National Oceanography Centre, Southampton

Research & Consultancy Report No. 25

MV *Franklin* Cruise 0406
14-23 Sep 2006

Habitat investigations on the West of Shetland continental slope

C L Jacobs

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ABSTRACT

The objectives of the *MV Franklin* 0406 cruise were to collect EM1002 multibeam bathymetry and backscatter data, carry out on-board processing and use interpreted mosaics to identify variations in seafloor geology and morphology. Using these interpretations as a guide to distinguish variations in benthic habitat, when required, additional high resolution sidescan sonar transects would be run, and, in areas of special interest, seafloor photograph and video imagery collected. 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 benthic habitats
- undertake photographic surveys of specific habitat areas to quantify the benthic ecology
- create high resolution bathymetric, backscatter and sonar maps of specific features as may be discovered, such as sponge reefs, carbonate mounds etc.
- complete, during the cruise, a preliminary interpretation of the above data

This was a highly successful cruise with almost all cruise objectives achieved. High resolution maps were made of the mid-slope channels to the west of the Shetland Isles and also the intersection of the Wyville-Thomson Ridge and UK Continental Shelf, a feature critical in physical oceanography and North Atlantic circulation studies, was imaged.

KEYWORDS

acoustic backscatter, bathymetric chart, cruise 0406 2006, EM1002, *Franklin*, West Shetland Slope, Wyville-Thomson Ridge, seafloor photography, iceberg plough-marks, multibeam bathymetry, seafloor mapping, sonar surveys, SEA4, SEA7

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CONTENTS

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Funding Acknowledgement

This project was funded as part of the UK Department of Trade and Industry's offshore energy Strategic Environmental Assessment programme. The SEA programme is funded and managed by the DTI and coordinated on their behalf by Geotek Ltd and Hartley Anderson Ltd. Additional funds were also made available from the Joint Nature Conservancy Council, U.K.

VESSEL

*Figure 1. The "business end" of the MV Franklin.**

Name:	FRANKLIN	Flag:	SWEDEN
Port of Registry:	GOTHENBURG	Call Sign:	S E I N
Class:	Lloyds Register (LR)	IMO.No.	8301797
Length:	55.6 m	Beam:	11.99 m
Draught:	3.8 m	Freeboard:	2.5 m
Gross Reg. Tons:	1179	Net Reg. Tons:	353
Displacement:	1218	Owner:	Shipriders AB Nya Varvet Byggnad 84 426 71 Vastra Frolunda SWEDEN Tel: +46 31 695280

Primary Survey Equipment for this project:

SIMRAD EM1002 Multibeam
Benthos 100/384 kHz sidescan sonar
Geoacoustics 100/500 kHz (deeptowed) sidescan sonar
SEATRONICS Deep Sea Camera, inc. a Valeport MIDAS CTD system.
Primary Navigation: ARON 2000 DGPS
USBL: GAPS, France

ITINERARY

Sailed, Lerwick, UK	13:00 UTC, 14th September, 2006
Docked Kirkwall, UK	07:00 UTC, 23rd September, 2006

* *Thanks to Joakim Arvidsson for permission to use the photograph.*

Background and Project Objectives

Seafloor Physiography and Geography

The continental shelf off northwest Scotland has been sculpted by the effects of a number of glacial events over the past million or so years. The current surficial sediments are the remnants of material deposited as the ice sheets waxed and waned; there is little present-day sediment input to the area. Typically the sediments are gravels, with sand sheets and also rock outcrop. In water depths of 20-100 m, shell-rich sand banks and ridges are formed by tidal current activity; further to the west, the Hebrides Shelf gives way to a shelf break at ca. 200 m, with along large parts of the shelf-edge, the unmistakable traces of iceberg plough-marks.

In terms of the tides and currents, in the SEA4 region the currents (both surface and benthic) are strongest over the inner shelf (> 1 ms^{-1}), though storm-induced benthic currents may increase this by up to tenfold. In the Fair Isle channel there are opposing tidal currents of approximately equal strength. Over the shelf-edge and in the deeper waters to the west, two main water masses can be recognized in the Rockall Trough, although both have complex origins. The upper water mass, (Eastern North Atlantic Water, or ENAW) occupies the upper 1,200 to 1,500 m of the water column, whilst at depth, 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 north-easterly 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 north-easterly 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.

The objectives of the *MV Franklin* 0406 (F0406) cruise were to collect EM1002 multibeam, backscatter and if required high resolution sidescan sonar data over the West Shetland Continental Slope in areas of interest to the DTI and JNCC that would help refine current models of the benthic topography, habitat and ecology. The specific areas chosen were the West Shetland Channels and the intersection of the Wyville-Thomson Ridge and the shallow continental shelf. The scientific rationale behind this research programme is guided by potential future hydrocarbon exploration over the UKCS in combination with the need to investigate areas deemed high priority/potential ANNEX I exclusion zones by the JNCC, and whilst at this stage it is not possible to be definite about the actual locations of future seafloor installations and/or drill-sites, 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.

The first step in this type of detailed scientific study of the seafloor environment is to produce 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 areas under study. Where seafloor conditions are interpreted as being markedly different and/or unusual, or where expert interpretation of the data indicates probable sensitive and/or unusual areas of benthic habitat, a photo-reconnaissance mission to allow "ground-truthing" of the geophysical data and definitive description and quantification of the benthic biology and geology will be attempted, possibly if conditions are appropriate, followed by some carefully targeted, physical sampling.

Cruise Narrative

(All Times UTC)

A detailed technical operations report was completed by the vessel operator (Marin Mätteknik). This section of the report describes seagoing activities and conditions encountered during the cruise as they affected the science priorities. An Observation and Preliminary Interpretation Section is on page 17.

Thursday 14 September (Day 257)

Whilst alongside, a safety briefing and tour of the vessel was given by the 2nd Officer. The vessel sailed from Lerwick at 13:00 after receiving bunkers and provisions, and began a transit to the West Shetland Channels (WSC) survey area, arriving and beginning operations with an SVP dip in thick fog at 22:45.

Friday 15 September (Day 260)

Surveying of the WSC area continued in excellent weather conditions, building on the few lines completed during Leg 3, with the northern section of the survey block completed at 23:30. Figure 2 shows the "on-line" data acquisition area in the *Franklin*'s main laboratory.

