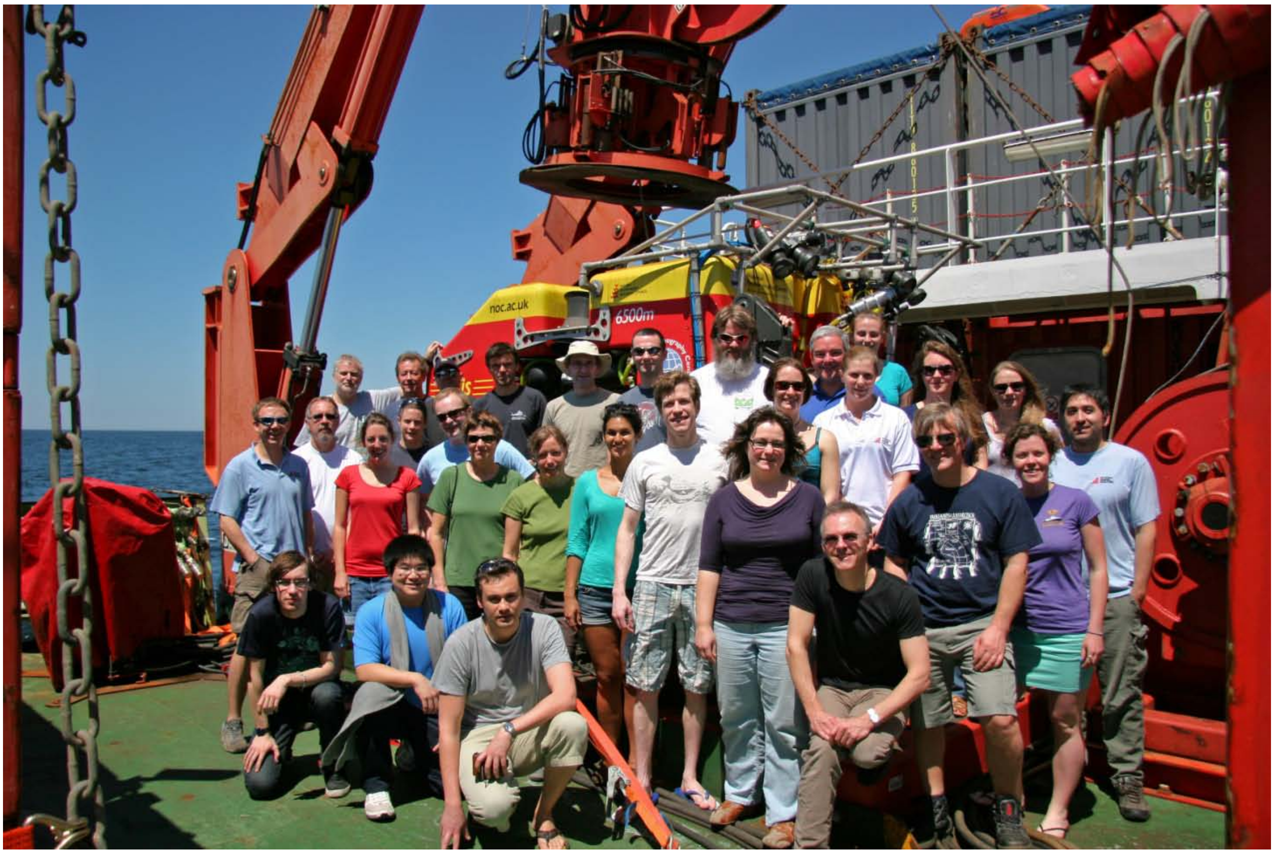
RRS *James Cook* Cruise JC80

The East Scotia Ridge and the Kemp Seamount Calderas

Cruise 4 of the NERC Consortium Grant 'Chemosynthetically-driven ecosystems in the Southern ocean: Ecology and Biogeography' (ChEsSo)

2nd December to 30 December 2012



The 12 Days of Christmas – JC80 Style

On the twelfth day of Christmas, my PI gave to me:

Twelve Kiwa crawling

Eleven chimneys smoking

Ten ice bergs lurking

A Force nine gale

Eight Humpback whales

a Seven armed starfish

Six mini Niskins

Five Meals a Day!

Four CTDs

Three slip rings

Two clicks of wire

And a brand new ROV!

Contents

1. Abstract

JC 80 was to sample the vents sites at E2 and E9 on the East Scotia Ridge, and the Kemp and Adventure craters at the southern end of the South Sandwich Islands. The sampling programme at E2 was very successful completing all the objectives assigned to that site. In addition, we found evidence of an additional vent site at E2 north. It was not possible to access the southern sites at E9 and the Kemp and Adventure craters because the sites were covered in ice as a result of the very hard austral winter, although we were optimistic this would be possible before the end of the cruise. As we were about to complete the study at E2 a crew member became ill and after 24h observation it was decided to evacuate him to land. The ship set sail to Montevideo, considered the most convenient port, which effectively ended the JC80 scientific programme.

2. Acknowledgements

We wish to thank the Master, Ships officers and crew for all their support during JC80. We also thank the continuing support of the technical staff from NMF. This research cruise was part of the consortium grant ‘Chemosynthetic ecosystems south of the Polar Front: Ecology and Biogeography’ (NE/D01249X/1) from NERC which is gratefully acknowledged.

3. Scientific and Technical Party

Scientific Party

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Diva Amon	Southampton
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4. Master and Crew of RRS *James Cook*

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Captain	John Leask
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Third Officer	Richard Pennell
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Third Engineer	Michael Murren
ETO	Martin Ulbricht
Bosun (CPO-D)	Philip Allison
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POD	Stephen Day
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ERPO	Brian Conteh
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Catering Assistant	Stephanie Spence

5. Executive Summary and Objectives of the 'ChEsSo' programme

Chemosynthetically-driven Ecosystems South of the Polar Front: Biogeography and Ecology (ChEsSo)

Executive Summary

We propose a consortium of UK marine scientists to investigate the chemosynthetic environments and associated ecosystems south of the Polar Front. Sites in the East Scotia Sea (East Scotia Ridge, South Sandwich Arc and forearc) will be compared with chemosynthetically-driven communities in the Bransfield Strait, and north of King George Island, Antarctica. The primary objective of this work is to evaluate whether these sites, collectively, represent a Southern Ocean "gateway" to enable gene-flow of chemosynthetic fauna from the Southern Pacific Ocean to the South Atlantic Ocean. To address this issue our consortium of PIs will collectively conduct a detailed investigation and analysis of four contrasting types of chemosynthetically-driven communities, together with their regional tectonic setting, and the specific hydrothermal vent and cold seep environments they inhabit. The communities chosen for our investigation comprise: those associated with high-temperature, bare-rock hydrothermal vents on the East Scotia Ridge, high-temperature, sediment-hosted hydrothermal activity (Bransfield Strait), mud volcanoes (South Sandwich forearc basin) and methane hydrates (north of King George Island). To achieve these aims, we propose a three-cruise (involving international collaboration) and laboratory-based programme. Cruise 1 will be to the East Scotia Sea where we will locate vent and seep sites, using existing evidence for active plumes, examine their tectonic setting and sample the discharge at hydrothermal and cold seep sites. This cruise will rely primarily on proven water-column survey techniques, combined with very high resolution bathymetric mapping and video/image capabilities provided by WHOI's ABE autonomous underwater vehicle. These methods will locate precisely and begin to characterise individual vent and seep environments on the deep sea-floor. Cruise 2 will be to the same area and will use the UK's Remotely Operated Vehicle (ROV) Isis to dive on, sample and thoroughly characterise the biological, chemical and physical environment surrounding vent and seep sites identified during Cruise 1. Cruise 3 will be a combined geophysical, chemical and biological cruise, using the ROV Isis to dive upon and examine hydrothermal vent and cold seep environments, at least some of which have been closely spatially-constrained already, both north and south of King George Island, Antarctic Peninsula. Subsequent analysis of geological, chemical and biological (both microbial and metazoan) samples will allow us to compare the hydrothermal and seep communities among these four sites. We will also use morphological, molecular, lipid and stable isotope analyses to

determine the phylogeography of species, and understand their food web processes. In concert, our programme will determine whether colonisation of vents and seeps, in these most isolated of chemosynthetically-driven ecosystems, is driven by oceanographic or geologic processes or, instead, whether any site has hosted completely isolated evolution.

Specific Objectives and Deliverables

*Our **single specific objective** is to investigate contrasting chemosynthetically-driven ecosystems south of the Polar Front, Antarctica and their relation to their geological, oceanographic and chemical environments. We will determine whether these ecosystems represent one or more unique biogeographic provinces, separated from the Global Ocean by the Polar Front or CDW, or instead are related to vent and seep ecosystems in the Pacific and Atlantic Oceans providing 'stepping stones' between the two. Detailed objectives include:*

1. *to locate individual vent and cold seep sites using a combination of the deep-tow vehicle BRIDGET and the Autonomous Benthic Explorer (ABE), and to use the sampling/deployment capabilities of ROV Isis to investigate these sites in detail (see subsequent objectives 2 to 6)*
2. *to sample and analyse focussed and diffuse vent fluid compositions (temperature, pH, sulphide, methane concentrations, metals and other redox-active elements) to evaluate the contribution of the reduced chemicals supplied to the overall energy budget within the chemosynthetic food-web, and to ascertain if there are any systematic geochemical differences in the detected chemosynthetically-driven ecosystems.*
3. *to sample the vent and seep sites for metazoan organisms, and for micro-organisms using standard techniques*
4. *to compare the biota of the examined vent and seep sites, using both morphology and molecular techniques, and determine their place in the global biogeographic context for both hydrothermal vent and cold-seeps.*
5. *to determine whether the fauna of any or all the four study sites are inter-related due to migration along the seafloor (eg via volcanic or tectonic links) or by hydrographic controls.*
6. *to elucidate food-web structures using state of the art techniques of stable isotope and lipid analyses, and to compare these chemosynthetic-community types and locations both within the chosen region and outside it.*

This report is a description of Cruise 4 of the ChEsSo programme

6. Aims

JC80 was a supplementary cruise to JC55. On JC55 there was significant damage to *Isis* and this curtailed the sampling programme. The damage to *Isis* prevented us completing the following:

i. Collecting megafauna for molecular analysis, isotope and reproductive analysis
ii. Deploying traps for larger species of megafauna and fish for isotope analysis
iii. Collecting end member fluids for chemical analysis
iv. Collecting diffuse flow fluids for chemical and microbial analysis
v. Completing ROV swath at fine scale over vent areas
vi. Collecting cores in the crater for geochemical analysis
vii. Continuing the fine-scale video mosaicking of the vent fields

The aim of JC80 was to complete this sampling programme.

7. JC 80 Cruise narrative

Saturday 1st December 08.00 GMT All scientific party on board.

Sunday 2nd December 05.30 GMT James Cook moves from berth at Punta Arenas town pier to bunkering station outside Punta Arenas. 17.00 James Cook departs bunkering and proceeds eastwards down Magellan Straits to open sea

Monday 3rd December Steaming eastward over the Argentinian shelf south of the Falkland Island. No scientific operations.

Tuesday 4th December Steam east, south of the Falklands. No scientific operations

Wednesday 5th December 10.00 GMT JC hoves to at ~ 54° 23'52S; 52° 57'00W over 3000m of water for ROV tether deployment. Conditions considered marginal so deployment postponed and JC continues on eastward track. 16.30 GMT Conditions improved and tether deployment successfully completed at 54° 28'9S; 51° 49'2W

Thursday 6th December JC continues steaming towards E2 in fairly calm seas south of South Georgia. JC slows at night because of patchy fog and possibility of ice

Friday 7th December JC continues steaming towards E2 in fairly calm seas. At 17.00 GMT JC hove to and deployed the CTD for a full ocean depth (3600m), off-vent profile at 55° 26'39S; 38° 25'37W (JC80_001_CTD#01). CTD back on deck at 20.00 GMT after successful cast and water collection. JC remained hove to because of slip ring problems with the hydrowinch. These were to be addressed and a 3400m test of the CTD (minus Niskins) carried out. 23.16 GMT CTD recovered and test completed successfully. Data stored (JC80_002_CTD#02). 23.46GMT JC resumes transit to E2

Saturday 8th December JC continues steaming towards E2.

Sunday 9th December JC arrive at E2 at 04.30 GMT. The CTD was deployed and used in tow-yo mode to locate and then track the plume (JC80_003_CTD03). This was completed by 09.00 GMT. AT 10.00GMT *Isis* was prepared for deployment and deployed on dive 187 (JC80_004_Isis187). During deployment a chinstrap penguin swam into one of the thrusters but escaped with a bashed head. *Isis* was held in the water until checks were made that no damage had been done. *Isis* continued to dive and reached the seabed at 12.55GMT. Because of navigation problems at E2 during JC42 a series of east-west transects were run to locate and video the main active vent sites and as many of the inactive chimneys as possible. To make as much progress as possible no sampling took place during the transects except for a very rare long-tentacled anemone that is believed to represent a new family. Towards the end of the dive the lighting video for mosaicking was checked, the Niskin samplers were fired for chemistry and microbiology sampling and a piece of bacterial mat-covered chimney was collected for analysis. The last aspect is quite a challenge as the chimney material is very friable. *Isis* returned to the surface at 14.00GMT and was on board by 00.47GMT 10th December

Monday 10th December During the night a series of CTD tow-yos (JC80_005_CTD04) were carried out to the area north of the Dog's Head. An intense hydrothermal plume was tracked towards its source. The CTD deployments were completed by 09.00 GMT. *Isis* was due to launch but during pre-dive preparation it was discovered the tubing carrying electrical cables and fluid had frozen in the night and cracked. This took 3h to repair and the *Isis* swath dive (JC80_006_Isis188) was launched at 14.56GMT. At 300m the systems were tested (this is a brand new swath) and *Isis* dived to 40m above the seabed and completed a test swath to test all systems and output. *Isis* then continued with a series of N-S transect lines to provide the clearest bathymetry of the vent area identified earlier today. Weather conditions calm.

Tuesday 11th December *Isis* was recovered from JC80_006_Isis188 dive at 11.00GMT after a very successful swath dive with all the brand new systems working exceptionally well. From 13.00 to 18.00 a series of tow-yos with the CTD minus Niskin bottles was conducted (JC80_007_CTD) in the northern sector of E2. The data obtained did not support the identification of the source of the plume discovered earlier and because of the time available we decided to deploy *Isis* for biological and chemical collections at the site we know at E2S (JC80_008_Isis189). *Isis* was deployed at 19.30GMT and a 9h dive was planned.

Wednesday 12th December Overnight there was a deterioration in the weather and we extended the dive time by completing the Dive 189 tasks, completing additional mosaicking and finding news sites of chemosynthetic fauna. Excellent collections of fauna and chemical samples were made. *Isis* was recovered at 00.30GMT on 13th December

Thursday 13th December CTD operations were conducted overnight (JC80_009_CTD05) over the southern section of E2. At 13.10GMT *Isis* was launched at E2S (JC80_010_Isis190). This was a very successful dive collecting a considerable amount of both biological and chemical samples including end-member fluid by the titanium syringes. *Isis* was on deck by 00.43GMT 14th December.

Friday 14th December At 02.38 *Isis* was launched on a ROV swath dive over E2S (JC80_011_Isis191) and completed a successful swath being recovered at 13.05GMT. Immediately a CTD was deployed (JC80_012_CTD07) together with a SAPs and recovered 4h later. At 18.54GMT *Isis* was launched (JC80_013_Isis192) at E2N but a problem was noted with the USBL navigation. After a variety of tests *Isis* was brought back on board (aborted dive) at 20.49GMT. The navigation transponder was checked and replaced but it was also noticed that the seals on one of the thrusters was leaking and this took over an hour to replace. *Isis* was relaunched at 23.44 GMT (JC80_014_Isis193) at E2N

Saturday 15th September At 05.53GMT there was a complete electrical failure on *Isis* at the seabed and the ROV was recovered 'dead'. Fortunately the seas were very calm and the recovery was successful at 09.00GMT. A variety of off-vent fauna was collected. There was damage to the tether and this required retermination. At 10.00 a CTD was deployed at E2S (JC80_015_CTD08) and a successful profile completed. Contingency plans discussed with the Master. The CTD (minus Niskins) was then deployed in tow yo mode at 15.00 and continued until 20.30, then recovered(JC80_016_CTD09). By this time the retermination has been strength-tested and the tether was paid out to 2600m (21.00) to take out any residual torque resulting from the deployments. Recovery was at 01.00 16th December

Sunday 16th December *Isis* was launched at 03.53GMT (JC80_017_Isis194) and conducted a systematic survey along a defined path informed by the CTD results. No new vent sites were found and the dive finished at the Dog's Head at E2S where samples of *Kiwa* and end member fluid were obtained. *Isis* was recovered at 18.57GMT. However there was a hydraulic leak in the port manipulator arm that was rapidly fixed. At 19.15 JC started steaming south towards E5N. Because ice was still reported at E9 we elected to do a survey of possible vent sites in each segment down the East Scotia Ridge as long as the ice-free conditions would allow.

Monday 17th December JC arrived at E5N at 09.00GMT and deployed a standard CTD (JC80_018_CTD10) which was recovered at 12.30GMT. JC moved to E5central and redeployed the CTD (JC80_019_CTD11) at 13.30GMT and recovered at 16.30GMT. Only during the second of these deployments was there possibly a hint of hydrothermal activity. On recovery of the second CTD, the CTD wire was seen to be splitting as a result of de-torquing and the wire was paid out to 2000m with an attached weight at 16.45GMT. This was recovered and a CTD deployed at 18.00GMT (JC80_020_CTD12) and recovered at 20.00. At this point it was noticed that the main CTD wire was damaged and that it would have to be re-terminated. At 19.00GMT there had been a meeting of the PIs and the options were considered. We decided to go back to E2north and continue the hunt for the elusive vent as this was considered the best use of ship time especially in regards to the ice situation which could now be seen way off to port. At 20.30 JC set off northwards to E2north.

Tuesday 18th December JC arrived at E2N at 10.00GMT. On arrival it was announced that there was a major repair required to the slip ring on the hydro winch or it might fail during deployment. The PI agreed this repair should be effected. In the interim JC ship-swathed areas just to the west of E2 (JC80_021_swath1). Ice still covering E9. At 15.30GMT JC was back on station and the CTD was deployed (JC80_022_CTD13). This series of tow-yos was used to constrain the plume but at 23.15GMT the CTD failed. The CTD was brought to the surface and was on deck at 23.00GMT.

Wednesday 19th December We decided that the best way to locate the vents in the absence of a CTD was to use the ROV in swath mode fitted with a CTD and lss sensor. *Isis* was launched at 02.00GMT (JC80_023_Isis195) and recovered after a major electrical failure at 06.00GMT. This was the second electrical failure in the water and recovery of a dead boat. The ROV team set about a forensic examination of the whole system and found there was a short in the tether about 1300m from the drum end. A conference was convened with the Master and ROV techs plus PI and it was proposed that JC steam to the northern end of the South Sandwich Trench in 7000+m depth, stream 6900m of the ROV tether, stop it off and cut out the offending 1300m. Permission was obtained from NMF in NOC and risk assessment written whilst JC steamed in the northeasterly direction. JC arrived over 7115m depth at 22.05GMT. Retermination of the distal end of the tether was almost complete.

Thursday 20th December The tether was deployed at 01.30GMT and the cropping operation continuing through the night. After removing the offending 1900m of tether the electrical signal was correct. The end of the tether was on board by 13.30. The new CTD cable plus weight was immediately streamed. This was recovered at 17.20GMT and JC set steam for E2N. JC arrived back at ESN at 23.55.

