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Research & Consultancy Report No. 7

SV *Kommandor Jack* Cruise 01/05
11 Jul – 08 Aug 2005

Multibeam bathymetry and high resolution sidescan sonar surveys within the SEA7 area of the UK continental shelf

Principal Scientist
C L Jacobs

2006

National Oceanography Centre, Southampton
University of Southampton, Waterfront Campus
European Way
Southampton
Hants SO14 3ZH UK

Author contact details:
Tel: +44 (0)23 8059 6576
Fax: +44 (0)23 8059 6554
Email: clj@noc.soton.ac.uk

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AUTHOR
JACOBS, C L, et al

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ABSTRACT

The objectives of the *SV Kommandor Jack* 01/05 cruise were to collect EM120, and where water depths permit, EM1002 multibeam bathymetry and backscatter data, and also where desired, high resolution sidescan sonar data, over Anton Dohrn Seamount, George Bligh and Rosemary Banks, the eastern margin of Rockall Bank and selected areas of Hatton Bank. The aims were to

- create high quality bathymetric maps of the survey areas
- create acoustic backscatter maps over the same areas
- when possible, define the extent of any potential coral habitats
- create high resolution bathymetric, backscatter and sonar maps of specific features as may be discovered, such as mud diapers, carbonate mounds etc.
- complete, during the cruise, a preliminary interpretation of the above data, to be used as a guide for the sampling and seabed photography cruise which followed immediately

This was a highly successful cruise with virtually all cruise objectives achieved. 6,384 line-km of multibeam bathymetry and backscatter data were obtained in water depths between 150 and 2,400 m. In addition, approximately 240 line-km of high resolution sidescan sonar were collected in depths between 150 and 1,500 m, and 6,323 line-km of high resolution CHIRP profiles were also collected.

KEYWORDS
acoustic backscatter, bathymetric chart, cruise 2005, EM1002, EM120, Rockall Bank, Anton Dohrn Seamount, Hatton Bank, George Bligh Bank, Rosemary Bank, *Kommandor Jack*, *Lophelia*, carbonate mounds, multibeam bathymetry, seafloor mapping, sonar surveys

ISSUING ORGANISATION
National Oceanography Centre, Southampton
University of Southampton, Waterfront Campus
European Way
Southampton SO14 3ZH
UK

Not generally distributed - please refer to author

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CONTENTS

SCIENTIFIC PERSONNEL

Colin L. JACOBS	Principal Scientist	National Oceanography Centre, Southampton
Peter WAGENER	OSAE Party Chief	OSAE Ltd
Lorenz KARSTEN		OSAE Ltd
Stefan DASCHNER		OSAE Ltd
Maik STISKAL		OSAE Ltd
Jan ELVERS		OSAE Ltd
Holger KLENE		OSAE Ltd
Jurgen PASCHE		OSAE Ltd
Andreas VOGT		OSAE Ltd
Alexander IFFLAND		OSAE Ltd
Carolyn VOISEY	Marine Mammals	Ocean Maid

SHIPS PERSONNEL

Michael TAYLOR	Master
Phillip ALLEN	Chief Officer
Norman CUNNINGHAM	Second Officer
Edward STACHURA	Chief Engineer
Rolando BAUTISTA	Second Engineer
Diogenes BARROCAMO	Motorman
Ruben RODEO	Able Seaman
Edwin ABAT	Able Seaman
Joven DAYOT	Able Seaman
William ROSALDO	Able Seaman
Denmark PADILLA	Cook
Joel SECAPURI	Steward
Elve RICFUERTO	Steward

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ITINERARY

Sailed Fairlie, UK 22:00 UTC, 11th July, 2005
Docked Fairlie, UK 17:18 UTC, 8th August, 2005

Figure 1. The Research Vessel SV Kommandor Jack during mobilisation in Fairlie on 11 July 2005.

SEA7 REGIONAL SETTING

Seafloor Physiography and Geography

The physiography of the SEA7 area is summarised in Figure 2. The Hebrides Shelf gives way to the west at a shelf break of ca. 200 m into the Rockall Trough, a 2,700 m deep (shallowing northward) basin that separates the shoal areas of the Hebrides and Malin Shelves from Rockall Bank. Three large seamounts sit within the Rockall Trough, from south to north they are the Hebrides Terrace Seamount, which sits adjacent to the UK continental slope and rises from 2,300 to 1,000 m, Anton Dohrn Seamount, a distinctive seamount that sits in the centre of the northern Rockall Trough and rises from 2,200 to 600 m waterdepth, and the Rosemary Bank, a very large moated seamount that sits at the northern end of the Rockall Trough and rises from around 2,200 m in its moat to 500 m. Further to the west is the Rockall Bank, and a large area of various shoals and ridges that include the George Bligh and Hatton Banks, which rise from 1,100 m to about 500 m. The northern Rockall Bank shoals to 200 m over much of its area and has the small pinnacle of Rockall Island.

Figure 2. Physiography of the SEA7 survey area.

Seafloor Sediments

Previous studies in parts of SEA7 have allowed a generalised overview of the types of sediments to be expected in various parts of the SEA7 area, and work undertaken for the AFEN consortium (AFEN 1998, 2000) and academic studies (Wheeler et. al. 1999, Bett et. al. 2001) have allowed a further level of detail to be unveiled, especially within areas such as the NE Rockall Basin.

Generally speaking, in waters less than ca. 500 m deep relict iceberg ploughmarks will be encountered, away from the main European shelf edge these will be from drifting icebergs as opposed to calved bergs from grounded ice sheets. In the NE Rockall Basin below the iceberg ploughmarks, down to approximately 1,100 m there is a zone of predominantly gravely sand, but also some areas of sand and muddy sand, with Holocene deposits being of the order of 20 cm, thick over the entire Basin area. Lineations on sonar records suggest that there are strong bottom currents within the NE Rockall Basin at these depths. The lower continental slope is characterised by sand and silt contourite deposition, often in the form of sheets up to 25 cm in thickness. The centre of the NE Rockall Basin has sediment drifts and north or north-northeast migrating sediment waves with amplitudes of 10-15 m and wavelengths of 1.5 km. Other features of note here are the *Lophelia*-topped 5 m high, ~70 m wide mounds, probably best characterised as sand volcanoes, and now known as the Darwin Mounds. To the east and south of the Darwin Mounds, is a field of pockmarks that individually range in size from 20-50 m across.

Further west, along the northwestern margin of the Rockall Trough, bottom water flow generates a large contourite formation known as the Feni Ridge, which runs along the whole length of the western margin of Rockall Bank. The seabed at the northern edge of the Feni Ridge is dominantly erosive implying substantial bottom current accelerations as currents are deflected around George Bligh and Rockall Banks. Limited sampling in the region indicates that sediments are usually 20 cm or so of foram-rich marls overlying glaciomarine silty-clays with admixtures of sands and dropstones. Some science investigations at the northern end of Rockall Bank looking for thermogenic gas and gas-escape structures have proved so far inconclusive, though results suggest that faults may occur at the seabed near George Bligh Bank, however, the occurrence of sediment waves is also a possibility for small-scale surface irregularities.

Tides and Currents

Two main water masses can be recognized in the Rockall Trough, although both have complex origins. An upper water mass, referred to as Eastern North Atlantic Water (ENAW) occupies the upper 1,200 to 1,500 m of the water column. Below this, the lower water mass consists primarily of water derived from the Labrador Sea. Overall flow patterns within the ENAW are complex, with "irregular movements of eddies and gyres" superimposed on an overall northeasterly transport. Consistent flow towards the northeast occurs only in a narrow zone along the Hebrides slope, between the shelf edge and depths of about 1,000 m. The deeper part of the northeasterly flow is blocked by the topography of the Wyville-Thomson Ridge and is probably deflected to the west, although there is little published evidence for this. The deeper water mass circulates in an anticlockwise direction around the Rockall Trough, constrained by the topography. In additional Norwegian Sea Overflow Water enters the Rockall Trough across the Wyville-Thomson ridge, and some of this flow is deflected southward along the western margin of Rockall Trough.

CRUISE OBJECTIVES AND SCIENTIFIC RATIONALE

The objectives of the *SV Kommandor Jack* 01/05 (KJ01/05) cruise were to collect EM120 and where water depths permit, EM1002 multibeam, backscatter and also high resolution sidescan sonar data over the seamounts of Anton Dohrn, George Bligh and Rosemary Banks and primarily the eastern margin of Rockall Bank and selected areas of Hatton Bank. The aims were to

- create high quality bathymetric maps of the survey areas
- create acoustic backscatter maps over the same areas
- where possible define the extent of any potential coral habitats
- create high resolution bathymetric and backscatter maps of specific features as may be discovered, such as carbonate mounds etc.
- complete, during the cruise, a preliminary interpretation of the above data, to be used as a guide for the sampling and seabed photography cruise which followed immediately

The scientific rationale behind this research programme is guided by potential future hydrocarbon exploration along this sector of the UKCS in combination with the need to investigate areas deemed high priority/potential ANNEX I exclusion zones by the JNCC. Whilst at this stage it is not possible to be definite about the actual locations of future seafloor installations and/or drillsites, exploration wells are moving to ever deeper waters and further offshore into areas where little or no details are known about seafloor conditions except on the broadest of scales. This mapping exercise, in partnership with the sampling and photography studies defined by a team from the Scottish Association for Marine Science (SAMS) and to be carried out on the following Leg, will allow a holistic picture to be obtained of the seafloor within this environmentally sensitive and globally important area). The first step to support detailed scientific studies of the seafloor environment of SEA7 is to produce in a geographically prioritised manner, an accurate base-map of the topography, and, as a derivative, a seafloor acoustic reflectivity map which in turn will allow large-scale differentiation of the varying habitats within the diverse frontier area of SEA7. Where seafloor conditions are interpreted as being markedly different and/or unusual, the second step is to undertake a sampling and photo-reconnaissance mission to allow "ground-truthing" of the geophysical data and definitive description and quantification of the benthic biology and geology.

Specific targets are the UK's largest seamounts, Anton Dohrn Seamount and Rosemary Bank, which are thought to be hotspots of seabed biodiversity. It is believed that they may harbour unique populations as a result of their isolation from areas of similar depth for millions of years, yet, at the same time, these potentially unique marine environments are both poorly known and threatened by over-fishing. Slightly further to the west are the triumvirate of George Bligh Bank, northern Rockall Bank and Hatton Bank, which whilst being in relative close proximity to each other, have also been separated from the European continental shelf for millions of years and may also contain a unique biodiversity. Further, the bases of these features are known to be areas of higher than normal current activity and depending upon whether in the lee or main-stream of any current, different habitats, and therefore biota, may be expected.

Recognition of the general importance of seamount biodiversity is not matched by knowledge of detailed biological composition and ecology, let alone the origin and possible endemicity of species at individual seamounts (Rogers, 1994). There is also growing concern regarding their vulnerability to anthropogenic disturbance. These seamounts have been highlighted by the Joint Nature Conservation Committee (JNCC) as potentially qualifying under Annex I of the EU Habitats Directive for designation as offshore marine Special Areas of Conservation (SAC), on the basis of the possible occurrence of the cold water coral *Lophelia pertusa* (Roberts et al. 2003) and other reef-forming species. It is known that trawlers have already targeted these seamounts for orange roughy and other commercially-valuable species (Koslow et. al. 2000, BIM 2002) but there is no detailed information on the extent of seabed disturbance or consequences for benthic communities.

Along with the high quality bathymetry, acoustic reflectivity maps that, with interpretation, serve as a proxy for habitat differentiation (seafloor type) will also be produced. Once interpreted, these reflectivity maps will allow precise targeting for the high-resolution sidescan, sampling and photographic studies to be undertaken that will "ground-truth" the reflectivity maps. Along all survey tracks it is proposed to use a high-resolution profiler that will give a detailed view of the upper sedimentary section of the seafloor, enabling habitat modifiers such as faults (potential fluid migration pathways), (? carbonate) mounds, and shallow subsurface blanking (due to gas) to be identified as well as discrete local or regional sub-bottom sediment packets.

SURVEY STRATEGY

After discussion with the OSAE party chief, it was decided that most of the proposed survey areas could be surveyed as single blocks, but that the East Rockall Bank Margin would be split into two blocks. The long passage/transit survey lines were planned so that each represented a SAMS sampling transect, and each would be considered as a separate survey "block".

CRUISE NARRATIVE (All Times UTC)

Monday 11 July (Day 192)

Whilst alongside, a safety briefing and tour of the vessel was given by the Chief Officer. The vessel sailed from Fairlie at 22:00 after temporary repairs were affected to the ship's main crane. It had suffered a fault in its electrical starter circuit for the hydraulic power pack. The transit to the EM120 calibration site began at full speed as soon as the vessel was clear of the inshore area.

Tuesday 12 July (Day 193)

Typical North Atlantic grey with light rain has settled in to replace the 30°C and clear skies of Fairlie. However, there was only a slight wind and a swell of around only 1 m allowed a transit speed of around 10 knots to be maintained for most of the day. An Emergency Muster drill was held early in the afternoon. The vessel arrived in position for calibration of the EM120 at 16:30, and this commenced with a Sound Velocity Probe (SVP) dip to ~100 m, followed by a short transit to deeper water and an XBT to 1,100 m. Then short reversed lines to tie-in calibration offset values were run.

Wednesday 13 July (Day 194)

The EM120 calibration was completed by 00:35 and the first survey line (SAMS2A) was begun, at a target speed of 7 knots at 01:00. All systems were on-line, though many re-boots of the navigation logging/display system were needed, and surveying was suspended for a total of four hours whilst the problem was sorted. The weather in the morning was excellent for survey, sunny and light, though strengthening winds. By late evening (22:00) winds had picked up to 30 knots over the port quarter and the survey speed had reduced to around 6 knots, which by midnight had reduced to around 5 as the sea and wind continued to increase.

