RRS Discovery

Cruise D321b

Reykjavik to Clyde
via Rockall, Scotland and the Wyville Thomson Ridge

24 August to 9 September 2007

T. Sherwin, A. Baker, T. Brand, J. Fromlett, R. Gibson, L. Gieschen, H. Harden-Davies, R. Holland, D. Hinz, M. Inall, A. Kirkham, K. McKendrick, M. Nielsdottir, S. Painter, M. Porter, A. Reynolds, S. Sauer, S. Thomalla, E. Venables, A. Veszelovski

A joint SAMS / NOCS cruise led by
the Scottish Association for Marine Science

Internal Report No 255

Dunstaffnage Marine Laboratory
Oban, Argyll, PA37 1QA, Scotland

Tel: [+44] (0)1631 559000
Fax: [+44] (0)1631 559001
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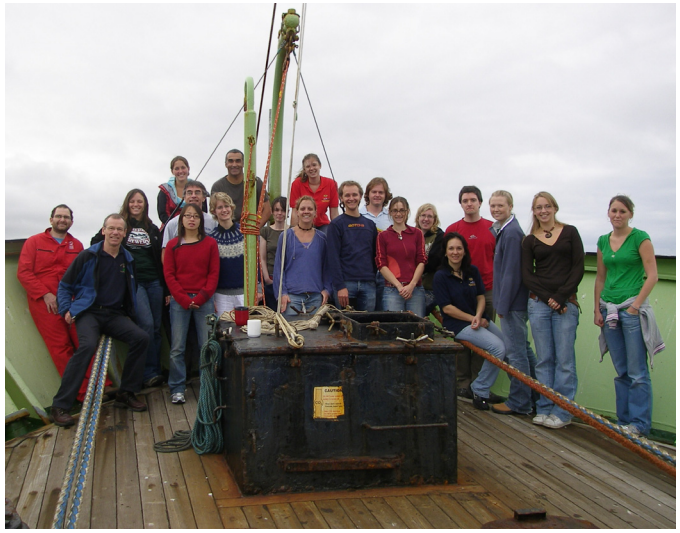
D321b Cruise Report

Scientists, technicians and crew at Fairlie



Scientists at Fairlie

Scientific crew

Toby Sherwin	SAMS	PSO / Physical oceanography
Andrea Baker	NOCS	Molecular markers for dinoflagellate func.
Tim Brand	SAMS	Nutrient chemistry
Joerg Fromlett	NOCS	Dissolved oxygen calibrations
Rachel Gibson§	NOCS	Lab support for dinoflagellate func.
Lena Gieschen§	U. Kiel	Lab support for 14C/15N
Daria Hinz*	NOCS	FRRF and iron addition incubations
Harriet Harden-Davies§	NOCS	Lab support for dinoflagellate func.
Ross Holland	NOCS	Flow cytometry - bacterioplankton
Mark Inall	SAMS	Physical oceanography
Amy Kirkham*	U. Warwick	Photosynthetic picoeukaryote ecology
Kimberly McKendrick	Aquapharm	Bacterial isolations
Maria Nielsdottir*	NOCS	Iron and macro nutrients
Stuart Painter	NOCS	Physical oceanography
Marie Porter§	UEA	Physical oceanography
Andy Reynolds§	SAMS	Undergraduate experience
Simone Sauer§	NOCS	HPLC samples and phytoplankton taxa samples
Sandy Thomalla	U. Cape Town	14C/15N primary production incubations
Emily Venables*	SAMS	Physical oceanography
Andrea Veszelovszki§	SAMS	Undergraduate experience

* PhD student

§ Undergraduate (or equivalent)

NMFSS technicians

Dougal Mountifield	Technical liaison officer
Paul Provost	Moorings technician
Jeff Benson	CTD technician
Emma Northrop	CTD technician
Martin Bridger	Computing support

Ship's crew:

Roger Chamberlain	Master
Richard Warner	Chief Officer
Malcolm Graves	2nd Officer
Kieron Hailes	3rd Officer
David Hartshorne	Purser Catering Officer
George Parkinson	Chief Engineer
Stephen Bell	2nd Engineer
Neil Dawes	3rd Engineer
Ian Collin	3rd Engineer
John McNally	ETO
Michael Drayton	CPO (Deck)
Stephen Smith	CPO (Scientific)
Iain Thomson	POD
Gerry Cooper	SG1A
William McGeown	SG1A
Eric Downie	SG1A
Lee Stephens	SG1A ERPO
John Haughton	Head Chef
Wilmot Isby	Chef
Graham Mingay	Steward

Summary

This report describes the events and activities that occurred during D321b, a joint SAMS / NOCS cruise on the NERC *RRS Discovery* that took place in the late summer of 2007. The principle objective of the cruise was to undertake the sampling of the Extended Ellett Line, an annual section of CTD and biogeochemical (nutrients, chlorophyll and particulate carbon-nitrogen) monitoring stations that runs from Iceland to Rockall and on to Ardnamurchan Point in Scotland. The Ellett line is funded by NERC under Oceans2025 (http://www.oceans2025.org/).

In addition to the primary objectives a number of complimentary scientific investigations were carried out, these included:

i) Undertaking a major investigation of the structure of turbulence in the internal wave field north of the Wyville Thomson Ridge

ii) Turning around an ADCP mooring on the Wyville Thomson Ridge

iii) Making trace metal and associated biogeochemical observations with a view to researching the limiting role of iron in biological production in the Iceland Basin

iv) Isolating water column marine bacteria and microbial diversity

v) Phytoplankton identification

vi) Phytoplankton photo-physiology and molecular ecology

vii) Phytoplankton new and regenerated production experiments

Four of the above activities involved collecting data for PhD studentships. In addition the scientific staff included 7 undergraduates. Thus, and as this report shows, the cruise itself was about more than just collecting monitoring data - it also provided a platform for student training, additional process studies and novel research.

In all 61 oceanic CTD stations were occupied and the ship travelled a total of about 3000 km between Reykjavík in Iceland and Fairlie on the Clyde. A relatively small amount of downtime was encountered - due to bad weather - and the cruise achieved all its major objectives.

Part of the Ellett line section had been undertaken by the preceding cruise D321a. The remaining stations - in the northern part of the Iceland Basin, across the Rockall Plateau and Rockall Trough - were all completed. However, a few stations on the Scottish Shelf were not conducted; two near Barra because of bad weather and two near Ardnamurchan Point because of time constraints. On the Wyville Thomson Ridge an ADCP that monitors the overflow across the ridge was successfully replaced, and the microstructure probe was deployed with great success, on one occasion reaching a depth of over 800 m. Nearly all of the CTD and underway sensors (including the ADCPs) performed satisfactorily and in particular the oxygen sensor on the stainless steel CTD performed very well. However, the temperature and conductivity cell on the stainless CTD frame were poorly sited, and there was a tendency for the temperature sensor to over read by up to 0.1 ºC in the thermocline. The titanium frame CTD was also noisy. None of these data conform to WOCE / CLIVAR standards although they should be suitable for less rigorous applications.