Friday 21st December. The CTD was deployed at E2N (JC80_025_CTD130) to conduct a series of tow yos to try and constrain the plume source. This continued all day following the increases in plume concentration and turning away from decreases. At 20.44GMT we got a direct hit of diffuse venting with warm water registering on the CTD. On technical advice the CTD was recovered as this was a new wire. At this point the weather was starting to deteriorate and on the advice of the Master we moved south to E5 as 48h of rough conditions were predicted for E2. JC steamed slowly to E5

Saturday 22nd December JC arrived at E5 12.00GMT and it was decided to stream the CTD wire as there appeared to be some twisting in it. This was completed in deteriorating weather conditions and it was decided to steam back to E2N to find the new vent site. On the way back the PI was approached by the Captain and the Doctor requesting a medical evacuation of one of the crew members who had become ill. The PI agreed and this abruptly terminated the scientific part of the JC80 cruise. JC set off for Montevideo in rough seas.

Sunday 23rd December to Sunday 30th December. Steam to Montevideo

Sunday 30th December Arrive Montevideo 20.00GMT

Monday 31st December Depart Montvideo 15.00 GMT for international waters

Tuesday 1st January Hove to in Rough seas

Wednesday 2nd January Continue to station

Thursday 3rd January 02.00 to 08.30 swath area of abyssal plain. 11.00 GMT Launch test dive Isis 196. All systems working excellently. Isis retired at 23.00 GMT

Friday 4th January Steam for Montevideo

Saturday 5th January Arrive Montevideo

8. JC80 Subject reports

8.1 Swath mapping

Veerle Huvenne, Jon Seddon, Leigh Marsh

The rebuilt ISIS ROV has been equipped with a new multibeam echosounder (MBES): a RESON Seabat 7125 dual frequency (200 and 400 kHz) system with 512 beams. The set-up is a modular one, where the MBES can be slotted in the location of the mini-Niskins (port aft quarter of the ROV) when required for a swath dive. The vehicle offsets versus a common reference point are listed in Table 1 and 2. The system was only delivered to NOC shortly before the shipping of the ROV for JC080, hence it had not been possible to fully integrate and test it before the cruise. This means that the first ROV swath dive of JC080 (Dive 188) basically was an equipment trial.

Table 1 Offsets for the various sensors versus a common reference point on ISIS (front of vehicle) as entered in PDS2000 (X: positive starboard, Y: positive forward, Z: positive up, all in metres)

	X	Y	Z
Compatt (USBL)	-1.01	-0.36	1.46
Doppler	0.58	-2.91	-0.17
MBES	-0.47	-1.78	-0.82
Octans (attitude)	0.00	-0.86	-0.49
Parascientific (depth)	0.55	-1.48	0.00

Table 2 Relative positioning of MBES transducers on the RESON base plate, as entered in the 7k hardware configuration settings

	X	Y	Z	Tilt (°)
200 kHz sensor	0.125	-0.218	0.050	0.00
400 kHz sensor	-0.125	-0.125	0.031	0.00

The sonar is operated and the settings are managed through the 7k software module, and the data is then forwarded to the PDS2000 software for real-time map visualisation and –more importantly- acquisition and storage. During JC080, the data were recorded in PDS2000, georeferenced with the USBL navigation. PDS2000 takes in Doppler information to steer its navigation Kalman filter, but does not actually take it as alternative navigation stream. However, the pilots used the Doppler navigation (through DVLNAV and OFOP) to fly the vehicle, and this navigation was then integrated with the bathymetry during processing (see below). Hence a Doppler reset was carried out at the start of every line. For ease of processing, the TECHSAS line number was also increased at the start and end of every line. Unfortunately the TECHSAS recording failed on 2 occasions for part of a line (once during each survey). The navigation and depth data for those sections were reconstructed from the Doppler raw data (DVLNAV .csv files).

The multibeam data were recorded in the PDS2000 own format, and in .xtf format for easy importation in both the Caris HIPS and SIPS and PRISM Backscatter processing software suites. However, in the end it was decided to process the data in CARAIBES, the software package from IFREMER, because this gives some advantages in terms of data handling for ROV surveys (easy importation of attitude and depth information, adjustment of navigation etc.). To facilitate this, the data were exported from PDS2000 in .s7k format too. The processing steps are summarised in the flowchart in Fig. 1. Basically, they include data importation/conversion to CARAIBES formats, combination of the Doppler navigation and vehicle depth data with the bathymetry data (*Genexy* and *Coratt*), determination of potential pitch and roll offsets through calibration (*Calbat*), rectification of the Doppler navigation drift (*Regbat*) and gridding (*Mailla*). The resulting .flt and .hdr files can then be imported directly into the ArcGIS toolbox to be converted into an ESRI grid or .img file.

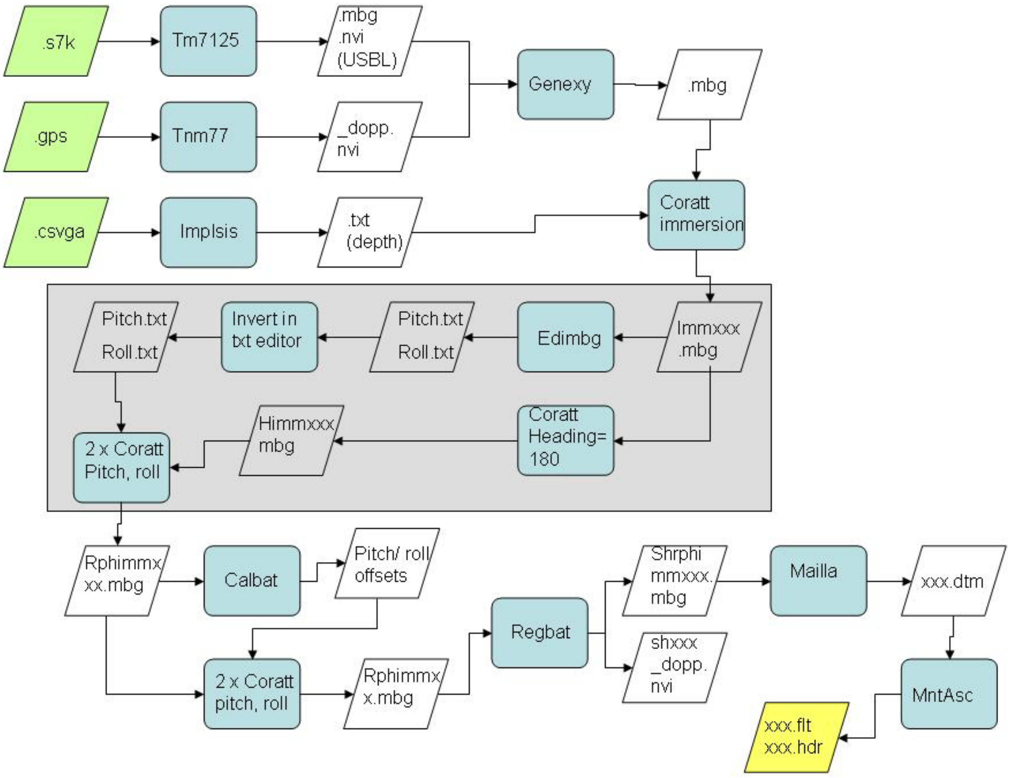


Fig. 1 Flowchart of the CARAIBES data processing. Input files from PDS2000 or TECHSAS for a standard processing flow are indicated in green, output files (.flt and .hdr) in yellow. The section indicated in grey was only applied to the data from Dive 188 to compensate for the reverse mounting of the RESON swath system.

Two ROV swath dives were completed during the cruise (D188 and 191), and a third survey was started, but was aborted after the calibration lines due to a black-out of the vehicle (D195). The settings for each of those surveys are summarised in Table 3. The maximum ping rate was kept at 10 Hz, as this is the frequency of data recording of the Octans attitude sensor. With a survey speed of 0.3kn (0.15 m/s) this gives sufficient data density along-track.

Table 3 RESON survey settings for Dive 188 and 191

	Dive 188 – E2N	Dive 191 – E2S
MBES Frequency	400 kHz	400 kHz
Altitude	40 m	20 m
Line spacing	100 m	30 m
Beam angle	120-140°	100-120°
Power	210 dB	210 dB
Gain	25 dB	23 dB
Duration (at seabed)	15 h	6 h
Area covered	576000 m^2	72600 m^2
Pixel size	40 cm	15 cm

Dive 188 – E2N

Dive 188 was the very first survey using the RESON system mounted on ISIS. The ROV was kept at ca. 40 m above the seafloor to create an overview map of a potential new vent site that had just been identified from a tow-yo CTD. After some initial trouble with the settings of the 7k programme, the system was managed through the 'single head, 400kHz' setting and the data acquisition went smoothly. Unfortunately no sidescan sonar and snippets information were recorded during this survey as their recording had not been set up in PDS2000 during the original RESON installation. Additionally, the pressure reading from the Digiquarts depth sensor was not correctly converted to depths within PDS2000, hence all data were recorded as relative depths below the vehicle. Actual vehicle depths were then applied during post-processing, using depth values recorded in TECHSAS.

In addition, following the initial acquisition of the calibration data, it emerged that the system was mounted back-to-front. The resulting mis-positioning was rectified during post-processing by applying a 180° heading offset and inverting the pitch and roll corrections.

The resulting swath map is presented in Fig. 2.

Dive 191 – E2S

The second swath dive consisted of a high-resolution survey of the vent chimneys of E2S. This was partly a repetition of a swath survey carried out during JC042 with the old SM2000 system. The aim was to get a map of higher quality, and most importantly, a map that is correctly positioned. During JC042, major problems were encountered with the USBL navigation, which meant that so far none of the chimneys of E2S were correctly positioned.

Dive 191 was carried out at an altitude of 20 m above the seabed (during the calibration, an altitude of 15 m was tested, but this was deemed to be too risky and it was decided to increase the height to 20 m and reduce the beam angle to keep the same horizontal resolution). The instrument was mounted correctly on the ROV this time, but the depth recording in PDS2000 was still not correct, hence it still had to be repaired in post-processing.

The resulting map is presented in Fig. 3, with an indication of all identified chimneys.

Additional note:

In the event of a power shut-down on the MBES (e.g. as the result of a vehicle blackout), the Reson system and 7k software may show errors upon restart. This can be repaired by running the small program 'Reset to factory defaults' which can be found on the desktop.

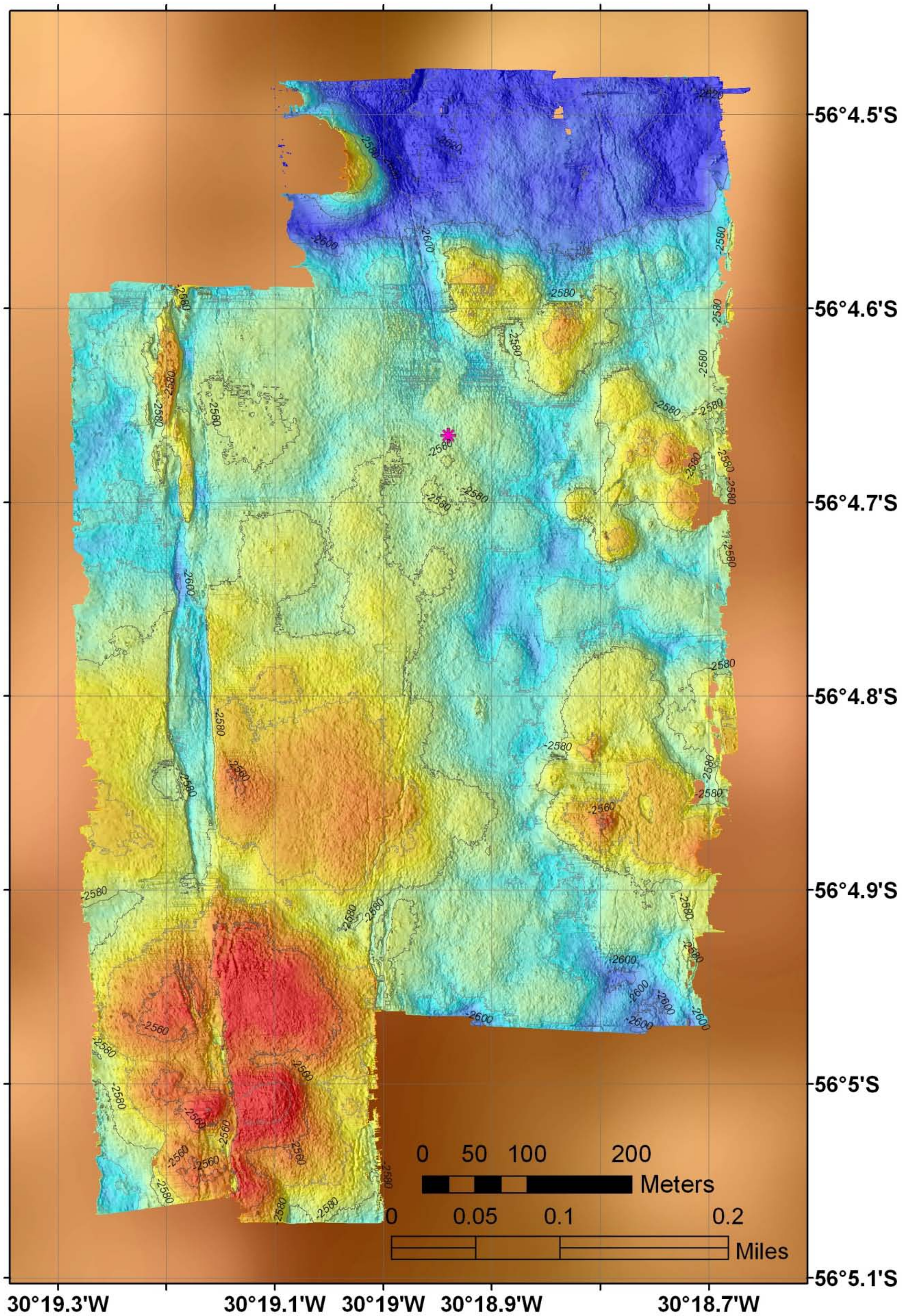


Fig. 2 Bathymetric map of E2N. Pink star indicates location of high Eh and LSS signal observed during CTD4

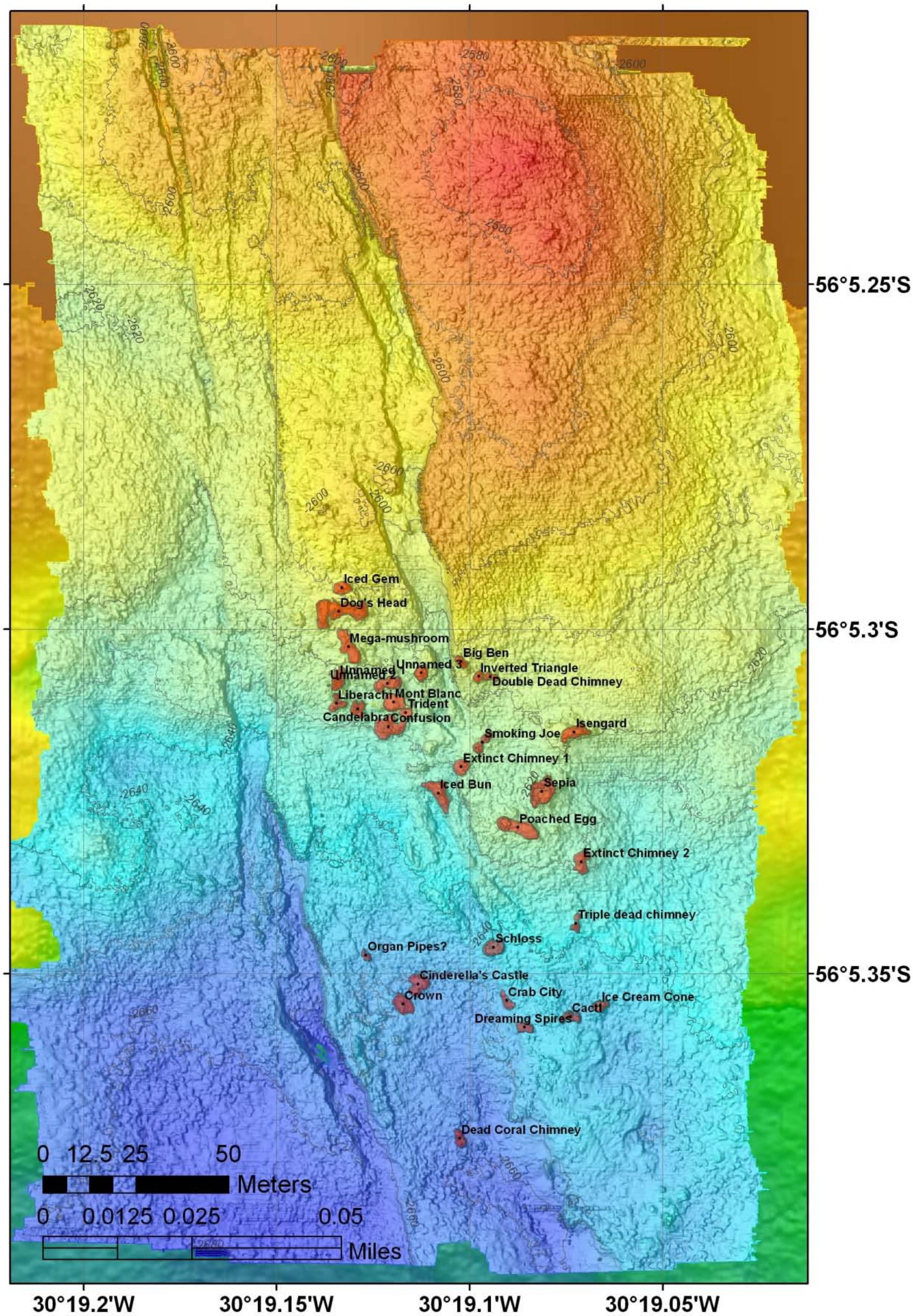


Fig. 3 Bathymetric map of E2S with indication of main features identified during Dives 187 and 189

Table 4 Feature locations (centre points)

Name	Feature nr	Lat	Long	Lat degr	Lat min	Long degr	Long min
Dog's Head	0	-56.088291	-30.318898	56	5.2974	30	19.1339
Iced Gem	1	-56.088234	-30.318884	56	5.2940	30	19.1331
Mega-mushroom	2	-56.088377	-30.318856	56	5.3026	30	19.1313
Liberachi	3	-56.088513	-30.318907	56	5.3108	30	19.1344
Candelabra	4	-56.088527	-30.318815	56	5.3116	30	19.1289
Confusion	5	-56.088570	-30.318683	56	5.3142	30	19.1210
Trident	6	-56.088536	-30.318608	56	5.3121	30	19.1165
Mont Blanc	7	-56.088511	-30.318661	56	5.3106	30	19.1196
Big Ben	8	-56.088413	-30.318370	56	5.3048	30	19.1022
Inverted Triangle	9	-56.088448	-30.318294	56	5.3069	30	19.0976
Double Dead Chimney	10	-56.088449	-30.318242	56	5.3069	30	19.0945
Isengard	11	-56.088583	-30.317881	56	5.3150	30	19.0728
Sepia	12	-56.088726	-30.318021	56	5.3236	30	19.0812
Poached Egg	13	-56.088814	-30.318125	56	5.3288	30	19.0875
Iced Bun	14	-56.088731	-30.318466	56	5.3238	30	19.1080
Extinct Chimney 1	15	-56.088667	-30.318369	56	5.3200	30	19.1021
Smoking Joe	16	-56.088607	-30.318278	56	5.3164	30	19.0967
Schloss	17	-56.089103	-30.318230	56	5.3462	30	19.0938
Cinderella's Castle	18	-56.089192	-30.318555	56	5.3515	30	19.1133
Crown	19	-56.089240	-30.318621	56	5.3544	30	19.1172
Organ Pipes?	20	-56.089122	-30.318781	56	5.3473	30	19.1269
Dreaming Spires	21	-56.089296	-30.318096	56	5.3577	30	19.0858
Crab City	22	-56.089232	-30.318172	56	5.3539	30	19.0903
Cacti	23	-56.089271	-30.317897	56	5.3562	30	19.0738
Ice Cream Cone	24	-56.089244	-30.317769	56	5.3546	30	19.0661
Dead Coral Chimney	25	-56.089565	-30.318375	56	5.3739	30	19.1025
Extinct Chimney 2	26	-56.088896	-30.317850	56	5.3338	30	19.0710
Triple dead chimney	27	-56.089045	-30.317873	56	5.3427	30	19.0724
Unnamed 1	28	-56.088454	-30.318901	56	5.3072	30	19.1341
Unnamed 2	29	-56.088465	-30.318687	56	5.3079	30	19.1212
Unnamed 3	30	-56.088440	-30.318543	56	5.3064	30	19.1126

8.2 Chemistry

Douglas Connelly, Belinda Alker, Alfred Aquilina, Cathy Cole, Matt Cooper, Jeff Hawkes, Alistair Lough, Jenny Thompson.