After email from JNCC confirming the locations of the "proposed JNCC area closures" on Rockall Bank, a decision was made to extend the SAMS2A line out to 57°27.0'N 14°48.0'W which took the survey through the westernmost of the "proposed JNCC area closures" for a very small time penalty (approximately 8 hours using EM1002 only). The original survey plan already included the easternmost "proposed closure area". This revised plan was to study the acoustic reflectivity of the EM1002 as we transited the target area, and if features were seen to use the transit back across Rockall Bank toward Anton Dohrn with the high resolution sidescan deployed and thus make a high resolution reconnaissance survey across this western "proposed JNCC area closure", an area which currently has virtually no surficial geophysics coverage. Should we deploy the Geoacoustics sidescan, this will only add a further couple of hours to the survey time.

Thursday 14 July (Day 195)
By mid-morning (08:00) the wind had dropped by ~10 knots, and had moved around to be more bow-on (W-WNW). Survey speed had increased slightly and was between 5 and 6 knots. The multibeam systems had been switched to the EM1002 and although the vessel was pitching significantly into the swell, the data quality was still good. An early review of the incoming backscatter indicates that a sidescan survey would be very useful indeed. The vessel reached the end of line SAMS2A at 16:25 and slowed to deploy the sidescan. This was deployed by 16:50 and set to run at 500 kHz with a 100 m range (per side) to obtain the highest possible resolution images. Survey Line SAMS2B was started at about 17:45, with an ever clearing sky and decreasing wind. On-line results showed a fabulous data set from both the EM1002 and especially the sidescan sonar.

Figure 3. The launch of the Geoacoustics sidescan sonar fish.

Friday 15 July (Day 196)
The sidescan survey finished at 03:58 when the effective depth limit of the EM1002 was reached, and the fish was recovered. The survey continued using the EM120 until 07:36 when another calibration SVP was dipped in 1750 m of water. Surveying resumed at 11:04 after the dip was completed and the new calibration data downloaded. The delay was due to another crash of the navigation software, which is thought to be due to a “WINDOWS” problem more than anything else, with the main cause seeming to be the continually-updating moving map used by the deck officers to keep the vessel on-line. Other versions of this software were used to enable surveying to continue. The survey of Anton Dohrn Seamount began at 15:36 with a transect right across the top and onto a sediment drift at the base of the seamount on its western side. The sides of the seamount were however so steep (~1:3) that

imaging proved difficult and will need careful planning as we progress with this survey.

Saturday 16 July (Day 197)

Surveying the top of Anton Dohrn continues in foggy, though slowly clearing conditions through calm seas. To take advantage of the good weather, a 500 kHz sidescan run was undertaken virtually East-West across the summit of the seamount just south of latitude 57°30'N. It was quite difficult to safely "land" the fish onto the edge of such a steep-sided feature, so the easternmost edge was not imaged. However the transect was completed across the rest of the summit, with coverage on the western flank down to depths of ~900 m. The USBL beacon attached to the tow-cable just above the fish failed to respond after just a short while in the water, and so manual cable-out data had to be recorded and hand-entered into a database. After completion of the sidescan run, the tow-fish was recovered along with the USBL head and the survey of the summit area of Anton Dohrn resumed at 7 knots.

Sunday 17 July (Day 198)

The sea and wind both increased by morning with subsequent noise on the data as the survey across Anton Dohrn summit continued. The northern half of the summit survey was completed and a semi-circular transit standing just off the eastern shelf-break was started at about 17:15 to ensure 100% coverage of the very steep slopes just over the shelf-break (the seamount slopes are so steep that slope-orthogonal surveying was unable to image them fully). Surveying of the southern $1/3^{rd}$ of the summit area continued, although the swell did slow speed and adversely affected data quality.

Monday 18 July (Day 199)

By morning the wind had increased significantly and the swell was >2 m causing data quality problems. The vessel was slowed to try and reduce pitching, but with a survey

Figure 4. Even though the photograph shows the swell was not that large the data quality was severely reduced whenever the vessel pitched, probably due to aeration under the transducers.

speed of ~4 knots the data was still noisy, and with such steep topography over the seamount flanks there were no options for altering track-line orientation, so surveying continued. Also the southern flank of the seamount was a little more extensive than believed from existing charts, and this coupled with the swell and consequent low survey speed meant that the Anton Dohrn survey continued through into the night, though thankfully with ever-improving swell conditions.

Tuesday 19 July (Day 200)
Surveying around the flanks of Anton Dohrn to fill in the last data gaps continued though at 00:53 we had to simply transit to the next survey line as the swell from the north was too bad to collect useable data, and at 06:25 we continued the survey. Another transit was made to the western flank of Anton Dohrn between 10:35 and 13:51, where, in much moderated weather, the final sector of survey was begun. The survey block of Anton Dohrn was finally completed at 17:24 and course was set to begin the transit across Rockall Trough for the East Rockall Bank survey at 17:31. Multibeam data was still being logged during this transit but speed was considered more important as there were no potential ground-truthing targets along the transit.

Wednesday 20 July (Day 201)
Prior to beginning the East Rockall survey both SVP and XBT dips were done to ensure data quality was maintained. Surveying of East Rockall (southern) block began at 00:52. The weather was very benign, the wind was <10 knots and the swell had diminished to <1 m. Surveying along the southern section of the East Rockall margin progressed very smoothly.

Thursday 21 July (Day 202)
There was a dense fog from early in the morning. This meant that the sea was flat and data quality superb. The survey of East Rockall continued to make progress upslope, though in places the steepness of the upper slope meant that some lines had to be adjusted and the vessel re-positioned during the survey. Also problems turning the vessel too fast for the multibeam along the adjusted survey lines meant that some time was lost as some portions of those lines then had to be re-run. Between 17:12 and 17:58 an SVP and XBT were also completed. During the night a Norwegian long-line fishing vessel passed in front of the *Kommandor Jack* trailing lines causing us to make a 1-hour transit around the vessel. No data were lost.

Friday 22 July (Day 203)
The South Rockall survey continued in fine weather, the survey finally concluding at 14:22. It was decided to use this fine weather window to make a speedy transit to the Hatton Bank survey area, rather than face the possibility of battering through high winds for perhaps two days or so at a later period. With the vessel at full speed for the transit, we continued logging of the EM12, though for soundings only, and also the CHIRP, recognising that the data will likely be degraded due to the high speed of the vessel.

Saturday 23 July (Day 204)
The weather during the transit remained in our favour, and a single transect was run across the summit of Hatton Bank to try and see if the gross topography would enable an efficient survey plan to be devised, though sadly this did not prove to be the case and lines were run NE-SW approximately along the trend of the Bank summit. The

Hatton Bank survey block was reached at 9:36, when the vessel was stopped and SVP and XBT dips taken. The survey began at 10:10 at a speed of 6 knots to ensure highest quality and along-track resolution.

Sunday 24 July (Day 205)
The Hatton Bank survey continued through the day, and as a number of very unusual ~E-W lineated highs (50 m) and lows (to 100 m) were imaged running down almost to 1,000 ~m on the western flank of Hatton Bank the survey was extended further than the original pre-cruise plan to try and fully delineate the occurrence of these features.

Monday 25 July (Day 206)
Excellent weather early in the day allowed very good quality data collection as the survey of the lineated highs and lows on Hatton Bank continued with a 4-track swath completed to the west to see how deep the features went, followed by exploratory tracks to the southeast and then to the east to try and delineate their boundaries (or extensions) in those directions. The southeastern track turned up what appeared to be a series of linear aligned depressions (~100 m deep) on the southern flank of Hatton Bank, so further time was invested in looking at the distribution of these. The weather deteriorated during the evening and the seafloor terrain also proved rather formidable across the ridges and troughs that we wished to investigate, so it was decided not to use the 500 kHz sidescan, but to finish the EM120 work in this region and then move to the crest of Hatton Bank for a transit along that back toward George Bligh Bank and complete the East Rockall Bank survey. This transit along Hatton Bank was begun at 23:28.

Tuesday 26 July (Day 207)
The eastward transit along Hatton Bank was made with Force 6 winds mostly against our starboard beam, and although we also had a rising sea state data quality was still good at a speed of 7 knots. The turn south toward George Bligh Bank was made at 16:14 in ever decreasing winds and seas.

Wednesday 27 July (Day 208)
The first survey line along East Rockall (north) was begun at 02:18, and run approximately along the 1,000 m contour (as taken from the latest GEBCO bathymetry) and subsequent lines run firstly upslope from this, then, down-slope. The weather was not the best for survey with a swell from the northeast, but data quality was more than adequate. The slope topography was sadly too rough for a 500 kHz sidescan survey.

Thursday 28 July (Day 209)
The East Rockall survey continued in reasonable weather, with winds decreasing through the day from F4/5 to F3, though again the very steep slopes just off the shelf-break meant that on occasion the vessel had to be re-positioned and lines re-occupied.

Friday 29 July (Day 210)
The complex topography of the Rockall Bank at it’s northern edge required two extra survey lines to be undertaken to ensure 100% coverage of the upper continental slope (even so we were unable to get full coverage from the base of the slope to the shelf break). A 500 kHz transect had been planned down the continental slope, however

the steep slope angles meant that our options were restricted, and in fact our eventual chosen path was blocked by fishing buoys, so this transect was postponed until later in the cruise when it was hoped the fishing would have been completed and the buoys removed. The outermost survey lines of the East Rockall survey continued, with a short transit to the eastern part of the first East Rockall survey block to ensure good coverage around 57°30'N.

Saturday 30 July (Day 211)
Completion of the northern section of the East Rockall survey block was at 00:40, when course was set for a transit to the SAMS3 transect from Anton Dohrn seamount to Rosemary Bank. SAMS3 (Part 1) was begun at 07:25. The ships speed was increased to full whilst we crossed Anton Dohrn seamount as we already had coverage in this area, and in fact a high speed was maintained through most of the day along SAMS3 due to very calm conditions. At 19:58, the intersection of SAMS3 and SAMS1, following an SV and XBT dip, we switched coverage to run east, up the continental slope, along SAMS1.

Sunday 31 July (Day 212)
At 06:27 the eastern end of SAMS1 was reached and a course set to run a survey line to the north across the NE Rockall Basin. This area was surveyed using the TOBI deep-towed sidescan system in 1998 for the AFEN consortium, and this transect should allow cross-correlation of the results from that underway study with this. The northern transect was completed by 13:38 and the vessel then headed east for the start of the SAMS3 (Part 3) transect. The navigation system crashed at 14:00, the first time in a couple of weeks that we have experienced a problem and it caused just over 1/2 hour downtime. At 23:36 the northern end of SAMS3 was reached and surveying began southward.

Monday 1 August (Day 213)
The Rosemary Bank summit survey began at 04:19 after an SVP and XBT dip, and throughout the day weather conditions worsened, with a swell from the southwest increasing in height and consequently slowing survey speed and decreasing data quality.

Tuesday 2 August (Day 214)
Through the early hours of the morning the winds dropped but the swell was still significant enough that heading East surveying was comfortable at around 7 knots, but, when heading West the speed had to be reduced to around 5-6 knots, this was especially true later in the afternoon when the headwind picked up speed again.

Wednesday 3 August (Day 215)
The weather deteriorated through the previous night and early hours so that by 08:00 the winds were F7, regularly gusting to 8, and, more importantly, the sea was running with a 3-4 m swell, severely hampering speed (down to 4 knots or less into the swell) and data collection. Thus any notion of running a deep sidescan line was abandoned on the grounds of safety during launch, and due to the fact that a N-S track orientation would also have proved dangerous to all on-board as this would have been beam-on to the swell. It was decided therefore to finished Rosemary Bank and then sail west

toward George Bligh Bank with logging suspended due to the weather. This meant having to abandon the short central section of SAMS3, but this is not as bad as it seems, the line section missing is quite short and other high quality data (e.g. *RRS James Clark Ross*) does exist that will fill most of the gap. The Rosemary Bank EM120 survey was completed at 17:01. The weather had remained bad throughout the day and speed westward was reduced to between 4-5 knots.

Figure 5. The effect of the bad weather on the EM120. Note the two almost blank signal level boxes, centre-left and the "gaps" in the coverage monitor on the right.

Thursday 4 August (Day 216)

The winds had dropped but a 2-3 m swell was still running from the west making data collection still a little noisy. Surveying had resumed at 07:58 as the eastern flank of George Bligh Bank was approached. Survey lines were run "up-and-down" the flank rather than the preferred slope-parallel method to ensure that we had at least some coverage of the whole slope in case the weather turned again.

Friday 5 August (Day 217)

Surveying on the eastern flank of George Bligh Bank continued, although the swell was still giving problems when heading west early on, by evening this had moderated greatly and a fine sunny end to the day was in prospect. The survey lines were shortened to ensure coverage of the flanks and base of the seamount as apart from the ploughmarks there was not much other structure to see over the summit area.

Saturday 6 August (Day 218)

The EM120 system had a major problem at midnight, so whilst this was being investigated and as the weather conditions were extremely favourable, the opportunity was taken to have a sidescan run from the summit area of George Bligh Bank down its eastern flank to 1,500 m (the depth limit on the fish). The EM120 was successfully re-started during this run, and the swath survey of the southeast flank of George Bligh Bank was continued, both whilst the fish was being recovered and afterward until completion of this survey block at 19:57. The final survey line, SAMS1 was begun at 21:18.

Sunday 7 August (Day 219)
Survey completed at 09:05, and began transit to Fairlie.

Monday 8 August (Day 220)
Transit to Fairlie in amazingly calm conditions, and with wind and tide working in our favour the vessel made an amazing speed, allowing us to dock at 17:18.

Figure 6. The effect of the good weather and tides on vessel speed during the transit to Fairlie.

Tuesday 9 August (Day 221)
Demobilisation from KJ01/05.

