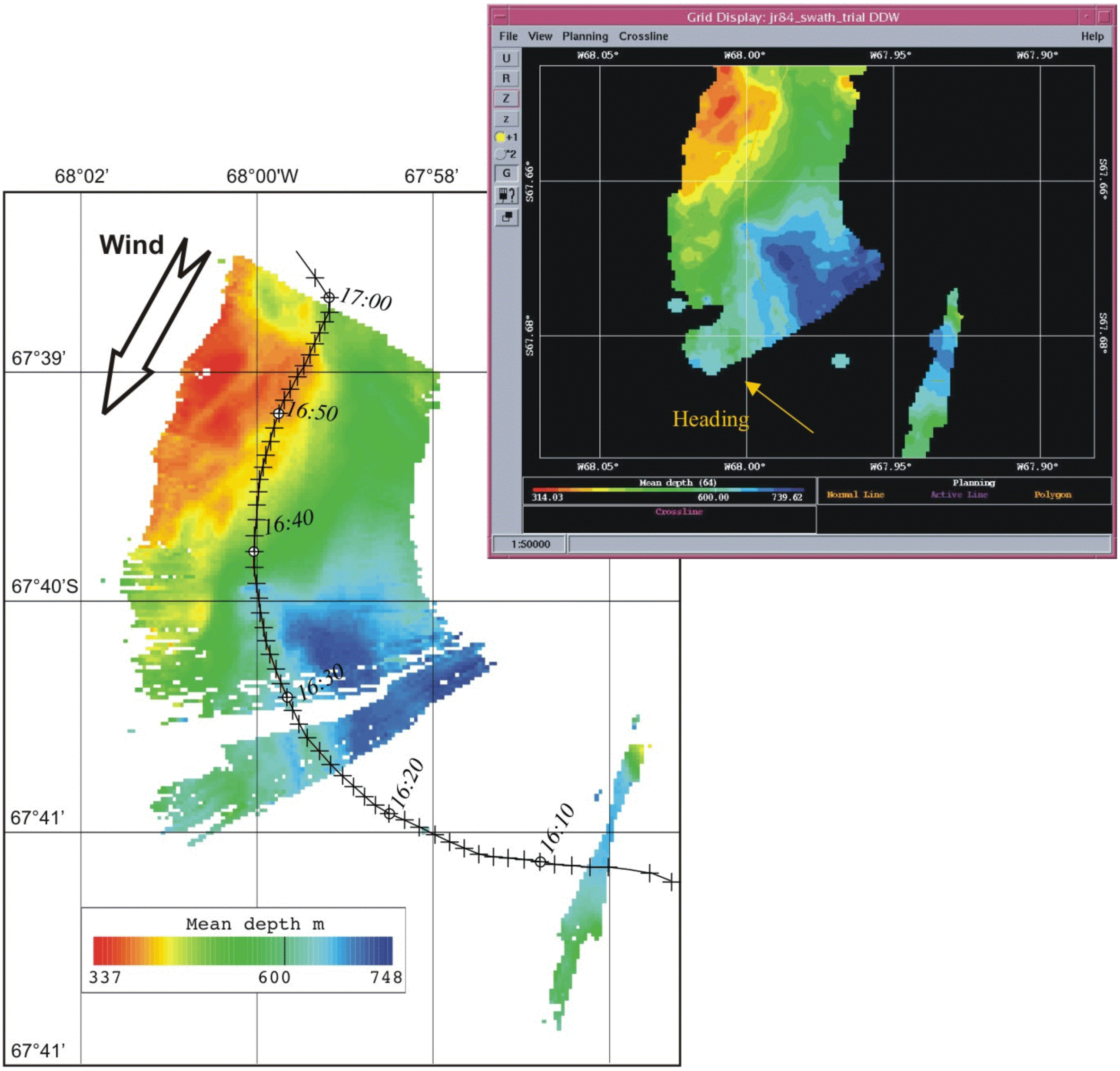




(Figure missing from JR84 document)