Following the JC055 cruise we had a clear set of goals to achieve on this cruise. There are now three PhD student projects linked to ChESSO; Jeff Hawkes, Cathy Cole and Alistair Lough. JC080 provided a great opportunity to collect samples to add to last year’s data set and in addition collect a set of samples for new analytical approaches developed over the past 12 months.

CTD operations and Water Sampling

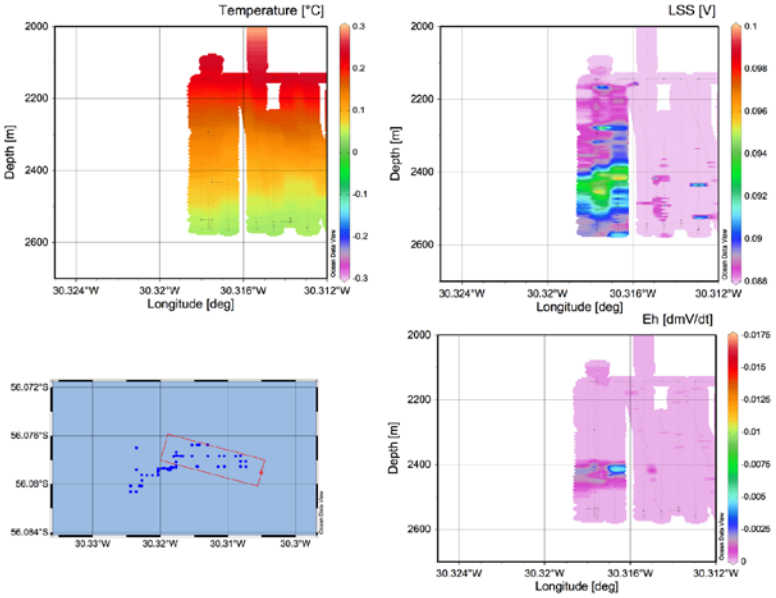
On arriving at the ship we filled the Niskin bottles on the CTD rosette with freshwater and put an aliquot of hydrochloric acid to clean them. The first CTD was conducted off site near South Georgia as a shake down for chemistry. Metals were not sampled as nitrogen pressure adaptors for the Niskin bottles were not available. DOC, methane, nutrients, oxygen were all taken from 6 depths. Additionally samples were collected from this cast for Anni Djurhuus for microbiological studies. We then proceeded to E2 and did a series of CTD casts.

CTD 3 (referred to by seabird software as CTD2) was a vertical CTD for Anni Djurhuus to take buoyant plume (and non hydrothermal) samples for POC and bacteria. Support chemistry was taken for her (methane, DOC, nutrients) from 6-7 depths. Metals were filtered through the vacuum/collection system from lowest 2 depths. Niskin 4 smelled quite strongly of sulphide.

CTD 4-26 was a Tow-Yo over the Dog's Head vent chimney at E2. A full set of samples were collected from this CTD cast, including methane, nutrients, DOM, TOC, metal (dissolved and total) and nitrogen isotopes.

Since we were unable to head south due to ice cover over E9 and the Kemp caldera we had more time at E2. Between ROV dives we were able to explore areas identified in 2009 as having high LSS signals. The difference between that survey and the one we could do now is that we have an Eh sensor from Ko-ichi Nakamura of AIST, Japan. The detection of LSS and Eh anomalies together indicates a relatively young plume as Eh dissipates rapidly in seawater as it is thought to be a mainly result of dissolved hydrogen sulphide which is high in vent fluids but is rapidly diluted and/or oxidised in seawater. CTD 26-43 and 46-63, were a series of Tow Yo surveys over the northern part of E2. We did not get any closer to identifying where the source of these strong Eh and LSS signals in the water column. A summary of this data can be seen in Figure 4.

Figure 4. CTD Tow-Yo data shown for anomalies in light scattering (LSS) and reductive potential (Eh). The diffusive area of venting discovered is indicated. We do not think that this was the source of the strong Eh/LSS plume (also indicated).



trong plume
from high-
temperature source

CTD 43 and 45 were CTDs over Dog's Head with a SAPS for a temporal study of the neutrally buoyant plume. This CTD was a cast into hot water with the SAPS. The SAPS ran for one hour in up to 1°C fluid and was dark grey/brown afterwards. One bottle had been closed in the NBP (N1) and 10 were closed one per minute in the 0.3-1 °C water. The sample bottles were closed according to anomalies in light attenuation, temperature and reductive potential, as shown in figure 5.

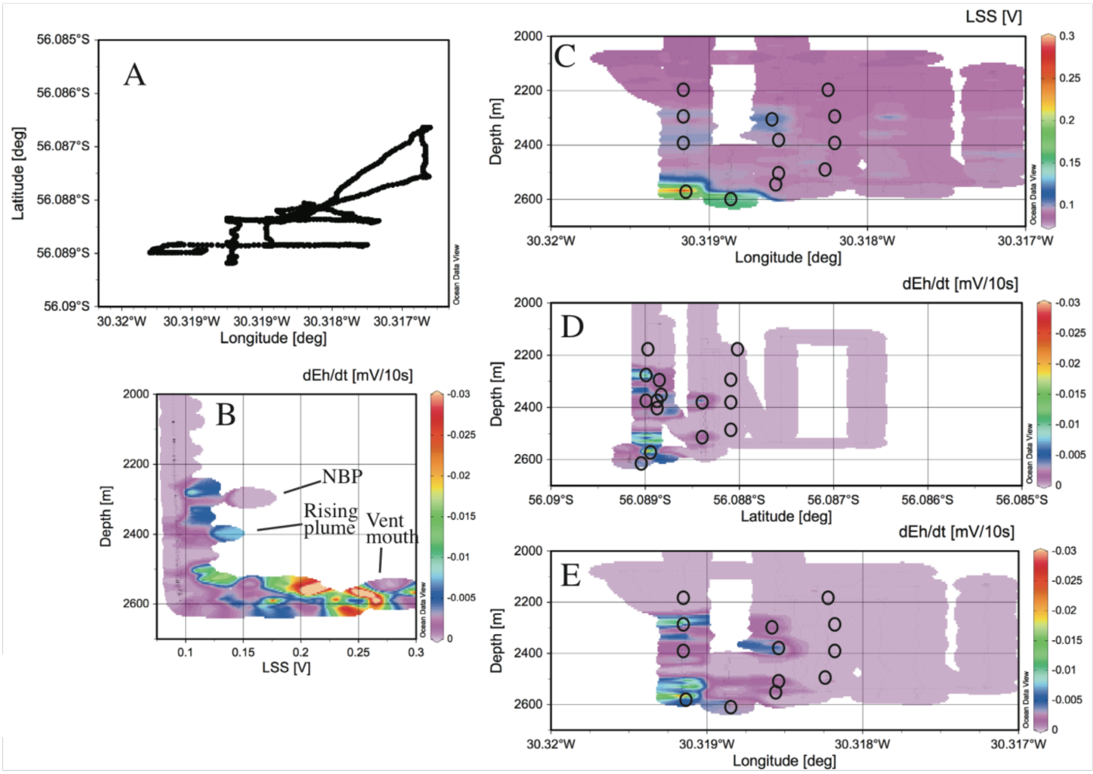


Figure 5: One of the two main chemistry sampling CTD stations (CTD43) showing water column characteristics and sampling strategy. A: Latitude vs. longitude map of the area surveyed to find various parts of the plume. B: Light Scattering Sensor (LSS) plotted as a depth profile (averaged for all data) with change in reductive potential (dEh/dt) shown in colour. Three parts of the plume were encountered, as indicated on the plot (NBP = Neutrally buoyant plume). C-E: LSS and dEh/dt shown as colours along longitude or latitude vs depth. Sample locations are indicated by black circles. We sampled several parts of the plume and four nearby 'background' sites, which showed no anomalies in LSS or dEh/dt.

CTD 44 was a CTD conducted over Dog's Head for SAPS and for Anni Djurhuus. Bottles were closed at 7 depths (same as usual including 1000, 200m and Chl max) and the SAPS was run for 1 hour just over the chimney. The signals came and went, and the resultant filter was green with black specks. TOC and nutrients were taken for all Anni Djurhuus's depths.

We moved to segment E5 for three CTD (64, 65, 66) drops, at the northern, middle and southern section of the segment. This was the area in 2010 where we located a small anomaly. These casts identified a small anomaly but since it was beyond the depth that the ROV was certified for working at we returned to E2.

CTD 67-130 was a series of two back to back Tow Yo casts. On the last cast the CTD detected an anomalous temperature spike of 0.2 °C close to the seabed to the NW of the Mermaids Purse area on E2.

A summary of CTD casts and samples taken is shown in Table 5.

JC080- Stn	JC080- CTD	Date	CTD Cast No.	Start Lat	Start Long	Deck Log	Bottles Fired	Chemistry Tak CH4	O2	Nutrients	TOC	DC
001	001	07/12/2012	001	55 26.664	38 25.63	Y	24	6	6	8	6	
002	002		002			N	0					
003	003	09/12/2012	003	56 05.322	30 19.106	Y	24	7				8
005	004	10/12/2012	004-026	56 04.663	30 18.923	N	Tow-yo					
007	005	11/12/2012	027-039	56 04.863	30 19.149	N	Tow-yo					
009	006	13/12/2012	040-043	56 05.295	30 19.132	Y	24					
012	007	14/12/2012	044	56 05.339	30 19.148	N	19 + 1SAPS					
015	008	15/12/2012	045	56 05.339	30 19.144	Y	20 + 1SAPS	20	11	20		2
016	009	15/12/2012	046-063	56 04.684	30 18.833	N	Tow-yo					
018	010	17/12/2012	064	57 23.594	30 09.304	N	0					
019	011	17/12/2012	065	57 25.202	30 08.4	N	0					
020	012	17/12/2012	066	57 27.506	30 06.80	N	0					
022	013	18/12/2012	067-072	56 04 498	30 18.9202	N	0					
025	014	19/12/2012	073-130	56 04.660	30 18.924	Y	4	4		4	1	

Vent fluid sampling

Following from JC042 we had a series of questions related to the chemistry of the end-member fluids at the identified vent sites at E2, E9 and the Kemp caldera. End member fluids are collected using a set of titanium syringes and 6 mini-niskins on the ROV are used for diffuse vent samples and rising plume samples.

In summary the titanium syringes worked well but the mini-niskins malfunctioned on all but one ROV dive. The details of samples collected are as follows:

ISIS187

The mini-niskin bottles were closed simultaneously (accidentally) in the vicinity of Dog's Head. Unfortunately the bottles leaked on ascent and so the operation was used as a shake down for chemistry sampling. The bottles were worked over for seals and rubber bands for shutting them tight.

ISIS189

The mini-niskin bottles did not seal properly, so all leaked by the surface. The Ti samplers were taken in Crab City for Cathy (quite early in the dive, note kinetic effects) and at Dog's Head at the end. The sampler came out of the chimney towards the end and the pH was measured as 4 (c.f. JC042 2.9). The Ti samplers were successfully sampled for all routine analytes.

ISIS190

Ti samplers and mininiskin bottles were taken at Dog's Head. Both Ti samplers (and both barrels of each) fired successfully, and the mininiskins worked for the first time, except for Niskin 4 which fired and then opened. All usual analytes were taken and DOM (500ml) was taken from all. This was filtered for the mininiskins so that Alisdair Lough could recover more material for his Ph.D.

ISIS192

Was an exploration dive at E2N with plans to move to Dog's Head to collect samples, but there was a complete power outage on the ROV so the dive was aborted and the ROV winched up.

ISIS194

Only one Ti sampler was fired as there was a loss of oil pressure and the mini-niskins did not close. The Ti sampler was sampled for all the usual analytes at around 1900 GMT. Nitrate isotopes and DOC was taken filtered and unfiltered for this sample – the TOC will be filtered at the point of analysis to see if there is a difference.

Mineral samples

During the project we collected three samples of rocks and minerals from the vent fields. Two of these were collected by accident and although catalogued there is some question as to the exact sampling locations. The final samples were collected directly from the main chimney of Dog's Head at E2, with minimal damage to the site. These were photographed and will be returned to NOCS for further analysis.

8.3 .Biology

Macro- and Megafauna sampling

Katrin Linse, Diva Amon, Chong Chen, Jane Heywood, Leigh Marsh, Will Reid, Chris Sweeting, Helena Wiklund, Claire Woulds, Paul Tyler

One of the main objectives for the fourth ChEsSO cruise JC80 to the East Scotia Ridge is to sample the macrofauna organisms from hydrothermally active sites (vents, seeps) and the neighbouring non-vent organisms for later taxonomic (morphological and molecular), biogeographic, phylogenetic and ecological studies. The macrofaunal collection and sample distribution protocol followed the one developed for JC42. During JC80 three areas had been planned for ISIS collection dives: the East Scotia Ridge segments E2 and E9, the Kemp Caldera and Adventure Crater.

Work at sea:

During the ROV Isis dives 187, 189, 190, 193 and 194 benthic macro- and megafauna was collected with the suction sampler and placed either into the bioboxes or the suction sampler's storage cylinders. In total more than 1350 specimens of 17 species have been collected at E2 vents and in the off-vent area (Table 1). On deck the specimen were counted and distributed to the relevant scientists for fixation following suitable protocols for their work. In specimens for taxonomic studies tissue subsamples were taken for molecular analysis and the rest fixed in 4% formaldehyde for morphological studies.


Figure 6: Long-armed red big anemone

Of particular interest is the collection of three specimens of a long-armed red big anemone (Figure 6) that is a different species of probably a new order of hexacorals according to taxonomist Estefania Rodriguez.

Table 6. Species and specimen numbers at E2S

Station	Dive	Area	Location	N	taxon
4	187	E2		1	Vulcanolepas
4	187	E2	off vent	1	large armed anemone
8	189	E2	Cindy's Castle Crab	16	anemone white
8	189	E2	city/village Crab	4	anemone white
8	189	E2	city/village	5	Vulcanolepas
8	189	E2	Cindy's Castle Crab	1	Kiwa
8	189	E2	city/village	80	Kiwa
8	189	E2	Dog's Head Crab	7	Kiwa
8	189	E2	city/village	10	Lepetodrilus
8	189	E2	Cindy's Castle	408	Lepetodrilus

8	189	E2	Dog's Head	26	Lepetodrilus
8	189	E2	Cindy's Castle	431	Peltospiroid
8	189	E2	Dog's Head	46	Peltospiroid
8	189	E2	Dog's Head	51	Provannid
8	189	E2	Cindy's Castle	7	seaspiders spp
10	190	E2	Sepia	5	Vulcanolepas
10	190	E2	Dog's Head	1	Vulcanolepas
10	190	E2	Sepia	11	Kiwa
10	190	E2	Dog's Head	1	Kiwa
10	190	E2	Sepia	10	Lepetodrilus
10	190	E2	Sepia	2	Limacina
10	190	E2	Sepia	12	Peltospiroid
10	190	E2	Sepia	1	Polynoid
10	190	E2	Sepia	102	Provannid
10	190	E2	Dog's Head	22	Provannid
10	190	E2	Sepia	34	red anemone
10	190	E2	Sepia	6	seaspiders spp
10	190	E2	Dog's Head	14	white anemones
14	193	E2	E2 North	1	? Colony
14	193	E2	E2 North	1	ascidian, carnivor
14	193	E2	E2 North	1	brisingid
14	193	E2	E2 North	4	brittle star
14	193	E2	E2 North	1	crinoid
14	193	E2	E2 North	2	large armed anemone
14	193	E2	E2 North	1	octocoral
14	193	E2	E2 North	1	stalked crinoid
14	193	E2	E2 North	2	Sterechinus
17	194	E2	Anemone Field	36	Kiwa
17	194	E2	Anemone Field	2	Provannid
				1367	

Polychaete taxonomy (Helena Wiklund & Diva Amon)

Introduction

Polychaetes are abundant in almost all marine habitats, occurring from the intertidal zones to the deep sea. Some polychaete species seem to be specialised on ephemeral habitats such as hydrothermal vents, cold seeps and whale falls. The aim of this study is to assess the polychaete diversity at the vent sites, and to investigate possible species overlaps with other habitats to elucidate distribution patterns and dispersal pathways.

In total 288 polychaete specimens were picked out from samples collected at the site E2. The specimens, 96 from Cindy's Castle, 178 from Sepia and 14 from Dog's Head, were all preserved in 100% ethanol for future molecular and morphological studies. The collected worms represent eight species from five different families; Polynoidae (2 spp.), Dorvilleidae (1 sp.), Maldanidae (2 spp.), Cirratulidae (2 spp.) and Spionidae (1 sp.).

At least two of the species, *Ophryotrocha* sp. (Dorvilleidae) and *Raricirrus* sp. (Cirratulidae) are new to science.

The samples will be analysed further at the Natural History Museum in London, where the species will be identified to species or formally described, and molecular phylogenetic studies will be conducted. Using the material collected at E2 and E9 during the previous cruise, JC42, population connectivity studies can be performed for three of the species.

Zonation in the reproductive biology and population structure of the crab *Kiwa* n. sp.

Leigh Marsh, Jon Copley and Paul Tyler, University of Southampton

The aims of this study are to 1) assess spatial variation in sex ratios; 2) examine ovarian structure, morphology and development; 3) to assess synchronicity of oocyte development; 4) to examine spatial variation in reproductive maturity; 5) to examine fecundity and reproductive effort and finally, provide an insight to the life-cycle driving the "*Kiwa assemblages*" as defined by Marsh et al. (2012) at the ESR vent fields.

Samples of *Kiwa* n. sp were recovered from three spatially distinct sampling areas.

- Dive 189 (Crab City, diffuse flow site)

- Dive 190 (Dog’s Head high-temperature site) and
- Dive 194 (Anemone Field low-temperature site).

On recovery from the ROV, all samples were photographed, measured and sexed. For reproductive analysis the following information from each individual was recorded:

- Sex
- Carapace length
- Carapace width
- Stage of moult (i.e hard or soft, colour of carapace)
- Signs of necrosis on carapace
- Brooding?
- Presence of funiculus on pleopods
- Generation of next carapace.

The primary tissue material collected for this work consists of the gonad of specimens where all other tissues were then removed for studies of microbiology (Jane Heywood, BAS), population genetics (Chong Chen, Oxford), isotope composition (Chris Sweeting ad Will Reid, Newcastle) and heavy metals (Cathy Cole, University of Southampton) making maximum use of all the tissues available from each individual.

Gonadal tissue was removed from each specimen and fixed in buffered 4% seawater formaldehyde solution for 48 hours. Samples were subsequently washed twice with distilled water and then stored in 70% ethanol. Where individuals were brooding, the clutch was removed and stored in buffered 4% seawater formaldehyde solution.

Prior to preservation in formaldehyde solution, oocytes from one individual (JC80-F-04/66) were imaged by light microscopy. This sample has now been fixed in formalin solution and stored in 70% ethanol. The oocytes will be re-measured to assess the dehydration caused by the fixation process and a calibration curve will be created.

JC80 ROV Isis Video operations for inter-annual variability at the E2 vent field.

Leigh Marsh, Jon Copley and Paul Tyler, University of Southampton

In 2010, two vertical video mosaics were completed at the E2 vent field; one at the Dog's Head chimney complex and one at the Sepia diffuse flow structure. Two years later, during operations on Dive 189, these two mosaic surveys were re-run to assess differences in chimney structure, fluid flow exits and distribution of faunal assemblages.