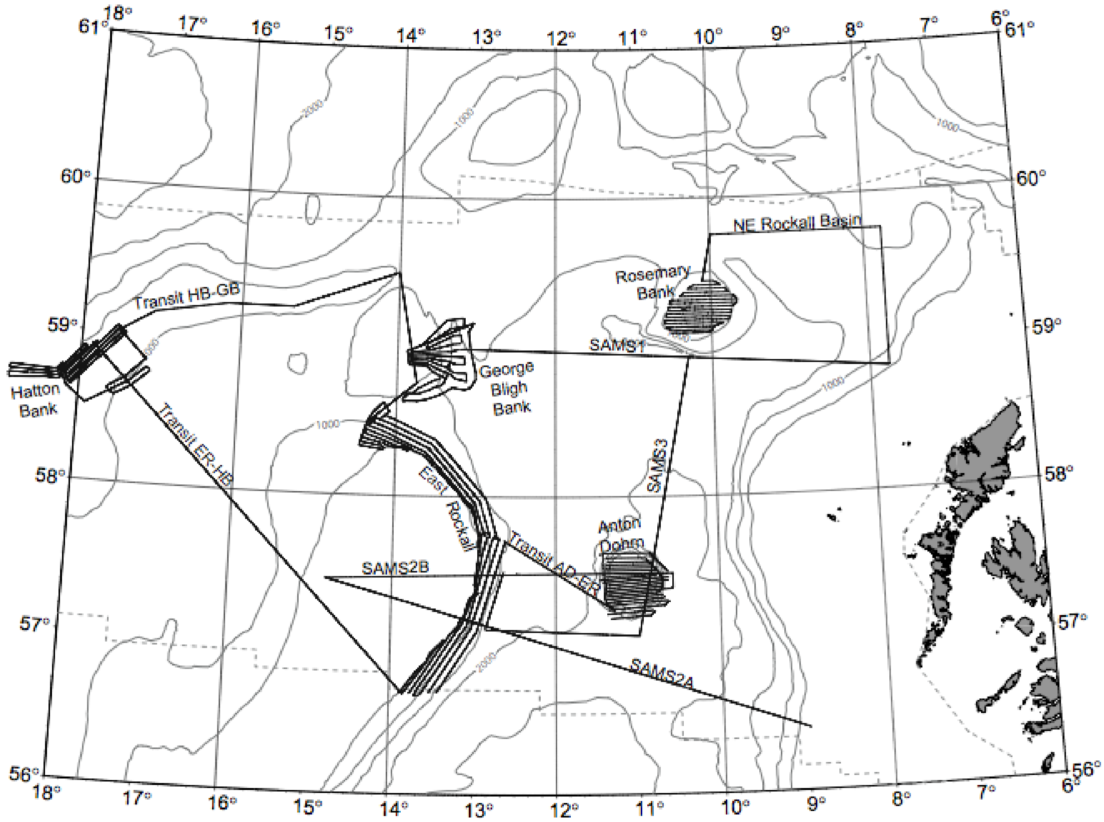

Figure 7 Final Track Chart showing survey blocks and Transects completed during KJ01/05

TABLE 1 Use of Time (Assumes Vessel "on-hire" and "off-hire" at 1200)

Date (Julian Day)	Mob/ Demob	Transit	EM120* EM1002	Sidescan Sonar[1]	Weather Downtime	Vessel Downtime	Technical Downtime
11 July (192)	10:00	2:00	-	-	-	-	-
12 July (193)	-	19:20	4:40	-	-	-	-
13 July (194)	-	0:35	19:14	-	-	-	4:11
14 July (195)	-	-	24:00	7:32	-	-	-
15 July (196)	-	-	24:00	4:50	-	-	-
16 July (197)	-	-	24:00	6:20	-	-	-
17 July (198)	-	-	24:00	-	-	-	-
18 July (199)	-	-	24:00	-	-	-	-
19 July (200)	-	8:48	15:12	-	-	-	-
20 July (201)	-	-	24:00	-	-	-	-
21 July (202)	-	0:55	23:05	-	-	-	-
22 July (203)	-	-	24:00	-	-	-	-
23 July (204)	-	-	24:00	-	-	-	-
24 July (205)	-	-	24:00	-	-	-	-
25 July (206)	-	-	24:00	-	-	-	-
26 July (207)	-	-	24:00	-	-	-	-
27 July (208)	-	-	24:00	-	-	-	-
28 July (209)	-	-	24:00	-	-	-	-
29 July (210)	-	1:29	22:31	-	-	-	-
30 July (211)	-	6:41	17:19	-	-	-	-
31 July (212)	-	-	23:27	-	-	-	0:33
1 August (213)	-	-	24:00	-	-	-	-
2 August (214)	-	-	24:00	-	-	-	-
3 August (215)	-	6:59	17:01	-	-	-	-
4 August (216)	-	7:58	16:02	-	-	-	-
5 August (217)	-	-	24:00	-	-	-	-
6 August (218)	-	-	21:45	6:48	-	-	2:15
7 August (219)	-	14:55	9:05	-	-	-	-
8 August (220)	6:42	17:18	-	-	-	-	-
9 August (221)	12:00	-	-	-	-	-	-
total Hours	28:42	84:58	573:21	25:30	-	-	6:59
total Days	1.20	3.54	23.89	1.06	-	-	0.29

* includes calibration time, SVP's and XBT's

1 running simultaneously with EM120 or EM1002

TABLE 2 Start and End-of Lines and Survey Blocks

Line / Block Name	START	STOP	Comments
SAMS2A	01:00/193	16:28/195	Transit from Malin-Hebrides Shelf to Rockall Bank
SAMS2B	17:11/195	15:36/196	Transit across Rockall Bank to Anton Dohrn
Anton Dohrn	15:36/196	17:24/200	100% coverage of seamount and flanks
Anton Dohrn to East Rockall	17:31/200	00:02/201	Transit from Anton Dohrn to East Rockall
East Rockall (South)	00:52/201	14:22/203	100% coverage of slope from shelf break to ~1,500 m
ER – HB	14:33/203	07:30/204	Transit from East Rockall to Hatton Bank
Hatton Bank	07:30/204	23:28/206	Obtain coverage of E-W highs and troughs, and NE-SW seabed depressions
HB – GB – ER	23:28/206	02:08/207	Survey along crest of Hatton Bank toward East, then South to George Bligh Bank and Rockall Bank
East Rockall (North)	02:18/207	00:40/211	100% coverage of slope from shelf break to ~1,500 m
SAMS3 (Part 1)	07:29/211	19:58/211	Between Anton Dohrn and SAMS1
SAMS1 (Part 1)	20:20/211	06:27/212	Running East
NE Rockall Basin	06:27/212	13:38/212	Coverage over western AFEN 1998 area plus survey to SAMS3 (Part 3)
SAMS3 (Part 3)	23:36/212	03:15/213	North of Rosemary Bank to SAMS1
Rosemary Bank	04:19/213	17:01215	Coverage of summit area above ~1,000 m
SAMS3 (Part 2)	Abandoned	Weather	South of Rosemary Bank to SAMS1
George Bligh Bank	07:58/216	19:57/218	Eastern flank of George Bligh Bank
SAMS1 (Part 2)	21:18/218	09:05/219	Running East

SURVEYING, DATA ACQUISITION AND OUTPUT

There were five main data acquisition systems: navigation, EM120 bathymetry and backscatter, EM1002 bathymetry and backscatter, Geoacoustics sidescan sonar and a Datasonics Chirp profiler.

Navigation
There were several DGPS systems onboard, but during this survey the C-Nav system was used as the primary system from which all other data acquisition systems took their time stamp. This system had a theoretical accuracy of better than 0.5 metres, which was way above requirements for this survey. The positional data was then run through the navigation logging and display software QINSy, with continuous QC checks being run during each watch.

Bathymetry
Following the use of the *SV Kommandor Jack* for the collection of EM120 bathymetry and backscatter data during the SEA4 survey in 2002 (Masson and LeBas 2002), a number of points were raised in that cruise report regarding the ability of the vessel to collect high quality bathymetric data in moderate/bad weather conditions, and also about the on-board data processing of backscatter data that often contained a degree of noise that could mask real alterations in the level of seafloor backscatter.

During this survey the following should be noted:

EM120 and bathymetric survey - The performance of the survey crew, vessel and the survey equipment was of a high standard and fully met the requirements of the survey. However, as in 2002, the limited ability of the vessel to collect good quality bathymetry data in moderate/bad weather conditions was proven. In winds of force 5/6 and/or sea states of 4/5, survey speed had to be reduced to between 4 and 6 knots, especially when steaming into the weather when the data quality degraded rapidly.

EM120 backscatter data - Following the reports from the 2002 multibeam survey, the quality of the backscatter data obtained from the EM120 system was as expected **–** i.e. disappointing and less than ideal for determination of habitat differentiation. In bad weather conditions (see above) often the backscatter data became totally unusable. Having said this, although the level of speckle noise affecting the data was often at a similar level to any ‘geological’ signals contained in it, it was possible to identify a number of geological boundaries, though it remains unknown how many more subtle changes in backscatter, and real geological differences, were not reproduced on the final production backscatter mosaics. The quality of the backscatter mosaic also depended upon the waterdepth, with the greatest amount of speckled noise in deeper waters, a very noticeable and significant change in quality above and below 800 m, with the shallower data being of quite good quality, whilst the deeper being very poor indeed. Looking at raw data on the EM120 console a similar step-change is seen, which suggests that this may be related to the in-built SIMRAD depth mode switching (and presumably data storage/compression) between shallow, intermediate and deep modes.

The EM1002 was only used for the first transit across Rockall Bank in good weather conditions, and it provided good quality results for both bathymetry and backscatter.

Sidescan Sonar
This system used a Geoacoustics SS942 fish and SS941deck unit. It was used over Rockall Plateau and Anton Dohrn summit and gave superbly detailed imagery of the seafloor for up to 100 m to either side of the tow-path of the vehicle. Sadly the long-range acoustic navigation beacon became unserviceable on the second (Anton Dohrn) deployment and so a simple layback model was used for tow-fish positioning, something which the acoustically navigated first deployment on Rockall Bank demonstrated was not as accurate as was ideal*. The final deployment was made over the eastern flank of George Bligh Bank. This deployment ran from the summit area of the Bank down to the depth limit of the fish, and went very smoothly, with at the end of the run 6 km of cable out for a depth of 1,500 m.

* During the deployment over Rockall Bank the ATS system showed that at times the tow-fish was displaced in a lateral sense relative to the vessel by up to 30 m. Simple lay-back positioning must always assume that the fish follows the towing vessel, which as demonstrated is not always correct. Further to this, although the cable-out data are logged on the OSAE system, the actual numbers for on-board processing are hand-entered into the processing system, which inevitably means an even higher degree of inaccuracy in the final charting. It would not take much for a software update to merge the cable-out and navigation data so that the best possible lay-back can be achieved.

CHIRP Profiler
The Datasonics CHIRP profiler proved reliable, though like the bathymetry systems, when the vessel encountered any adverse weather above F5 winds and sea-states of 4 and above the records degenerated very quickly and often when steaming into a swell, the data was almost unusable. The data was provided on paper records and also recorded digitally in SEGY format. Some of the best CHIRP data was obtained in the centre of the Rockall Trough where sub-bottom penetrations of up to 40 m were seen (SAMS3).

Data Output
The major data output product was a series of A0 size charts combining several or single data sets dependant upon the size of the particular survey block or region after discussion between the Client Representative (C L Jacobs, NOC, Southampton) and OSAE staff. Generally data was presented as a series of plots side-by-side comprising Track-line, Contours (at 50 m interval), Shaded Relief and Backscatter, with a Legend Box containing orientation, datum and chart-scale information. Scales varied from 1:100,000 for transit lines, 1:50,000 and 1:75,000 for specific survey boxes, and the 500 kHz sonar was output with the vessel track at a scale of 1:2,000. Some areas (e.g. Anton Dohrn Seamount) were of a sufficient size that each of the entire data sets was presented as a separate chart. All data were projected onto a datum of WGS84, and on appropriate UTM grids (areas 28 or 29). The CHRIP data were output in real time onto paper records (as well as being recorded digitally) that were subsequently cut to manageable lengths.