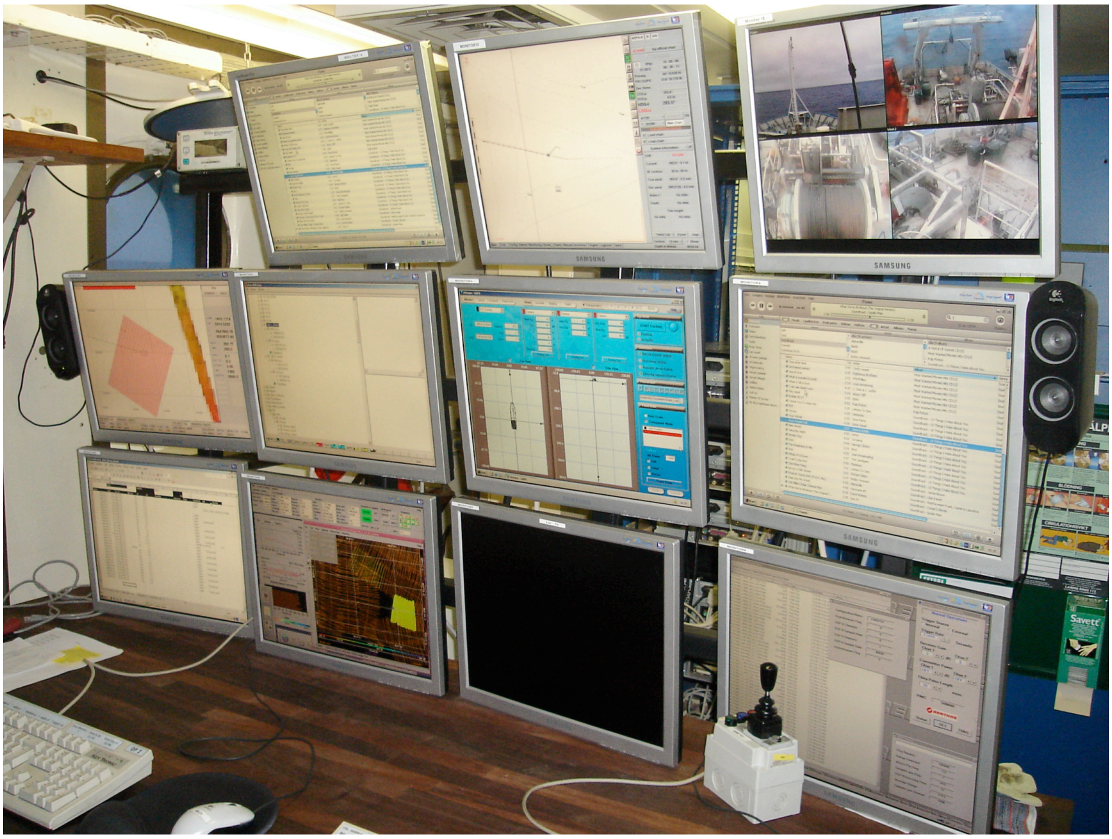


Figure 2. The "on-line" console area in the main laboratory of the Franklin.

Saturday 16 September (Day 261)

Transit was made to the first camera site (WSC_1) over the down-slope "dam" on one of the central channels. This first site was also an experiment to see how accurate the camera frame could be navigated with the strong, opposing surface and deep currents. Four successful camera runs were made over one of the centrally located channels after which the vessel moved to the northeast to occupy three further transects across one of the northernmost channels. However problems firstly with ship station-keeping and then water in one of the camera connectors meant that the first two drops of station WSC_7 had to be aborted. The final drop produced usable results, though station WSC_6 also suffered due to the benthic current. During WSC_5, the strong bottom currents and severe topography of the channel flanks caused severe problems in trying to maintain the camera position along the proposed survey track, and eventually after landing on the channel flank the camera frame inverted and the warp wrapped itself around one of the legs of the camera frame. The station was aborted and the camera gently recovered and cable re-terminated. EM1002 surveying was resumed over the remainder of the West Shetland Channel area.

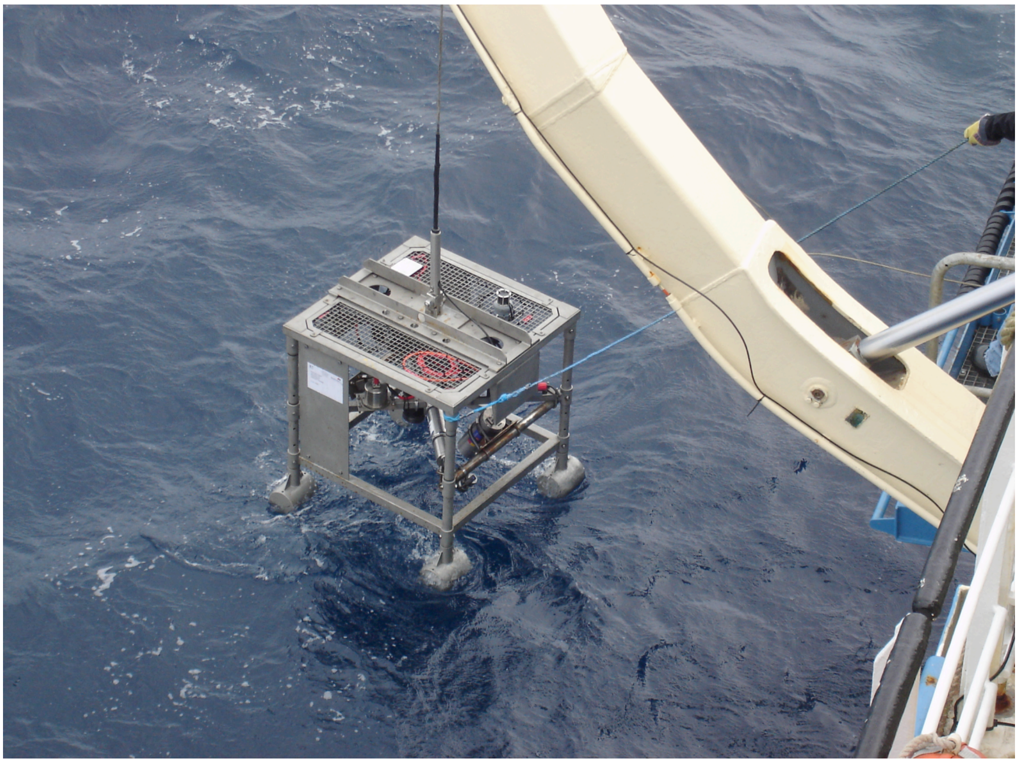


Figure 3. The SEATRONICS camera system being launched from Franklin.

Sunday 17 September (Day 262)

The EM1002 survey over the southern WSC area continued in excellent surveying conditions.