Vehicle Operations

Vertical videographic surveys (surveys of vertical substrata such as vent chimneys) were undertaken using the high-definition pilot pan-and-tilt (HDI-PPT) camera of the Isis ROV. For these surveys, this camera was configured to view horizontally forwards from the vehicle, so that its focal axis was perpendicular to vertical substratum surfaces. Two parallel lasers, 0.1 m apart, were mounted parallel to the focal axis of the camera to provide scale in images.

Vertical surveys were undertaken using closed-control of the ROV to maintain constant vehicle heading, and Doppler lock to enable movements of the vehicle over precise distances relative to the seafloor. These features enabled the ROV to undertake vertical lines up and down chimneys, offset by fixed horizontal distances to obtain overlapping video images of the structure from a particular heading. Distance from the vehicle to the structure was kept constant, so that survey lines lay on a flat vertical plane a fixed distance from the structure being surveyed. Camera zoom was set in vertical surveys to achieve image frames approximately 1 m wide, with no adjustments during lines, as images will be mosaiced together from overlapping lines for analysis.

Although mosaics were undertaken on the same heading as JC42, to recreate comparable survey run lines and reduce the effects of parallax, the image sequence produced from the mosaic runs from JC42 were used to align the ROV's field of view with the structure being surveyed.

Results: Dog's Head Chimney Complex.

Since the first mosaic survey undertaken in 2010 there has been a significant change to the structure of the Dog's Head complex and surrounding chimneys. As a result, the maneuverability and operability of the vehicle around the Dog's Head structure was limited and the ROV was unable to achieve Doppler lock. Transect lines were run using auto-altitude function of the ROV however, without Doppler lock, the vehicle and resultant video footage were subject to the effects of current. Consequently, producing a solid mosaic of the Dog's Head structure may not be achievable however, transect lines that were obtained will still be compared to those acquired in 2010 to assess changes in chimney structure, fluid flow exits and abundances of key taxa.

Sepia Diffuse Flow Structure

The mosaic survey undertaken at Sepia was straightforward. There was clear access for the vehicle to the chimney and Doppler lock was successfully achieved. Transect lines were undertaken at a heading of 074 and started at a minimum altitude of 1.3 m. Lateral displacement each transect line was 0.5 m. As a result of successful vehicle operations, a complete mosaic of the Sepia structure should be achieved and a direct comparison of faunal abundances and fluid flow exits can be made.

Additional Video Footage

High-definition video sequences were obtained at each of the *Kiwa* n. sp sampling sites. Using the 0.1 m laser scale an assessment of carapace lengths can be made and assemblages types (Marsh et al., 2012) defined.

Population genetics (Chong Chen)

Vents are patchy in distribution and are hotspots of biomass of organisms in the deep sea. Many of vent species are endemic to vents or chemosynthetic environments and cannot thrive in the vast majority of deep-sea floor. The means of connectivity between different vents and fields is virtually restricted to and by larval dispersal. To date, little is known about how vent endemic species maintain effective populations across vent fields. One objective of this cruise was to collect specimens in quantities satisfying the requirements of population genetic statistical analyses (>20 individuals per species per location) to fill in sampling gaps of JC42.

Target species were mainly the peltospiroid gastropod, *Kiwa* sp. of various cohorts (as defined in Marsh *et al*., 2012), anemones, 7-armed seastar and *Lepetodrilus* new species. For *Kiwa* sp. cohorts, RNA studies are also planned.

On E2 South, population genetic quantity specimens were obtained for the peltospiroid gastropod, *Kiwa* sp., *Lepetodrilus* new sp., anemone (Actinostolidae, most likely two species). Except *Lepetodrilus* new sp., all species were obtained in good quantity from at least two locations within the E2 South vent field.

On board the ship, only preservations of specimens was carried out. For genetic analyses, specimens were fixed in 100% ethanol. For whole anemones, genetic subsample was taken from both pedal disc and tentacles then the rest of the animal was frozen in -80℃ freezer. For RNA analyses of *Kiwa* sp., tissue subsample was taken from each individual and placed into RNALater solution (QIAGEN) and stored in 4℃ for two days before being moved into -80℃ freezer.

Samples will be transported to Department of Zoology, University of Oxford for analyses post-cruise, where all analyses will be carried out. The focus will be to evaluate genetic connectedness and population structure of the different vent fields surveyed on the ESR, for all species which enough individuals were collected. DNA extraction and sequencing of various genes will be the main lab techniques but microsatellite analyses will also be used. Data will be analysed statistically to assess significance of difference.

Food webs and trophic structure of East Scotia Sea chemosynthetic environments.
(Christopher J. Sweeting & William D.K. Reid)

Deep sea chemosynthetic systems represent oases of high relative productivity. Production in these systems is based on free living and symbiotic chemosynthetic bacteria to create high but localised abundances of marine life. Additional energy input is delivered as ambient photosynthetic material with the relative importance of inputs varying spatially. This energy then sustains subsequent faunal food chains/webs. However, the trophic structure of many chemosynthetic systems, the magnitudes and direction of energy flows and the trophic roles of constituent species are often poorly resolved.

The aim of this work is “to elucidate food-web structures… and to compare these chemosynthetic-community types and locations both within the chosen region and outside it” (Proposal objective 6).This has been subsequently refined to

i) to describe the sources of production sustaining communities

ii) link sources and magnitudes of production types to vent chemistry and local microbiology

iii) identify production transfer through the local food chains within the community

iv) define the trophic roles within and among constituent species

Faunal samples were collected during ISIS dives 187-194. Organisms were sorted to the lowest taxonomic level possible aboard. Those faunal samples allocated to trophic studies are detailed in table 1. 1-5g of tissue was excised from each individual. Tissues types were species specific and for target species e.g. *Kiwa* n.sp., multiple tissue types were collected. Where individuals were too small to excise appropriate tissue weights, animals were either retained whole e.g. stalked barnacles or individuals were pooled e.g. vent limpets. All samples were then frozen to -80oC until return to the UK where they will be freeze dried and ultimately combusted in subsequent analysis. Subsequent analysis includes tri-stable isotope ($^{12}C/^{13}C, ^{14}N/^{15}N, ^{32}S/^{34}S$) analyses and investigation of hopanoid biomarkers for bacterial symbionts.

A total of 589 samples were collected from approximately 225 individuals or pooled groups (Table 7). Sample collection was integrated. Dominant fauna collections included multiple tissue types. For *Kiwa* this included muscle, gill, digestive gland and bacterial scrapings. Peltospird gastropod tissues included foot muscle, gill, oesophageal gland, mantle, shell and ova. Stalk and tentacle samples were obtained from anemones. Where possible samples were shared and related back to individuals subject to genetic, microbiology and reproductive analyses.

Table 7: Number of individuals from which tissue samples were obtained for stable isotope and or lipid analysis. Numbers in parenthesis is the total number of samples inclusive of replicated or multi-tissue collections from a single individual or pooling for multiple small individuals.

Table 7	Anemone Field	Cindy's	Crab City	Dog's Head	Sepia	E2 North
Assemblage Dominant Fauna						
Kiwa n.sp. (multi-tisse)	28 (84)		35 (140)	8 (32)	11 (44)	
Peltospiroid n.sp. (multi-tisse)		36 (106)		11 (31)	10 (35)	
Vulcanolepus					1 (1)	
White anemone (multi-tisse)		16 (24)	4 (8)	13 (18)		
Red anemone (multi-tisse)					15 (20)	
Secondary Fauna						
Lepetodrilus (pooled individuals)		75 (2)		26 (1)	10 (1)	
Small peltospirid (polled individuals)		25 (1)				
Provannid (polled individuals)				41 (2)	50 (3)	
Small pycnogonid sp1		7 (7)			5 (5)	
Small pycnogonid sp2					1 (1)	
Large pycnogonid		1 (1)				
Off Vent Field Fauna						
ascidian						1 (1)
brisingid						1 (1)
brittle star						4 (4)
colonial unidentifed?						1 (3)
crinoid						1 (1)
long armed anemone						2 (6)
stalked crinoid						1 (1)
urchin						1 (1)
octocoral						1 (3)

Enrichment (Clare Woulds & Jane Heywood)

A stable isotope enrichment experiment was conducted using peltospiroid gastropods and 13C-labelled bicarbonate and glucose.

Objective

To provide direct evidence for endosymbiont identity, distribution, and metabolic function in peltospiroid gastropods from E2.

Method

- Peltospiriod gastropods were collected from 'Crab spa' at a depth of 2647 m E2 during dive 189.
- Three individuals were placed into each of nine 500 ml jars filled with sulphidic hydrothermal vent water (collected during JC80_003 CTD 03, from bottles 1 and 2, depth 2610 m, 56˚5.3485 S 30˚ 19.130 W).
- Three jars were kept as controls, three were amended with ^{13}C sodium bicarbonate (100 % ^{13}C to give final concentration of 1.5mM of labelled bicarbonate), and three were amended with ^{13}C glucose (100 % ^{13}C to give final concentration of 9 mg l^{-1}).
- All jars were capped with Parafilm with holes for ventilation, and incubated at 10˚C.
- One jar from each treatment was sacrificed at each of three time points. The time points were 6 h, 24 h and 60 h.
- Sacrificing of a jar involved removing the gastropods and rinsing them first in fresh seawater, and then in Mili-Q. Two gastropods from each jar were frozen immediately at -80˚C. The third gastropod was dissected, and the gill and oesophageal gland preserved in 4% paraformaldehyde overnight before washing in MilliQ water and serial dehydrations of 10 mins each in 50%, 70% and 96% ethanol before freezing in 96% ethanol at -80˚C.
- At the start of the experiment and at the time of sacrificing jars water samples were taken from each jar and preserved for dissolved sulphide analysis (by addition of zinc acetate).
- The water in 60 h jars was replaced with new and freshly labelled (where appropriate) plume water after 30h.

Planned Analyses

- Fluorescent In Situ Hybridisation

- DNA-stable isotope probing to identify microbes responsible for enriched isotope uptake.
- Nano-SIMS and ion probe isotope mapping to identify spatial distribution of enriched isotope uptake.

Environmental control of Kiwa distribution (Cathy Cole)

ISIS 189: Cindy's Castle *Kiwa* and diffuse fluid sampling.

Diffuse area of venting (shimmering water) found to support numerous *Kiwa* populations of mixed size and sex. Collection of diffusely venting fluids was conducted after deployment of the incremental temperature probe (56° 05.346 S and 30° 19.081 W; 2642 m). To reduce seawater entrainment, a fire-blanket skirt fitted to a titanium cone was used to focus the diffuse fluids, which were drawn up into a pair of titanium syringes (Y2) via a probe. Temperature was monitored using an ICL sensor attached to the syringe probe, and the maximum temperature measured was ~ 14 °C.

After diffuse fluid sampling, *Kiwa* individuals were collected from the same area using the suction sampler. A total of 18 *Kiwa* (11 female; 7 male) were collected (sample group JC80-189-F-4). Gill, digestive gland and muscle tissues were dissected on board, flash-frozen in liquid nitrogen and stored in the -80 °C freezer. These samples will be analysed for both metal accumulation and the expression of proteins involved in antioxidant/detoxification pathways.

ISIS 194: Anemone Field *Kiwa* sampling

A population of *Kiwa* were found at a diffusely venting area of cracked pillow basalts. An indication of temperature was given by the CTD sensor to the rear of the ROV (0.5 – 1.5 °C) though no temperature readings could be taken within animal groups. No diffuse fluid samples were taken as mini-niskins failed to fire. Six female *Kiwa*, of similar size (46 – 51 mm) were collected (sample group JC80-194-F-97) for tissue metal and proteomics research. Gill, digestive gland and muscle tissues were dissected on board, flash-frozen in liquid Nitrogen and stored in the -80 °C freezer.

8.4 Microbiology (Jane Heywood)

Deep-sea hydrothermal vents are hotspots of biological productivity, deriving their energy from the oxidation of reduced compounds (e.g. sulphur, hydrogen and methane) by chemoautotrophic microbes. The microbes are free-living as plankton, in biofilms attached to substrata or in sediments in the near vicinity of the vents or are associated with vent fauna. Chemosynthetic bacteria are associated with several invertebrate species either through symbiotic relationships or as epi/endobionts. During JC42 and JC55 water samples for microbial analyses were collected from the buoyant and neutrally buoyant plumes arising from the vents. Some invertebrate species hosting microbes were also collected during JC42.

The objectives for cruise JC80 were to collect microbes associated with vent fauna to investigate;

1. the diversity, distribution and metabolic potential of epi/endobiont bacteria
2. environmental influences on community composition and function by examining microbial communities from different sites

Free-living and invertebrate-associated microbes were collected from E2 vent sites for various molecular and microscopic analyses. Epi/endobionts were collected from the same individuals as sampled for isotope analysis where possible.

Free-living microbes

Water from 3 CTD casts was collected from the buoyant and neutrally buoyant plumes in 10L niskins and 50 ml subsamples were taken for flow cytometry, DNA analysis and phage counts (Table 8). Rock samples coated in biofilm from Dog's Head were collected using *Isis*. The bacterial mats comprised a thick white outer layer covering a thinner pink layer next to the rock. Samples were scraped off using a scalpel and preserved as described below.

Invertebrate-associated microbes

Epibionts were collected from 40 *Kiwa* by removing hairs from the carapace. Stomachs were also collected from 12 *Kiwa* for stomach content analysis. Blood samples were taken from the hearts of 12 *Kiwa* using a pipette for measurement of ecdysteroids. 5 whole *Kiwa* from Dog's Head were also preserved in 96% ethanol. The oesophageal gland and gills from 20 Peltospira gastropods (from Dog's Head and Cindy's Castle) were dissected for subsequent endobiont analysis. 27 whole gastropods from Crab City were collected for 13C uptake experiments with Clare Woulds (see 'enrichment'). 8 Pycnogonid seaspiders (2 species) from Cindy's Castle and Sepia were sampled for epibionts by removing 1 leg from each individual for various analyses. 27 limpets removed from the shells of the *Peltospira* gastropods at Cindy's castle were preserved for various analyses. Tentacles from 20 anemones (2 species) were collected from Dog's Head and Sepia.

Several methods were used to preserve samples for a variety of post-cruise analyses (see table 9). Where there was sufficient sample tissue from each individual it was divided and preserved for fluorescence in situ hybridisation (FISH), DNA and RNA extractions, flow cytometry (water samples only) and single cell genomics.

Flow cytometry (water samples only)

Water samples were preserved in paraformaldehyde (PFA; 1 % final concentration) overnight at 4°C and then stored at -80 °C. Additional plume samples were preserved in 0.5 % glutaraldehyde, snap frozen in liquid nitrogen and stored at -80°C for total phage abundance counts.

FISH

Tissue and biofilm samples described above were placed into 1.5 ml tubes containing 4 % PFA and stored at 4°C overnight. Samples were subsequently washed with milliQ water and dehydrated in 50 %, 70 % and 96 % ethanol for 10 mins each before storage in 96 % ethanol at -20 °C.

DNA samples

Samples for DNA extraction were frozen at -80°C.

RNA samples

As soon as possible after receiving samples, tissue subsamples were placed into 1.5 ml tubes containing RNA later (Sigma Aldrich). Samples were stored at 4°C for 24 hours and then transferred to storage at -80°C.

Single cell genomics

11 samples from gastropods, Kiwa and biofilm were placed in 5 % glycerol in 0.2 µm filtered seawater and frozen at -80°C for single cell genomics.

Post-cruise analyses (at BAS)

DNA and RNA will be extracted and used to determine the microbial community composition and metabolic gene expression. FISH and epifluoresence microscopy will be used to locate and identify various microbial groups on the host tissue. Samples for single cell genomics will be used for method development and trial purposes as, to date, this has not been achieved from host tissue samples. The diversity, both phylogenetic and metabolic, of epi and endobionts will be compared between hydrothermal vent species and across biogeographic provinces in order to elucidate their role in the ecosystem and the factors controlling their distribution and activity.

Table 8. Water samples collected from E2

Station	CTD	No. depths sampled	No. samples for various analyses			
			Flow cytometry	DNA	Single cell genomics	Phage abundance
1	JC80-CTD001	5	5			
3	JC80-CTD003	8	8	8	8	
9	JC80-CTD043	10	10		3	
12	JC80-CTD044	7	7		4	
25	JC80-CTD130	1	1		1	1

Table 9. Tissue/biofilm samples collected from E2

Dive	Area	Sample No.	Sample Type	No. samples for various analyses				
				FISH	DNA	RNA	Single cell genomics	Whole animal
D187	Dog's Head	JC80-F2	Biofilm	3	3	0	3	
D189	Dog's Head	JC80-F42	Kiwa					5
		JC80-	Kiwa hair	7	7	3		

		F22						
		JC80-F13	Peltospira gland	10	10	10		
		JC80-F13	Peltospira gills	10	10	10		
	Crab City	JC80-F40	Kiwa hair	5	5	3		
		JC80-F41	Kiwa hair	6	6	6		
	Cindy's Castle	JC80-F18	Lepetodrilus	6	6	6		9
		JC80-F9	Peltospira gland	10	10	10	2	
		JC80-F9	Peltospira gills	10	10	10	2	
		JC80-F29	Pycnogonid	6	6	5		
D190	Dog's Head	JC80-F50	Anemone	5	5			
		JC80-F49	Kiwa hair	1	1	1	1	
		JC80-F49	Kiwa haemolymph					1
		JC80-F49	Kiwa stomach	1				
	Sepia	JC80-F47	Kiwa hair	2	2	2	2	
		JC80-F47	Kiwa haemolymph					1
		JC80-F47	Kiwa stomach	1	1			
		JC80-F48	Kiwa hair	9	9			

		JC80-F48	Kiwa haemolymph					9
		JC80-F48	Kiwa stomach	4	5			
		JC80-F55	Pycnogonid	2	2			
		JC80-F53	Red Anemone	15	15	10		
D194	Dog's Head	JC80-F93	Biofilm	1	1		1	
	Anemone Field	JC80-F94	Kiwa hair	2	2	2		
		JC80-F96	Kiwa hair	2	2	2		
		JC80-F97	Kiwa hair	6	6	6	2	

Microbiology (Anni Djurhuus)

Marine microbes are the most numerous group of organisms on the planet. As a consequence of the huge diversity of this group, marine microbes are the major players in virtually all geochemical reactions occurring in the oceans (Kirchman, 2008). Microorganisms in the ocean include bacteria, archaea, fungi and protists. Abundances of fungi are very low, especially in pelagic marine habitats (Kirchman, 2008) and archaeal abundances are generally only a fraction of bacterial abundances in surface waters (Schattenhofer *et al.*, 2009). On the other hand, bacteria are a very abundant group of marine microorganisms through the whole water column and are ecologically very important. Bacterioplankton in oceanic environments plays a significant role in the flux of organic matter and global nutrient cycling, but have thus far been poorly explored (Rappe *et al*. 2000; Arrigo, 2005). In marine biology, the research of marine phytoplankton biomass and composition has been crucial in understanding the dynamics of marine ecosystems. Similarly to phytoplankton in the surface bacteria serve as primary producers around deep-sea hydrothermal vents.

The objectives of the free-living microbial research from this cruise is:

1) Study microbial diversity changes throughout the whole water column.
2) Link microbial diversity to environmental parameters, such as nutrients, POC, oxygen, pressure and salinity.
3) Investigate microbial diversity and abundance changes with various distances from plumes and between CTD casts.
4) Compare this dataset with previously collected data from the Southwest Indian Ridge.

To increase general knowledge about foodwebs in marine chemosynthetic ecosystems it is critical to undertake research of the lowest trophic levels.

In the present cruise four different samples for microbial community research were collected:

1) Free-living microbes (64 samples in total)
2) Microbes bigger than 0.2µm (associated with particles (64 samples in total))
3) Flow cytometry samples, for total count of microbes and viruses (186 samples in total)
4) Particulate organic carbon (64 samples in total)

Before collecting water the filtering system was rinsed (thoroughly rinsed with Milli Q water and subsequently washed with the sampling water) and new filters were placed into a suitable container. A pre- filter (47mm diameter, 3µm pore size) was used with a subsequent filter of 0.2µm pore size. The 0.2µm filter was placed on the iron “filter” first and then the 3.0µm filter. Care was taken not to touch the filters with fingers and sterile gloves were worn at all times during filtering.