TABLE 3 Listing of CHIRP Profiler Rolls (by Day and Time)

Roll #	Start Time	End Time	Approximate Region
1	01:50/194	05:32/195	SAMS2A Transect
2	06:10/195	22:50/195	SAMS2B Transect
3	00:02/196	18:57/196	SAMS2B Transect and Anton Dohrn
4	19:08/196	11:46/197	Anton Dohrn
5	12:00/197	07:33/198	Anton Dohrn
6	07:57/198	23:09/198	Anton Dohrn
7	23:39/198	18:45/199	Anton Dohrn
8	19:01/199	16:16/200	Anton Dohrn
9	16:20/200	10:18/201	Anton Dohrn and transit to East Rockall
10	10:49/201	06:44/202	Transit to, and survey of East Rockall
11	07:11/202	17:12/202	East Rockall
12	18:23/202	06:20/203	East Rockall
13	06:53/203	22:52/203	East Rockall and transit to Hatton Bank
14	22:57/203	09:36/204	Transit to Hatton Bank
15	10:43/204	04:12/205	Hatton Bank Survey
16	04:33/205	21:54/205	Hatton Bank Survey
17	22:01/205	13:45/206	Hatton Bank Survey
18	14:51/206	23:27/206	Hatton Bank Survey
19	23:39/206	11:25/207	Hatton Bank Survey and transit to George Bligh Bank and East Rockall
20	11:28/207	00:13/208	Hatton Bank Survey and transit to George Bligh Bank and to East Rockall
21	00:20/208	14:16/208	George Bligh Bank and East Rockall
22	14:30/208	10:36/209	East Rockall
23	10:50/209	02:47/210	East Rockall
24	03:11/210	00:44/211	East Rockall
25	00:52/211	13:25/211	Transit to, and SAMS3 (Pt 1) and SAMS1 (Pt1)
26	13:33/211	07:27/212	SAMS1 (Pt 1) and N E Rockall Basin
27	07:35/212	00:12/213	N E Rockall Basin and SAMS3 (Pt 2)
28	00:48/213	18:58/213	SAMS3 (Pt 2) and Rosemary Bank
29	19:00/213	07:10/214	Rosemary Bank
30	07:11/214	00:54/215	Rosemary Bank
31	00:56/215	15:21/215	Rosemary Bank
32	09:26/216	20:51/216	George Bligh Bank
33	21:53/216	05:47/217	George Bligh Bank
34	05:57/217	23:57/217	George Bligh Bank
35	04:47/218	19:58/218	George Bligh Bank
36	21:30/218	09:05/219	SAMS1 (Pt 2)

TABLE 4 Charts Delivered

Printed Charts - by Area	No. of Charts in Series	No. of Copies	Scale
SAMS1 (Track, Shaded Relief, Backscatter and Contours)	4	2	1:100,000
SAMS2 (Track, Shaded Relief, Backscatter and Contours)	8	2	1:100,000
SAMS3 (Track, Shaded Relief, Backscatter and Contours)	4	2	1:100,000
Anton Dohrn (Backscatter Mosaic)	1	2	1:75,000
Anton Dohrn (Tracks)	1	2	1:75,000
Anton Dohrn (Backscatter Mosaic+Contours)	1	2	1:75,000
Anton Dohrn (Contour Map)	1	2	1:75,000
Anton Dohrn (Shaded Relief)	1	2	1:75,000
Anton Dohrn 500 kHz (Track and Sidescan)	5	2	1:2,000
Anton Dohrn to E Rockall Transit (Track, Shaded Relief, Backscatter and Contours)	2	2	1:50,000
East Rockall to Hatton Bank Transit (Track, Shaded Relief, Backscatter and Contours)	4	2	1:100,000
Hatton Bank (Tracks)	2	2	1:75,000
Hatton Bank (Shaded Relief)	2	2	1:75,000
Hatton Bank (Backscatter)	2	2	1:75,000
Hatton Bank (Contours)	2	2	1:75,000
Hatton Bank to George Bligh Transit (Track, Shaded Relief, Backscatter and Contours)	5	2	1:50,000
East Rockall (Tracks)	7	2	1:50,000
East Rockall (Shaded Relief)	7	2	1:50,000
East Rockall (Backscatter Mosaic)	7	2	1:50,000
East Rockall (Contours)	7	2	1:50,000
Rockall 500 kHz (Track and Sidescan)	12	2	1:2,000
NE Rockall Basin (Track, Shaded Relief, Backscatter and Contours)	3	2	1:50,000
Rosemary Bank (Track)	1	2	1:75,000
Rosemary Bank (Shaded Relief)	1	2	1:75,000
Rosemary Bank (Backscatter Mosaic)	1	2	1:75,000
Rosemary Bank (Contours)	1	2	1:75,000
George Bligh Bank (Tracks)	2	2	1:75,000
George Bligh Bank (Shaded Relief)	2	2	1:75,000
George Bligh Bank (Contours)	2	2	1:75,000
George Bligh Bank (Backscatter)	2	2	1:75,000
George Bligh Bank 500 kHz (Track and Sidescan)	4	2	1:2,000

TABLE 5 Digital Data Delivered

Type and Label	Contents	No. of Copies
DVD SEA7_2005_1	Raw EM120 Data (Days 193-208)	2
DVD SEA7_2005_2	Raw CHIRP Data (Days 194-201)	2
DVD SEA7_2005_3	Raw CHIRP Data (Days 202-206)	2
DVD SEA7_2005_4	Raw CHIRP Data (Days 207-212)	2
DVD SEA7_2005_5	Raw CHIRP Data (Days 213-219)	2
DVD SEA7_2005_6	Raw EM120 Data (Days 209-219) Raw EM1002 Data (Days 195-203)	2
DVD SEA7_2005_7	Raw Sidescan Sonar Data (Days 195-218)	2
DVD SEA7_2005_8	Final Processed Multibeam Data: Anton Dohrn, East Rockall, George Bligh Bank, Hatton Bank, North East Rockall Basin, Rosemary Bank, Transits, Documentation	2
DVD SEA7_2005_9	Final Processed Multibeam Data: SAMS1, SAMS2, SAMS3. Final Unprocessed Data: Track, SVP, Tide	2
CD SEA7_2005_01	PDF Charts: Anton Dohrn, East Rockall, Hatton Bank, SAMS2, Anton Dohrn to East Rockall Transit, East Rockall to Hatton Bank Transit	2
CD SEA7_2005_02	PDF Charts and Reports: George Bligh Bank, Rosemary Bank, SAMS1, SAMS3, North East Rockall Basin, Hatton Bank to George Bligh Bank Transit, Field Report, Calibration Report	2

PRELIMINARY INTERPRETATIONS AND SUMMARY OF RESULTS

The following sections relate to each identifiably separate section of the survey programme, and are named for their geographic location or after the transect number suggested by SAMS in the Scoping Report for this project (Jacobs et. al. 2005, unpublished).

The interpretations presented herein are an initial and preliminary version put together primarily for use on the second of the *SV Kommandor Jack* research cruises, they are not a definitive statement of the results of the 2005 SEA7 deep-water research programme funded by the United Kingdom's Department of Trade and Industry and managed by Geotek Ltd. A full and comprehensive report on the data collected during the *SV Kommandor Jack 01/05* research cruise will be published in due course.

Each area section ends with a short table summary of potential sites (if any) with that area, and at the end of the report section there is a full table listing potential sites for sampling and/or photographic study based upon the data collected during this research cruise.

SAMS1 (Transect from George Bligh Bank to North Hebrides Shelf)

Where this transect crosses George Bligh Bank, the interpretation should be taken from that section. Elsewhere the bathymetry shows that east of the George Bligh Bank moat, there is a drift-like high rising to 1,500 m, followed by a gentle slope down to just deeper than 1,950 m at 11°20'W, before shallowing by about 50 m on approach to Rosemary Bank moat. Generally over the transect, the acoustic backscatter shows very little variation until the flank of Rosemary Bank is reached, there the backscatter intensity increases observed will be due to coarser sediments from current-winnowing and basement outcrop at the base of the Bank itself. Further east, moving into the North East Rockall Basin, the backscatter again shows no variation detectable on the shipboard mosaics until the waterdepth is less than 800 m, and when the variation is barely detectable. The bathymetry and shaded relief both show a smooth seafloor and gentle inclined continental slope. CHIRP data along SAMS1 shows that over the whole transect, except for the area within Rosemary Bank moat, the seafloor is smoothly undulating with a well-stratified sequence of sediments sub-surface. Within the Rosemary Bank moat the seafloor shows a much higher level of acoustic backscatter on the CHIRP and an erosive surface that terminates reflectors. In other parts of the moat outcrop occurs as a 100 m-high block, and also adjacent to this outcrop the seabed exhibits a single, prolonged acoustic reflection from the seabed. The continental slope of the NE Rockall Basin shows a slightly stronger surface return than the rest of the transect, with a 5-10 m thick transparent layer immediately below the seabed, though upslope this grades into a layered section. There are a few very small rills eroded into the seafloor at intervals upslope. There were no potential targets selected from this transect.

SAMS2 (Transect from Malin/Hebrides shelf to Rockall Bank)

The transect down the Hebrides Terrace continental slope and rise showed the uppermost sediments to be an acoustically transparent lens varying in thickness from 5-15 m in thickness. This is interpreted as Holocene drape. Beneath this drape are chaotic debris deposits of the Barra Fan. Further down-slope subsurface debris deposits and possibly sands were mapped, but over the whole transect across the

Rockall Trough, there appeared to be unconsolidated sediment at the surface, the data not giving any suggestion of potential coral habitat, and even lateral sediment type variation was very difficult to detect. Even so, the CHIRP provided the best data across the Rockall Trough, however this mostly concerned sub-surface geology and did not directly address habitat mapping along this transect.

There was virtually nothing to see on the EM120 backscatter, just a uniform low-level backscatter across the whole of the Rockall Trough, and rough weather also hampered data quality. On the shallow regions of the Rockall (and Hebrides) Slope and shelf features were identifiable.

There was a single long transect run across Rockall Bank, almost along the 57°30' parallel and starting on the western margin at a depth of ~350 m. This line crossed through both the "western" and "eastern" proposed closure areas of the JNCC, and the fine-scale detail of this data was used for primary target selection.

From the start of the 500 kHz transect to about 350 m waterdepth which occurs at about 57°28'N14°46'W there are low-intensity backscatter ploughmarks and numerous camera targets and dropstones. Over the next few miles to the east the ploughmarks, usually with a distinct infill in their centre furrow, become much more highly backscattering and numerous camera targets (potential coral reefs) are seen. The ploughmarks are mostly 20-40 m wide, with CHIRP profiles showing they are generally ~5 m deep, with some up to ~10 m. A large number of potential camera targets are seen between 290 m at 14°40' and 240 m at 14°32'W, with the CHIRP profiles showing that most of the rough (5-10 m) topography of the seabed has vanished, and instead the seafloor is now a gently sloping feature with just a few undulations in the surface. Further east at 180 m (14°15'W) the ploughmarks are very well imaged and show that many contain potential biological structures.

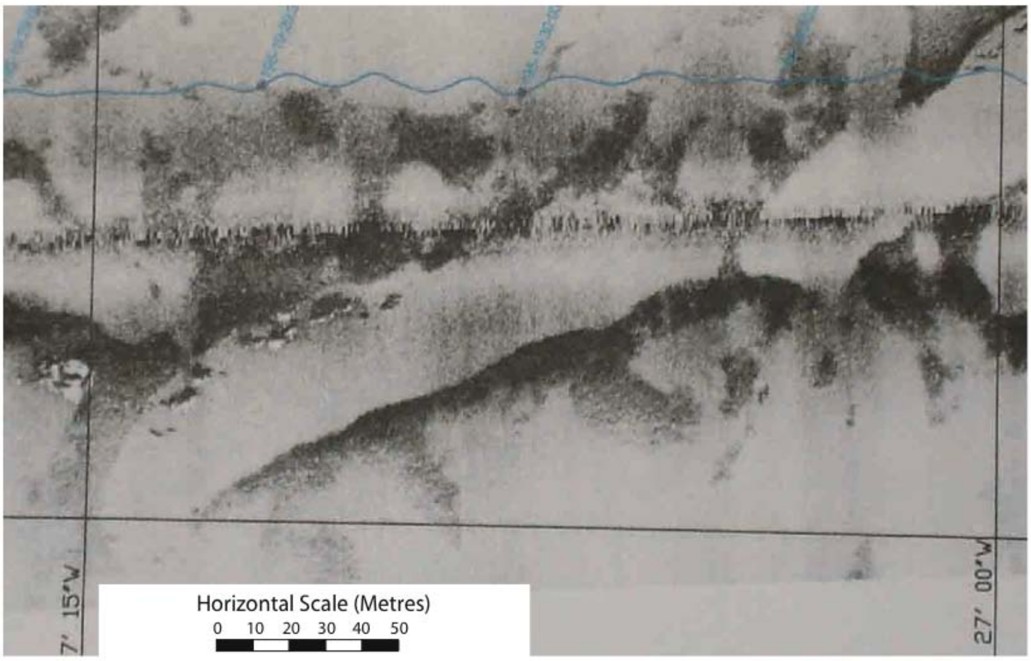

Figure 8 Ploughmarks and potential biological mounds on western Rockall Bank

Toward the 150 m contour at 14°03’W is an extensive zone of increasing higher backscatter toward the East, along with increasing signs of current activity such as ripples possibly small dunes, and current-parallel lineations. The ploughmarks virtually disappear as do the “biological” targets. East of 14°W where the depth is around 130 m, current features are indicative of a North to South flow direction, and trawl-marks become more evident. High-backscatter becomes the dominant seafloor type further east, by 13°25’ and at a depth of about 180 m, forming linguoid-barchan shapes.

Figure 9 Linguoid-barchan high-backscatter sheets on Rockall Bank

By 13°22’W as the shelf deepens to 190 m there is a return to alternating high and low backscatter sheets, often with intricate inter-fingering boundaries as they mix with and overlie each other. There is a very distinctive zone interpreted as outcrop at 200 m waterdepth, around 13°20’W within the general area of high and low backscatter. There are no identifiable pinnacles or other obvious non-geological features present on these outcrops. The low-backscatter areas separating each outcrop vary between 80 and 200 m in width, and each of these areas has its own ornament of higher-backscatter “streams” of 5-20 m in width that are orientated NE-SW. By 13°18’W ploughmarks once again dominate the seafloor below 210 m, though on this eastern flank they appear much degraded by current activity. These ploughmarks seem to be partially masked by lower-backscatter zones which contain individual high-backscatter blocks 2-4 m in size, often with some relief. Many of these blocks have halos of very high backscatter material around them, suggesting coarser material around a central block and thus are potential reef targets. These types of features were seen to the eastern end of the 500 kHz survey at 350 m waterdepth.