Water column nutrient analysis and chlorophyll measurements were performed throughout the cruise without major problems and the respective datasets were worked up on board and are displayed as concentration -depth transects in this report, (Sections 10 and 20 resp.). The chlorophyll results show good agreement with the remotely sensed 7-day composite MODIS image of sea surface chlorophyll concentration (Figure 1.3). Particulate carbon and nitrogen sample collection was also successful and analysis will be performed on shore.

A weblog of the cruise was kept and can be found at www.sams.ac.uk

D321b Cruise Report

Acknowledgements

This success of this cruise not only depended on the skills of the master, but also on the professionalism and good humour of the whole of the ship's crew. Most scientists only spend a very small part of their time at sea so it is particularly important to have an understanding crew. The skills of the bridge officers in holding the ship on position, of the engineers in maintaining the running of the ship's systems, of the catering staff in providing excellent food, and of the ABs in operating winches and handling sensitive scientific equipment is much appreciated.

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D321b Cruise Report

1 Introduction

1.1 *Chronology*

Date	Julian Day		Location	Activity
24-Aug-07	236	Friday	Reykjavik	Under way
25-Aug-07	237		Iceland shelf	Hove to
26-Aug-07	238		Iceland Basin	Ellett line
27-Aug-07	239		Iceland Basin	Ellett line
28-Aug-07	240		Hatton and Rockall banks	Ellett line
29-Aug-07	241		Rockall Trough	Ellett line
30-Aug-07	242		Rockall Trough / Scottish Shelf	Ellett line
31-Aug-07	243	Friday	Scottish Shelf	Ellett line
1-Sep-07	244		NE Atlantic	Under way
2-Sep-07	245		Wyville Thomson Ridge	ADCP mooring in Ellett Gully
3-Sep-07	246		Wyville Thomson Ridge	Microstructure profiling and thermistor chain mooring
4-Sep-07	247		Wyville Thomson Basin	Recovering thermistor chain mooring
5-Sep-07	248		Wyville Thomson Basin	CTD / microstructure profiling
6-Sep-07	249		Wyville Thomson Basin	Microstructure profiling and thermistor chain mooring
7-Sep-07	250	Friday	Wyville Thomson Ridge	CTD section / thermistor chain mooring
8-Sep-07	251		Scottish shelf	Under way
9-Sep-07	252		Fairlie, Clyde	Cruise demob

1.2 Cruise track

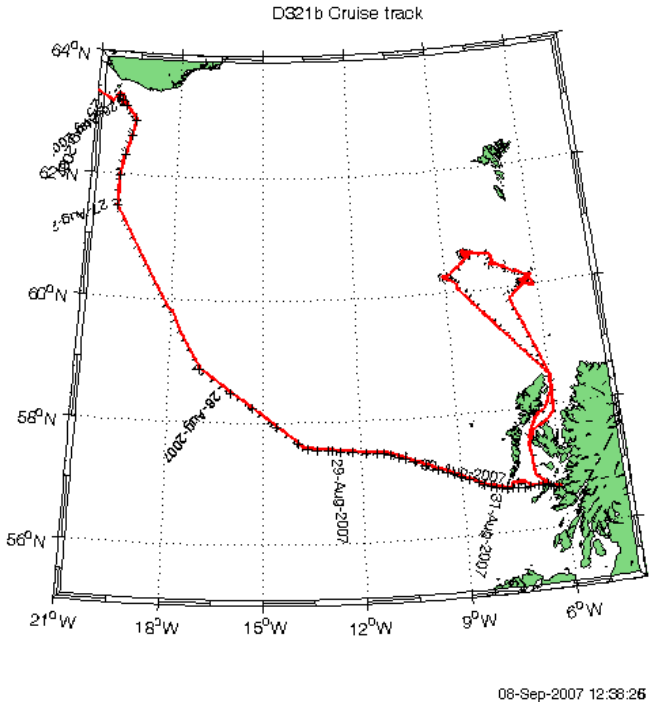


Figure 1.1. The cruise track from Iceland to Scotland

1.3 Sea surface temperature field

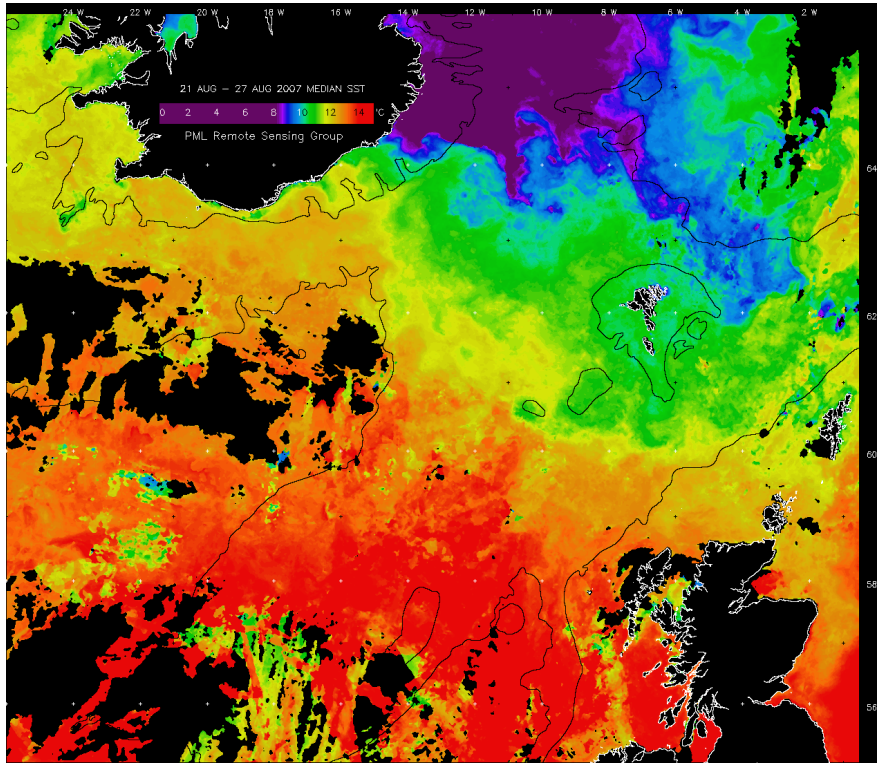


Figure 1.2. AVHRR image of the North West Atlantic showing a 7 day composite of sea surface temperature for the period 21 to 27 August 2007. Courtesy of Rory Hutson, PML Remote Sensing Group.