When the filtration system was set up, water was poured from the niskin bottle into each of the filtration systems. If the filter became saturated, filtering was stopped and note taken of the quantity of water filtered. This was repeated until the filters were saturated. Note was taken of how much water was filtrated through each system.

After filtration, the two filters were placed in separate cryovials and store at -80°C until analysed. Cryovials were labelled appropriately with filter pore-size, where and when the sample was taken, and quantity of water filtered as well as other relevant comments.

Flow Cytometry:

Samples were fixed and stored at -80°C prior to being analysed. Glutaraldehyde will lead to slightly higher cell loss than pure formaldehyde, but is clearly preferable to fixation with poor formaldehyde, which leads to a lot of background noise (cell debris, small particles), making flow cytometric analysis impossible.

Fixation Procedure: 1. Add glutaraldehyde ~100µl from a 25% stock solution for a 0.5% final concentration or a mixture of formaldehyde and glutaraldehyde (0.5% and 0.05%, respectively) into cryovials. 2. Collect ~4900µl of seawater in a 5 ml cryovial. 3. Mix by vortexing rapidly but gently. 4. Incubate for at least 15 minutes at room temperature. 5. Samples should then be stored at -80°C, as storage at -20°C beyond 1 week will result in rapid sample degradation.

Where possible three samples were collected at each sampling point (station).

POC sampling:

1. For POC samples, 3-4 litres of seawater was filtered through a pre-combusted 0.7µm glass microfiber filter (GFF). 2. When filtering was finished, the filter was placed on the tin foil it was packed. 3. Samples were frozen at -20°C.

Care was taken never to contaminate the sample with carbon. Gloves were always used and the filter or the inside of the tin foil were not touched.

Figure 1 Water filtration system used on the JC80 cruise. One manifold with six glass containers with filters to sample the microorganisms in seawater was used. The glass containers were held in place with rubber bands (orange) and clamps (blue).

1.2.5 Bibliography

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Rappé S. Michael, Vergin Kevin and Giovannoni J. Stephen, (2000): Phylogenic comparison of a coastal bacterioplankton community with its counterparts in open ocean and freshwater systems. FEMS Microbiology Ecology 33, pp. 219-232.

Schattenhofer M., Fuchs B. M., Amann R., Zubkov M. V., Tarran G. A., Pernthaler J. (2009): Latitudinal distribution of prokaryotic picoplankton populations in the Atlantic Ocean. Environmental Microbiology 11:2078-2093.

9. Appendices

1. JC080 Station List
2. JC80 Cruise report (technical)

ISIS System Cruise Report

RRS James Cook (JC080)

28th Dec 2012

Cruise Dates: 2nd Dec 2012 to 5th Jan 2013

Principal Scientist: Paul Tyler

ROV Operations Supervisor: Dave Turner

Sea Systems Cruise Manager: N/A

NMFD ROV team: Andy Webb, James Cooper, Dave Edge, Russell Locke, Allan Davies, Will Handley (contractor)

NMFD Techs: Neil Sloane, John Wyner, John Seddon

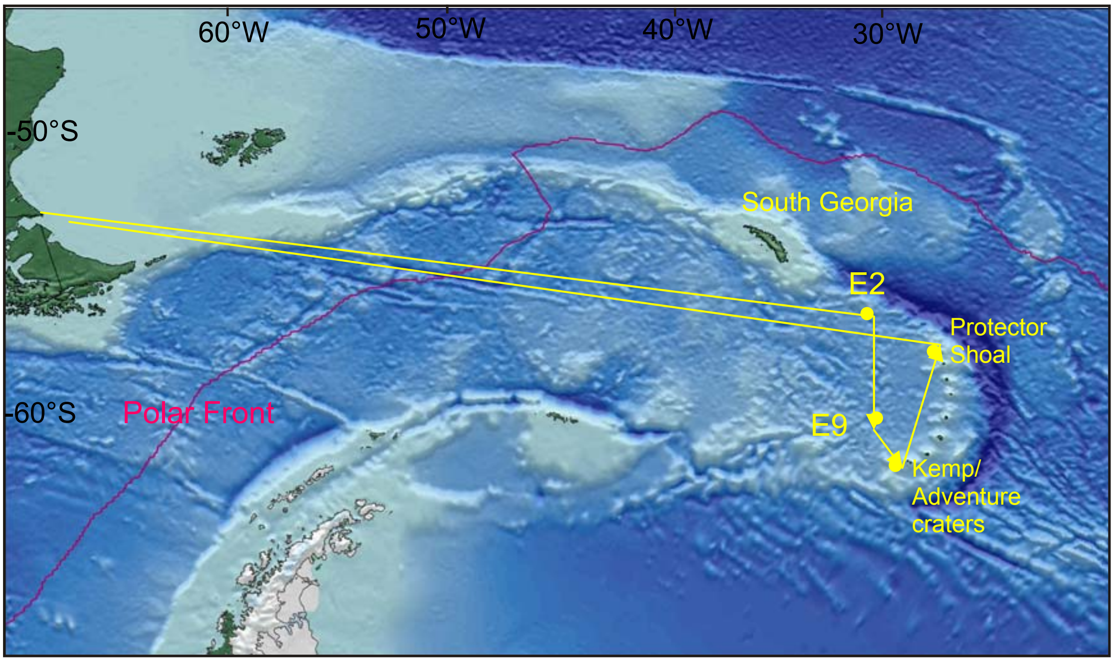
Cruise Outline:

This cruise will be of ~33d duration to the region of the East Scotia Ridge and South Sandwich archipelago and is a supplement to JC55 in which the ROV *Isis* was damaged severely. The damage to *Isis* prevented us completing the following:

1. Collecting megafauna for molecular analysis, isotope and reproductive analysis
2. Deploying traps for larger species of megafauna and fish for isotope analysis
3. Collecting end member fluids for chemical analysis
4. Collecting diffuse flow fluids for chemical and microbial analysis
5. Completing ROV swath at fine scale over vent areas
6. Collecting cores in the crater for geochemical analysis
7. Continuing the fine-scale video mosaicking of the vent fields

The priority objectives will be to use the ROV *Isis* to characterise the chemosynthetic fauna and the environmental conditions that sustain them at a range of sites of active seafloor fluid-flow: back-arc hydrothermal vents (Areas E2 and E9 on track chart), arc-hosted hydrothermal vents (Kemp and Adventure craters). The combination of observations, sampling and analyses will vary at each site encountered but a common priority will be to complete a thorough mapping (using the Reson 7125 multibeam) and photographic (video and stills photography, and mosaicking) documentation at each site.

The first *sampling* priority at each site will be to obtain end-member vent or seep fluids. This will be achieved using four sets of "major-pair" vent-fluid samplers with which the ROV is equipped – each with its own ICL high-temperature sensor to (a) characterise the fluids and (b) ensure collection of high-quality samples for shipboard and shore-based analyses. In areas of diffuse fluid-flow, the diffuse vent water sampler will also be utilised. After sampling of fluids, the ROV will sample the plume within 10m of the seafloor for hydrothermal chemistry and microbiology. In case of poor weather or ROV technical problems, we will sample the plume using a CTD. This will be followed by sampling of sediments for pore water analysis, sediment geochemistry, microbiology and meio- / macro-infauna analysis.
All the above geochemical programme will be planned and conducted in close relation to the microbial and metazoan sampling programme. Using individual collecting methods, such as the suction sampler and manipulators, we will sample the representative fauna close to and around each hydrothermal vent and cold-seep site. All such techniques were well established during JC42. Biological samples will be preserved for morphological, molecular biological, phylogeography and food web analysis studies in the lab. (Objectives 5, 6, 7 and 8 of our consortium proposal). Sampling will be restricted to that material required for lab analysis as we are aware of the anthropogenic impact of scientific collecting at vent sites (Tunnicliffe et al. 1995). Lastly, because of the motility of fish we plan to deploy baited traps to trap fish that are at the top of the food chain in most chemosynthetic communities (Objective 8). The higher levels of the food web in any Antarctic waters are of interest owing to the absence of large Crustacea, found commonly at all main vent sites in the world ocean. Finally, we plan to examine areas peripheral to both the vent and seep sites to determine the dominant fauna at these off-vent/seep areas in relation to the vents and seeps. This aspect can give an insight into vent/seep vagrant species that live away from the vent but may use the vent/seep as a source of food (Objective 8). The outcome of this cruise would be the discovery, analysis, video and still documentation and samples from the chemosynthetic environments.



Isis Stats:

No. of dives	10 (dive no. 187 to dive no.196)
Total run time for (JC080) thrusters:	102.5 hrs
Total time at seabed or survey depth:	67 hrs
Isis ROV *total* run time:	2801.23 hrs
Max Depth and Dive Duration:	2696m and 9.5 hrs
Max Dive Duration and Depth:	15.5 hrs and 2549m (dive 188)

Cruise Data Volume:	Reson Seabat (78.1GB)
	Techas (3.08GB)
	CTD (0.23GB)
	DVLNAV (4.29GB)
	Sonardyne (0.2GB)
	OFOP Event Logger (0.3GB)
Video Hard disks	Master1 Mybook Ser #WUM225000579
	(Dives 187–189)
	Backup1 Mybook Ser #WUM225000593
	Master2 Mybook Ser #WUM225000587
	(Dives 190-195 + Cruise Data)
	Backup2 Mybook Ser#WUM225000589
Qty Video Tapes:	70 off 186min HDV

NB: A copy of the JC080 Isis Data will remain on the Isis RAID system for a period of one month commencing from the end date of the cruise after which it will be deleted.

ISIS System Cruise Report

RRS James Cook (JC080)

28th Dec 2012

Contents

ISIS System Cruise Report

RRS James Cook (JC080)

28th Dec 2012

1. *Mobilisation:*

Punta Arenas, Chile: 26th Nov to 1st Dec 2012

The mobilisation of the system should be very straight forward but rust build up on the underside of both the traction winch and storage drum gave alignment problems with the tomb stones which are now welded to the deck frame. The underside of the traction winch was cleaned which helped with the alignment although one fixing bolt was not fitted as we were unable to fully correct alignment issues. The LARs system uses UNC bolts whilst the deck uses metric bolts, after installation it was found that a metric bolt had been used instead of a UNC bolt in the high stress fixing points this could cause a serious failure of the LARs system.
The umbilical termination was also made during this period, and was pull tested to 7,000kg.

- After De-mobilization in Southampton underside of traction winch and storage drum require rust to be removed and painted.
- Dry fit storage drum and traction winch to base plate and check alignment of tomb stones rectify if required.
- Investigate if a better marking system is required to distinguish between the metric and UNC bolts ie paint bolt heads.

2. *De-Mobilisation:*

Southampton UK : TBC

The de-mobilisation will take place at NOC, Southampton, following JC080/82/83 and transit home from Antigua.
The ROV will be moved from the LARS on arrival at Montevideo and secured alongside the spares container, for its transit to Jamaica. The LARS will be collapsed and secured for this transit. All other systems will remain in their current locations, assembled, and ready for operation on the next cruise.

3. Isis Handling System:

3.1 Hydraulic Power Unit (HPU):

Worked well for the duration of the cruise.

Future modifications/requirements:

- Block Filter indicators are corroded and need replacing.
- All Filters Elements should have been replaced before JC80 and spare elements bought. This will now have to be deferred to post JC082/3.
- Oil was changed two years ago, but has stood for the duration since.

- Possible oil change required.
- General removal of rust, and grease where required.
- Inspect and replace hoses where necessary.
- Re-paint at some point in near future.
- Integrate spares form Base Engineering into blue boxes.
- Inspect hyd hoses and replace damaged as necessary.

3.2 Storage Drum/ Traction Winch:

Prior to JC076T cruise and during load testing it was noted that the storage drum motor was weeping oil from its shaft seal. The motor was removed and inspected. The shaft showed signs of pitting, and the seal needs replacing. Unfortunately due to limited time, replacement parts were not available. The shaft was cleaned and the motor re-assembled. It was thought that the duration of the trials cruise would not be too much of a problem if the leak was monitored carefully. This worked well for the duration with no signs of further deterioration, or the leak getting worse.
Continuing on from JC076T a spare motor was procured, but due to time restraints was not replaced with the leaking one. The new unit was put onboard for JC080 should it be required. No further deterioration of the leaking shaft occurred during JC080, and therefore has been left in place. Monitoring during the next cruise will continue, with a view to replace upon return to NOC in April 2013.

Prior to the first ROV dive, and following the termination and load test, the umbilical was streamed vertically to 2600m. This stream is a standard procedure following re-termination in an attempt to remove some of the torsion in the cable. Previous experience has indicted that the inner core can build up turns after several dives, resulting in power failure to the ROV.

The umbilical had to be re-terminated twice during the cruise. The first time was during dive 193 when the Ground Fault Monitor indicated a breakdown in insulation of the High Voltage system, resulting in a 'dead vehicle' recovery. Upon inspection it would appear that some turns were present in the inner core, but not enough to cause a dead ROV. However, a small split was present allowing water to ingress into the cores and an electrical breakdown occurred at this point. This small split could have been a result of freezing temperatures. 80m of the umbilical was removed, the cable was re-terminated and load tested to 7000kg.

The second time the umbilical had to be re-terminated was again the result of a power failure to the ROV during dive 195. This again resulted in a 'dead vehicle' recovery.

Further investigation into this power failure and the course of action required to rectify are detailed later in the report (See section 9)

After the removal of wire from storage drum the shells were found to be suffering from corrosion along with the drum wings. These were cleaned as best as possible with hand tools.

During operation of the traction winch from the deck control station the storage drum back tension operating leaver was accidentally knocked this caused the auto back tension system to become disengaged although this was quickly rectified it is a potential serious failure point.

Future modifications/recommendations/maintenance:

- Replace storage drum motor.
- Refurbish existing motor and keep as spare.
- The chain drive should be closely monitored as part of routine operational checks, maintenance intervals reduced, the chain and drive sprocket considered as a consumable item.
- Thoroughly clean and lubricate traction grooves.
- Lubricate cable.
- Check gearbox oil levels as per Dynacon instruction.
- Check proximity switches on traction head diverter sheave, order spares if required.
- Remove rust and grease accordingly.
- Touch up paintwork.
- Re-paint at some point soon
- Remove slip-ring and send away for servicing
- Add thermocouples to inner wall of center of the drum, for monitoring cable temp. (discuss options for best way to do)
- Consider options for replacing the umbilical, or end for ending the current one.
- F/O and electrical termination to be re-made. Junction box on side of the storage drum needs attention as the lid does not secure properly.
- Winch drum and shells require refurbishment when the wire is replaced or end for ending.
- Investigate replacement back tension control leaver with a ‘dead mans handle’ type.
- Produce spray bar for winch cooling.

3.3 Launch and Recovery System (LARS):

This worked well for the duration of the cruise; however the docking head is in serious need of some lubrication. It was also noted that the aft upper ram is showing signs of leakage through its wiper seal. Careful monitoring of this leak has taken place during this cruise, and it would appear not to be getting any worse. Due to its location and complexity to replace in the field it is recommended that the replacement of seals be completed at NOC in April 2013

Future modifications/recommendations/maintenance:

- Thoroughly grease all mechanical points.
- Touch up paint work.
- Re-paint at some point.

- Build protection for exposed control valves.
- Inspect, and provided spares for control valves.
- Replace all hyd ram seals and wipers.
- Remove docking head and service thoroughly.
- The supporting pins for the docking head rams should be dismantled, inspected and lubricated during the port call between JC081 and JC082.
- Long term it should be considered that the ROV deployment system be returned to the ROV group for maintenance and ownership. Being a relatively complicated system it is best placed that the operators take care of the system and are fully converse in its operation and maintenance history. The current arrangement does not work.
- The lower safety chain is missing on the LARS and should be replaced. All three chains should be rigged with Senhouse slips to remove the requirement to adjust the bottlescrews every time the chains are taken down. The top bottle screw fell apart when I brushed against it while working behind the ROV as it was only engaged by less than 1 turn.

3.4 CCTV:

The CCTV system used for launch, recover and winch monitoring performed without problems. One camera providing a through A frame, a 2nd and 3rd providing storage and traction winch and a pan & tilt unit for following vehicle and floats when at the surface.

Future modifications/recommendations/maintenance:

- Inspection and refurbishment as necessary is needed following JC083
- Plenty of spare 110V bulbs needed for floodlights.

4. ISIS External Equipment:

4.1 Elevator A:

Was not used for the duration of the cruise.

Future modifications required:

- None

4.2 Elevator B:

Was not used for the duration of the cruise.

Future modifications required:

- None

4.3 USBL & LBL Acoustic System (Sonardyne):

ISIS control room USBL suite (PC and NCU)

NCU

Performed function without incident.

Fusion USBL survey PC

Fusion USBL was not used. Navigation display was provided by Ranger and OFOP.

Homer

Not used for the duration of the cruise.

Compatt Beacons

Compatt beacon serial # 263656-001 failed and was replaced by the spare unit. A continual ground fault condition was noted on the pilot/engineer GUI prior to the unit failing. On recovery, it was found that communication was not possible with the unit using the DTU, both acoustically and serially. Corrosion was noted on the pressure housing just beneath the retaining collars. The unit will be returned to Sonardyne for repair and service.

Future modifications/recommendations/maintenance:

- The spare unit functioned without incident.

4.4 Football Floats:

Worked well for the duration of the cruise

Future modifications/recommendations/maintenance:

- Make sure new 6000m are being freighted to Jamaica.

4.5 Suction Sampler:

The suction Sampler worked well for the duration of the cruise. The Suction nozzle took a couple of bad knocks, and the end tubes had to be replaced. A slight modification to this design to make a little more rugged, with the possible option to change the nozzle bore dia would improve things dramatically.

Future modifications/recommendations/maintenance:

- A spare rotator motor is needed. A search of archive project data at NOC should reveal the type no. which will allow a replacement to be ordered following JC083.

4.6 Push Cores:

Not used for the duration of the cruise.

4.7 Niskin Bottle Arrangement:

The new 6-bottle Niskin arrangement had limited success. The cocking and hydraulic releasing mechanism worked well on deck but not all bottles would fire on the sea bed. The un-fired bottles would then fire as the vehicle was recovered and brought onto deck. It is believed that this was due to old perished rubbers inside the bottles so all rubbers were changed. The arrangement has not been tested since the rubbers have been replaced.

Future modifications/recommendations/maintenance:

- None

5. Isis ROV:

5.1 Thrusters:

None of the thruster bearings required replacing during the cruise. The aft-starboard thruster developed an oil leak and so was removed and stripped down. The bearings and gold speedi-sleeves showed no signs of wear, however the two shaft seals were found to be worn and were replaced.

The new-spare thruster was stripped down on the bench. The Chinese bearings were replaced with SKF bearings and new shaft seals were fitted. Gold speedi-sleeves were fitted to the thruster shaft and the bore of the shaft-end-cap and seal-plate were machined to accept the increased diameter. A 90 degree elbow was added to the connector end of the wiring loom to match existing thrusters in use.

Intermittent ground faults were detected when using the aft lateral thruster. The ground fault was determined by isolating each thruster in turn. During visual inspection, no problem was observed and the mating connectors were cleaned re-greased. The ground fault did re-occur during vehicle decent but cleared when the sea bed was reached.

Future modifications/improvements/maintenance:

- Items used from stock spares; 4-Off gold speedi-sleeves, 1-Off SKF bearing 606-2Z, 1-Off SKF bearing 6005-2Z, 4-Off shaft seals.
- Purchase new tube of Parker O-Lube.
- Update instructions in thruster service manual and add extra photos where required.