TABLE 6 SAMS2 Transect – Potential Sites for Ground Truthing

Site Label	Latitude	Longitude	Notes	Identifying System
SAMS2_A	57°27'02.5"	14°45'37"	Potential Reef, W Rockall Plateau	500 kHz
SAMS2_B	57°27'07"	14°43'58"	Potential Reef, W Rockall Plateau	500 kHz
SAMS2_C	57°27'14.5"	14°39'41"	Potential Reef, W Rockall Plateau	500 kHz
SAMS2_D	57°27'17"	14°38'53"	Potential Reef, W Rockall Plateau	500 kHz
SAMS2_E	57°27'17.5"	14°37'44"	Potential Reef, W Rockall Plateau	500 kHz
SAMS2_F	57°27'16.5"	14°36'45"	Potential Reef, W Rockall Plateau	500 kHz
SAMS2_G	57°27'22.5"	14°32'51"	Potential Reef, W Rockall Plateau	500 kHz
SAMS2_H	57°27'33"	14°26'30"	Iceberg Plough-marks, W Rockall	500 kHz
SAMS2_J	57°27'31.5"	14°27'12"	Potential Reef, W Rockall Plateau	500 kHz
SAMS2_K	57°28'01"	14°09'09"	Potential Reef, W Rockall Plateau	500 kHz
SAMS2_L	57°28'51"	13°27'43"	High Bksc. sheet, E Rockall Plateau	500 kHz
SAMS2_M	57°28'57"	13°20'15"	Outcrop/Reef, E Rockall Plateau	500 kHz
SAMS2_N	57°29'06"	13°10'21.5"	Potential Reef, E Rockall Plateau	500 kHz
SAMS2_O	57°29'10"	13°08'41"	Potential Reef, E Rockall Plateau	500 kHz
SAMS2_P	57°29'11.5"	13°05'59"	Potential Reef, E Rockall Plateau	500 kHz

SAMS3 (Transect from Anton Dohrn Seamount to Rosemary Bank)

This transect started 10 km south of Anton Dohrn where the seafloor is composed of horizontally-bedded deposits to the south of the very shallow moat (~10 m) that is in evidence on the CHIRP data to the south of the seamount. There is good sub-bottom penetration to over 30 m, showing a well-stratified drift-like deposit, the return-echoes being laterally discontinuous in terms of their strength with the uppermost 10-12 m being unconformable on the underlying material. The surface reflection is not particularly well-defined and cannot be interpreted in terms of habit, lithology, or small-scale (<5 m) topography. The EM120 backscatter shows the faintest hint of higher backscatter over the 2-3 km of drift deposits nearest to the seamount (including inside the shallow moat and on the surface of the "drift").

The section of SAMS3 over Anton Dohrn can be extracted from that section of this report.

The northern side of Anton Dohrn is similar to the southern except that here the moat is slightly broader. The sediments onlap onto the foot of the seamount, with, in the moat, an expanded section relative to the deposits that continue northward into the Rockall Trough. There is again only a very slight suggestion of higher acoustic backscatter levels from the EM120 over the area of the moat. The transect toward the north shows very little of note. The EM120 backscatter is of a uniform level almost the whole length of the transect, and the CHIRP shows an unremarkable section (to about 30 m sub-bottom) of well stratified layers, although there is a hint of possible low-amplitude sediment waves (with a height of < 5 m) and a wavelength of several hundred metres. However, they do not show in the contours or shaded relief, and without additional profiles it is not possible to prove they are real as opposed to (vessel) directional artefacts.

As with the section over Anton Dohrn, the section of SAMS3 across Rosemary Bank can be taken from that part of this report.

The short survey line to the south of Rosemary Bank was cancelled due to heavy weather, and it's loss should be of little consequence as the data is available from the *RRS James Clark Ross* cruise.

To the north of Rosemary Bank, SAMS3 extends for approximately 25 km. Similar to Anton Dohrn, Rosemary Bank has a moat around its northern margin. This moat is well expressed in the contours, shaded relief and EM120 backscatter as it is about 200 m deep and about 2.5 km wide. Although the contours indicate a rather broad, flat-floored moat, the CHIRP shows that there are in fact a number of acoustically transparent blocks, possibly parasitic cones from the seamount, that form a dam against which the sediment sequences rests. On the CHIRP profiles, the floor of the moat is represented by a single highly reflective seafloor echo, with no coherent sub-bottom reflectors. To the north away from the seamount, the CHIRP data shows a similar well stratified sequence as per the whole of the Rockall Trough transect. The EM120 backscatter shows a uniform low-backscatter return from the sediment surface, and it also detects as a higher backscatter return, the acoustic basement that is within the moat – however, this does not easily lend itself to interpretation as basement without the aid of the CHIRP.

NE Rockall Basin

Part of this area was surveyed during the AFEN surveys in 1998 and so it will provide an opportunity for comparative analysis of the different types of acoustic data.

The transect down the slope shows a smooth slope down to ~1,200 m with between 59°20' – 59°30'N a (know) sediment wave field being imaged. The waves are imaged both on the shaded relief and backscatter, where differences in sediment type are responsible for the very subtle backscatter variation. The run toward the west is over a virtually featureless, smooth seafloor, the CHIRP revealing a number of well-stratified sub-bottoms. As this area was surveyed during the AFEN 1998 survey, there is no intention of taking samples here, this transect was just for geophysical data comparisons.

Anton Dohrn

The seamount stands alone almost in the centre of the Rockall Trough. It has a circular shape and has a diameter of about40 km and a vertical relief of between 1,500 and 1,600 metres, rising from an average seafloor depth of 2,000 m on its western side and 2,200 m on its eastern, it has a domed top with a "shelf-break" at 850 m and thus it has almost sheer walls of over 1,200 m in height, with the "dome" across the summit region shoaling to ~550 m in the centre of the seamount. There is a slight moat to the northwest, where the seafloor is ~150 m below the regional depth, elsewhere there flanks of the seamount are marked by a simple slope apron from the regional depth up to the 1,500 m contour, which is where the walls become sheer. There are no canyons or gullies down the seamount flanks, the only "ornamentation" are a few small hills, possibly parasitic cones that site mainly adjacent to the seamount on its eastern and northwestern flanks. The relief across the summit area is generally a very uniform across the whole area, but in detail there are one or two "steps" in the topography, mostly on the southern flank of the summit. These may be due to primary structure (flow-front limits) or due to post emplacement faulting or even is some case, sediment slides. Most of these “steps” are 25 m or less in height, with the largest step being on the southernmost part of the summit at ~60 m. Other causes for topographic expression (again usually around 25 m or less) are basement outcrop.

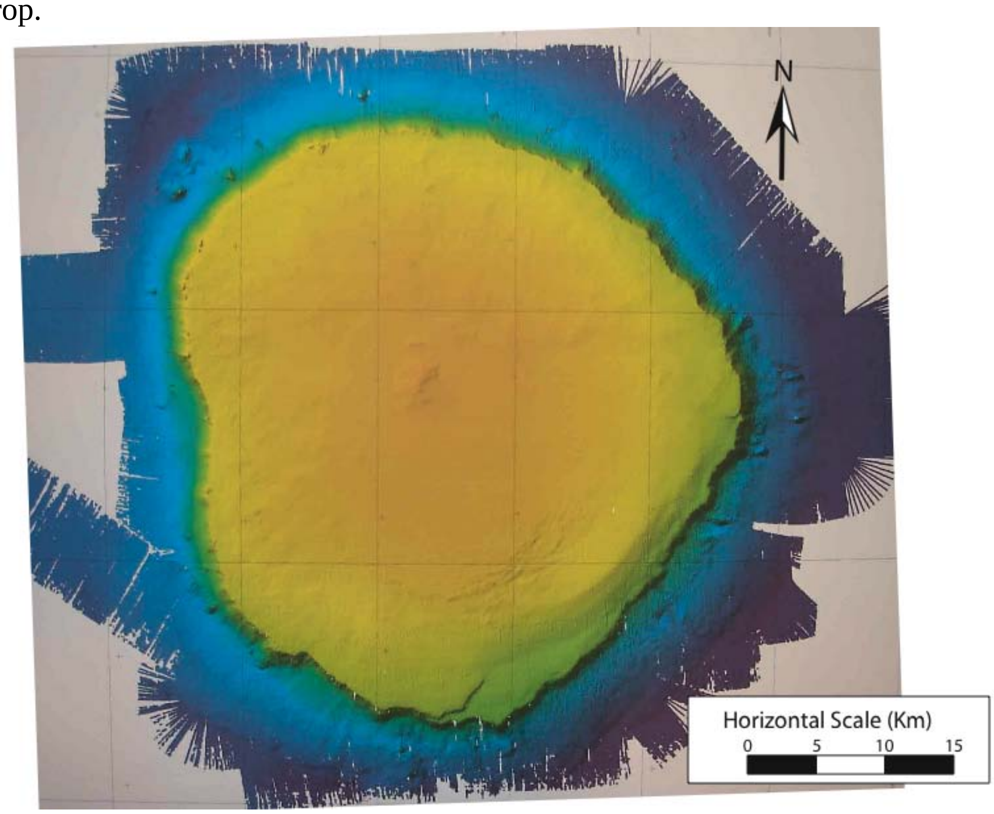

Figure 10. Anton Dohrn Seamount – Shaded Bathymetry

The EM120 backscatter shows a number of subtle changes that probably reflect differences of sediment type, especially over the north and western sectors of the summit area, however it is very difficult to correlate such backscatter changes with changes in the CHIRP profiles. To the east and south the backscatter changes are probably more to do with slope changes as they are very close to patterns observed on the shaded relief bathymetry. Acoustic basement outcrop over the seamount summit is easily defined as an area of darker acoustic backscatter than the surrounding seafloor, but other areas of acoustic basement outcrop are not imaged by the EM120. However, from the EM120 it is not possible to identify potential “biological” sampling or photography targets.

The CHIRP profiles show that over the whole of the seamount summit area there is a more-or-less uniform blanket of sediment cover, with at times a single sub-bottom reflector before the acoustic basement is imaged. Over much of the summit the acoustic basement can be imaged at depths of just 2-3 metres, though in other areas, and more especially in the south, the sediment cover is thicker. At a number of places the CHIRP shows scarp slopes varying between 5 and 50 m in height. These scarps reflect differences in the height of the basement (which is sometimes exposed) though from the data collected here and initial examinations, it is not possible to determine whether these scarp slopes are primary flow-fronts from effusive events or they are the hanging walls of faults scarps. The acoustic basement outcrop over the summit is easily correlated with that seen in the centre of the summit on the EM120, but it is imaged on the CHIRP at various places elsewhere, especially around the seamount summit margins.

The 500 kHz sidescan reveals for the most part a fairly uniform backscatter, though there are also numerous dropstones and trawl-marks. Across the centre of the seamount, the acoustic basement outcrop is imaged, and occurs as discrete areas of basement knolls each separated by several tens to hundreds of metres of sedimented seafloor. Also imaged are several areas of backscatter anomaly, with many almost circular higher-than-background backscatter halos around small areas of very high backscatter. These may well be biological in origin as there appears to be no geological or current phenomena that may be responsible.

TABLE 7 Anton Dohrn – Potential Sites for Ground Truthing

Site Label	Latitude	Longitude	Notes	Identifying System
AD_A	57°27’28.5”	11°03’11”	Potential coral colony on sediment	500 kHz
AD_B	57°27’18”	11°07’16”	Outcrop, potential coral habitat	500 kHz
AD_C	57°27’16”	11°07’37”	Potential coral colony	500 kHz
AD_D	57°30.9’	11°18.0’	Lithology Boundary	EM120
AD_E	57°29.0’	11°30.0’	Seamount apron characterisation	EM120
AD_F	57°29.0’	11°28.0’	Seamount apron characterisation	EM120
AD_G	57°29.0’	11°27.0	Seamount apron characterisation	EM120
AD_H	57°27’24” to 57°27’22”	11°04’38” to 11°05’12”	Trawl ecosystem damage	500 kHz

East Rockall Margin

A brief initial interpretation is presented of this region, the narrative of which runs from the UK-Ireland boundary in the south toward the north. Beneath the shelf -break at about 350-400 m, the upper slope drops away quite steeply to about 550-600 m with the slope itself incised with bights up to several kilometres across and hundreds of metres deep spread at intervals, though more especially focussed south of 56°55’N. At about 1-1.5 km from the foot of the upper slope is the crest of a sediment drift standing 100-150 m above the moat that runs between it and the actual slope edge. The crest of the sediment drift occurs at between 550-650 m, with the contours showing for the most part an even slope down to 1,100 m, where the contours show a 100 m vertical drop. This deeper step-change is more-or-less continuous through the area. Below this bathymetric step the contours show a generally smooth slope to the edge of coverage at about 1,800-1,850 m. The exceptions to the above description are a discontinuous gully, about 50 m deep that runs from NW to SE across the slope between the sediment drift at 500 m down to 1,600 m, and a sediment slide, whose slip-plane is centred at about 56°44’N 13°39’W. The area affected is only 4 km in width, the other features of note are a few small scours, of the order of 1 km across, occurring almost exclusively below 1,100 m. The backscatter reveals many iceberg plough-marks on the shelf area of Rockall Bank, with the upper slope showing a number of areas of high backscatter that are correlated with incisions/valleys.

The surface of the upper sediment drift shows a uniform level of backscatter, though there are subtle patterns suggestive of down-slope depositional events such as small-scale sediment flows or slides. South of 56°47’N 13°30’W there are two higher-backscatter areas with structures, textures and shapes indicating that they may be the remnants of old slope failures, confirmed by the CHIRP profiles. Toward the north the crest of the sediment drift deepens to 750 m, and there are more small-scale sediment slips degrading the upper sediment drift. These are mostly of the order of 1-3 km in breadth, the largest being 5 km wide centred at 57°18'N 13°00'W. Below the 1,100 m depth of the step, north of 57°00'N, there are many more backscatter indications of down-slope sediment failure and transport, confirmed by examination of the CHIRP data which show degraded (eroded surface) sediment slide deposits.

Around 57°22'N is where the orientation of the Rockall margin changes from largely NE-SW to NNE-SSW, with the upper slope now extending from the shelf-break to 700-750 m, with in some places the slope dropping by 200 m vertically in just 150 m laterally, however these steep slopes are only encountered between 400-750 m. Another major effect of this change in orientation is the disappearance of the well-defined upper section of the sediment drift. Small slope-failure scars are common, and are imaged near the two largest canyons along the margin (Figure 11). Both canyons are of the order of 100 m deep and appear to almost define the boundaries of an area of slope that exhibits many small slope-parallel ridges, perhaps indicating past instability. Both of the canyons are in close proximity to small failure scars (old and new) and it may be suggested that the canyons have actually developed from previous slope failure events as neither canyon is traceable to the top of the continental slope.