1.4 Sea surface chlorophyll concentrations

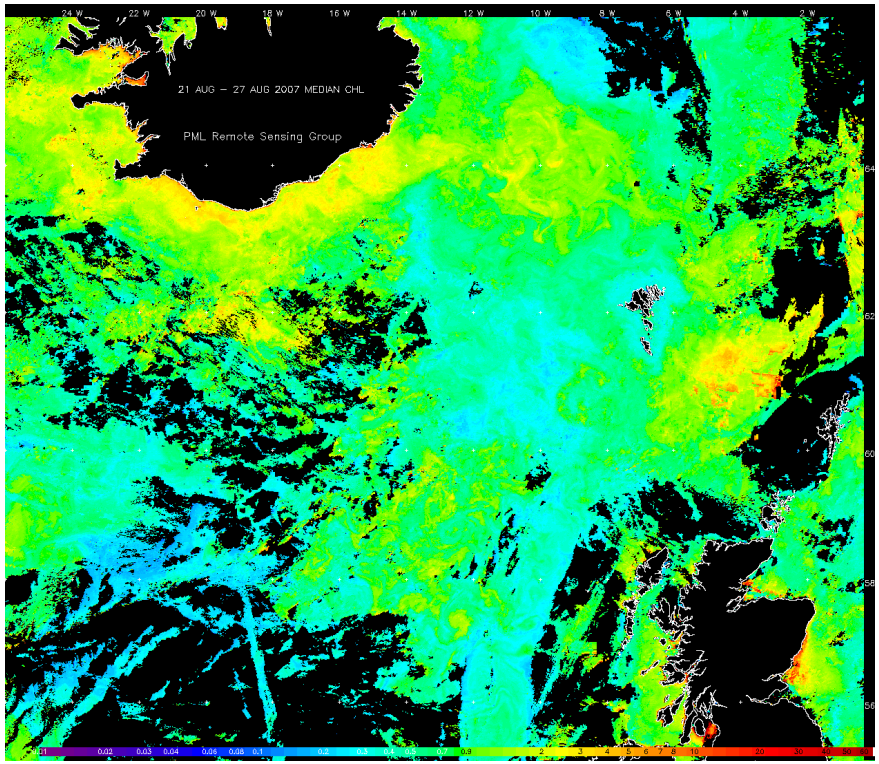


Figure 1.3. MODIS image of the North West Atlantic showing a 7 day composite of sea surface chlorophyll for the period 21 to 27 August 2007. Courtesy of Rory Hutson, PML Remote Sensing Group

1.5 Meteorological measurements

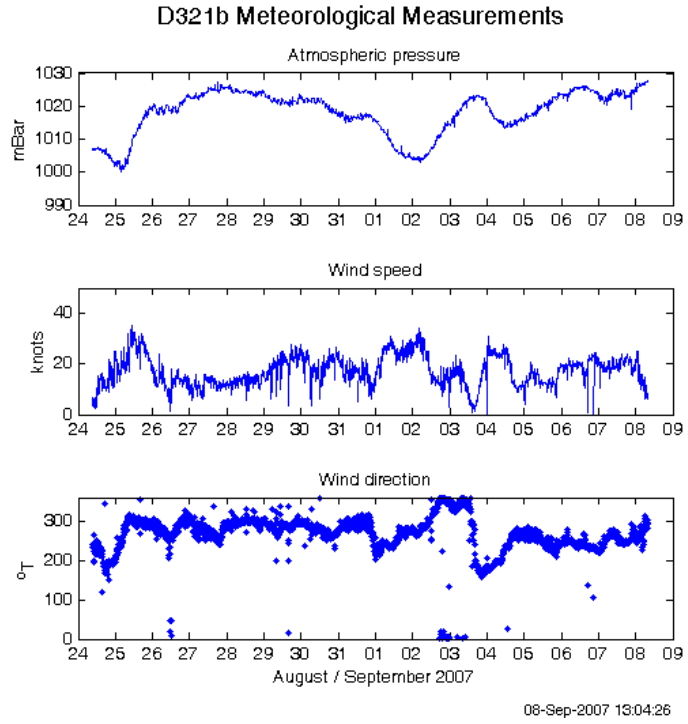


Figure 1.4 A summary of the meteorological measurements from the Surfmet logging system

1.6 Sea surface observations

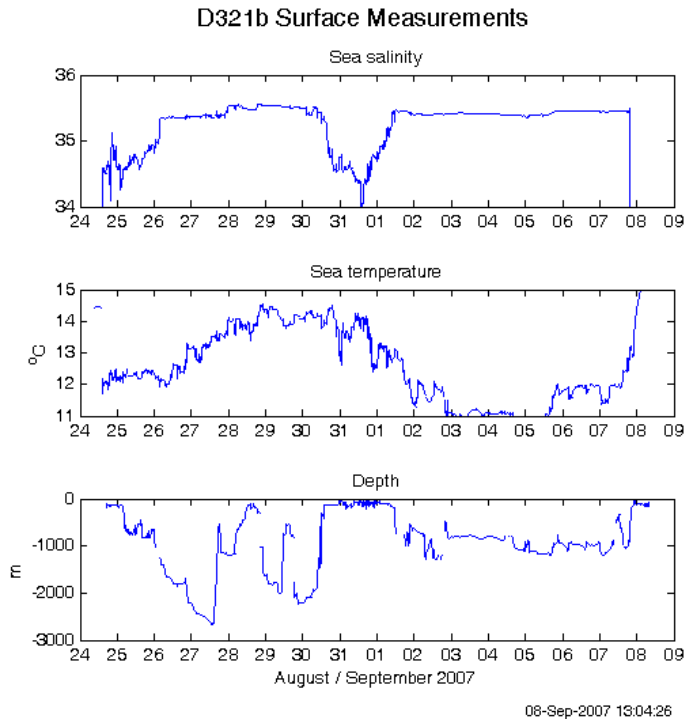


Figure 1.5. A summary of the oceanographic measurements from the Surfmet logging system. Gaps in the depth data are due to spike removal.

2 Narrative

Friday 24 August

Day 1. Iceland shelf; Sta IB23S

Left Reykjavik at 1200 local time heading for the first station (IB23S). There was a minor problem in the morning because a large number of spares which should have arrived from Heathrow airport failed to turn up having been sent via Norway. After a careful investigation of the shortfall it was decided that there were no serious show stoppers, and after sourcing some heat shrink tubing in town Discovery set sail rather than risk a 24 h delay.

Several meetings were held: 0830 Captain's cabin for final check before departure; 1000 Signing on and safety briefing; 1300 Scientists get together; 1400 Watchkeepers; 1530 Familiarisation for scientists and crew; 1615 Muster.

Main problems at this stage relate to organising CTD sampling such that there is the minimum of delay at CTD stations. Most of the original NMF staff were on board the previous cruise so the CTD side of things should go smoothly.

1643 iron fish over the side; launching of PES delayed because of nearby longline fishing. Proceeding under a forecast of strong northerly winds tonight followed by several days of settled weather. Expecting minor pandemonium at the first station.

Saturday 25 August

Day 2. Iceland Shelf; Sta. IB22S; Weather W Gale F8.

PES deployed at 0216. Gale force winds gusting to 33 knots all day held us up working from 0407, and it was not until 2215 that we restarted on IB22S. A couple of scientific staff suffered sea-sickness.