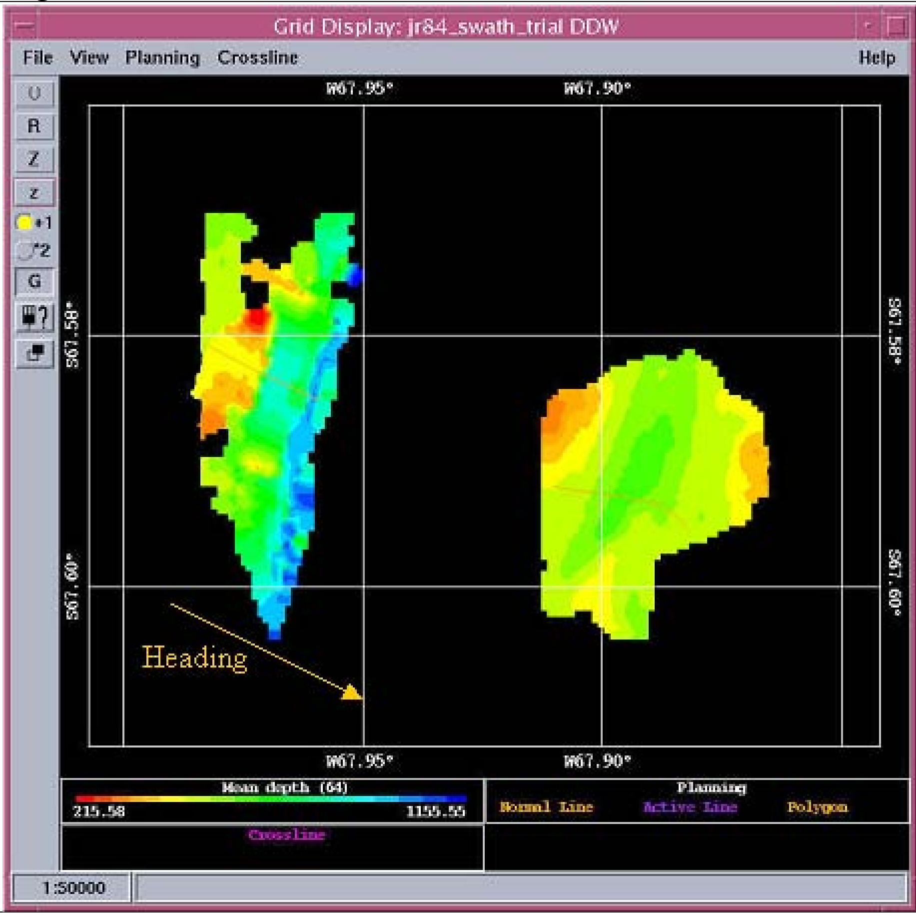
Third trial was to maintain a fixed speed and to adjust the angle to the wind and thus the amount of leeway the ship was making.

Leg 5 – Different heading, constant speed (4knots)				
Heading	**Course over ground**	**Leeway**	**Wind direction relative to ship**	**EM120 Quality**
290°	276	-14	090	Poor to average, EA500 lost bottom
310°	297	-13	070	None to poor, EA500 lost bottom
330°	317	-13	050	None to very poor, EA500 lost bottom
350°	337	-13	030	Poor, EA500 found bottom
000°	349	-11	025	Poor to average, EA500 has bottom
010°	002	-8	015	Average, EA500 has bottom
020°	015	-5	010	Very good, EA500 has bottom
030°	029	-1	000	Good to very good, EA500 has bottom