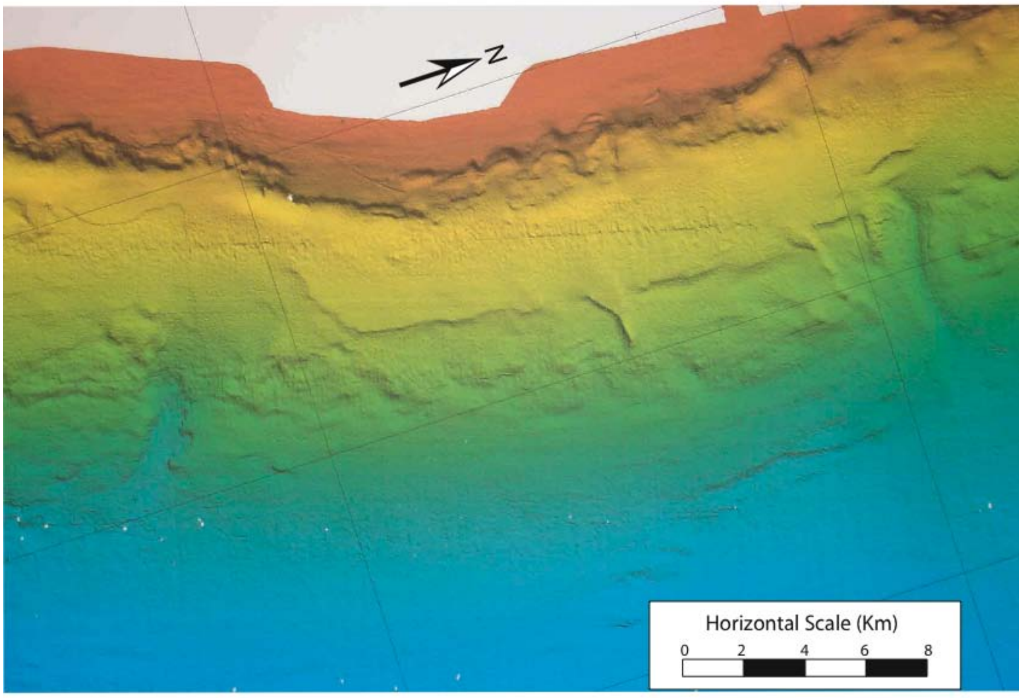

Figure 11. Canyons and landslides illustrated with shaded relief on the East Rockall margin.

Between the two canyons described above the seafloor exhibits a generally higher level of backscatter than elsewhere in this area, and also, especially over the immediate areas of both the canyons, the backscatter shows the distinctive down-slope patterns indicative of slide deposits (Figure 12).

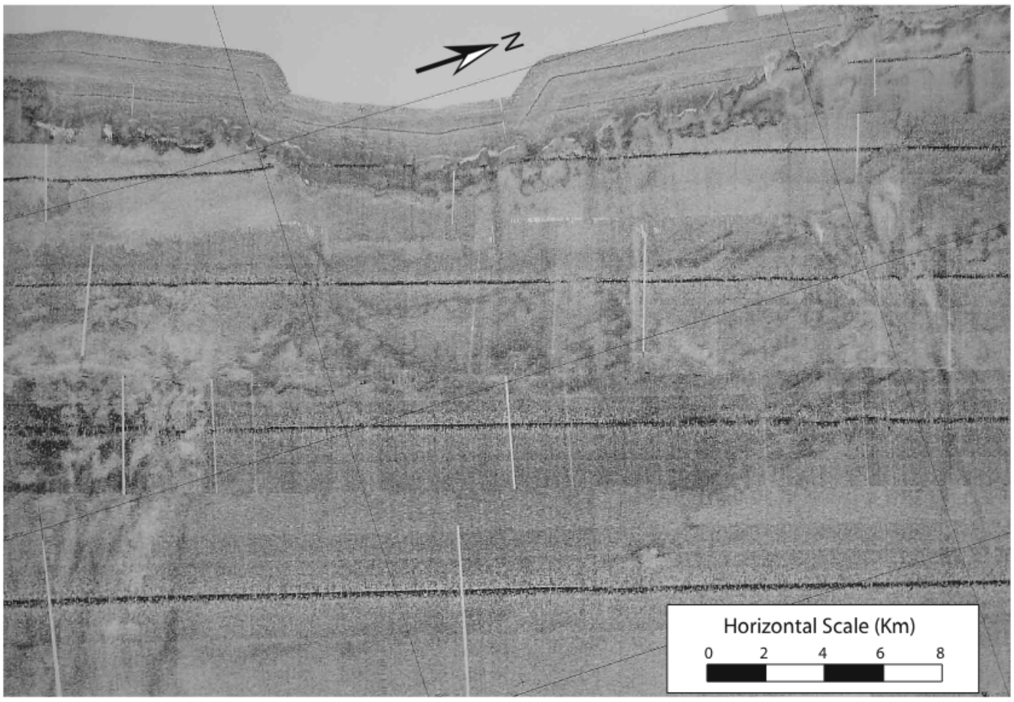

Figure 12. Backscatter mosaic over the area of canyons on the East Rockall margin showing typical textures indicative of sediment slides.

As the Rockall margin orientation moves from NNE-SSW through to NW-SE the shelf edge is at about 350 m and the upper slope is again extremely steep with the at about 600 m, thereafter the slope becomes gentle and smooth. There are few features presumably because the strong currents in this region are eroding all sharp-edged features. As the shelf curves further toward the west the shelf-break effectively disappears, the distance from the 500 m contour down to the 950 m isobath becoming a broad (7 km) smooth slope. The upper part of the slope does however retain the iceberg plough-marks and the eroded embayments and bights that characterise the rest of the Rockall Bank shelf and margin further to the south.

One of the few features on the mid-slope along this part of the East Rockall margin lay between 13°30' and 13°40'W, where the shaded relief shows a 5-10 m topography on the seabed surface and the backscatter shows a distinctive texture. This feature lay immediately down-slope from an embayment, and the CHIRP over this area shows that is a now-buried and sculpted slide deposit (Figure 13).

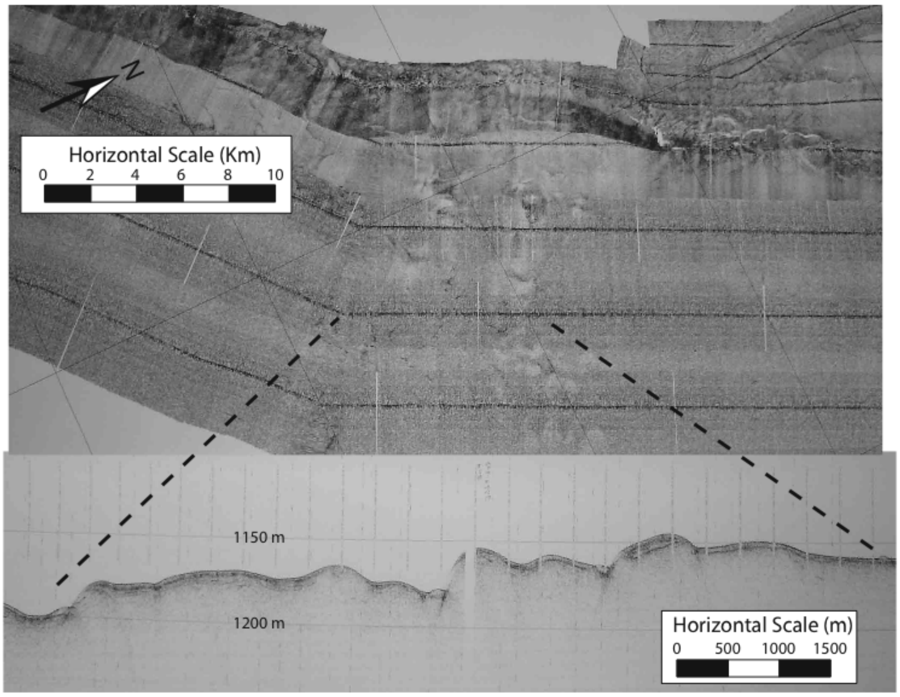

Figure 13. The backscatter mosaic and CHIRP profile across an old slide deposit on mid mid-slope off northern Rockall margin.

At 58°21'N 13°42.5'W there is a small (1 x 2 km) isolated pinnacle just over 100 m in height, maybe a remnant part of the slide deposit or a distinct body such as an igneous intrusion.

The northern-most part of the survey area lay in the saddle between George Bligh Bank and Rockall Bank and covers one of the entrances to the Hatton-Rockall basin. West of 14°W it is a very complex area topographically, the northern slope of Rockall now becoming greatly extended and changed from all other areas. The shelf area is imaged at the limit of coverage at about 500 m, with a shelf-edge parallel ridge running almost E-W at 520-580 m (the crest is deeper toward the west). The whole of the slope down to over 900 m is in fact now a series of stepped terraces, with the steps and terraces at various depths along the slope. There are a number of canyons running slope-orthogonal, however their origins are below the shelf edge at 700 m and they lose identity by 1,000 m.

Along this northern flank of Rockall Bank there is another significant curvature of the steepest part of the slope. At 13°55'W, it lay between 750-950 m and trends west of north-west, by 14°00'W the steep slope has moved lower to 800-1,000 m, and by 14°05'W the trend has changed to north-west and the depth of the steepest slope is now 1,000-1,100 m. Here however the foot of the slope has changed character completely. In a sweeping arc from 58°23'N 13°56'W through 58°26'N 14°00'W and 58°35'N 14°07'W the foot of slope takes the form of a series meander-like incised arcuate features, of between 60 and 120 m in depth, these features are clearly imaged by both shaded relief and CHIRP (Figures 14 and 15).

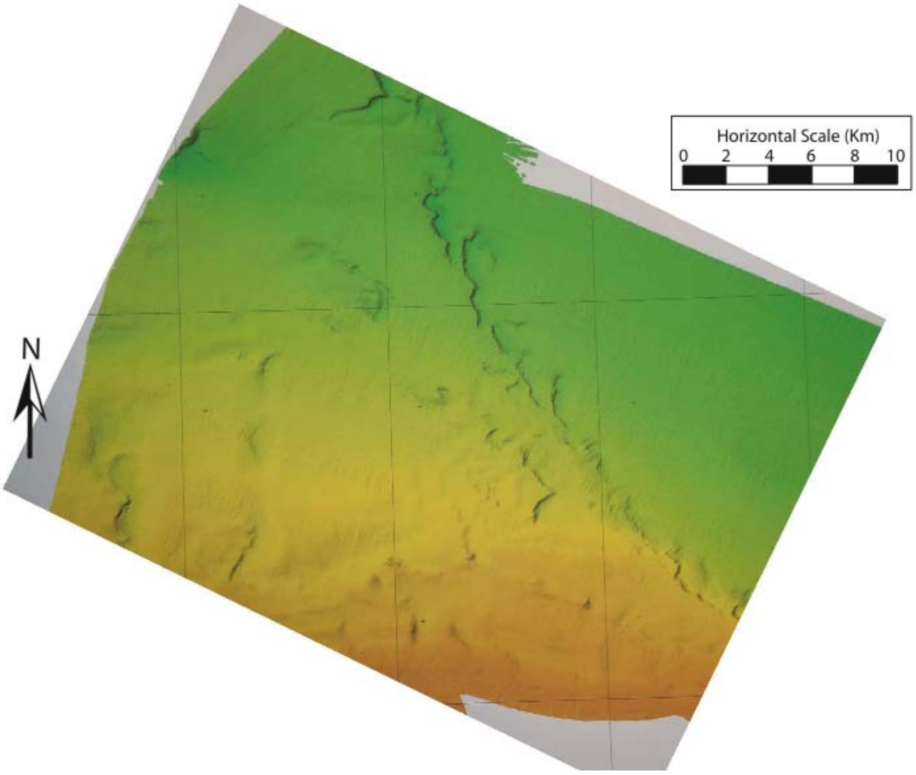

Figure 14. The meander-like incisions at the foot of the northern margin of Rockall Bank, becoming deeper and more developed to the northwest across the saddle between Rockall Bank and George Bligh Bank.

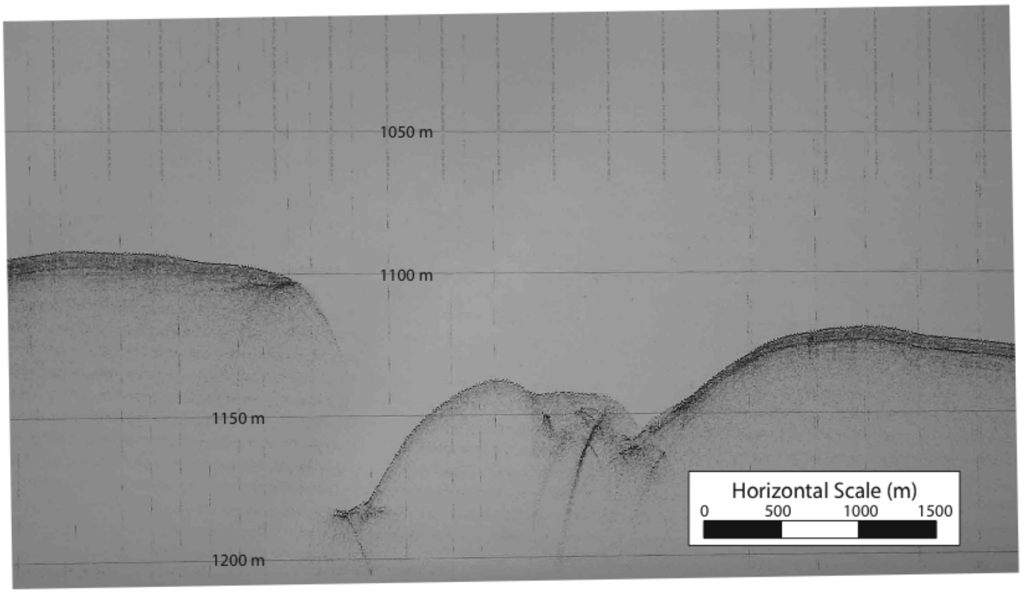

Figure 15. CHIRP profile across meander-like incision at the foot of the northern margin of Rockall Bank (Note: higher bank is toward west - the saddle between Rockall and George Bligh Bank).