Monday 18 September (Day 263)

The multibeam survey was completed in the early hours of the morning and the vessel moved to site WSC_8 to begin camera operations. The first site had to be abandoned as the bottom currents proved too strong to keep the camera close to the ship and there was a risk of overturning the frame again. The vessel re-positioned and started WSC8#2 from the north to south and the station was successful. A few problems with the camera booting up correctly during subsequent drops held things up slightly, but the final four WSC stations were completed by 10:45. The vessel steamed to the northern flank of the Wyville-Thomson Ridge (WTR) and began the EM1002 survey in the early evening.

Tuesday 19 September (Day 264)
The EM1002 multibeam survey over the WTR continues in deteriorating weather, winds during the middle of the day were steady at 40 knots, frequently gusting to 50. Ultimately the sea and wind became too energetic and surveying was suspended just before 11:00. By early evening the wind and swell had died enough that the vessel could at last turn back toward the survey area (heading into the prevailing sea and wind had taken us to the Darwin Mounds), and data collection was resumed adjacent to the southernmost line collected over the WTR during F0306.

Wednesday 20 September (Day 265)
The EM1002 survey over the WTR area continued through the day as the weather improved rapidly. The first sites for the camera stations were also identified.

Thursday 21 September (Day 266)
The EM1002 over the WTR was completed by 0700 when the vessel moved to the first of the camera sites in this area, WRTN_7. Following successful completion of the station, the camera system suffered from serious electrical problems during deployment on the second station and was recovered. Inspection revealed that seawater had somehow penetrated the inner core of the conducting signal cable, and the cable would require re-termination, which could take up to 18 hours. It was decided to continue with the multibeam survey whilst the camera was repaired and to re-deploy the system in the Wyville-Thomson Ridge area in the last hours of the cruise as the results from the first drop were so spectacular. The focus of the multibeam survey would now shift from Wyville-Thomson Ridge itself to the upper continental slope immediately adjacent to it to the southwest.

Friday 22 September (Day 267)
By 03:00 when it was hoped to re-start camera operations, the wind had increased to 30 knots and combined with a rising swell made conditions unsuitable for station work, thus the multibeam survey continued until 0700 when conditions had moderated enough to test the camera system prior to deployment. The test was disappointing as it revealed that the cable termination potting compound had not set properly and there was the possibility of further seawater ingress. Therefore the rest of the day would be devoted to more multibeam coverage over WTR until it was time to head for Kirkwall. The multibeam logging stopped at 19:30 and the transit to Kirkwall began.

Saturday 23 September (Day 268)
The vessel docked in Kirkwall at 07:00.

TABLE 1 TABLE OF PHOTOGRAPHIC TRANSECT LOCATIONS*

* *NOTE: The stations were run in geographical order, which was not necessarily in numerical order.*

Site Label	Start Time	Start Latitude (North)	Start Longitude (West)	End Time	End Latitude (North)	End Longitude (West)	Notes
WSC_1	0141/261	60.828517	3.741649	0217/261	60.824746	3.737908	63 images + video
WSC_2	0338/261	60.796788	3.701381	0422/261	60.792915	3.705210	96 images + video
WSC_3	0532/261	60.760367	3.665017	0624/261	60.768930	3.669323	84 images + video
WSC_4	0753/261	60.718415	3.599416	0830/261	60.713983	3.597807	61 images + video
WSC_5	1638/261	60.874645	3.606848	1659/261	60.873355	3.607302	33 images + video
WSC_6	1429/261	60.810883	3.517078	1456/261	60.815100	3.514081	45 images + video
WSC_7#3	1208/261	60.751516	3.409697	1249/261	60.747128	3.414895	107 images + video
WSC_8 #1	0202/263	60.795518	3.889921	0209/263	60.795670	3.888900	16 images + video
WSC_8#2	0246/263	60.801030	3.883281	0320/263	60.796054	3.887355	90 images + video
WSC_9	0436/263	60.805040	3.872467	0520/263	60.801868	3.879939	106 images + video
WSC_10#2	0739/263	60.676290	3.690549	0820/263	60.672266	3.695340	144 images + video
WSC_11	1002/263	60.686800	3.668008	1038/263	60.684078	3.675075	112 images + video
WTRN_7	0820/266	59.876330	5.946695	0859/266	59.880382	5.943097	117 images + video

SURVEYING, DATA ACQUISITION AND OUTPUT

Navigation

Vessel navigation was by DGPS using the ARON 2000 system, a bespoke navigation system developed by Marin Mätteknik. All other data acquisition systems took their time stamp from this navigation signal ensuring seamless positioning of all types of data collected during the cruise. The navigation system had a theoretical accuracy of better than 2 metres, which exceeded requirements for this survey. The positional data was run through navigation logging and display software, with continuous QC checks being run during each watch.

The USBL navigation system was based upon the French-designed GAPS. The system was fully integrated into the primary DGPS and proved very reliable, giving highly accurate fixes.

Bathymetry

EM1002 bathymetric survey - The performance of the survey crew, vessel and the survey equipment was of an exceptionally high standard and fully met the requirements of the survey. On-board processing was completed in near-real-time and output presented in whatever format was requested. Fledermaus ".sd" and ".scene" files were the primary data requested, but for some areas data was also produced in UTM coordinates (for direct importation into ArcGIS).

EM1002 backscatter data – The quality of the backscatter data obtained from the EM1002 system after on-board processing was suitable for determination of different seafloor types, even though it effectively just used the raw voltage amplitudes from the transducers on a scale from 0 to 50 (volts). The data were presented during the cruise as overlays on the bathymetric Fledermaus ".scene" files, and used the convention of high backscatter areas (rougher textures) being dark and low backscatter areas being light (white). This allowed the user to view and manipulate scales so that idealised perspectives could be seen and sites for photography determined precisely.

Sidescan Sonar

The sidescan sonar was unused as winch problems left only the camera-cable operable. This needed to be re-routed from the starboard winch astern through blocks and so it was to have been the last type of survey operation prior to steaming for port. However, the camera cable itself gave problems at the end of the cruise and could not itself be used.

Data Output

The major data output product was a hard drive containing all data collected in digital form (swath, backscatter, photographs, video and CTD). Paper products and .pdf files will be delivered direct from MMT in Gothenburg post-cruise.

OBSERVATIONS AND PRELIMINARY INTERPRETATIONS

Introduction

A map of the areas surveyed during F0406 is presented in Figure 4. The geological interpretation is based upon both the acoustic signatures in the geophysical data and a brief appraisal of the seafloor photography.