Every cruise throws up its own problems and on this occasion it is the large number of chemical / biological observations that need to be planned and meshed together to ensure an orderly and continuous collection of data. Some scientists are already showing signs of strain and to some extent we seem to be understaffed for the total amount of work that has been planned. There may need to be some rationalisation of the total effort.

Sunday 26 August

Day 3. Iceland Basin; Stas IB21S to IB16; Winds light and sea state slight.

At 0830 h there was a meeting of departmental heads, where the plan of cruise activities was discussed. (0830 h meetings were a regular feature of the cruise from then onwards). We continued working south along 20° W towards our cut-off point on this part of the line (IB16). CTD data had some large spikes due to possible wire damage, but this was cleared up by IB20S. Set up weblog and started underway system monitoring. IB20S was a dawn station, which required a very large amount of water to be collected for the various incubation and filtering activities, passed through without hiccup.

At 1600 h had a meeting of all scientists to decide future conduct of cruise in view of the fact that there is a dense line of stations coming up from the Hatton Bank. After a

full discussion it was agreed that the dawn CTD should set the programme for the biology and chemistry stations for that day, which would be determined by the leading chemists and biologists.

The captain kindly provided wine at the evening meal to welcome the scientists aboard.

Monday 27 August

Day 4. Iceland Basin; Stas IB16X and IB5; Wind light and sea state slight

The final station on the 20° W line (IB16) was completed by 0030 h using the titanium frame. There was some bad spiking of temperature and salinity in the upper 100 m and subsequently all sensor plugs etc were subsequently serviced. An Argo float that should have been deployed after IB16 was not launched because of a failure to switch on. *Discovery* then proceeded to the next planned Ellett line station for this cruise (IB5). En route a dawn CTD was conducted to 125 m at IB16X a little to the north of the usual line. The PSO gave a seminar on 'The Sub-Polar Gyre and the northern part of the Atlantic Meridional Overturning Circulation' in the library at 1630 h.

SAMS software for undertaking the preliminary CTD processing has been completed and batch files are in place. SAMS software for predicting section timing is (how_far.m) working reasonably accurately. The program uses the following algorithm to compute the total elapsed time between CTD stations, *T*:

$$T = X / u + H / w + C$$

where *X* is distance to the next station; *u* is ship speed; *H* is the depth of water at the next station; *w* is a representative descent speed for the CTD and; and *C* is the 'stand time' or overhead. With typically 12 bottle firings per cast, suitable values were *u* = 10 knots; *w* = 40 m per min; and *C* = 50 minutes. With fewer bottles these values tended to overestimate *T*.

Tuesday 28 August

Day 5. Rockall Plateau; Stas IB4 to E; Wind W and gradually increasing

We continued to work the Extended Ellett Line across the higher part of the Hatton Bank, picking up where cruise D321 had left off. We passed Rockall at 1430, although not sufficiently close to make good photographs, and onto the old Ellett line stations. No particular problems although the titanium frame CTD has periodic spiking on its temperature signal. This was fixed by replacing the temperature cable. During the day we discovered that the PI responsible for analysing the zooplankton net was leaving SAMS a month or so after the end of the cruise. Since this meant that almost certainly no-one would be available to analyse the net contents, it was decided to abandon zooplankton sampling in order to reduce the total work load.

Wednesday 29 August

Day 6. Rockall Trough; Stas F to M; Wind W and freshening to F6

Discovery continued along the Ellett line through the deep stations of the Rockall Trough and across the Anton Dohrn Seamount. Data processing of the CTD started to come together, with contour plots of the Iceland Basin data nearly ready and initial

post-processing software complete. Jörg Frommlet gave an interesting talk on 'Intraspecific diversity in the marine dinoflagellate species *Linglodinium polyedrum*'. A rendezvous with SAMS fast RIB at the northern entrance to the Sound of Mull to allow the transfer of some equipment was confirmed.

Thursday 30 August

Day 7. Rockall Trough to Scottish Shelf; Stas N to 13G; Wind W generally fresh

At the dawn CTD station N, the wind had freshened sufficiently to have to hove to for sampling. Thereafter conditions abated and CTD sampling continued between stations. At the end of the day (Sta. 14G, 110 m) it was realised that both CTD packages on the stainless frame, which are located within the rosette of 24 bottles, was suffering sever contamination due to surging within the frame. A full report of the problem is provided elsewhere in the report. Although the data should be good enough for work that requires a lower accuracy of measurement (such as relating biological observations to water mass types), it is unlikely that they will be suitable for climate and precise physical oceanographic studies. Following this discovery the frequency of salinity calibrations was greatly reduced. By 2300 h the wind and sea state had increased to such an extent that it was no longer possible to profile in the exposed waters to the west of Barra and the decision was made to abandon Stas 12G and 11G and move on to Sta 10Ga, which was positioned at the same longitude as the traditional Sta. 10G but about 5 nm to the north, where the ship was sheltered by Mingulay.

Some justification for this decision is required since it involved the loss of two stations and the relocation of 3 others. The problem that any PSO has on a section like this is choosing between the need to acquire synoptic observations (which are required for meaningful interpretation of the section), the desirability of repeating precise positions (which make it easier to compare year on year changes) and the competing requirements for ship time. On the Scottish shelf the stations are quite close together so the loss of two of them should not severely devalue the rest of the section, and by moving the three stations only a small distance to the north of the line should not encumber future plotting or interpretation. By doing this it was possible to complete the line and make the rendezvous with the RIB the next day without causing a major disruption to the overall schedule.

Friday August 31st

Day 7. Approaching the Scottish coast; Stas 10Ga to Sta. 1G; wind W and moderating

Subsequent stations were conducted along the new latitude to Sta. 8Ga, thereafter returning to the Ellett line proper as far as Sta. 4G. After the rendezvous with the RIB in Mingary Bay at 1500 h Sta. 1G was completed as the last Ellett line station. Whilst the CTD was in the water tests the microstructure probe was lowered over the side to test for, and adjust, its buoyancy. Following this, *Discovery* set off for the Wyville Thomson Ridge through the Minch for the physical experiments. Checks on the underway system were stopped and the watches temporarily stood down. Work continued on preparing the ADCP mooring for deployment in the Ellett Gully, on making up the thermistor chain mooring to accompany the microstructure probe observations, and with setting up and testing the microstructure probe itself.

Saturday September 1st

Day 8. The Minch to Wyville Thomson Ridge; wind SW backing NW increasing to F8

Steaming from the Scottish end of the Ellett line towards the Ellett Gully to undertake mooring work. On rounding the Butt of Lewis, the wind and sea state conditions forced a reduction in ship speed to ~7 knots, which meant that it would be impossible to recover the existing mooring before dark. The plan changed to deploy the new ADCP first, if conditions allowed, at midnight and watch keeping was set to start then. However, rather than moderating, the wind increased and *Discovery* had to heave to near the Ellett Gully for the night. In the evening Maria Nielsdottir gave a talk entitled 'A cruise to the South Atlantic: JR161' which had some stunning photographs of Antarctic wildlife.