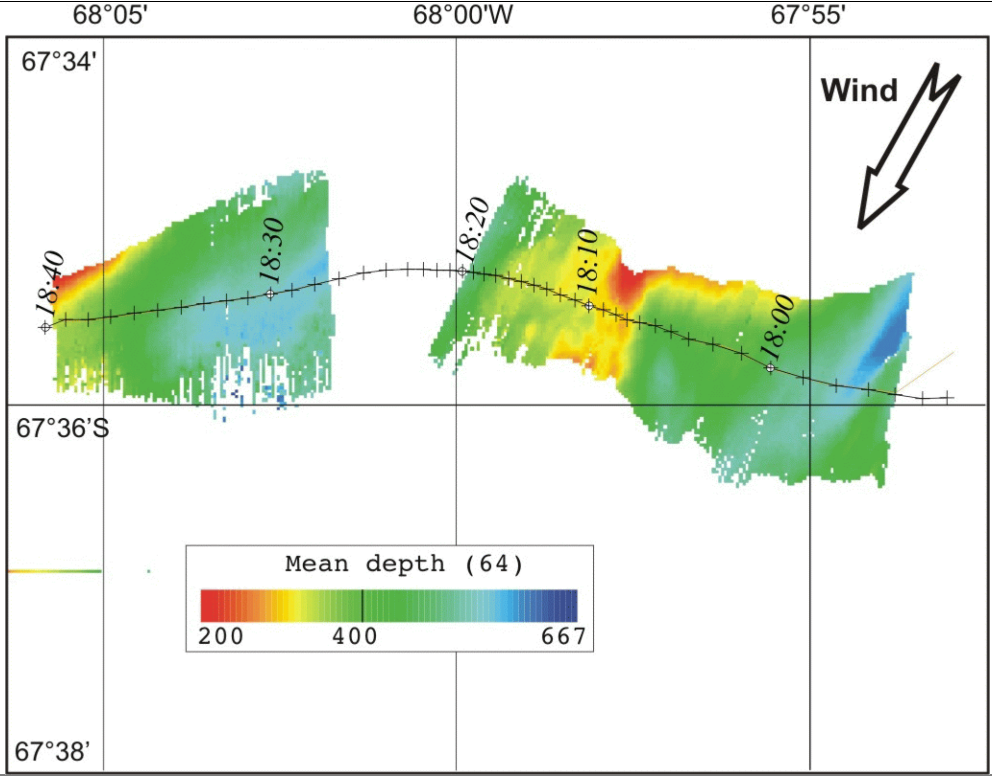


Fourth trial is to see if the EA500 experienced the same drop out, under the same conditions as the EM120, when it is run in active mode.

Leg 6 – Comparison EM120 to EA500 (active)					
First run					
Speed	**Heading**	**Course over ground**	**Leeway**	**Wind direction (relative)**	**Sea state**
4	103	118	15	270°, 30 knots	Rough
Good response from the EA500 in these conditions when in normal ping mode and active. EM120 lost signal.					



Second run					
Speed	**Heading**	**Course over ground**	**Leeway**	**Wind direction (relative)**	**Sea state**
4	293	280	13	080 & 25Kn	Rough
EM120 dropped out. EM120 switched off and EA500 set to normal ping and active. No return signal. Increased speed with the EA500 only. Signal returned at 6Kn and became good at 7.5Kn					



<u>Conclusions</u>

The EM120 and the EA500 display similar performance problems when the ship is running with 10° or more of leeway. Reducing the amount of leeway causes the instruments to perform more reliably.

An entry in the EM120 manuals indicates that the EM120 will not perform with a yaw of more than 10°. Currently it is uncertain as to whether the EA500 has the same limitations.

It is suggested that when the ship is being pushed through the water at an angle to its heading air is being sucked down along the hull and producing a thin layer of air across the transducers.

<u>Actions</u>

All PSOs should be informed that conditions producing more that 10° of leeway make the EM120 unreliable.

Captain Elliot suggested that the ship's models from the original design process should be tested in a tank to see what happens to the water flow under the observed conditions.