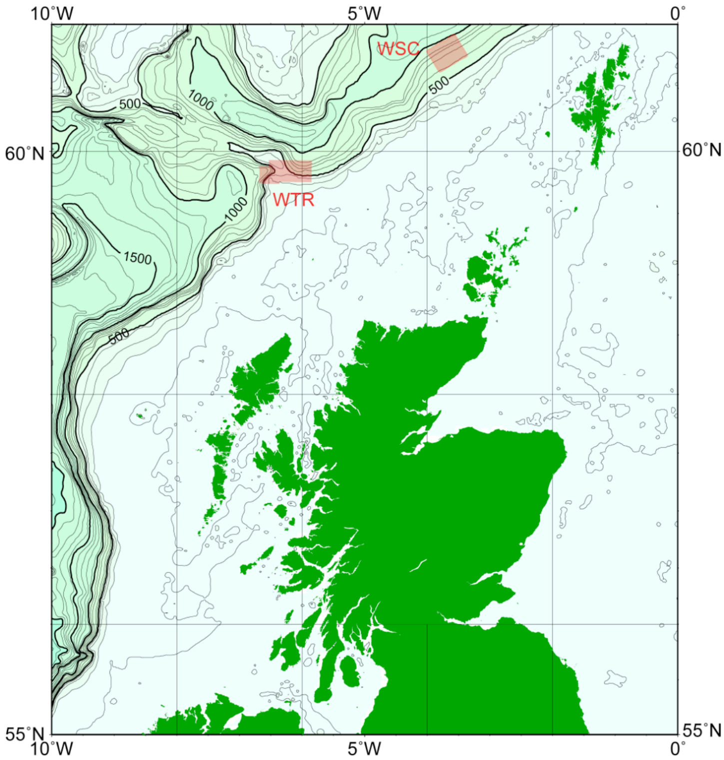


Figure 4. A location map of the Franklin 0406 cruise, showing EM1002 survey areas superimposed on the regional (GEBCO) bathymetry.

West Shetland Channels

The EM1002 multibeam survey allowed production of a detailed DTM of the West Shetland Channels (Figures 5 & 6). There are 11 Channels altogether, although 3 of these are almost totally in-filled, the rest being in-filled generally below 950 metres and above 730 metres. The lower part of the slope below two of the channel mouths (X and Y) shows morphology consistent with an erosive regime, and there are subtle slope-parallel lineations formed by geostrophic current activity. It should be noted that these slope-parallel features are at a very fine-scale; they are only discerned by using the sun illumination over the DTM where the seabed slope angle generally increases from ~1.5° to around 3° (Figure 5).

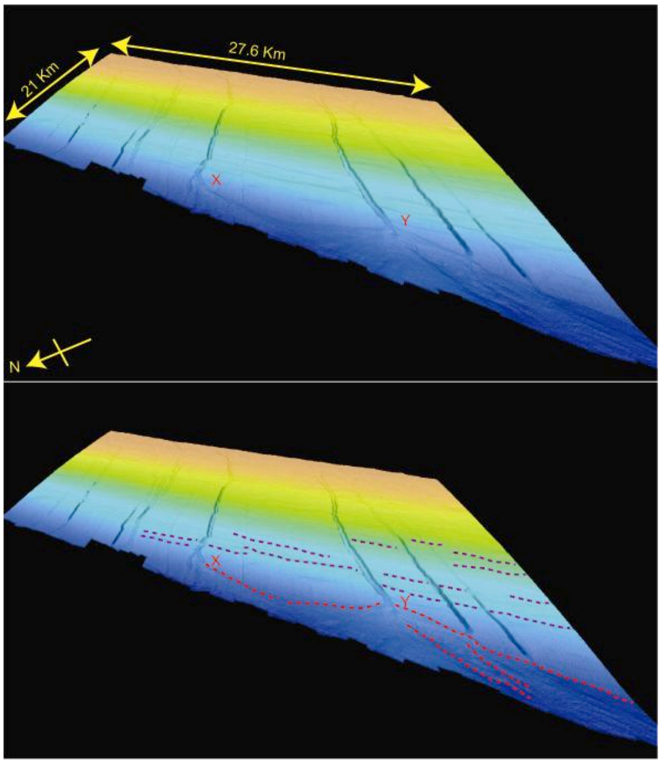


Figure 5. A DTM of the West Shetland Channels survey area, looking toward the southeast and upslope. The morphology below points X and Y is consistent with an erosive regime (red dashes), and there are subtle lineations formed by geostrophic current activity (purple dashes).

The contour chart (Figure 6) shows the spatial relationships between the various channels, and highlights how they are mostly orthogonal to the evenly spaced contours that define the smooth slope. Only at the foot of the slope (in the area of stations WSC_8 and 9) do the contours show any significant sinuosity, and this is over the area interpreted (above) as an area of erosion.

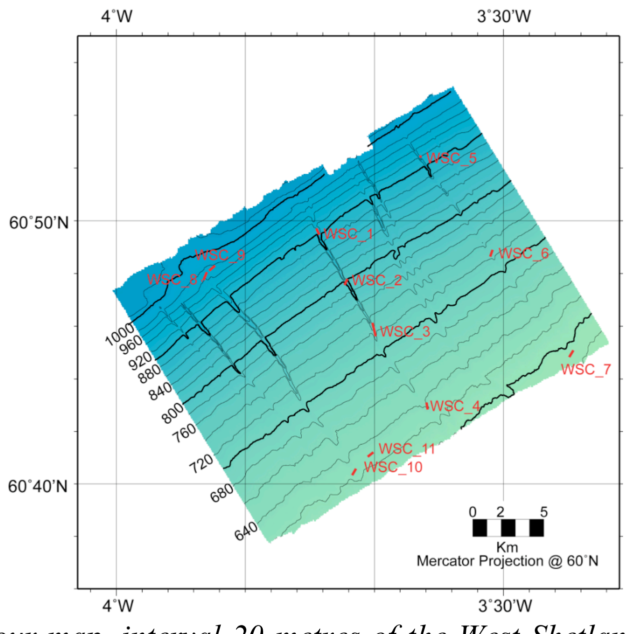


Figure 6. A contour map, interval 20 metres of the West Shetland Channels survey area showing the camera station locations.

The acoustic backscatter mosaic shows only a few subtle backscatter variations that are likely due to changes in the sediment type (Figure 7). There is an overall decrease in acoustic backscatter upslope, suggesting that the sediments are finer and/or more homogenous above 700 metres, and on the flanks on the downstream side (in terms of geostrophic flow) of some of the in-filled, or mostly in-filled channels there are narrow zones of ultra-low backscatter, probably due to deposition of very pure fine sands. Backscatter variations within the channels themselves vary from channel to channel, with some showing relatively high backscatter along the walls and channel floor, whereas other channels show no distinct differences from the surrounding seafloor. Where backscatter variations are seen within the channels, they are discontinuous over small (10-50 m) areas.