Sunday September 2nd

Day 9. Wyville Thomson Ridge; ADCP moorings; wind F8 but moderating

The morning saw *Discovery* still hove to waiting for the weather to moderate sufficiently to allow the ADCP moorings work to start. Throughout the day there were occasions when the sky cleared and the sea turned blue, so there may have been opportunities for some AVHRR images. By mid afternoon it was possible to deploy a CTD with a release attached for a wire test prior to the mooring deployment. At 1720 h an ADCP mooring was deployed at 60° 14.71' N, 9° 00.76' W in about 1280 m of water on the northern side of the Ellett Gully, further deeper and west of the existing ADCP site. Following this we moved about 3 miles eastward and at 1915 h successfully recovered the ADCP at 60° 15' N 8° 55' W. As I write the instrument is still pinging in its floatation buoy awaiting a suitable opportunity for us to download its data. *Discovery* then moved on to the first 25 h microstructure profiling position at the western end of the Wyville Thomson Ridge (M800W).

Monday September 3rd

Day 10. Wyville Thomson Basin; Microstructure profiling; weather good, but wind increasing

During the night *Discovery* deployed a lightweight thermistor chain mooring with a Dahn buoy surface marker in 800 m on the northern side of the ridge (Sta. M800W), conducted a CTD nearby and then began the long process of profiling the upper 650 m of the water column with the SAMS microstructure profiler. After some initial problems with the winch (during which the CTD was yo-yoed for a couple of dips) the profiling sequence started at about 0545 h(?) with four people on each watch (two on the winch and two on the computer) taking turn and turn about throughout the day. At 0900 the ship was drifting W at about 1 knot in a surface tide which caused the bridge to have to deviate from the planned track. A trawler was sighted to the west working the 500 m contour of the Faroe Bank. Initially the day was very pleasant (with a blue sky, good for satellite imagery), but towards late afternoon cloud started to cover and the wind increased as the profiler worked into the night.

Tuesday September 4th

Day 11. Wyville Thomson Basin; Microstructure and CTD profiling; wind fresh (SW), with poor visibility

The microstructure profiler was finally brought in at about 0720 h having completed the first ever 25 h stretch of deep microstructure profiling in the open ocean to depths of over 650 m. Visibility was poor and as there was no sign of the marker buoy from the mooring a titanium CTD dip was made about 5 miles from the mooring whilst waiting for an improvement in the weather. Thereafter we returned to the mooring to look for the marker, but when it was not seen we waited until 1330 h when visibility had improved sufficiently to fire the release. Following protracted recovery leading to the eventual grappling of the mooring it was brought aboard at about 1430 h. *Discovery* then moved into the deeper water of the Wyville Thomson basin to start a line of alternate CTD and Basil (microstructure) profiling starting at Sta. WT1 (a CTD cast) and proceeding eastward along the channel.

Wednesday September 5th

Day 12. Wyville Thomson Basin; microstructure and CTD; wind moderate to light but with westerly swell

Continued along the WTB stations. The total depth to which the profiler could deploy varied considerably over this period, and at times there was a considerable shear in the deep water. Large tidal currents were also detected with the ship borne ADCPs. Bottles were fired 'on the fly' at the CTD stations to allow sampling of nutrients, bacteria and other parameters, but there was no surface sampling at this time as they would have taken too long. CTD calibrations should have only taken place at the bottom of the water column but on Friday morning it was discovered that no salinity samples were taken at this or any other time following Sta. 1G. At the final CTD station (WT6) the swell had increased (possibly because of an interaction between swell and tide) to an extent that *Discovery* would not lie in a way that made it possible to deploy the CTD. At Sta. WT6 a heavy swell combined with an unfavourable wind direction made CTD work impossible, and instead an additional microstructure profiling stations was substituted.

The swell continued to prevent CTD work for the rest of the day, and also made it impossible to sail a direct course to the second mooring site (M800E) when the microstructure profiling was complete. On eventual arrival at M880E the only XBT cast of the cruise was conducted using a Sippican T-7 to a depth of 756 m. It showed the deep pycnocline located between 500 and 600 m. The thermistor mooring at M800E was successfully deployed by 2050 h and a 25 h microstructure profiling session started at 2135.

Thursday September 6th

Day 13. Wyville Thomson Basin; microstructure profiling

Basil performed splendidly throughout the day, with the 8 – 12 watch achieving a record profiling depth of 819 m thanks to a careful combination of slow cable deployment and slow forward motion by the ship. Unfortunately the 8 – 12 watch rather blotted their copybook later on when they failed to record the final cast of the

day, which consequently had to be repeated much to the dismay of the winch drivers who were standing out on the starboard quarter in unpleasant conditions.

Friday September 7th

Day 14. Wyville Thomson Ridge; CTDs and thermistor mooring; wind moderate

The final activity of the cruise was a CTD section from southern end of the Faroe-Shetland Channel across the WTR and into the Rockall Trough (the Poseidon section). At Sta. M800E on the northern side of the ridge the section was broken to recover the thermistor chain mooring, which unlike M800W came up without a hitch. With the addition of a few more CTD stations the main working activities of the cruise ended at Sta. PA2 in the Rockall Trough and the packing phase of the cruise began. Underway sampling ended at 2200 and the ADCPs, met station and navigation were switched off at about 1200 h on 8 Sept.

2.1 Watchkeepers

Along the Ellett line:

12 – 4 NMF technician, Stuart Painter, Andrea Vezselovzski, Kim McKendrick

4 – 8 NMF technician, Mark Inall, Emily Venables

8 – 12 NMF technician, Toby Sherwin, Andy Reynolds, Marie Porter

Microstructure profiling and Wyville Thomson Ridge:

12 – 4 Emma Northrop (NMFSS), Mark Inall, Jorg Fromlett, Andy Reynolds

4 – 8 Dougal Mountifield (NMFSS), Emily Venables, Lena Geischen, Andrea Vezselovzski

8 – 12 Jeff Benson (NMFSS), Stuart Painter, Kim McKendrick, Marie Porter

The watch leader is underlined. During microstructure profiling the first two names operated the winch, and the second two names operated the logging computer.

3 Navigation, Ship's Attitude and Position

Stuart Painter (NOCS, also PI)

Meaningful water velocities from the vessel-mounted acoustic Doppler current profiler can only be obtained when the ADCP data are corrected for the ship's direction, speed and attitude; in effect removing the ship's motion from the ADCP's initial estimate of water column movement. Several processing steps are performed which combine the required navigational information prior to ADCP data processing. Position, gyro-heading and ship's attitude information were transferred from the NMF Tech-SAS and Level C data streams to Pstar files daily and processed as described below.