Thruster Controllers:

There were several occasions where AC ground faults showed. In most cases this was resolved by servicing the connectors.
The controllers are now a obsolete item and a replacement needs to be researched, this could also include pressure housing arrangement or if a pressure tolerant if it could be installed within motor housing.
During routine thruster checks it was found that the fore / aft thrusters had their power supply and communication lines crossed. Powering off one would turn off the communications of the other and vice versa. This would normally not be noticed as all thrusters are usually enabled together. It is our assumption that it is the power lines that are switched otherwise we would have expected an effect on vehicle control during the cruise.

Future modifications/improvements/maintenance:

- Switch power lines on fore / aft thruster pods and prove operation.
- Research replacement controller
- A bent pin was found on one of the thrusters. xxx

5.2 Vehicle Main System Compensators:

The vehicle main system compensators worked well during the cruise with no leaks giving a good vehicle underwater duration.

The new HV umbilical junction box has proven difficult to work in due to the small size of the box and the constant re-filling of compensator oil, when opened.

Future modifications/improvements/maintenance:

- Consider design improvements of HV umbilical junction box to ease HV terminations. Considerations should include space required inside box, position of box on vehicle and controlling compensator oil flow.
- Consideration should be given to possibly moving the HV JB to the stbd aft side opposite the Hydraulic Comp. If the box were mounted flat on the grating such that it could be raised up on the side of the foam pack when it was required to open it then it would be easy to drain the comp oil down. It could be then lowered to fill it u again.

5.3 Tool Sled:

Drawer:

This worked well for the duration of the cruise.

Future modifications/improvements/maintenance:

- None

Swing Arms:

This worked well for the duration of the cruise.

Future modifications/improvements/maintenance:

- None

5.4 Hydraulic System:

The hydraulic system worked well for the duration of the cruise.

The hydraulic lines for the Niskin rosette were taken from the 'Trigger' port of the 8-way manifold. The port swing arm latch was tee'd into the starboard swing arm latch to free up a hydraulic function which was then used to operate the titanium sampler.

During operation of the titanium sampler it was found that the trigger ram would not remain extended once the hydraulic pressure was removed. This affected the operation of the sampler and so hydraulic pressure was maintained during the sampling process. Fitting a non-return valve to that function of the 8-way manifold should remove this problem.

Following one dive it was noted that water had leaked into the hyd circuit. No obvious point of entry was found, however some blanks were used on the feed for the ram that fires the Niskin bottles, which may have possibly leaked. The hyd system was flushed and a new water separator filter put in place. No further problems were encountered.

During dive 194 the hydraulic gauge and GUI level indicator showed gradual loss of hydraulic oil. The dive was abandoned when the gauge read empty and the GUI level indicator reached 15. When on deck inspection of the vehicle revealed a loose hydraulic fitting on the main hydraulic pressure line to the port manipulator. The connection in question was tightened and all other manipulator hydraulic fittings checked.

Future modifications/improvements/maintenance:

- Replace all filters/seperators and re-stock spares.

- Research the use of Parflex hose fittings supplied by Hydrasun.
- For titanium sampler operation, consider fitting a non-retun valve to the 8-way manifold to stop actuator creep.
- Hydrasun can supply crimp fittings for the 1/8" Parker PDH-2 hose
  Contact Kenny Fulton <kenny.fulton@hydrasun.com>
  Jic4 fittings Synflex swaged hose ends for the Parker PDH-2 hose(390A-02544)£101.15 each ex/stock, along with the Synflex Die(4540-30200)£76.93 each ex/stock and the Synflex pusher 4599-FP010 £43.93 each ex/stock. All parts are less 40% discount
  ¼" Standpipe SS.SP02-04R7 £25.48 each less 40%... Pusher 02-HMD-05 £84.33 less 40% both ex/stock.
  The tooling will work with the Synflex Crimp tool we have for the swagelok hose fittings. 1/4" Standpipe fittings.

5.5 Manipulators:

Port Side:

The port manipulator worked well for the duration of the cruise. A comp oil leak was discovered during a pre-dive check and was traced to a split hose. (coms line from bottle to arm) It was considered likely that it had failed due to the low temperature and was replaced with new 'Tygon' tubing which has a greater range of temperature capability.
One of the pressure/return hydraulic lines became loose at the connection point to the arm leading to the loss of hydraulic oil during a dive. This was easily rectified by tightening the fittings. A claw spanner was modified to gain access to the joint area.
No further problems were experienced during the cruise.

Starboard Side:

To pre-empt similar faults occurring on the starboard arm, the coms OFPB line was replaced and the hydraulic fittings tightened.
During the pre-dive of 196 the azimuth of the arm would not function. It was noted when the slave was moved that the pot numbers did not. This will be investigated on the steam to Montevideo. The arm was secured and not used for this final dive.

Future modifications/improvements/maintenance:

- Look into procuring a hard coating for exposed aluminium.
- Schedule full service of arms after JC082/83
- Design and make free-standing pedestal for servicing arms off of the vehicle.

5.6 Pan & Tilt Units:

Worked well for the duration of the cruise.

Future modifications/improvements/maintenance:

- The Kongsberg pan and tilt could have the cameras mounted on the side plates rather than the saddle. This would make a more compact unit. The Pan and Tilt may have to be mounted lower to achieve this.
- The height of the side cheeks of the channel section camera mounts on the Science Pan and Tilt could be lowered to try to balance the Cameras better.

5.7 CWDM Fibre Optic Multiplexor

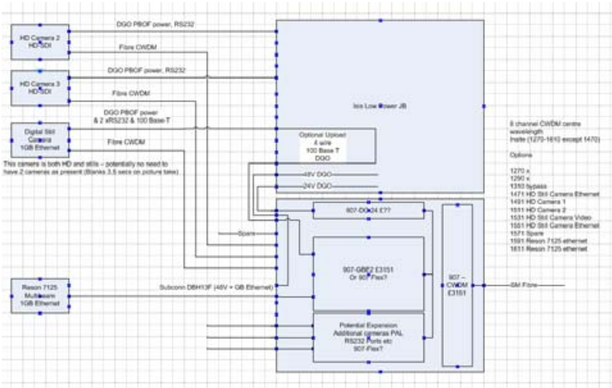
Isis ROV operates with a Rochester A302351 umbilical. 3 electrical passes for power and 3 single mode fibre passes for data. Vehicle data communications require one fibre but with the addition of two high definition cameras in recent years the 2nd and 3rd fibres are utilised for the transmission of HD-SDI video leaving no fibre redundancy. This combined with the requirement to operate a Reson 7125 multibeam sonar for this cruise required the development of a Coarse Wavelength Division Multiplexor (CWDM) unit to include a 1GB Ethernet multibeam data link (original capability 10MB) This enables multiple data transmissions over a single fibre ultimately producing a redundant fibre.

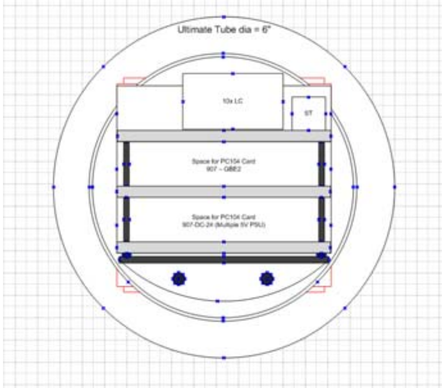
The system modular, rack fibre multiplexor is sited in the vehicle telemetry tube. Expanding this unit would have caused problems with breakout wiring capability to the Low power junction box. It was therefore deemed prudent to develop a standalone solution with its own pressure bottle.

The development path chosen to meet the cruise delivery schedule was to define a solution that could utilise a spare titanium pressure housing originally designed for the Kraft manipulator controller (117mm dia). An outline design was presented to Moog (Focal), a world leader in design of bespoke fibre data transmission systems. They derived a solution to meet our exacting requirements, in budget and with delivery from Canada direct to the ship in Punta Arenas the day before sailing.

Two new end-caps were designed and manufactured, associated connectors and cables ordered and power supplies installed in readiness. In parallel new cameras were ordered with transmission wavelengths compatible with the new multiplexor.

The diagrams below detail the original outline designs

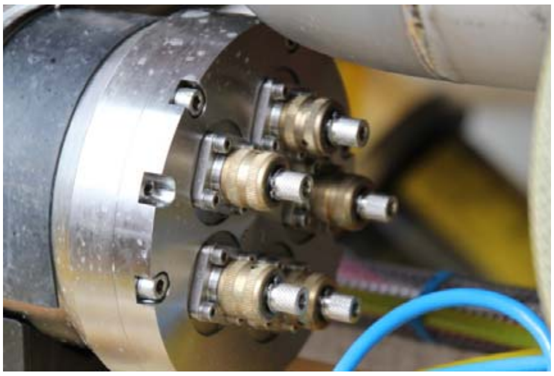




The solution comprised a topside rack mount unit housing components, virtually identical to the subsea stack, with rear panel fibre ST connector breakouts and front panel indicator LED's.

Mounting and connector wiring of the subsea stack in the pressure housing was completed during the cruise mobilisation period and proved operational with the Reson multibeam.

Topside Rack mounted CWDM unit *Subsea bottle mounted on Isis ROV*



The connectors have engraved end-cap labels

- **OUT** – main fibre (On this cruise we swapped with the Science HD Camera when multi-beaming)
- **1** – for connection to HD1 camera HD-SDI video (1490nM)
- **2** – for connection to HD2 Camera HD-SDI video (1510nM)
- **3** – for connection to Digital Still HD-SDI video (1530nM)
- **4** – Spare (1570nM)

Multiplexor bottle depicting 5 Seacon fibre *connectors fitted with pressure proof blanks.*

On the other end-cap are mounted the Reson 13 pin 1GB Ethernet connector and a DGOBrien connector for 24V power to the bottle, 48V pass through for the Reson LCU and 10MB Ethernet pass through from the new 10M Digital Stills camera image uplink.

- Consideration to obtaining spares and potential pressure bottle enlargement to provide for optimum electronics mounting with scope for expansion. (Bottle previously used for connector pressure testing)

5.8 Cameras:

3 Chip Atlas:
This PBOF was used for operation of the pilot HD camera as there are no serial wires connected in the Low power junction box (a rebuild error).

Future modifications/improvements/maintenance:

- This should be corrected and the dual video channels used as Y/C for the Atlas camera be separated to provide 2 individual PBOF camera channels.

Pegasus:

Used in the fixed position, front facing.
Worked well for the duration of the cruise

Future modifications/improvements/maintenance:

- None.

Scorpio digital still with flash unit:

The camera would not boot correctly for download of images with the deck cable. The deck cable was initially remade but found the problem with the camera. This unit is soon to be superseded with a 10Mp HD still camera and in-situ Ethernet image uplink possible removing the requirement to resolve the problem and need for deck cable.

The Scorpio stills flash unit was found to container water. It was removed, dried, and put into temporary storage.

Future modifications/improvements/maintenance:

- Possible return unit to Insite for repair.
- Bring new Super Scorpio units on line

High Definition Pilot and Science camera units

Both HD cameras functioned without incident. HD pilot is now fitted to the Kongsberg pan and tilt unit. HD science is fitted to the high mounted ROS pan and tilt unit. During bathymetric swath operations the OPTI-CON fibre optic connector was moved from the science HD to the WDM ('Kraft') bottle.
New laser transmitter modules have been fitted to BOTH HD pilot and HD science. They are significantly more powerful and function transparently with the current deck side Telecast Rattler systems.

Future modifications/improvements/maintenance:

- Trial WDM on both HD cameras.

Mini Cams:

Uplook , Drawer, LED Sampler/Gauges

All worked well for the duration of the cruise.

Future modifications/improvements/maintenance:

- None

Mercury (Aft Cam):

This is an excellent low light monochrome camera providing sharp pictures with minimal lighting and is well suited for vehicle rear view monitoring. No problems were encountered.

5.9 Lights:

The 4 new Aphos LED lamps performed well.
Various combinations for angles and placement need to be carried out to optimize coverage.

Future modifications/improvements/maintenance:

- Look at power consumption with a view to increasing the power output of the LED's from 375W up to 600W

5.10 Lasers:

A GF was occurring on one of the lasers

Future modifications/improvements/maintenance:

- Identify laser GF and rectify

5.11 Sonar's:

RDI Doppler WorkHorse Navigator 300KHz:
This new unit was setup at the start of the cruise and installed on the vehicle. Setup requires running a batch program Go-Bat sited on the DVLNAV PC. However the only approach found to work was to connect the Doppler to a physical COM1 port (USB – Serial adaptors on laptop did not work). Using BBTalk software CK /CS save settings CB611 change baud rate to 38400bd. (The unit was delivered as 9600bd)
An angular adjustment of -6 degrees was entered into DVLNAV to correlate seabed track with USBL positioning.
This operated well for the duration of the cruise.

Tritech Imaging (Fwd):
The new Tritech Super Seaking dual frequency head performed well throughout the cruise

Reson Multibeam
The Reson transducers, Receiver, 200KHz & 400KHz transmitters were mounted on a plate that could readily be slotted into the rear port side of the vehicle tool-sled, space also utilized by the Niskin bottle rosette. The electronics bottle (LCU) mounted just forward of this.
After an initial dive it was found that the plate with transducers was mounted incorrect by 180deg – the transceiver connector should be to the port vehicle side. The plate was rotated with new mounting holes and performed well for the remaining swath dives. As a rule, to avoid damage to the transducers no seabed excursions were permitted with the system installed.

- Consideration to obtaining spare connectors / leads / dummies
- Consider moving the topside unit from the control van on the floor to the rack in the data container.

5.12 Digiquartz Pressure Sensor:

Worked well for the duration of the cruise.

5.13 Electrical Systems and Wiring:

The repairs carried out to the boards within the telemetry tube worked well and the previous faults rectified.

5.14 Altimeter:

Worked well for the duration of the cruise.

5.15 Novatech Radio/Strobe Beacons

Worked well for the duration of the cruise

5.16 PRIZM –FO Comms

Worked well for the duration of the cruise

5.17 Scientific Sensors

CTD: SBE49 Ser#
This new Seabird Fastcat CTD unit was installed for this cruise, mounted at the aft port side base of the vehicle tool-sled. A 12V power supply pre-installed in the low-power tube and cable glanded into the low-power junction box with RS232 communications.

<table>
<tr><td>MCIL-4-F Connector</td><td rowspan="5"></td></tr>
<tr><td>1 0V</td></tr>
<tr><td>2 RS232 Rx</td></tr>
<tr><td>3 RS232 Tx</td></tr>
<tr><td>4 Vin</td></tr>
<tr><td></td><td>Top left - Turbidity Sensor
Bottom centre - CTD</td></tr>
</table>

The unit operated without problems

Thermometer: SBE38 Ser#
This new Seabird thermometer unit (0-35 deg C calibrated) was installed for this cruise, fitted with a T-handle and mounted in a holster on the tool drawer. A 12V power supply pre-installed in the low-power tube and connected to SB6 with RS232 communications.

MCIL-4-F	LPIL-7-MP
1 0V	1 ,2 (0V & RS232 shield)

2 RS232 Rx	6
3 RS232 Tx	5
4 Vin	7


Thermometer with T- handle mounted on tool-drawer

The unit operated without problems

Turbidity: ECO-NTU-RTD

This new turbidity sensor (0-1000 NTU) was installed for this cruise. A 12V power supply pre-installed in the low-power tube and connected to SB5 with RS232 communications.

MCIL-6-F Pins	LPIL-7-MP Pins
1 0V	1, 2 (0V & RS232 shield)
2 RS232 Rx	6
3 Reserved	
4 Vin	7
5 RS232 Tx	5
6 Analogue out	

The unit operated without problems.
Maybe more useful in future if configured with a more sensitive NTU range for background plume detection (Maximum counts observed in dense plume 500NTU).

ECO Flntu's are available in five ranges:

0 - 30 ug Chl/l -- 0-10 NTU with approx .008 ug/l /0 .003 NTU resolution

0 - 50-ug Chl/l -- 0-25 NTU with approx .013 ug/l 0.007 NTU resolution

0 - 50-ug Chl/l -- 0-100 NTU with approx .013 ug/l 0.025 NTU Resolution

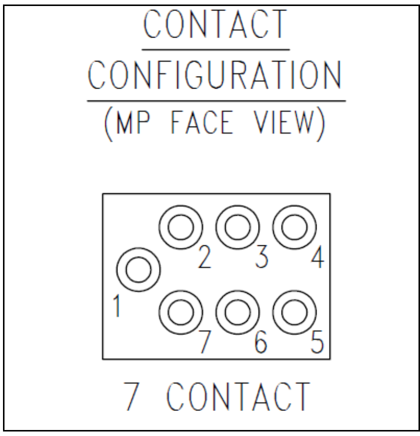
0 - 75-ug Chl/l -- 0-200 NTU with approx .02 ug/l 0.06 NTU Resolution

0 - 250 ug Chl/l -- 0-1000 NTU with approx .03 ug/l 0.25 NTU Resolution

- Investigate range change

ICL Probe:

The Inductively Coupled Temperature probes provide a decoupled solution designed for operation with the titanium water samplers. Software developed by the Isis team operating on the Control Van Device Controller computer provided a clear indication of communication link status when coupled to within 1cm of the battery operated probe. Alignment of the 2 coils, one mounted on a hydraulic ram on the port manipulator and the other attached to the titanium sampler, required precision positioning achieved by rotation of the manipulator jaws. This could be improved by introducing a less critical alignment coupling technique and reduce the need for precise settings on the actuating trigger bolts. Communication and power normally provided through Isis science bus port 7 configured for 12V and RS232 communications had the power linked to operate in parallel with SB6 as a rebuild wiring fault was identified (no power wires).
At the start of the cruise the probes which had previously been used and returned damaged required repair of the electronics bottle connector. This was implemented and tested ok. The Power rails were shorted. U1 (LT1120) was de-soldered and a short still existed so U3 (4047) was removed this cleared the short so both U1 and U3 were replaced. Both bottles work. C1 needs to be replaced on the spare bottle in the pelicase. The replacement ICs U1 and U3 were not pressure cycled prior to fitting.



1. 0V
2. RS232 Shld
3. NC
4. NC
5. Uplink
6. DownLink
7. +12V

Future modifications/improvements/maintenance:

- Correct Low- Power junction box wiring
- Some additional stocks of both U1 and U3 should be purchased.
- More temperature lances should be made up. The drawings for making the lances are in the ICL manual in the Van. We have new WHOI supplied spares but some do not work.
- The ICL probes are not calibrated. It would be prudent for the Scientific users of the probes to make a note of which bottle and probe combination are used together and calibrate them post cruise.
- Some of the ICL lance bottles need repair.

5.18 Low Voltage JB (port side):

Some wiring wrong in JB for science bus
Blank left off SB 4? Now corroded and U/S
The new ISIS frame design has resulted in the HV transformer box being higher this has resulted in it becoming more difficult to connect the SB impulse connectors. Due to the nature of the right angle connector coupled with the new position of the HV transformer box this has lead to side loading of the connector and a potential leak path of the connector.

- Investigate changing SB connectors for different type ie mini subconn
- Correct Low- Power junction box wiring
- Replace damaged connector

6. Isis System Topside:

6.1 Clearcoms:

The Clearcoms system (full duplex, wired communications) was installed early in the year. It comprises of a 4 channel master rack unit with goose neck microphone mounted in front of the ROV engineering position in the control van. Remote units may then be sited anywhere on the ship utilising the in-house CAT6 wiring. For this cruise a unit was sited at the Dynamic Positioning (DP) console on the Bridge with 2 flying leads to the deck winch operator and deck coordinator headphones. New cables were made with IP rated sockets as deck connectors are prone to water ingress.

XLR to Cat 6 Cable

- Pin 1 Gnd – Green Cable Pair
- Pin 2 Pwr 30v – Blue Cable Pair
- Pin 3 Audio – Orange Cable Pair

Worked well for the duration of the cruise.