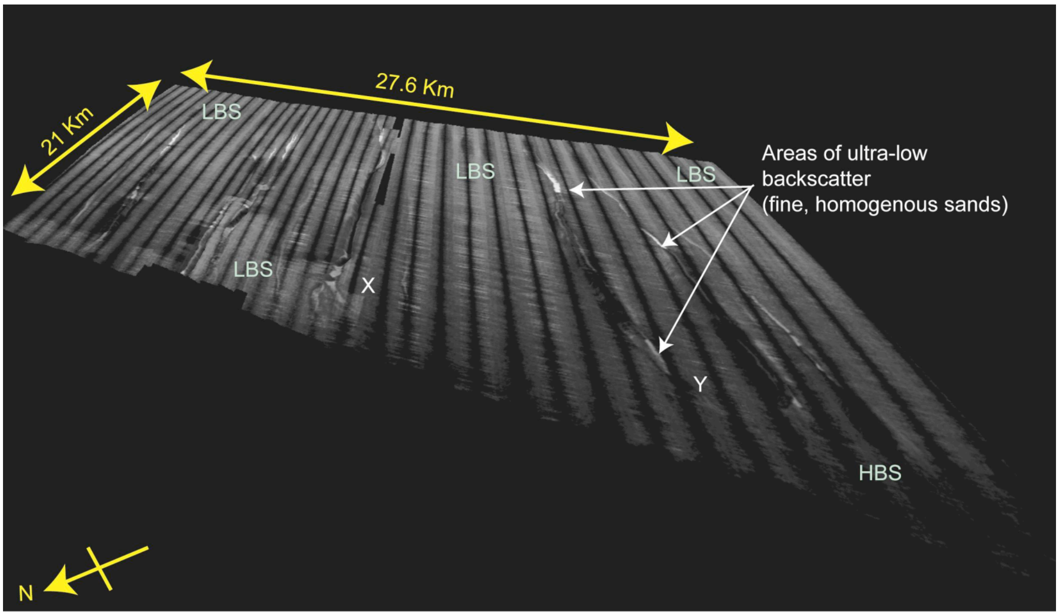


Figure 7. The draped backscatter mosaic of the West Shetland Channels survey area, viewed from the same direction as Figure 5. LBS= Low Backscatter, HBS = High Backscatter, note a number of distinct areas of ultra low backscatter down-current from some of the channels.

The camera transects are described below, with individual descriptions of the seafloor geomorphology and geology. Refer to Figure 6 for locations.

WSC_1 was located at the deeper (~920 metres), in-filled end of one of the central Channels, to try and determine the nature of the lower dam. The seafloor was overwhelmingly composed of clean, bioturbated sand, with minor dropstones of cobble/boulder size. The surficial sand appeared to be composed of two parts, the first forming the main substrate and a minor constituent being a series of starved ripples, often showing fine "cracks" over their surface, suggesting that the superimposed starved ripples are composed of an even finer sand (Figure 8). The starved ripples, although bioturbated, appear not to be as intensively bioturbated as the rest of the seafloor. Toward the end of the tow (over the dammed channel surface) the seabed becomes considerably rougher in texture, with gravel lags and detritus covered dropstones forming the slope of the dam.

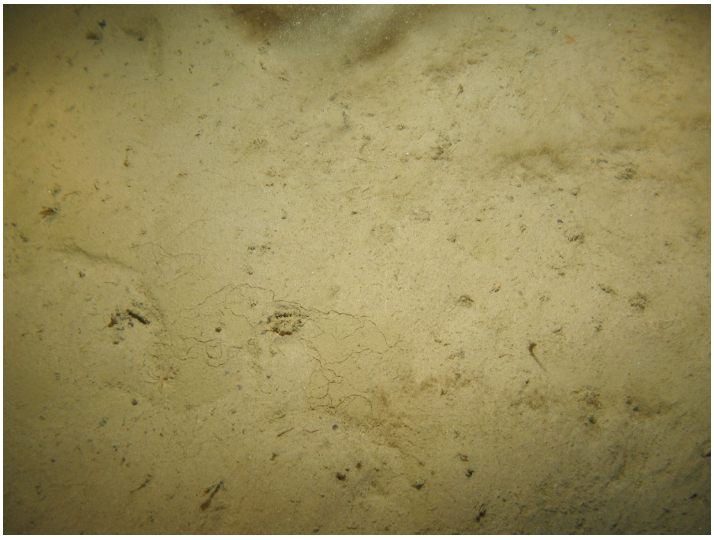


Figure 8. Starved ripples overlying a slightly coarser bioturbated sand

WSC_2 was a section across an open part of one of the central channels at a water-depth of about 800 metres. The seafloor adjacent to the channel is a detritus-draped conglomeratic mix of cobbles and boulders within a sand matrix. The density and size of the conglomerate clasts varies seemingly at random, along with the amount of detritus that covers the seafloor, with in a very few discrete areas a washed lag. The walls of the channel are in places very steep >20º and have eroded through a sequence of inter-bedded sands and conglomerates (Figure 9).

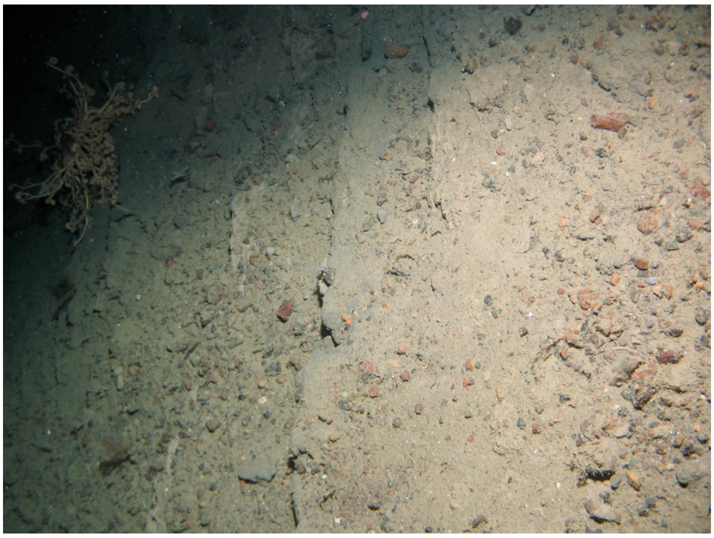
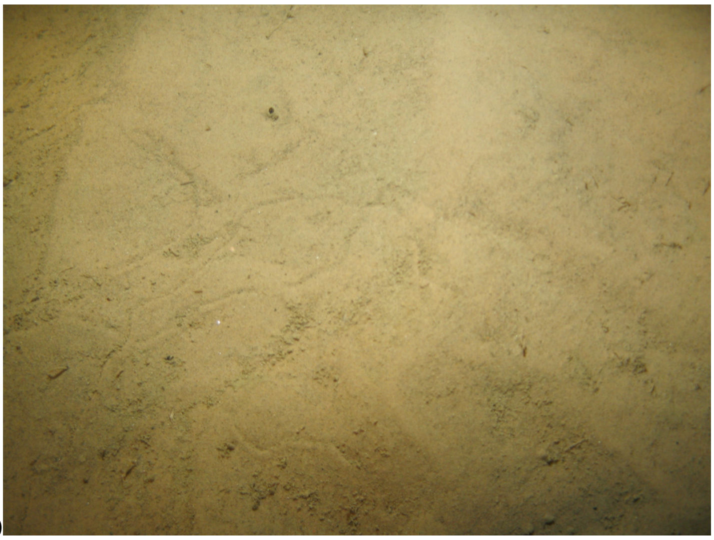