3.1 Ship's position and navigation data

The ship's best determined position was calculated by the NMF process 'bestnav'. The main data source was the ships GPS Trimble 4000 system, which provides the most accurate position, determined on previous cruises to be ~1.0 m. Data were transferred daily from the NMF Tech-SAS 'bestnav' file to the Pstar absolute navigation file 'abnv3211' for use in Pstar processing. GPS_4000 data ('gps_4000' datastream) were also transferred and processed daily.

The ship's gyro instrument is the most reliable direction indicator on the ship and provides essential information for correcting the ADCP velocities to earth co-ordinates. The gyro data stream 'gyronmea' is processed as described below and a correction subsequently applied to individual ADCP profiles which is more accurate than correcting averaged ensembles. However, the gyro suffers from drift when the ship manoeuvres and therefore needs correcting with the ships attitude. Gyro data were transferred daily using the script gyroexec0.

The Pstar execs used for processing navigation datastreams were:

navexec0: transferred the NMF Tech-SAS 'bestnav' data stream to Pstar format. Ship's velocities were calculated from position and distance run calculated after appending to the master abnv3211 file.

gps4exec0: transferred the NMF Tech-SAS 'gps_4000' data stream to Pstar format. Data with pdop (position dilution of position) outside the range 0-7 were removed. Further edits were made to remove outliers and gaps interpolated before the file was appended to the master file gp432101 and distance run calculated. A 30 second average file gp432101.30sec was also created.

gyroexec0: transferred data from the NMF level C 'gyronmea' stream to Pstar format. Headings outside the range 0-360° were deleted and the file appended to the master gyr32101 file.

3.2 Ship's heading and attitude

The ship's attitude was measured every second by the 3D GPS Ashtech navigation system. Four antenna, two on the boat deck, two on the bridge top, measured the phase difference between incoming satellite signals from which the ship's heading, pitch and roll were determined. Ashtech data were read from the NMF Tech-SAS stream 'gps_ash' into Pstar and used to calibrate the gyro heading information as follows.

ashexec0: transferred data from the NMF Tech-SAS 'gps_ash' data stream to Pstar binary file ash321nn, where nn is a daily processing stamp.

ashexec1: merged ashtech and gyro heading data and calculated the ashtech – gyro heading difference (a-ghdg). All values were set between -180 – 180°

ashexec2: edited the data outside the following ranges

heading 0 - 360
pitch -5 - 5
roll -7 - 7
attitude flag -0.5 - 0.5
measurement RMS error 0.00001 - 0.01
baseline RMS error 0.00001, 0.1
ashtech – gyro heading -7, 7

Heading differences greater than 1.0° from a 5 point running median were removed. Data were then averaged to 2 minute intervals and further edited to remove data cycles where

pitch -2. - 2.
mrms, 0 - 0.004
a-ghdg, -10 - 10

Results were merged with the gyro file and ships velocities calculated. Thereafter all daily files were appended to the mast Ashtech file ash321b.int.

During the cruise a number of short gaps occurred in the Ashtech datastream. Those greater than 60 seconds are listed below.

time gap : 07 237 23:30:35 to 07 238 08:28:10 (9 hrs)
time gap : 07 238 21:01:24 to 07 238 21:02:31 (67 sec)
time gap : 07 240 21:58:51 to 07 240 22:00:02 (71 sec)
time gap : 07 240 22:13:34 to 07 240 22:14:37 (63 sec)
time gap : 07 240 22:28:12 to 07 240 22:29:20 (68 sec)
time gap : 07 242 06:11:59 to 07 242 06:13:03 (64 sec)

3.3 150 kHz vessel mounted ADCP

Summary

As highlighted during Cruise D321a operational problems with the 150 kHz VM-ADCP have been encountered. A technical investigation revealed that one of the four transducer heads was no longer functioning resulting in considerable data drop out during use, not only on the dead head but also on the remaining three transducers. In an effort to rectify this problem a spare transducer head from the decommissioned RRS Charles Darwin was recently fitted to RRS Discovery by diver whilst the Discovery was in port on the Clyde. This appeared to correct the problem of the dead transducer head as the VM-ADCP began to operate normally again when powered up. However, the replacement of the ADCP appears to have altered the misalignment angle of the ADCP relative to the ship. During cruise D306 the misalignment angle was reported as ~45^{o}, during cruise D321a a misalignment angle of 14.4^{o} was obtained. As noted during cruise D321a operation of the 150 kHz ADCP was only maintained by using a 3 beam solution with the instrument set for bottom tracking. Rather than risk another failure of the instrument the working config file from Cruise D321a was reused during Cruise D321b.

3.3.1 Performance

The 150 kHz vessel mounted acoustic Doppler profiler (VM-ADCP) was operated and logged throughout the cruise albeit with some concern over the quality of the data given the operational problems noted above. The transducer unit is installed in the hull 1.75 m to port of the keel, 33 m aft of the bow at the waterline and at an approximate depth of 5 m. Data were logged using IBM Data Acquisition Software (DAS) version 2.48 with profiler software 17.10. The instrument was configured to sample over 120 second intervals with 96 bins of 4 m depth, using pulse length 4 m and blank beyond transmit of 4 m. Two configuration files were set up, one for water tracking only, the other for bottom tracking in shallow water.

Raw data were recorded on an AP PC and like all PC's the clock lost time steadily throughout the cruise at approximately 50 seconds per day (a very poor internal clock indeed). This was corrected during the data processing.

Spot gyro heading data are fed into the 150 kHz ADCP transducer deck unit where they are incorporated into the individual ping profiles to correct the velocities to earth co-ordinates before being reduced to 2 minute ensembles. The averaged ADCP data are logged continually by the NMF level C computer. From there data were transferred usually once a day to the Pstar processing system. Standard processing was used, thus; the clock error was corrected, the gyro heading was corrected using the Ashtech heading information, the velocities were calibrated for instrument misalignment angle and scaling and finally corrected for ships velocity and converted to absolute velocities using the ships position from the absolute navigation files. The following scripts were used:

adpexec0: transferred data from the NMF level C "adcp" data stream to Pstar. The data were split into two files; "gridded" depth dependant data were placed into "adp" files while "non-gridded" depth independent data were placed into "bot" files. Velocities were scaled to cm/s and amplitude by 0.42 to db. Nominal edits were made on all the velocity data to remove both bad data and to change the DAS defined absent data value to the Pstar value. The depth of each bin was determined from the user supplied information.

adpexec1: created a file of time corrections that was merged, linearly interpolated and added to time in (both) the adcp files. This corrected the clock drift problems caused by the pc logging of the ADCP data.

adpexec2: merged the adcp data (both files) with the ashtech a-ghdg created by ashexec2. The adcp velocities were converted to speed and direction so that the heading correction could be applied and then returned to east and north. Note the renaming and ordering of variables.

adpexec3: applied the misalignment angle, ø, and scaling factor, A, to both adcp files. The adcp data were edited to delete all velocities where the percent good variable was 25% or less. Again, variables were renamed and re-ordered to preserve the original raw data.

adpexec4: merged the adcp data (both files) with the absolute navigation file created by navexec0. Ship's velocity was calculated from the 2 minute positions and applied to the adcp velocities. The end product was the absolute velocity of the water.