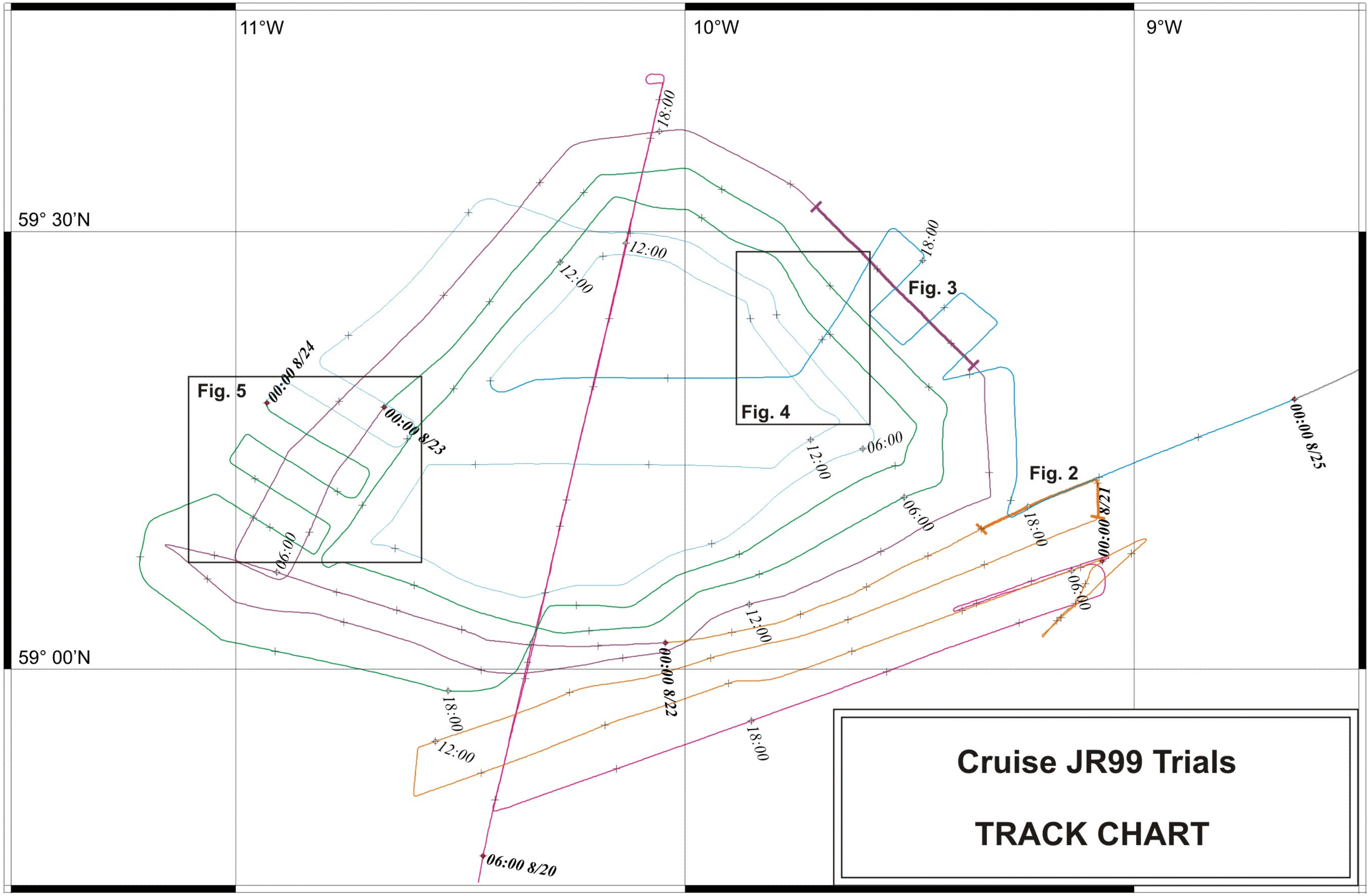

11°W
10°W
9°W
59° 30'N
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Fig. 2
Fig. 3
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18:00
12:00
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Cruise JR99 Trials
TRACK CHART

Leaving Cork Harbour