Figure 9. The exposed sub-seabed sequence in one of the channel walls.

WSC_3 was located to try and image the shallower "dam" at a water-depth of around 730 metres. The seafloor is composed of a fine, rippled and bioturbated sand, with many open burrows, fine worm casts and feeding trails. The surface ripples are small-scale barchan-like starved ripples. Toward the "dam" in the channel, the seafloor texture becomes much rougher, and is dominated by detritus-draped cobbles and pebbles with encrusting fauna.

WSC_4 was located on a shallow (640 metres) in-filled part of the central channel. The seafloor is typically sand with patches of gravel and dropstones, though a small patch of seafloor exhibiting a rubble-like appearance (due to the large amount of pebble and cobble-sized material draped by a thin veneer of sand and detritus) may be the expression of the “dam” material. Generally the fine bioturbated rippled sand surface shows common feeding trails, with minor gravel and coarser material, and in places the coarser material is aggregated in the troughs of the ripples (Figure 10).


a)

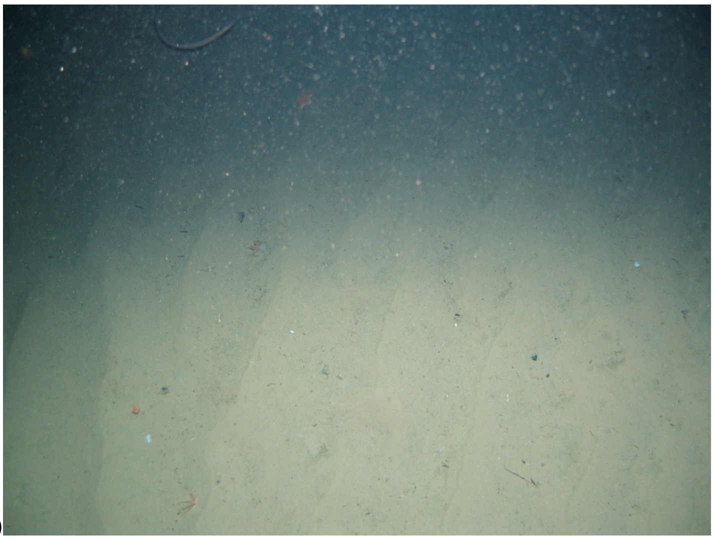

b)

Figure 10. Shows a) close-up and b) far view of the bioturbated rippled sands of the seafloor in this region.

WSC_5 was a transect across a channel flank and wall at a depth of around 920 metres, crossing an area of very high EM1002 acoustic backscatter on the northern flank of the channel. The seafloor had the appearance of a rubble-strewn landscape, with cobbles and boulders, some of which were colonised by sponges, with virtually all of the seafloor appearing to be coated with detrital material.

WSC_6 was located approximately mid-slope across the channel, at a depth of around 725 metres, to examine a well-defined area of very low acoustic backscatter on the northern flank of the northern channel. This in-filled channel has a gentle northern slope (1-2°), whereas the southern more highly backscattering channel flank has a slope of ~3°. The seafloor was a bioturbated, rippled fine sand with (generally very few small, pebble-sized) dropstones. Some of the “dropstones” are non-geological in origin, e.g. a broken house-brick was imaged (Figure 11).

Figure 11. Recent deposition – a house-brick!

WSC_7 was located at the shallower (595 metres), in-filled end of one of the northern channels. Here the seabed was mostly sand with gravel and dropstones of cobble and boulder size, that, along with most of the seafloor appeared to be covered by a fine detrital material. Behind some of the larger dropstones were small areas of gravel lag. Also small discrete patches of pure sand were imaged on the seafloor, frequently these were associated with straight boundaries against seabed with distinct gravel and or cobbles, suggesting that they may be historic, now partially infilled trawl marks (Figure 12).