3.3.2 Calibration for misalignment angle and scaling factor

The run out from Glasgow during Cruise D321a to the shelf edge provided ideal conditions for calibration of the instrument using bottom track data. The values of ϕ (misalignment angle) = 14.4^o and A (scaling factor) = 0.9683 were derived. The result of this is surprising as the misalignment angle is considerably different to previous cruises and may relate to the diver replacement operation of the dead transducer head. Due to ongoing concerns over the operability of this instrument the misalignment angle was not rechecked during our departure from Iceland at the start of Cruise D321b and left as determined during D321a.

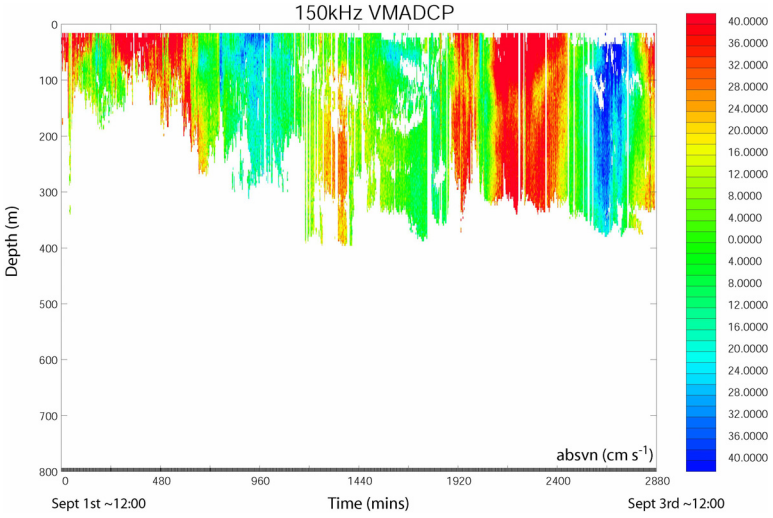


Figure 3.1: Example of the 150 kHz VMADCP data from the Wyville Thomson Ridge. Red signifies a northward current, blue a southward current. The velocity scale has been restricted to 40 cm s^{-1} to present maximum detail within the data. The period Sept 1st to Sept 2nd represents underway passage to the ridge whereas the period Sept 2nd to Sept 3rd represents occupation of the ridge and clearly shows strong tidal signals within the data.

3.4 75 kHz "Ocean Surveyor" ADCP

The vessel mounted RDI Ocean Surveyor 75 kHz ADCP was configured to sample over 60 bins of 16m depth at 120 second intervals for the majority of the cruise but reconfigured to sample over 100 bins of 8m thickness when we arrived at the Wyville Thomson Ridge. The PC was running RDI software VmDAS v1.43.19. Gyro heading and GPS Ashtech, location and time are automatically fed into the software. The software logs the PC clock time, stamps the data (start of each ensemble) with that time, and records the offset of the PC time from GPS time. This offset is automatically applied to the ADCP data in the processing path before merging with the navigation data. Throughout the cruise the instrument was operated in water tracking mode with the calibration of the instrument left as determined during Cruise D321a.

Calibration of the instrument during bottom track mode was established during the run out from Glasgow during D321a over the continental shelf. Values of ϕ (misalignment angle) = -59.4636 and A (scaling factor) = 1.0019 were obtained. The magnitude of the misalignment angle reported here differs from previous cruises and results from the offset angle being set to 0^o in the software (previous cruises sometimes set the offset angle to 60^o in the software and thus obtain a far smaller value for ϕ). This is corrected for during the data processing.

Data were written to the PC hard disk with a .STA extension. Sequentially numbered files were created whenever data logging was stopped and restarted and although the software was set to close files when they reached 100 Mb in size. Data logging was stopped once every 24hrs to allow transfer of the data to the Unix directory /data32/d321b/os75. Previously this has been by ftp transfer but this has now been simplified via the inclusion of a direct network link from the ADCP PC to the Unix directory. Once transferred processing of the data could be performed as outlined below.

surexec0: data read into pstar format from RDI binary file. Water track velocities written into 'sur…' files, bottom track velocities into 'bot…' files. Velocities scaled to cm s^{-1} and amplitude by 0.45 to dB. The time variable was corrected to GPS time by combining the PC clock time and the PC-GPS offset. The depth of each bin was determined from the user supplied information. Output files sur321##.raw and bot321##.raw.

surexec1: data edited according to status flags. Velocity replaced with absent data if variable 2+bmbad was greater than 25% (this being a measure of the number of times more than 1 beam was bad).

surexec2: Merges the adcp data with the ashtech a-ghdg created by ashexec2. The adcp velocities are converted to speed and direction so that the heading correction could be applied and then returned to east and north components. Output files sur321##.true and sbt321##.true.

surexec3: Applies the misalignment angle (ϕ) and scaling factor (A) to both files (if both are present). Variables are renamed and reordered to preserve original data files. Output files sur321##.cal and sbt321##.cal.

surexec4: merges the adcp data with the GPS4000 navigation file (gp432101) created by gps4exec0. Ship's velocity was calculated from spot positions taken from the gps432101 file and applied to the adcp velocities. The end product is the absolute velocity of the water. The time base of the adcp profiles was then shifted to the centre of the 2 minute ensemble by subtracting 60 seconds and new positions were taken from gp432101. Output files sur321##.abs and sbt321##.abs.

Two master data files (sur321b.mast and sur321c.mast) were created by appending the daily files after processing. The first master file (sur321b.mast) contains data from the initial configuration (60 bins of 16m thickness) whilst the second master file (sur321c.mast) contains the data from the reconfigured ADCP (100 bins of 8m thickness).

4 CTD report

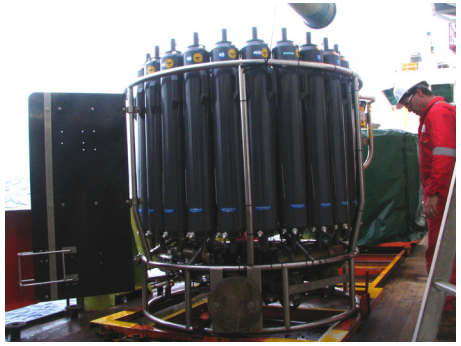


Figure 4.1 The stainless steel CTD frame with its rosette of 24 20 litre Niskin bottles.