Higher on the slope at 58°30'N 14°00'W, 58°28'N 14°08'W and 58°25'N 14°03'W appear to be the ghosts or remnants of previous meander-like incised areas, perhaps abandoned as erosion moved progressively down-slope.

The backscatter in this area is quite surprising in that it shows very few features indeed. The iceberg plough-marks are still present on the shallowest parts of the coverage, but they are lost below 500 m. The rest of the slope is an almost uniform intensity, apart from the banks of the highly meandering incised area at the base of the slope, and the areas indicated above that may be remnants of previous meandering incisions.

TABLE 8 East Rockall – Potential Sites for Ground Truthing

Site Label	Latitude	Longitude	Notes	Identifying System
ER_A	57°01.5'	13°23.7'	Typical shelf (south)	EM120
ER_B	57°05.4'	13°16.2'	Typical upper slope (south)	EM120
ER_C	57°01.7'	13°18.8'	Upper Drift (top)	EM120
ER_D	57°00.0'	13°20.0'	Upper Drift (base)	EM120
ER_E	57°01.5'	13°04.0'	Typical mid-slope (south)	EM120
ER_F	57°30.0'	12°51.7'	Slide-scar (recent)	EM120
ER_G	57°15.0'	12°50.0'	Slide deposits	EM120
ER_H	58°08.7'	13°24.0'	Typical shelf (north)	EM120
ER_J	58°10.0'	13°20.0'	Typical upper slope (north)	EM120
ER_K	58°14.0'	13°12.0'	Typical mid-slope (north)	EM120
ER_L	58°30.0'	14°05.0'	Channel-Bank deposits	EM120

Hatton Bank

An enigmatic area. A series of lineated highs (> 70 m above the surrounding seafloor) and often-associated troughs (with scraps of > 100 m adjacent to their associated "linear highs") occur without any obvious relationship to the regional slope, and slightly to the southeast are a series of lineated troughs, with a very different physiography, without any linear topographic highs associated with them.

The high and low lineations lie over the crest of the Hatton Bank at a depth of 550-600 m (Figure 16). The features appear to be focussed along two discrete orientation planes, the westernmost group are orientated just south of E-W and the eastern group are orientated NE-SW. The ridges are not all associated with an adjacent trough, some are smaller (in height) and have no bathymetric depression associated with them. There are smaller features that display a much more circular shape that may easily be correlated together in lineated groups that, if expanded or grown, could very easily be transformed into the lineated ridges imaged here. The deepest expression of the ridges is at 750 m, whereas the individual, more circular highs can be imaged to about 900 m waterdepth. The eastern group of ridges and smaller targets are much the same as described above except that their orientation is different and the smaller individual highs, tend to be much more clearly aligned along trends as opposed to forming loose "fields". These features are seen to >800 m and also continue to the east of this immediate study area.

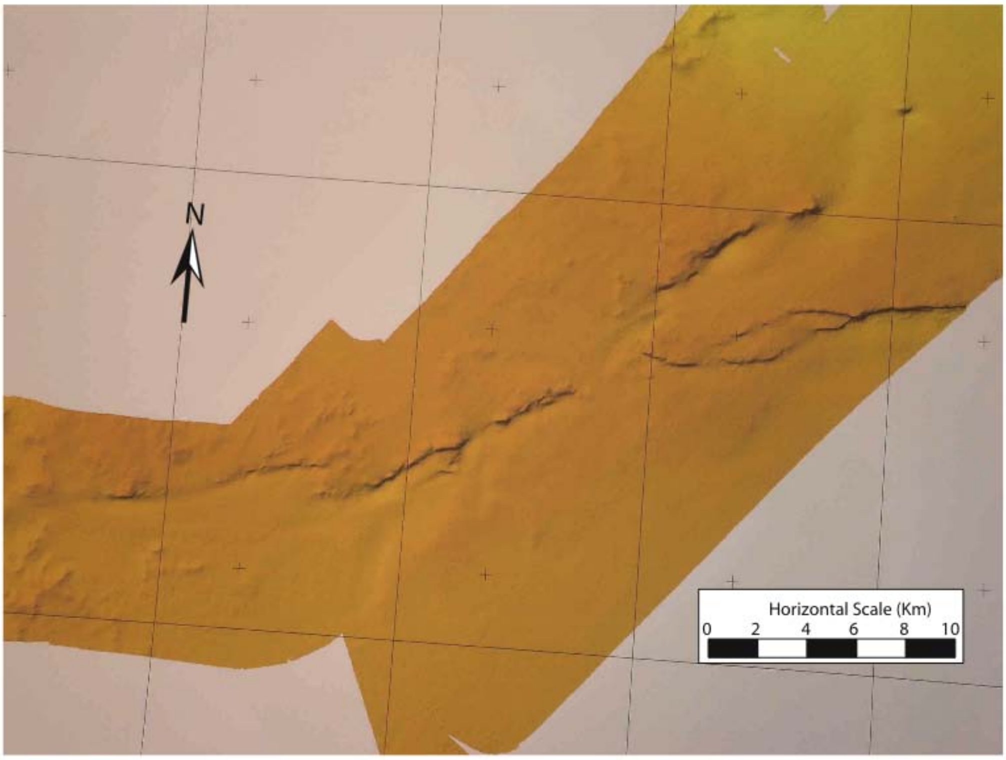

Figure 16 Some of the Ridges and Mounds over the summit of Hatton Bank

In terms of the acoustic backscatter, both east and west groups of features show much the same characteristics. The surrounding seafloor shows a medium-low level of acoustic backscatter yet around many of these mounds or ridges there is a halo of higher than normal backscatter, encompassing several tens of metres. Also well-imaged are points of very high backscatter located along the tops of (some of) both the elongate lineations and the individuals highs. Across the “fields” of smaller individual highs, the backscatter is also significantly higher than the surrounding seafloor, suggesting a different material is being insonified.

The CHIRP profiles typically show a series of hyperbolic echos across the top of the mounds, with the associated deeps typically showing a strong seafloor reflector at up to 100 m below the surrounding seafloor. The bathymetry, acoustic backscatter and CHIRP data taken together all strongly suggest that these may be carbonate constructions possibly with coral colonies.

Other features of note on Hatton Bank are a series of bathymetric lows, the shaded bathymetry suggesting that they take the form of smooth sculpted hollows up to 100 m deep. They lay just to the south of the ridges and mounds noted above, again these lows lay along a trend, generally NE-SW. Transverse CHIRP sections across these features show that they are in fact a series of perched basins.

The survey of Hatton Bank finished with a transect approximately parallel to/over the crest area, toward the east and George Bligh Bank.

TABLE 9 Hatton Bank – Potential Sites for Ground Truthing

Site Label	Latitude	Longitude	Notes	Identifying System
HB_A	58°42.7’	18°21.5’	Potential Coral Mound (west)	EM120
HB_B	58°42.6’	18°21.5’	Coral-Mound Trough (west)	EM120
HB_C	58°44.3’	18°08.0’	Potential Coral Mound (central)	EM120
HB_D	58°44.2’	18°08.0’	Coral-Mound Trough (central)	EM120
HB_E	58°57.2’	17°42.0’	Potential Coral Mound (east)	EM120
HB_F	58°57.0’	17°41.9’	Coral-Mound Trough (east)	EM120
HB_G	58°42.3’	17°22.7’	Perched Basin	EM120
HB_H	59°09.7’	17°06.0’	Outcrop or Coral Mound	EM120
HB_J	59°28.6’	14°07.7’	Orientated high backscatter features	EM120

George Bligh Bank

The single swath made from the north on approach to GBB shows small-scale channels (~10 m deep) with possible outcrop forming the banks and also some smaller mound-like features up to 100 m in height and ~1 km across, some are very rounded whilst at least one is significantly more angular. At its summit region, at 450 m, are iceberg plough-marks, though two different types of acoustic character are noted. The first is the same couplet as seen on Rockall and Rosemary Bank, but here over a very specific small part of the summit of GBB the acoustic returns from the ploughmarks are very high intensity. The CHIRP across this area shows hyperbolic mounds characteristic of what would be expected over a carbonate mound (Figure 15). The mounds imaged on the CHIRP vary from 5-15 m in height.

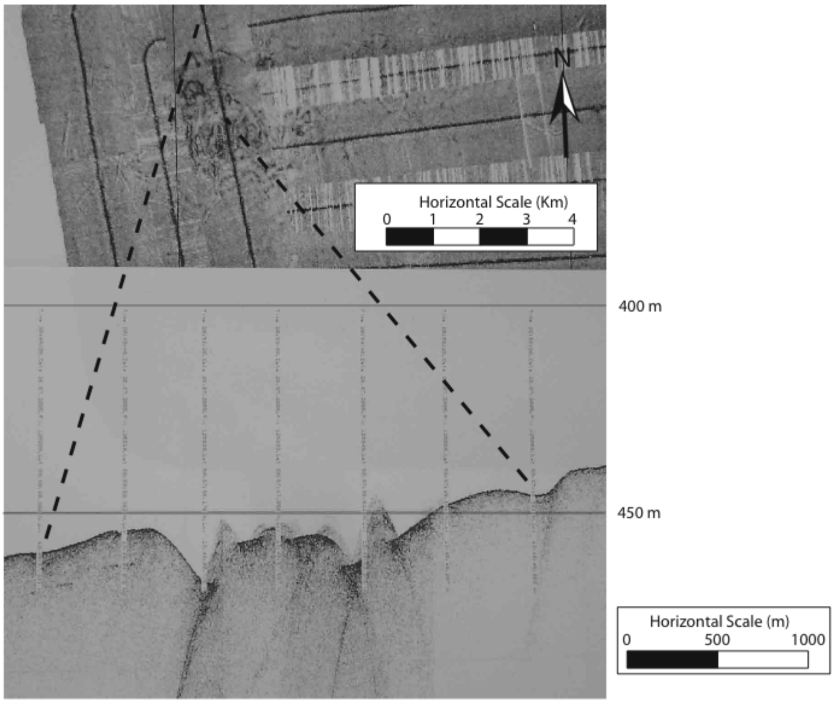

Figure 17 Summit area of GBB with highly reflective plough-marks and CHIRP showing typical “coral mound” characteristics

On the eastern flank at 800-850 m, are a series of concentric areas of backscatter change, these appear to equate to areas of acoustic basement outcrop on the steep flank, where there is otherwise a thin veneer of sediments that cover the seabed. Further downslope at about 1,150 m (around 58°75'N 13°25'W) the backscatter shows several distinct slope-parallel lineations of high backscatter, which on the CHIRP are imaged as a series of small (10-15 m) step-faults. Further downslope from the step-faults the EM120 mosaic shows a very large area of high backscatter, approximately 7 km across (east-west) running parallel to the contours. This correlates with an area of steep slope and basement outcrop that merges into a zone of very high seafloor reflectivity and hyperbolic echoes from the seafloor when imaged on the CHIRP, suggesting a zone of intense current activity and probably erosion occurring here (Figure 16). The moat around the base of GBB deepens from north to south, being in excess of 1,650 m where coverage ends in the south.

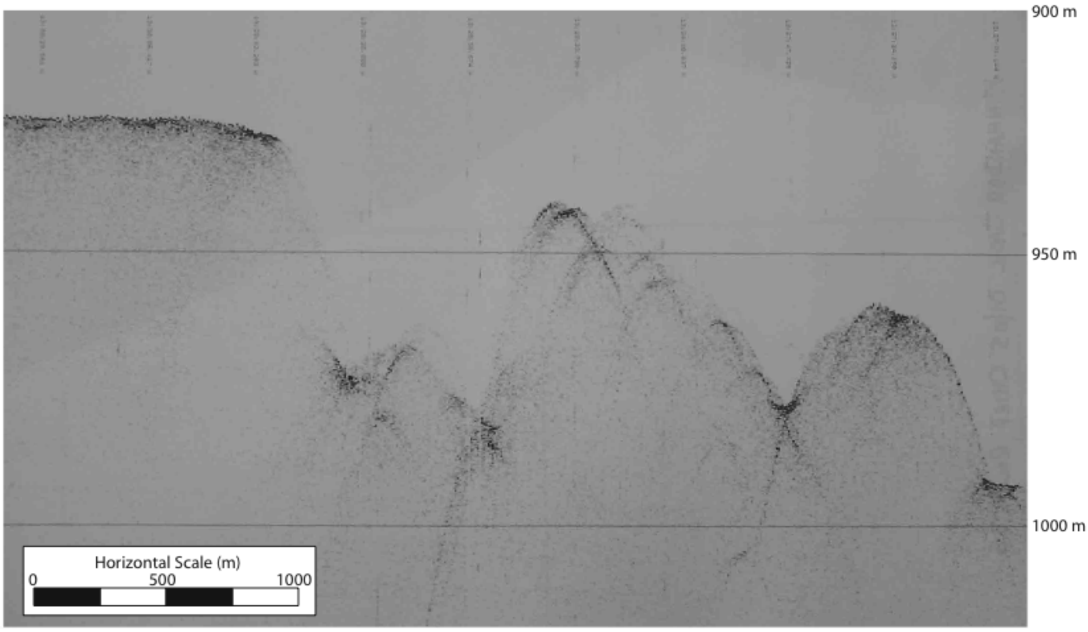

Figure 18 Zone of erosion and steep slope on southern face of GBB at 58°47.5'N 13°29.0'W

To the east, the edge of the sediment drift-like deposit is imaged, showing a uniform level of backscatter, the CHIRP revealing a well-stratified sequence of reflectors to over 30 m sub-bottom.