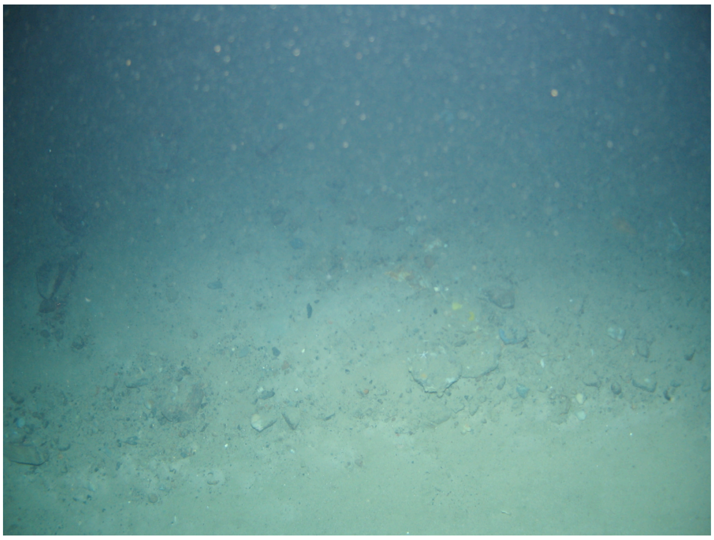


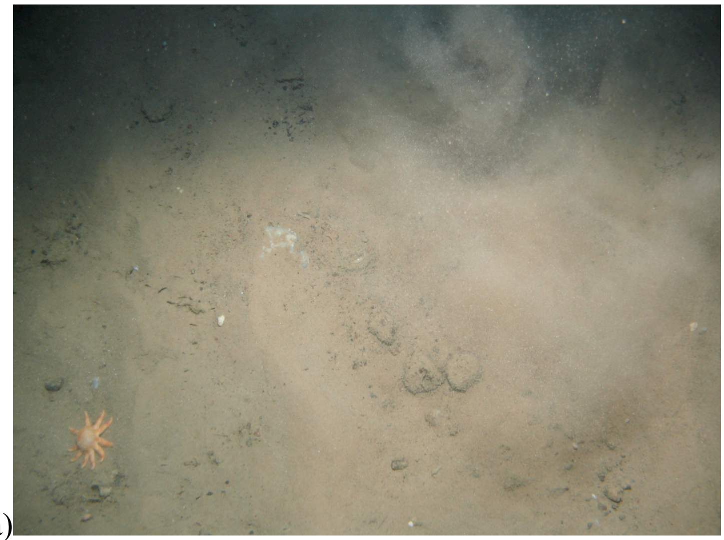
Figure 12. Discrete patches of pure sand with straight boundaries against a seabed with distinct gravel and/or cobbles may be historic, now partially in-filled trawl marks.

WSC_8#1 and WSC_8#2 were run over a fan-like structure at the base of the deeper end of one of the southernmost channels to see what, if anything, might be flushed down-channel. The seabed varies between bioturbated gravely sand with blocks of varying size, to homogeneous burrowed sands, with and the entire seafloor appearing to be draped in a fine detritus; tube-worms and grazing trails are frequently observed.

Toward the south-western end of the transect, the seafloor takes on a more rubble-strewn appearance as the amount of cobbles and pebbles increases dramatically a.

WSC _9 was targeted to be just upstream (in terms of the geostrophic current) of the lower mouth of the canyon in an attempt to catalogue the background benthic fauna outside of any potential down-slope influence of the channel. The seabed is much the same as the previous station in that it is composed of sand with gravel and an apparent fine detrital coating. However, the size of the individual gravel and pebble clasts within the sand are generally much smaller than seen elsewhere.

WSC_10#2 was run over the shallower mouth (catchment) of the southernmost channel to investigate whether the faunal compositions here are the same as at the base of the channel. The start (north-eastern) part of the transect shows a fine rippled sand with coarser material in the ripple troughs (Figure 13a). Sub-angular to rounded dropstones, sometimes hosting sponges and other fauna are seen irregularly, also mostly covered by a fine sand layer. Toward the south-western end of the transect, the gravel and pebble content of the seafloor increases and the ripples disappear with the effect of increasing the cm-scale surface roughness of the seabed (Figure 13b).



a)

b)

Figure 13. a) Pure sand with ripples within which coarser material is aggregated in the ripple troughs, and dropstones covered by a fine sand layer; b) the gravel and

pebble content of the seafloor increases and the ripples disappear with the effect of increasing the cm-scale surface roughness of the seabed.

WSC_11 was located just to the north of the upper mouth of the channel investigated during the previous three stations for general slope characterisation away from the influence of the channels. The seabed is rippled sand with gravel in the ripple-troughs, and larger dropstones. Both the seafloor and dropstones appears to have a thin detrital coating, though some dropstones are encrusted with fauna including occasional sponges, and some of the larger dropstones have gravel halos around their bases.

Wyville-Thomson Ridge

The EM1002 multibeam survey imaged the intersection of the Wyville-Thomson Ridge (WTR) and the slope of the contiguous United Kingdom Continental Shelf (UKCS), revealing that the saddle between these features was deeper than the main summit area of the WTR by approximately 90 metres. Easily apparent from the DTM is the rough texture of the seafloor on both the shelf and the WTR. These rough textures are due in for the most part to the remnants of iceberg plough-marks. This roughness, on scale of 1-10 metres, is seen on both the sun-illuminated map and on the NW-SE cross section (Figure 14). Also illustrated on the cross-section is the 90 m deep saddle; note how the seabed texture is smoothed by current action (overspill from the north to south) in comparison with the rest of the WTR and UKCS slope.

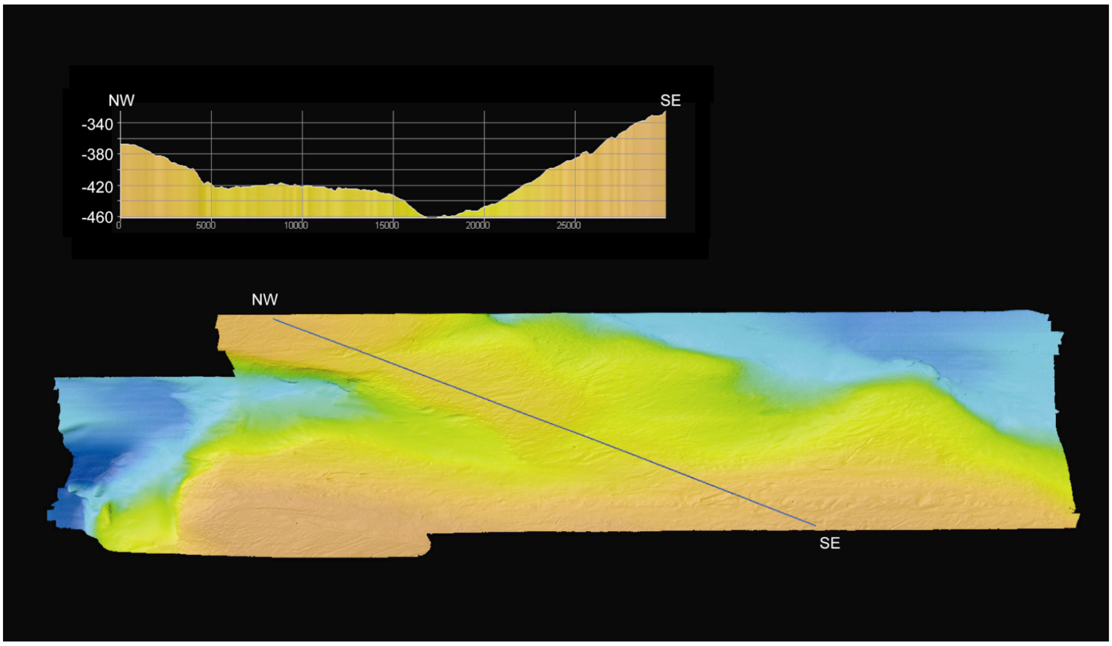


Figure 14. A DTM of the Wyville-Thomson Ridge and the contiguous UKCS viewed from the south, with conspicuous iceberg plough-marks. The location of the section is also marked.