6.2 Jetway:

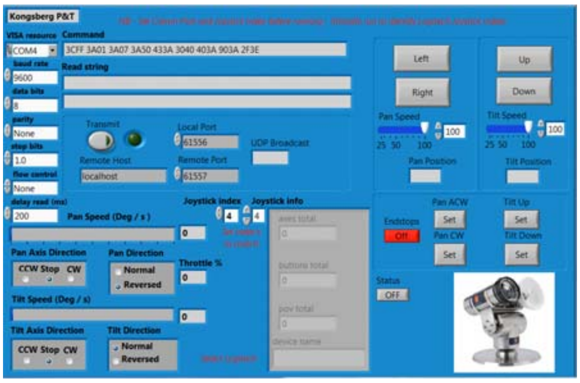
This operated well for the duration of the cruise.

Future modifications/improvements/maintenance:

- It was observed during the cruise that no status indication lights are present within the Jetway compartment neither is there any provision for an external emergency stop control nor any convenient means of earthing the high voltage outgoing cable. On return to NOC after JC083 these deficiencies should be addressed.
- The opportunity should also be taken to overhaul the high voltage system including a transformer oil change and general tidying of the system.
- Look into external cooling of the transformers (water cooled, etc)

6.3 Device Controller:

During mobilization it was found the device controller PC system disk would not boot. It was subsequently tested with a USB SATA disk interface but still could not be read. During this process the PC was switched with a spare to prove the problem. The Windows XP master disk was replaced with a pre-configured Windows 7 software and programs brought for trial during the cruise and operated without further problems.
Prior to the cruise software for the new Kongsberg pilot pan & tilt was developed for operation with proportional control firmware. Operation in parallel with the ROS science pan & tilt and operation from pilot joybox and ancillary joysticks required further development during mobilization. This performed well throughout.



Kongsberg P&T GUI

Future modifications/improvements/maintenance:

- Previous cruise recommendations remain -
  A proposal for discussion was submitted to the Isis technical leader (2009) to develop the system onto a deterministic real-time operating system together with associated ergonomic control boxes incorporating present and recent additional high definition controllers.
- Purchase a USB / SATA disk interface / Disk duplicator.
- Ensure spare disks are available and are configured with the latest software.

- Consideration to the life expectancy of current HP computers – potential 1U Dell servers providing a cost effective solution.

6.4 Techsas PC:

This Linux computer provides the major data logging tasks and also acts as an NTP server for time synchronisation for the other computers. This performed without problems with only file incrementing per dive requiring intervention.
This operated well for the duration of the cruise.

The dual Juniper Firewall access units require resetting as there were no password details – these units prevented routine access to the RAID data from the ship network. To overcome this a chrontab process 1minute past each hour copied the data to the ship server via the ROV server 2nd Ethernet port.

Future modifications/improvements/maintenance:

- Reset Juniper Firewalls and configure

6.5 CLAM PC:

This is a major bottleneck in the data processing chain as the CLAM PC redistributes data via various obscure virtual serial ports to other systems and thus has to be working before these other systems can function. Additionally the memory intensive nature of the program inserts a large delay between when the winch system outputs information and when CLAM actually displays it. This leads overall to a very inefficient operating environment.

Future modifications/improvements/maintenance:

- Consideration could be given to separating out the data strings to provide dedicated feeds to the various display units and rationalize the CLAM program to remove the latency.

6.6 Event Logger PC:

The event logger PC is used to generate an electronic diary during ROV dives. It was decided OFOP software was to be used for this task. The control van back (science) bench was setup with a dual screen display with the right hand display repeated in front of the pilot (monitor ?). A USB extender was installed to provide access for science to pre-install dive waypoints and background maps. This port also provide for attachment of a composite video source selectable from the master video matrix switch. This enabled science to make video frame grabs during their observations.

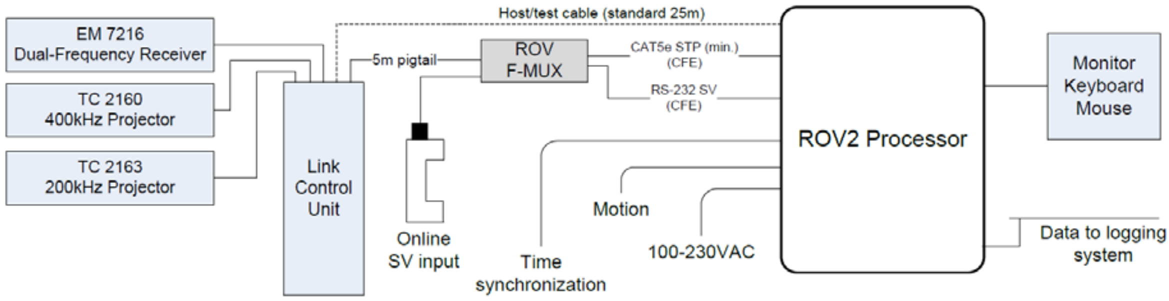
6.7. Reson 7125 Multibeam:

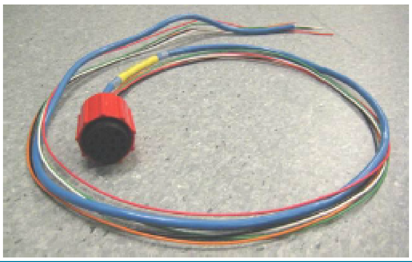
The new procurement of a multibeam sonar required installation and proving during this cruise. Data communication cables were installed from the ROV & ship sensors.

The new ROV fibre multiplexor, previously detailed operated without problems providing the necessary 1GB Ethernet link for the topside processor to communicate with the subsea link control unit.

Two issues arose – the paroscientific pressure sensor output requires a scaling factor & offset entered into the PDS2000 software and the 7K software module could not start in single head, dual frequency mode. After a number of emails with the Reson company this was easily resolved by restoring the sonar head parameters to factory defaults (Option 1).

System Block Diagram



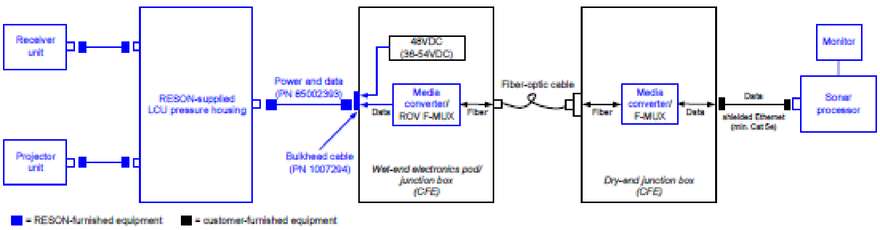


Bulkhead connector

- The internal side of the bulkhead connector has a Cat 5e Ethernet cable, 4 power wires, and a shield wire (orange), which should be connected to the electronics pod chassis ground. The shield wire is only AC-coupled in the LCU; no DC current is lead through.
- Cut the wires to the desired length. On delivery the wires are 1m long.

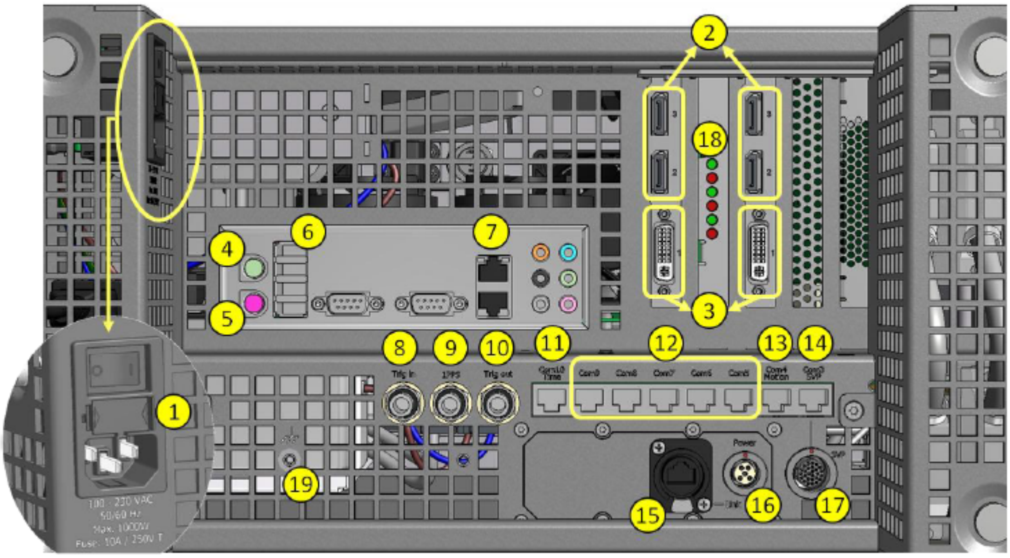
Bulkhead connections

ROV installation diagram



- **Connector J1:** LCU to processor cable
- **Connector J2:** Receiver to LCU cable
- **Connector J3:** 200kHz projector to LCU cable
- **Connector J4:** 400kHz projector to LCU cable
- **Connector J5:** Service connector

ROV2 Processor Rear Panel Connections



1) Power input and switch	11) Time marker serial port
2) Monitor output (4 display ports)	12) Serial ports with LED (x5)
3) Monitor output (2 DVI ports)	13) Motion sensor serial port
4) Mouse	14) Alternate SVP serial port
5) Keyboard	15) Host cable data connection
6) USB (x4)	16) Host cable power connection
7) Ethernet (x2)	17) Main SVP serial port with power
8) Trigger in	18) Diagnostic LEDs
9) 1PPS input	19) Protective earth screw for equipotential connection
10) Trigger out	

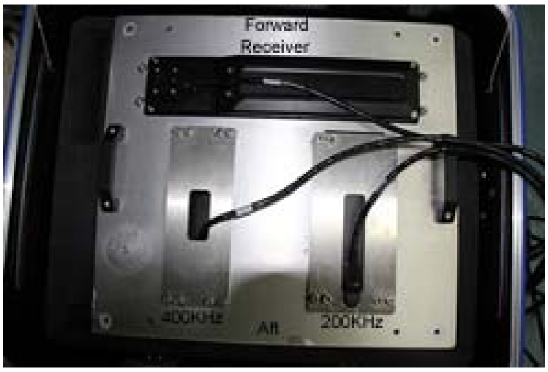
Computer connections

- **Coax 1** – Ship 1pps - Check positive or negative pulse and set in 7K
- **Serial 3** – SVP – from Prizm port (SB3)
- **Serial 4** 38400 – Isis Octans from splitter TSS2 format (TSS3 or EM3000 format for 7K roll stabilisation)
    - Set to 50ms / 20Hz (SER A) with Octans setup program on DVLNAV. Ideally 50Hz
- **Serial 5** 38400 – Isis Doppler from splitter PD5 format (Compatible with DVLNAV)
- **Serial 6** 9600 - PSON from Sonardyne (Isis Transponder)

- **Serial 7** 9600 – Isis ParoScientific – dual splitter - (requires scaling factor as Topside & Techsas) set in PDS equipment configuration depth multiplication factor
- **Serial 8** 19200 – From Ship VRU Simrad EM1000-EM3000
- **Serial 9** 19200 – From Sonardyne NMEA GGA
- **Serial 10** – Ship ZDA

Sonar Heads

The sonar heads – receiver and 200KHz, 400KHz transmitters are mounted on a plate which slides into and replaces the Niskin bottle rack at the Aft, Port tool sled base.



Vehicle Offsets

	X Stbd = +	Y Fwd = +	Z Up = +
Compatt	-1.015	-0.36	1.46
LBL			
OCTANS	0	-0.86	-0.494
DVL	0.58	-2.908	-0.175
Para Scientific pressure senser	0.547	-1.48	0
Reson Sonar Reference Point	-0.47	-1.784	-0.822
Reson Receiver Reference Point	-0.47	-1.567	-0.822

-15cm was added to the Sonar reference point when the array was remounted correctly with the receiver forward ie -1.784 + 15 = -1.634

Sound Velocity Profiler (SVP)

A Reson SVP70 was connected to Isis Science Bus 3 12V (9600,N,1). Originally to be placed on SB4 but a potential rebuild wiring error indicated no power.

MCIL9F pins	LPIL-7-MP pins
1 Comms-GND	2
2 RS232 Tx	5
3 RS232 Rx	6
4 RS422 TxP	
5 RS422 TxN	
6 RS422 RxP	
7 RS422 RxN	
8 0V	1
9 Vin	7

- Identify power issue on science bus 4

6.8 Tritech Super Seaking PC:

Operated well for the duration of the cruise

6.9 Topside PC:

This ran well for the duration of the cruise.

6.10 DVLNAV PC:

This worked well for the duration of the cruise.

6.11 Pilot/Engineer PC

During mobilization the Engineer PC was found to have a graphics problem resulting in no display. The hard disk was reinstalled in a spare PC and associated cabling re-routed.

- Investigate graphics problem

6.12 Video Recording / Archiving

ISIS System Cruise Report

RRS James Cook (JC080)

28th Dec 2012

Recording

Four KiPro rack dual drive hard disk video recorders were installed prior to the cruise. Each unit set to record with the Apple Pro-res codec providing superior quality recordings than HDV / DV tapes (Apple Pro-res 4:2:2 acceptable by the BBC). Each device has dual removable disk drives with a combination of 300GB solid state, 250GB and 500GB Sata drives available for data storage / transfer.

3 units were setup to record HD1 & HD2 HD-SDI cameras with the 3rd PAL source selectable from the REC1 video multiplexor. The 4th unit retained as a spare. Each unit was linked to an associated Tape deck to provide backup. Each source displayed on the quad display above.

KiPro 1 - 192.168.40.5 Science (Top P&T) HD-SDI i/p, HD-SDI loop through to HDV tape deck composite o/p to video mux

KiPro 2 - 192.168.40.6 Pilot (Bottom P&T) HD-SDI i/p, HD-SDI loop through to HDV tape deck composite o/p to video mux

KiPro 3 - 192.168.40.7 REC1 source selectable Composite i/p to AJA SDI converter, Composite loop through to DV tape deck

KiPro 4 - 192.168.40.8 Spare

Archiving

To reduce video files to a manageable size for archiving data disks were changed every 2 hours accumulating 150GB each for high definition (HD) cameras and 37.5GB for standard definition (SD)

An apple Imac computer, Kipro deckunit and 6TB Thunderbolt MyBooks was setup in main lab for archiving. Each of the recorded disks copied to a Master and Backup Mybook and returned to the ROV container when complete. In addition an HDV tape deck and monitor was setup and made available for tape reviewing.

- Procure Promise Thunderbolt Raid 3 x 18TB Stacks (6 x 3GB disks) Raid 5 = 45 TB to support archiving procedures. Future operations would then reduce Mybook quantities by half. Allowing for 2 HD and 1 SD channel recording with 10 day ROV seabed time requires circa 45TB ie 10 off consumable 6TB Mybooks per cruise

- Procure KiStor Docks for thunderbolt connectivity to removable disk drives.

- Consideration for a 2nd Imac to act as spare / editing PC with Final Cut Pro

Confidence Monitors

Video Matrix switch

KiPro 1 HD1Science

KiPro 2 HD2Pilot

KiPro 3 SD PAL

Kipro 4 Spare

HDV Tape Decks

DV Tape Decks

6.13 DVR PC:

The DVR provides a 5 frame a second h.264 per channel record (DVD quality) of up to 8 video channels. During this cruise the web server capability was used to provide a display for the bridge DP console via a PC / avocent feed in the computer locker.

7. Isis Topside Technical Details:

7.1 Ship Connections:

JC80 ISIS and Ship Interconnections
Jon Seddon 28th December 2012

Hangar Fieldbus FB17

204 Ship's network (input for ISIS firewall)
205 ROV network (to the ROV network switch in Main Lab Rack 3)
206 Phone Number 209
207 Seapath 200 serial data to the Reson, (blue EM3000 attitude from com 5)(green NMEA ZDA, GGA, VTG and HDT from com 8)(orange ZDA from com 6)(coloured core is data, colour and white is ground)
208 Avocent transmitter from the ROV USBL PC
209 Clearcomms to the bridge
210 Clearcomms to the main lab
211 (to 24 in the Computer Locker) CookFS to XServe for data backup

Note: the Reson S7K i/o module requires the ZDA and PPS signals. The ZDA initially came from the main lab splitter but the S7K i/o module wouldn't accept this, I think because of the slight delay in it from the Splitter. The PDS2000 processing modules take the position and attitude data. I haven't experimented with using a splitter cable to feed the ZDA contained in the com 8 green signal into S7K, but it might be worth doing this if you're short of outputs from the Seapath 200.

Hangar Scientific Wiring JB12

JB12 1:1 PPS from Seapath 200 (JB30 (Gyro Room) to JB28 (Hold) to JB12)

Hangar Scientific Wiring JB25

The connector on the base of JB25 connects into the wiring to the USBL changeover switch in the Main Lab.

Deck Lab Fieldbus FB5

126 connects to Plot 185 for the composite video feeds over a balun to the two big screens
127 connects to Plot 187 for the VGA feed from the ROV OFOP map screen

Main Lab ROV Network Switch

One input is used for the link to the ROV Van via Fieldbus 205. Another goes to the ROV Main Lab Moxa (192.168.40.64) and the final goes through the Fieldbus to the Computer Locker where there's the PC that provides the video feed via the web based system to the Bridge using Avocent.

Main Lab ROV Moxa

All the Main Lab ROV Moxa connections are recorded in the folder in the ROV van. To summarise them:

Port 1 DPS116 Ship's GPS
Port 2 POSMV Heading
Port 3 POSMV VRU
Port 4 POSMV GGA and HDT to CLAM which reformats them and sends them via UDP to DVLNAV
Port 5 POSMV RMC and HDT to OFOP
Port 16 EA600 Depth to CLAM

ISIS Techsas

To backup the ISIS Techsas data to the XServe a cronjob was setup on the ISIS Techsas:

01 * * * * rsync –rbt /data/JC80/* /mnt/server/JC80/Techsas

At one minute past every hour this calls rsync to do the backup. The rsync flags recurse into all sub-directories, backup rather than synchronise and preserve file modification times. To edit the cronjob type crontab –e and then use the usual vi commands to edit the file.

XServe Backup

Because the ROV firewall's password is unknown it was not possible to copy data to the ship's network over the network connection to the ROV van. Instead a direct cable from a spare Ethernet port on the ROV van XServewas run to the hangar fieldbus and the directly into Cook FS. That port on Cook FS was given IP address 172.16.20.20 and the XServe 172.16.20.30 with no gateway. Initially we wanted to export a drive from CookFS that the XServe would mount and the copying would be done in the ROV van. However, the XServe is running Mac OS 10.4 and its Samba doesn't play nicely with Windows Server 2008 due to password encryption. Rather than getting samba to work (and potentially breaking the samba shares to PCs in the van) the ISIS data share was shared via NFS as ISIS_NFS (nfs://172.16.20.20/ISIS_NFS). I had to create an ISIS user in the Active Directory and give it the Unix UID 501 so that the ISIS user on the XServe would be mapped to the ISIS AD user and the permissions would work. The sciguest user has read-only access to \\cookfs.cook.local\ISIS. However this failed as sciguest didn't always get read permission on files. An alternative approach was then taken where CookFS mounts the read only science export from the XServe (user \science and password science, but make sure that a domain is not specified, it must be just username science and be careful of Windows 7/Server 2008 automatically putting in a domain (it sometimes puts in the domain raid\)). Syncback on CookFS then copies the data from the XServe to CookFS hourly. Sometimes when ROV swathing, the back-up was changed to run every 15 minutes so that the calibration lines could be immediately processed in the Main Lab.

7.2 Fibre Optic Terminations:

Worked well. Due to a low bandwidth budget for the HD cameras a deck lead was put in going directly from the storage drum junction box, to the rattlers of the HD system. Removing all the additional interconnects vastly improved the budget allowing the system to work faultlessly.

7.3 Power Supplies

The power for the control room and science container used the 230V clean supply via a plug on the hanger bulkhead whilst the air-conditioning units were connected to the adjacent 230V dirty supply.
The Jetway power supply and was powered from a separate 415V 125A 50 Hz dirty supply.