Another feature that changes character and size from the eastern margin around to the southern margin are the size and number of small slide erosion scars. There is a large (11 km) scar on the southeast flank at approximately 1,000 m depth, and along the southern slope of the Bank between 850 and 1,200 m are a number of smaller, crescent-shaped scars, with the apex of the crescent up-current (toward the east). Apart from the single long slide-scar, the others, which do not appear to be slides, but are simply due to erosion, are masked to a great extend on the EM120 backscatter by the general high backscatter levels so that their shapes are difficult to determine accurately. They are best illustrated on the shaded relief bathymetry maps.

At 700 m on the southern flank of the seamount the backscatter shows an intertwined pattern of medium-high backscatter that looks, for descriptive purposes, like a series of snail-trails! The high-medium backscatter features show an apparent random orientation, similar to but less jagged than the patterns of plough-marks. These features are several hundreds of metres across, and their character on the CHIRP is not particularly diagnostic as the seafloor shows both hyperbolic mounds typical of carbonates, and subdued step-faults in the acoustic basement with a thin veneer (~1 m or less) of sediment. A similar texture is also displayed on the backscatter at 58°44’N 13°37’W, which lay just above the zones of erosion described above.

Sadly for operational reasons the 500 kHz sidescan transect was begun just outside of the area of ploughmarks at the summit. This transect is remarkable for the overall low intensity of acoustic backscatter over the length of the single downslope run. There are just a few areas exhibiting any form of high backscatter and these are over areas of blocks (dropstones?) such as at 59°10’20”N 13°29’00”W or potential outcrop. There is little evidence of trawling and virtually nothing that can be attributed to sedimentary processes, possibly due to an overall high current regime that has masked by sand deposition or has eroded any trace of primary structure.

TABLE 10 George Bligh Bank – Potential Sites for Ground Truthing

Site Label	Latitude North	Longitude West	Notes	Identifying System
GB_A	59°19.4’	13°57.3’	Mound on north side of Bank	EM120
GB_B	59°17.3’	13°57.0’	Mound on north side of Bank	EM120
GB_C	58°56.8’	13°48.7’	Ploughmarks with Carbonate Mounds?	EM120
GB_D	58°57.0’	13°25.8’	Step-faults (fluid/gas conduit)	EM120
GB_E	58°52.2’	13°22.2’	Eastern flank Erosion zone	EM120
GB_F	58°47.4’	13°30.7’	SE flank plateau above erosion zone	EM120
GB_G	58°43.0’	13°20.2’	High backscatter point on SE flank	EM120
GB_H	59°01’20” to 59°01’25”	13°41’10” to 13°40’45”	Area of medium backscatter with high concentration of large high-backscatter blocks	500 kHz
GB_J	59°04’03” to 59°04’12”	13°29’16” to 13°28’45”	Area of very high backscatter and many large blocks, possibly also outcrop	500 kHz
GB_K	59°04’54” to 59°05’02”	13°25’45” to 13°25’15”	Area of ultra-low backscatter with few or no blocks except for a few aligned linear strips of outcrop	500 kHz
GB_L	59°0518” to 59°05’26”	13°24’05” to 13°23’30”	Area of low backscatter then outcrop then low backscatter with blocks then high backscatter with blocks	500 kHz

Rosemary Bank

The summit survey of Rosemary Bank was a great success despite very poor weather for much of the time. The survey encompassed the most of the summit area above ~1,000 m, which overall forms a gentle dome, with discreet areas of parasitic volcanoes forming groups of over 10 km across. The peak summit depth averages about 500 m, however the individual parasitic volcanoes take the shallowest areas to less than 350 m. Across the centre of the dome, especially between 59°10-15’N 10°10-20’W, the shaded relief shows subtle hints of what appear to be sediment waves, however the CHIRP shows that these features are in fact a reflection of an acoustic basement topography. These “waves” do not have any clear expression on the backscatter mosaic.

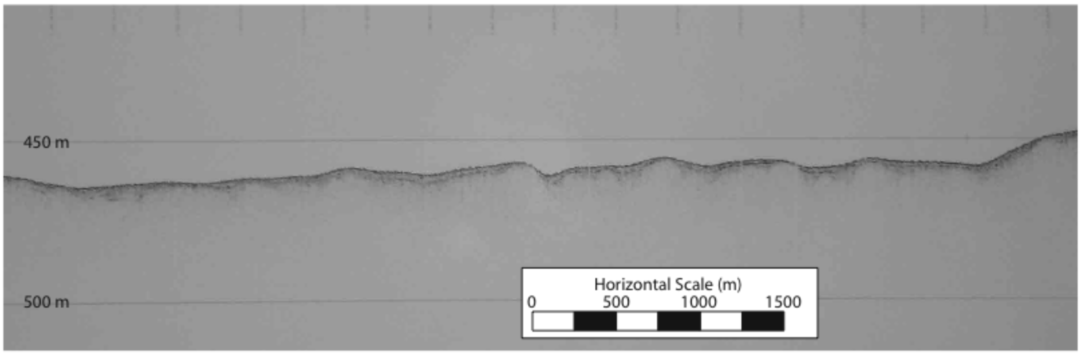

Figure 19 The “sediment waves” on the shaded relief are actually a representation of acoustic basement topography.

The entire summit area is covered by sediment, there is no evidence of outcrop though the flanks of some of the parasitic volcanoes does show very strong backscatter. CHIRP profiles across these volcanoes show that there is some degree of sediment cover on all slopes that are resolved by the profiler. Also clearly detected above 500 m are the distinctive trails left by iceberg plough-marks. The irregular, randomly orientated couplets of high and low backscatter are focussed in a small area right in the centre of the summit area, and although the weather has deteriorated the quality of the mosaic in this region, they are still easily identified. The CHIRP data in isolation would not allow interpretation of these features.

There are also what appear to be small channels along the northeast flank of the summit area, but the CHIRP profiles are not orientated to cross these and get ideal sections. Lithology changes are also seen on the backscatter data and these can be correlated with distinct changes on the CHIRP profiles. Generally the CHIRP shows penetration to a sub-bottom depth and acoustic basement at about 5 m over most of the summit, however toward the (eastern) flank(s) this does increase to about 12 m before acoustic basement is imaged.

In terms of sampling, there are no really unusual targets across the summit area, however a photographic reconnaissance of one of the volcanic peaks would be useful, and for comparative purposes so would a view of the iceberg plough-mark terrain. A further sampling target would be to either side of the lithology boundary noted above.

TABLE 11 Rosemary Bank – Potential Ground Truthing Sites

Site Label	Latitude	Longitude	Notes	Identifying System
RB_A	59°11.0’	10°10.0’	Parasitic volcano peak	EM120
RB_B	59°10.2’	10°14.5’	Iceberg plough-mark	EM120
RB_C	59°20.5’	10°20.0’	Lithology Change	CHIRP

TABLE 12. Summary of all Potential Ground Truthing Sites

The following table summarizes targets identified on the geophysics data collected during cruise KJ01/05, there will be other parts and areas of the deep water SEA7 that require sampling that are NOT tabulated below, for example possibly at the foot of each of the seamounts and/or in their moats and current and lee-sides as part of a general characterization undertaking.

The 500 kHz Sidescan sonar data was presented at a scale of 1:2,000 allowing a high degree of accuracy (~15 m) in pinpointing potential targets, thus they are specified as - Degrees Minutes and Seconds

The EM120 was presented at either 1:50,000 or 1:75,000 and thus targeting accuracy is less (~180 m), thus these are specified as – Degrees and Minutes to one decimal place.

To ensure that we can be as accurate as possible with locations identified on the EM120 data, each area or boundary or other feature of note was traced until it reached a “convenient” identifiable position requiring just one decimal place, i.e 17.5’ rather than 17.524’

Site Label	Latitude	Longitude	Notes	Identifying System
SAMS1_A				
SAMS2_A	57°27’02.5”	14°45’37”	Potential reef, W Rockall Plateau	500 kHz
SAMS2_B	57°27’07”	14°43’58”	Potential reef, W Rockall Plateau	500 kHz
SAMS2_C	57°27’14.5”	14°39’41”	Potential reef, W Rockall Plateau	500 kHz
SAMS2_D	57°27’17”	14°38’53”	Potential reef, W Rockall Plateau	500 kHz
SAMS2_E	57°27’17.5”	14°37’44”	Potential reef, W Rockall Plateau	500 kHz
SAMS2_F	57°27’16.5”	14°36’45”	Potential reef, W Rockall Plateau	500 kHz
SAMS2_G	57°27’22.5”	14°32’51”	Potential reef, W Rockall Plateau	500 kHz
SAMS2_H	57°27’33”	14°26’30”	Iceberg plough-marks, W Rockall	500 kHz
SAMS2_J	57°27’31.5”	14°27’12”	Potential reef, W Rockall Plateau	500 kHz
SAMS2_K	57°28’01”	14°09’09”	Potential reef, W Rockall Plateau	500 kHz
SAMS2_L	57°28’51”	13°27’43”	High Bksc, E Rockall Plateau	500 kHz
SAMS2_M	57°28’57”	13°20’15”	Outcrop/reef, E Rockall Plateau	500 kHz
SAMS2_N	57°29’06”	13°10’21.5”	Potential reef, E Rockall Plateau	500 kHz
SAMS2_O	57°29’10”	13°08’41”	Potential reef, E Rockall Plateau	500 kHz
SAMS2_P	57°29’11.5”	13°05’59”	Potential reef, E Rockall Plateau	500 kHz
SAMS3_A				
AD_A	57°27’28.5”	11°03’11”	Potential coral colony on sediment	500 kHz
AD_B	57°27’18”	11°07’16”	Outcrop, potential coral habitat	500 kHz
AD_C	57°27’16”	11°07’37”	Potential coral colony	500 kHz
AD_D	57°30.9’	11°18.0’	Lithology boundary	EM120
AD_E	57°29.0’	11°30.0’	Seamount apron characterisation	EM120
AD_F	57°29.0’	11°28.0’	Seamount apron characterisation	EM120
AD_G	57°29.0’	11°27.0	Seamount apron characterisation	EM120
AD_H	57°27’24’ to 57°27’22”	11°04’38” to 11°05’12”	Trawl ecosystem damage	500 kHz

TABLE 12. (continued)

Site Label	Latitude	Longitude	Notes	Identifying System
ER_A	57°01.5’	13°23.7’	Typical shelf (south)	EM120
ER_B	57°05.4’	13°16.2’	Typical upper slope (south)	EM120
ER_C	57°01.7’	13°18.8’	Upper drift (top)	EM120
ER_D	57°00.0’	13°20.0’	Upper drift (base)	EM120
ER_E	57°01.5’	13°04.0’	Typical mid-slope (south)	EM120
ER_F	57°30.0’	12°51.7’	Slide-scar (recent)	EM120
ER_G	57°15.0’	12°50.0’	Slide deposits	EM120
ER_H	58°08.7’	13°24.0’	Typical shelf (north)	EM120
ER_J	58°10.0’	13°20.0’	Typical upper slope (north)	EM120
ER_K	58°14.0’	13°12.0’	Typical mid-slope (north)	EM120
ER_L	58°30.0’	14°05.0’	Channel-bank deposits	EM120
HB_A	58°42.7’	18°21.5’	Potential coral mound (west)	EM120
HB_B	58°42.6’	18°21.5’	Coral-mound trough (west)	EM120
HB_C	58°44.3’	18°08.0’	Potential coral mound (central)	EM120
HB_D	58°44.2’	18°08.0’	Coral-mound trough (central)	EM120
HB_E	58°57.2’	17°42.0’	Potential coral mound (east)	EM120
HB_F	58°57.0’	17°41.9’	Coral-mound trough (east)	EM120
HB_G	58°42.3’	17°22.7’	Perched basin	EM120
HB_H	59°09.7’	17°06.0’	Outcrop or coral mound	EM120
HB_J	59°28.6’	14°07.7’	Orientated high backscatter features	EM120
GB_A	59°19.4’	13°57.3’	Mound on north side of Bank	EM120
GB_B	59°17.3’	13°57.0’	Mound on north side of Bank	EM120
GB_C	58°56.8’	13°48.7’	Ploughmarks with coral? mounds	EM120
GB_D	58°57.0’	13°25.8’	Step-faults (fluid/gas conduit)	EM120
GB_E	58°52.2’	13°22.2’	Eastern flank erosion zone	EM120
GB_F	58°47.4’	13°30.7’	SE flank plateau erosion zone	EM120
GB_G	58°43.0’	13°20.2’	High backscatter point on SE flank	EM120
GB_H	59°01’20” to 59°01’25”	13°41’10” to 13°40’45”	Area of medium backscatter with high concentration of large high-backscatter blocks	500 kHz
GB_J	59°04’03” to 59°04’12”	13°29’16” to 13°28’45”	Area of very high backscatter and many large blocks, possibly also outcrop	500 kHz
GB_K	59°04’54” to 59°05’02”	13°25’45” to 13°25’15”	Area of ultra-low backscatter with few or no blocks except for a few aligned linear strips of outcrop	500 kHz
GB_L	59°0518” to 59°05’26”	13°24’05” to 13°23’30”	Area of low backscatter then outcrop then low backscatter with blocks then high backscatter with blocks	500 kHz
RB_A	59°11.0’	10°10.0’	Parasitic volcano peak	EM120
RB_B	59°10.2’	10°14.5’	Iceberg plough-mark	EM120
RB_C	59°20.5’	10°20.0’	Lithology change	CHIRP

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