The shallower areas of both the WTR and the UKCS are quite flat with slope of less than 1º, the greatest increase in slope coming at over 400-450 m to the south of the WTR and 500-550m to the north, where the steepest parts of the slope reach in excess of 45º locally, though more generally they are around 20º-25º. Some of the larger iceberg plough-marks are visible in the contours (Figure 15) even though it is contoured at an interval of 15 m. The deepest of the plough-marks are found on the north-eastern margin of the WTR where they can be seen at depths of up to 630 m.

The acoustic backscatter mosaic (Figure 16) reveals expected differences between high-backscatter areas (dark) that are generally at the base of the slopes, and the lower backscattering areas of the shelves. The higher backscatter is due to high benthic current speeds keeping ice-rafted debris blocks and any outcropping bedrock free of sediment cover. The shelf areas of both the WTR and the UKCS show the chaotic couplets typical of iceberg plough-mark terrains, along with, at the edge of the UKCS to the south of the WTR, an linear couplet of ultra-low backscatter that is probably well-sorted sand deposited by geostrophic activity across the benthic saddle separating the two major seabed features.

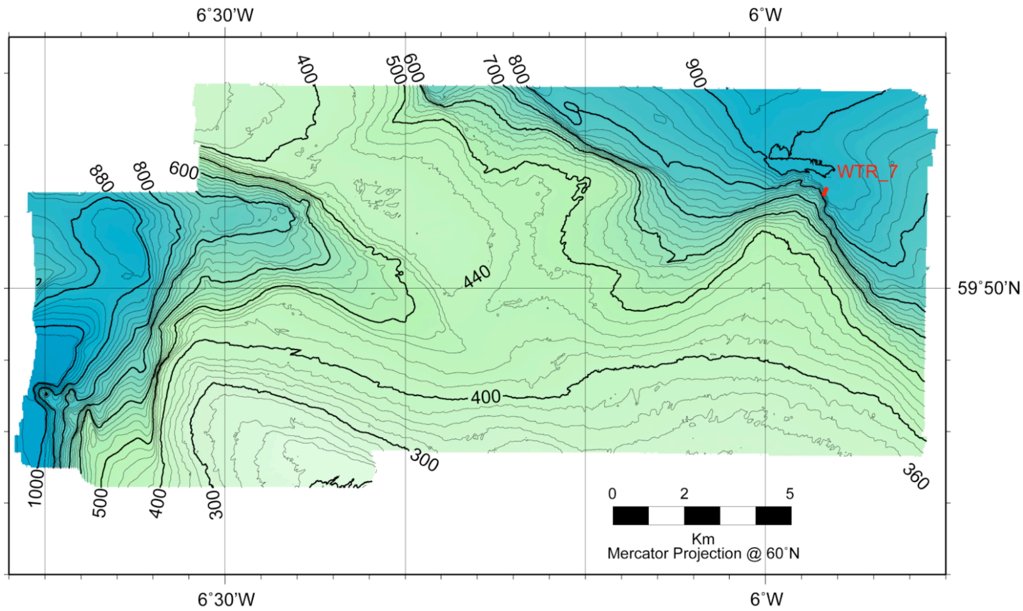


Figure 15. Bathymetric contour map of the Wyville-Thomson Ridge survey area with station location.

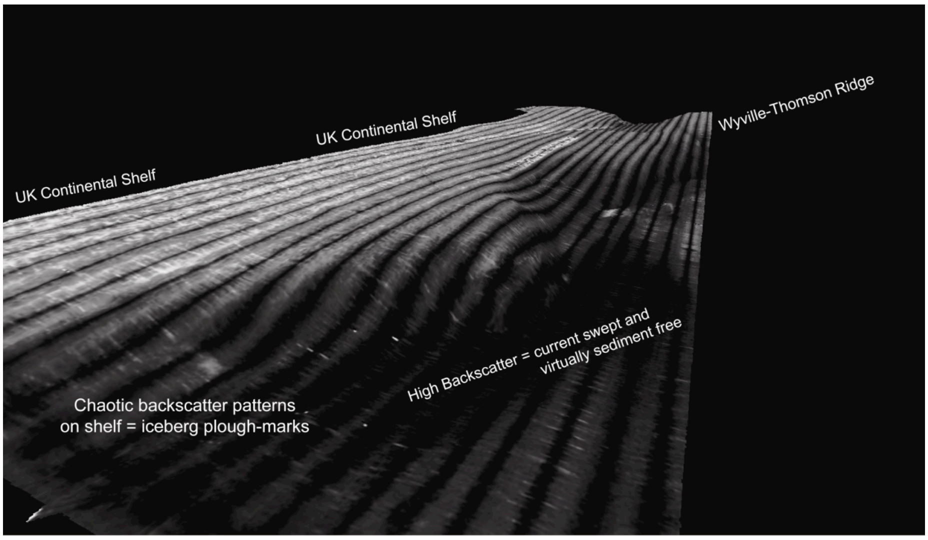


Figure 16. Acoustic backscatter mosaic of the UKCS and Wyville-Thomson Ridge intersection. Spacing between track-lines is approximately 950 metres.

WTRN_7 this station was spectacular in terms of the benthic biology, with a not very diverse, but plentiful seafloor covering of ophiouriods, anenomæ, crinoids, sponges and tube worms. The density of the biology was such that at times only glimpses of the seafloor geology were possible. When seen the seabed was seen, it consisted entirely of bedrock and boulder and rubble scree, there were no fine sediment deposits (Figures 17a and b). At the base of the slope and onto the plain at about 900 m the seabed changed to a washed lag gravel, again covered in fauna.

a)

b)

Figure 17. a) Possible outcrop with encrusting fauna part-way down the slope, and b) a sediment-free gravel pavement at the base of the UKCS, with little benthic fauna.

The CTD measurements revealed that the bottom temperature was around -0.5ºC to -0.6ºC for the entire transect.

Conclusions and Recommendations

The enigmatic channels that are incised into the West Shetland continental slope have been imaged in great detail to compliment the sonar investigations that took place in this area in the mid 1990's. Their physiographic descriptions are now well developed though work needs to be done to identify the benthos and any variations thereof within and without the channel system. Should there be the possibility of acquiring high resolution seismic profiles across the upper and lower projected extensions of the West Shetland Channels, they would provide insight into their history of formation and degradation.

The Wyville-Thomson Ridge – UK Continental Shelf intersection has at last been accurately mapped. This will allow detailed studies of cross-over paths of deep overspill currents to be undertaken. Unfortunately technical issues and weather prevented suitable camera and high resolution sidescan sonar data to be obtained to aid in habitat identification and differentiation, hopefully this area can be revisited at some future point, though data already in collected as part of other studies may prove useful in aiding interpretations within this study area.

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