Future modifications/improvements/maintenance:

- None

7.4 Air Conditioning Units

Worked well for the duration of the cruise

Future modifications/improvements/maintenance:

- Consideration should be given to supplying the A/C units cooling water from either the non toxic seawater line or a fire main to get the coolest water available during JC82/83
- Investigate an additional unit. Further confirmation as to the requirement will come following JC082/3

8.0 ISIS Dive Summary (hrs run)

Cruise	Dive No.	Dive Hrs	Cruise Total Hrs	System Total Hrs	Max Depth	Bottom Time
JC080	187	14			2696	9.5
JC080	188	20			2549	15.5
JC080	189	5			2641	1
JC080	190	11.5			2618	8
JC080	191	10.5			2600	6.5
JC080	192	0.75			330	0
JC080	193	8.75			2585	4.5
JC080	194	15			2606	12
JC080	195	5			2576	1
JC080 Totals	**10 (dives)**		**102.5**	**2801.23**	**2696**	**67.00**

9.0 Cable short Incident & cable length reduction exercise (20th Dec 2012) Following Dive 195 ROV Blackout.

Dive 195 – 19th Dec 2012

During dive 195 at 04-02hrs whilst carrying out a swath survey, the HV power was lost to the vehicle. The vehicle depth at the time of this incident was 2626m. Upon losing power and following some checks, the vehicle was declared dead and would require a dead vehicle recovery.

The dead vehicle recovery went very smoothly, without causing any damage to the ROV. The vehicle was secured on deck at 06-34hrs.

Upon initial visual inspection of the termination, tether and joint boxes there were no obvious signs of damage.

Following the isolation and making safe of the high voltage system the tether was disconnected and removed from ISIS and testing commenced.
An insulation resistance test of the entire system revealed no breakdown between any phase and the wire armor; however a resistance test between phases revealed that the green phase had a very low resistance to one of the other phases.
A continuity test of each phase revealed no problem with continuity being maintained throughout each.
A test of the three optical fibres revealed one of the fibres had lost continuity. In addition an insulation resistance test between the metal screen of the suspect optical fibre and the two suspect phases also revealed a very low resistance.
The initial conclusion therefore was that an interphase insulation failure had occurred.
The system was then split into four parts: the tether; the slip ring; the deck cable and the Jetway power supply.
Each section was tested again for insulation resistance and continuity and it was established the fault lay in the tether.
To confirm the integrity of the remainder of the system the Jetway, deck cable and slip-ring were reconnected together and powered up for 10 minutes without incident.
In the absence of any cable testing equipment a careful check of resistance values were taken of each phase of the tether and the results tabulated as follows:

Cable Length marker at slip ring end:	1168 ft
Cable Length marker at vehicle end:	30418 ft
Hence total length of tether: (30418 – 1168)	29250 ft.
Total loop resistance of the two healthy phases:	82.3 Ω
Hence resistance of each phase: 41.15Ω	
Manufactures dc resistance figure (Rochester A302351)	1.5Ω / kft
Hence calculated length of tether should be:	27430ft
Total percentage error between calculated length and indicated length:	1.07%
Total loop resistance between the two suspect phases when measured from the vehicle end :	70.5Ω
Total loop resistance between the two suspect phases when measured from the slip ring end:	12.3Ω

Combined total resistance from each end (70.5 + 12.3): 82.8Ω

As the total loop resistance of the healthy phase and the two suspect phases was within 0.5Ω then a very low resistance short circuit fault must have developed between the two faulty phases.

By comparing the ratio of the loop resistance from either end of the cable to the total loop resistance it can be seen that the fault is likely to be at or about 15% of the total distance in from the slip ring end. (100 - (70.5 / 82.3 X 100).

This equates to around 4387 ft 6 inches (1329m) from the inboard end of the cable.

The next stage was to determine whether or not it was feasible to remove slightly more than 1329m from the inner end of the drum. To achieve this several things needed to be available.

1. Enough wire on the drum, such that when approx 1500m was removed there would be enough remaining to conduct ROV operations on JC082/3 working in 5000m of water.
2. There was a suitable location that would allow approx 7000m to be deployed over the side (straight down)
3. There was a suitable method and equipment onboard to stopper off the cable.
4. Suitable weather conditions and weather window were available to complete the task.

Item 1 was addressed by calculating the max wire out for a 5000m deployment JC082/3). With the ROV approx 100m away from the ship 5100m would be required; increasing this to 200m away from the ship 5400m would be required. Therefore allowing for 5,500m for deployment should be adequate.

Fortunately within 90Nm from the ships location there was an area with 7,200m of water depth. Therefore by streaming the cable to 7000m, and allowing for 130m to be wound back onto the drum, this would allow 1777m to be removed. (Note: by removing more than initially thought, was the safer side to be on, with the outcome more likely resulting in the removal of the fault. Removing less than 1777m would be more complicated, as this cable would have to have been managed on deck.)

Total length of cable:	8,915m
Amount to be removed:	1,777m
Total remaining:	7,138m
Total on drum with 5,500m deployed for ROV operations:	1,638m

Two x complete lays of the storage drum equates to 557m, and therefore having 1,638m remaining was deemed more than adequate.

A safe system of work and risk assessment was put together following a toolbox discussion, and a dry run of the operations to be carried out. The cable stopper was tested on the cable and load tested to the requirements of the operation. The outboard load with 7000m of wire deployed would be 6,335kg.
Additional checks were made with the winch manufacturers (Dynacon) as to what loads might be seen on the inboard side of the traction winch unit. Based on 6,335kg outboard it was estimated that the inboard load would not be in excess of 569kg.

The proposed plan was to stopper the cable off on the inboard side of the traction head, with an additional stopper on the outboard side for ‘just in case’.

On arrival to the deep water location, the weather was assessed, and deemed suitable before the operation was to commence.

Following the deployment of 7000m and the stoppering of the cable, all was left for approx 30 minutes so as to monitor any creep or slippage in the stoppering device. This all appeared ok, and indeed indicated that the inboard side of the traction winch was seeing no load.
The cable was then cut and electrical tests carried out on the 7000m of cable overboard. These tests proved to be good indicating that the damaged cable was still on the storage drum. The remaining 1,777m was then hand spooled from the storage drum and coiled into the hold via a floating sheave block positioned over the stern stbd hatch. The outboard 7000m of cable was then connected to the storage drum; the back tension applied, and then spooled back onto the drum in a normal recovery fashion.

Following the termination of the cable into the winch slip-ring and the ROV, a full power and communications test was completed revealing that both power and optical fibres were now working to full capacity.

Note:

Had this umbilical fault not been a dead short, enabling us to use a resistance measurement to determine the location within the 8,915m of cable, this process of removing umbilical at sea would not have been possible.
Had the fault been an open circuit or a very high resistance it would have been virtually impossible to locate the fault within the umbilical’s length.

To avoid this possible electrical diagnostic problem it is recommended that a test unit (Bicotest T625 cable analyser) be procured. This unit does the same job on electrical cables that an OTDR does on the fibre cables, enabling the exact position of the fault to be determined in the absence of it being a dead short.

The supplier of the test unit RS, and the current retail price is £4,000.

Note from Will:

The Bicotest T625 is for LV mains cables. There is another unit the Bicotest T631 that is also for HV cables to 12km long. It has better resolution accurate than the T625 and is a similar price £2999 plus VAT.

if a spare reel of cable is available at NOC then it would be prudent to contact TDR manufacturers to see what TDR they would recommend for the 0.680 rochester try the unit out on the cable before purchase.

If the faulty cable section was taken back to NOC then the TDRs could be trialed on it as well.

Stopper Arrangement:

5T Stopper

Outboard Stopper

Spooling into hold via hanging block

JC080

NMFSS CTD Operations Report

PSO: Prof. P Tyler
2nd December 2012 – 5th January 2013

JOHN WYNAR
Sensors & Moorings Group
National Marine Facilities Division
National Oceanography Centre, Southampton

CTD System Configuration

An all titanium system was employed and the initial sensor configuration was as follows:

- Sea-Bird 9*plus* underwater unit, s/n: 09P-24680-0637
- Frequency 0 - Sea-Bird 3 Premium temperature sensor, s/n: 03P- 2919
- Frequency 1 - Sea-Bird 4 conductivity sensor, s/n: 04C-2571
- Frequency 2 - Digiquartz temperature compensated pressure sensor, s/n: 110557
- Frequency 3 - Sea-Bird 3 Premium temperature sensor, s/n: 03P - 4151
- Frequency 4 - Sea-Bird 4 conductivity sensor, s/n: 04C-3054
- V0 - Sea-Bird 43 dissolved oxygen sensor, s/n: 43-2055
- V1 - Free
- V2 - Free
- V3 – Eh sensor (user supplied)
- V4 – CTG Alphatracka transmissometer , s/n: 161048
- V5 – CTG Aquatracka MKIII fluorimeter, s/n: 088244
- V6 - WETLabs turbidity sensor, s/n: BBRTD-182
- V7 – Benthos 916T altimeter, s/n: 41302
-

Ancillary instruments & components:

- Sea-Bird 11*plus* deck unit, s/n: 11P-24680-0587
- Sea-Bird 24-position Carousel, s/n: 32-31240-0423
- 24 x Trace Metal Free OTE 10L water samplers, s/n's: 1 through 24
- TRDI WHM 300kHz LADCP, s/n: 10607

CTD Operations

The following CTD casts were made including a test cast, T1:
CTD 04 to 26 were part of the first Tow-yo cast;
CTD 27 to 40 Tow-yo cast 2;

CTD 46 to 63 Tow-yo cast 3;
CTD 67 to 72 Tow-yo cast 4;
CTD 73 to 130 Tow-yo cast 5.

Log sheets were scanned and included with the data from this cruise.

The pressure sensor was located 30cm below the bottom and approximately 75cm below the centre of the 10L water sampling bottles.

The configuration file used for all CTD casts was JC080_Ti_0.xmlcon (see Appendix 1).

Sensor Failures

A large number (88) of modulo errors were recorded during the first cast despite having re-terminated the wire beforehand. This was discovered to be due to a noisy pass-through in the winch slip-ring. Fortunately the slip-ring had a redundant pass-through and the system was re-wired to take advantage of this. The following test cast was completely free of modulo errors.

During cast 40 the transmissometer signal appeared noisy on the up-cast. After recovery the cable was inspected but no water ingress or corrosion was found so the cable was changed.

Up till cast 72 CTD2 had been used and varying numbers of modulo errors were detected. From cast 73 onwards CTD1 (which was new and had recently been installed) was used and no further errors were observed. *It can only be concluded that CTD2 has been the source of all the modulo errors recorded during CTD casts*.

Data Processing

CTD cast data was post-processed according to guidelines established with BODC (ref. Moncoiffe 7th July 2010) by the data manager Mr R. Thomas. Loop Edit was not employed during processing due to the fact that most casts included a certain amount of "yo-yoing".

Salinity measurement

A Guildline Autosal 8400B salinometer, s/n: 68426, was used for salinity measurements. The salinometer was sited in the Electronics Workshop, with the bath temperature set at 24°C, the ambient temperature being approximately 23°C. A bespoke program written in Labview called "Autosal" was used as the data recording program for salinity values.

TRDI LADCP Configuration

The TRDI WHM 300kHz LADCP (s/n: 10607) was deployed in a downward-looking orientation on the CTD frame. Battery voltage could not be monitored as the cable was diode protected. The instrument was configured to ping at intervals of one second, use 16 bins, a blanking distance of 5m and a depth cell size of 10m thus yielding a range of approximately 165m in ideal conditions. The ambiguity velocity was set to 250 cms^{-1} and pings per ensemble to 1.

Built-in pre-deployment tests *(PA and PT200)* were run before each cast, and then the following command file sent *(F2)*:

Master command file (WHM_JC079.txt)

```
PS0
CR1
CF11101
EA00000
EB00000
ED00000
ES35
EX00000
EZ0011101
WM15
LW1
LD111100000
LF0500
LN016
LP00001
LS1000
LV250
SM1
SA001
SW05000
TE00:00:01.00
TP00:00.00
CK
CS
```

Deployment Comments

Each deployment BBtalk terminal session was logged to a file (*F3)* of the form: *JC080_XX.txt*, where *XX* is the CTD cast number. Downloaded data files were re-named to be of the form: *JC080_XX.000*.

The real-time clock of the LADCP was checked prior to deployment *(TS?)* and re-synchronised with the ship's GPS clock if it was more than a few seconds in error. The time difference was written on the log sheet.

Paper log sheets were used for all casts, the LADCP file number being defined by the CTD cast number.

JC080_02m.000 is a considerably smaller file than would have been expected. The log file shows that several errors were registered when the deployment command file was sent and this is probably the cause of the poor data set.

Stand Alone Pump (SAP)

A SAP s/n: 03-03 was deployed twice and on both occasions it was fitted to the titanium CTD frame in place of 4 or 5 water sampling bottles. The SAP was configured to pump for 1 hour with a 1.5 hour delay on two CTD casts: 44 and 45. On each occasion the CTD was lowered until the BBRTD and the Eh sensor indicated that the package was in the plume of the vent and then suspended there until pumping had ceased. During cast 44 the volume pumped was 590 litres of water and 716 litres during cast 45.

APPENDIX 1

Initially, the config file used was the following:

Instrument configuration file: C:\Program Files\Sea Bird\SeasaveV7\JC80\JC080_Ti_0.xmlcon

Configuration report for SBE 911plus/917plus CTD

Frequency channels suppressed : 0
Voltage words suppressed : 0
Computer interface : RS-232C
Scans to average : 1
NMEA position data added : Yes
NMEA depth data added : No
NMEA time added : No
NMEA device connected to : deck unit
Surface PAR voltage added : No
Scan time added : No

1) Frequency 0, Temperature

Serial number : 03P-4380
Calibrated on : 06 July 2012
G : 4.37240289e-003
H : 6.55641662e-004
I : 2.41975555e-005
J : 1.96516897e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

2) Frequency 1, Conductivity

Serial number : 04C-3873
Calibrated on : 08 May 2012
G : -1.01892351e+001

H : 1.35658277e+000
I : -8.40271362e-004
J : 1.26154873e-004
CTcor : 3.2500e-006
CPcor : -9.57000000e-008
Slope : 1.00000000
Offset : 0.00000

3) Frequency 2, Pressure, Digiquartz with TC

Serial number : 79501
Calibrated on : 05 Oct 2011
C1 : -6.052590e+004
C2 : -1.619787e+000
C3 : 1.743190e-002
D1 : 2.819600e-002
D2 : 0.000000e+000
T1 : 3.011561e+001
T2 : -5.788717e-004
T3 : 3.417040e-006
T4 : 4.126500e-009
T5 : 0.000000e+000
Slope : 0.99981000
Offset : -1.56740
AD590M : 1.293660e-002
AD590B : -9.522570e+000

4) Frequency 3, Temperature, 2

Serial number : 03P-4712
Calibrated on : 12 April 2012
G : 4.40429939e-003
H : 6.33712203e-004
I : 1.93910012e-005
J : 1.21754846e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

5) Frequency 4, Conductivity, 2

Serial number : 04C-3529
Calibrated on : 08 May 2012
G : -9.92100765e+000
H : 1.57088965e+000
I : -2.46163303e-003
J : 2.83958048e-004
CTcor : 3.2500e-006
CPcor : -9.57000000e-008
Slope : 1.00000000

Offset : 0.00000

6) A/D voltage 0, Oxygen, SBE 43

Serial number : 43-0862
Calibrated on : 30 May 2012
Equation : Sea-Bird
Soc : 4.47700e-001
Offset : -4.94400e-001
A : -1.81230e-003
B : 7.74760e-005
C : -1.66500e-006
E : 3.60000e-002
Tau20 : 1.02000e+000
D1 : 1.92634e-004
D2 : -4.64803e-002
H1 : -3.30000e-002
H2 : 5.00000e+003
H3 : 1.45000e+003

7) A/D voltage 1, Free

8) A/D voltage 2, Free

9) A/D voltage 3, User Polynomial

Serial number : 01
Calibrated on :
Sensor name : Eh
A0 : 1.00000000
A1 : 0.00000000
A2 : 0.00000000
A3 : 0.00000000

10) A/D voltage 4, Transmissometer, Chelsea/Seatech/WET Lab CStar

Serial number : 161048
Calibrated on : 24 July 2012
M : 23.5620
B : -0.1720
Path length : 0.250

11) A/D voltage 5, Fluorometer, Chelsea Aqua 3

Serial number : 088244
Calibrated on : 30 May 2012
VB : 0.018300
V1 : 1.974300
Vacetone : 0.113200
Scale factor : 1.000000

Slope : 1.000000
Offset : 0.000000

12) A/D voltage 6, Turbidity Meter, WET Labs, ECO-BB

Serial number : 182
Calibrated on : 17 August 2010
ScaleFactor : 0.003301
DarkVoltage : 0.087700

13) A/D voltage 7, Altimeter

Serial number : 41302
Calibrated on : 13 March 2006
Scale factor : 15.000
Offset : 0.000

Scan length : 37

Mechanical Report JC080

CTD Wire 2

At the start of JC080 100m was cut of reducing the cable to 7283m. This was done on the advice of the CTD technician due to the large amounts of module error coming from the CTD.
After several CTD deployments it was noticed that the outer wire of the cable had started to open down past the traction system and back to the storage drum, so it was decide to do a vertical stream of the cable with a clump weight and swivel to try and re-torque the cable. On inspection of the stream cable it was found to be back in it's correct condition. A further CTD was then done, during this cast a large number of module errors occurred on recovery the wire was inspected and the outer wire had open up as far as the storage drum. The CTD technician thought this was the cause of the module error so a further 86m was cut of reducing the cable to 7197m. After a re-termination was complete a CTD cast still showed module errors occurring. After further discussion it was decide to investigate the slip ring where a fault was found. A power cable was switched to a spare ring and a subsequent casts showed no errors. Again after 2 CTD cast the outer wire began opening up and the module error returned. The slip ring from CTD winch 2 was change with CTD winch 1. This did not remove the module errors and the wire continued to open, so it was decide with an opportunity of over 7000m of water to do a vertical stream of the new wire on CTD winch 1.
On electrical inspection of CTD cable 2 by the CTD technician it was found to be a good electrical condition with a mega test.

Wire 2 Operating Specifications

- New onboard 4/6/09
- Hours 1360
- Operating metres 597951

Picture of wire at the top of spurling pipe.

CTD Wire 1

On completion of 7000m vertical stream and on return to work site a YOYO CTD cast was done for 21.7 hours. The metres on the wire for the cast was 18,750m. On recovery of the CTD the wire was inspected and it was clear to see the outer layer of the wire had opened all the way back to the traction system. The cable was streamed using a clump weight and swivel to 200m past YOYO operating depth. This closed the outer wire back up.

Wire 1 Operating Specification

- New onboard 08/10/12
- Hours 30
- Operating metres 36,750

Scotsman Ice Maker

The ice maker was showing a warning light (wrong rotation/evap.temp). After reading the manual and inspection of the unit the problem was thought to be the Evaporator sensor. It was replaced with spare sensor (620404-10 Evap sensor). The unit was reset and continued to produce ice but within a day the problem reappeared. This time the condenser sensor was replaced with a spare (620404-11 Condenser sesor). The unit again failed after a day's operation. Once again the unit was reset but eventually tripped. A potential cause of problem could be low refrigerant gas (R134A) but without gas onboard to recharge the unit this will need to be done on return to NOC.

Super Crane

The slew lever on the proportional control valve stuck in both slew rotation directions. On visual inspection the valve block appeared in a bad condition and without spares did not think wise to try and force the cap head bolts to undo and inspect valve cap covers. The crane is in need of a full strip down and rebuild on return to NOC.

RN Container NMFU 200 207-8

The heater element kept tripping. Following investigations by me and the ETO it was found to be the control module. The control module needs to send a 415v pulse but instead it was giving 415v continuously. This made the heating element over heat and thermo trip. Instructions or spare controller could not be found.

CC Container NMFU 200 226-8

The AC cooling plastic pipe return line split on starting. This section was replaced with hose and jubilee clips. No spare pipe or fittings on-board. Plastic pipe from the sink drain also fell apart so required re-gluing. I would advise all new container pipe work to have an inspection for damage.

415v phase correction indicator did not work. In any phase orientation the phase indication box did not report an error. I.M.E need to look at this fault.