4.1 Introduction

4.1.1 Objectives

CTD casts were undertaken with the objective of

1. Defining water mass characteristics between the sea surface and the sea bed from their temperature, salinity and dissolved oxygen characteristics
2. Estimating the heat content and mean salinity of the 'surface' waters along the Ellett line at Stas IB23 to IB16 and from IB5 to 1G. (It had been agreed with NOCS that Stas IB6 to IB15 would be occupied during cruise D321a).
3. Determining the full depth buoyancy frequency near the Wyville Thomson Ridge
4. Defining the depth of the near surface chlorophyll maximum from fluorescence measurements for subsequent biological sampling from water bottles
5. Measuring beam transmission (no specific objective at this stage)

4.1.2 Methodology

Two CTD systems were used during the cruise, one housed in a standard stainless steel (SS) frame (Fig. 4.1), and the other housed in a titanium (Ti) frame. The CTD in the SS frame was equipped with dual T and C sensors, the one in the Ti frame had only single T and C sensors. The CTD was operated by trained NMFSS technicians throughout the cruise who oversaw all aspects of CTD operations from preparing the bottles to monitoring its performance during a cast to maintaining it on deck. Regular watch keepers from the scientific staff collected samples for salinity and helped with other water sampling as required.

4.2 Data processing

Mark Inall, SAMS

CTD data were processed following standard paths as used on many previous hydrographic cruises. After each CTD cast was completed the data were saved to the deck unit PC and transferred over the network to a Unix data disk. The Seabird logging software writes four files per CTD: "CTD station number" with the following extensions: .dat (raw data file), .con (data configuration file), .BL (contained record of bottle firing locations), and .HDR (a header file).

All raw data files will be banked with BODC.

SBE Seasave Win32 V 5.35 software was used to perform all processing steps. Processed data were loaded into Matlab for plotting. Three separate processing paths where followed. A description of the function of each Seasave routine used precedes the lists of the three processing paths.

Processed data will not be banked with BODC, but are available from the data originator upon request.

4.2.1 SeaBird Seasave CTD processing routine Descriptions:

DatCnv: converted raw CTD data in the .dat file from engineering units using the calibration information provided in the configuration file (.con). Files output consisted of binary .cnv files containing the 24hz down and up casts and .ros files containing values at the time each Niskin bottle was fired.

AlignCTD: used to shift the dissolved oxygen sensor output relative to the pressure data by 5 seconds to compensate for lags in the sensor response time. The routine overwrites the oxygen variable in the .cnv file.

WildEdit: de-spikes data by calculating the standard deviation of a set number of scans. Two passes through the data were made, both taking the mean of 500 scans. Values outside two standard deviations from the mean on the first pass and ten standard deviations from the mean on the second pass were flagged as bad. Output was written to the .cnv file.

CellTM: removes the effect of thermal 'inertia' on the conductivity cells using the algorithm:

a = 2 * alpha / (sample interval * beta + 2)

b = 1 - (2 * a / alpha)

dc/dt = 0.1 * (1 + 0.006 * [temperature - 20])

dt = temperature - previous temperature

ctm [S/m] = -1.0 * b * previous ctm + a * (dc/dt) * dt

sample interval is measured in seconds and temperature in °C, and ctm is calculated in S/m.

where, alpha, the thermal anomaly amplitude was set at 0.03 and beta, the thermal anomaly time constant, was set at 1/7 (the SeaBird recommended values for SBE911+ pumped system). The sample interval is 1/24 second, dt is the temperature (t)

difference taken at a lag of 7 sample intervals. ctm is the corrected conductivity at the current data cycle.

corrected conductivity = c + ctm

FilterFilter runs a low-pass filter on one or more columns of data. A low-pass filter smoothes high frequency (rapidly changing) data. To produce zero phase (no time shift), the filter is first run forward through the data and then run backward through the data. This removes any delays caused by the filter. The pressure channel was filtered with a time constant of 0.15 seconds prior to running loopedit as recommended by Seabird.

Loopedit Loop Edit marks scans bad by setting the flag value associated with the scan to badflag in input .cnv files that have pressure slowdowns or reversals (typically caused by ship heave). Loop Edit was also used to mark scans assocated with an initial surface soak with badflag. The badflag value is documented in the input .cnv header.

Bottlesum Bottle Summary reads a .ros file created by Data Conversion and writes a bottle data summary to a .btl file. The output .btl file includes:

Bottle position, and date/time

Derived variables depth, salinity and dissolved oxygen - computed for each bottle from mean values of input variables (temperature, pressure, conductivity, etc.)

AsciiOut: converts the binary .cnv files into ASCII format .cnv files for reading into other packages, for example Matlab.

4.2.2 Seabird CTD processing scripts

Raw and processed CTD data are found in the <final_copy_all_processing> directory of the DVD marked 'CTD_disc'. All raw data files are in the <raw_data> directory. Matlab scripts to plot the ascii data are in the <mfiles> directory - use 'D321b_CTD_first_plots.m'. On board processing did not include salinity calibrations. Note also that there appears to be severe contamination of the CTD data by ship rolling, which may render the data unsatisfactory for climate and other high precision studies.

Processing Path 1: 1m binned downcast and rosette summary file processing.

The primary processed data. The 'processed_data_down' directory contains 1 m binned data for the down casts as *.asc, *.cnv and *.hdr files. In the <psa_files> directory the file 'down.txt' used these Seabird commands to create the *.asc and *.cnv files from *.dat and *.con files. For most purposes these files will be the starting point for any further processing. The routine calls were:

datcnv /iC:\D321B\ctd\raw_data\%1.dat /cC:\D321B\ctd\raw_data\%1.con /pC:\D321B\ctd\psa_files\DatCnv.psa /oC:\D321B\ctd\processed_data

wildedit /iC:\D321B\ctd\processed_data\%1.cnv /pC:\D321B\ctd\psa_files\WildEdit.psa /oC:\D321B\ctd\processed_data

wildedit /iC:\D321B\ctd\processed_data\%1.cnv /pC:\D321B\ctd\psa_files\WildEdit.psa /oC:\D321B\ctd\processed_data

alignctd /iC:\D321B\ctd\processed_data\%1.cnv /pC:\D321B\ctd\psa_files\AlignCTD.psa /oC:\D321B\ctd\processed_data

celltm /iC:\D321B\ctd\processed_data\%1.cnv /pC:\D321B\ctd\psa_files\CellTM.psa /oC:\D321B\ctd\processed_data

filter /iC:\D321B\ctd\processed_data\%1.cnv /pC:\D321B\ctd\psa_files\Filter.psa /oC:\D321B\ctd\processed_data

loopedit /iC:\D321B\ctd\processed_data\%1.cnv /pC:\D321B\ctd\psa_files\LoopEdit.psa /oC:\D321B\ctd\processed_data

bottlesum /iC:\D321B\ctd\processed_data\%1.ros /pC:\D321B\ctd\psa_files\BottleSum.psa /cC:\D321B\ctd\raw_data\%1.con /oC:\D321B\ctd\processed_data

derive /iC:\D321B\ctd\processed_data\%1.cnv /cC:\D321B\ctd\raw_data\%1.con /pC:\D321B\ctd\psa_files\Derive.psa /oC:\D321B\ctd\processed_data

binavg /iC:\D321B\ctd\processed_data\%1.cnv /pC:\D321B\ctd\psa_files\BinAvg.psa /oC:\D321B\ctd\processed_data_down

asciiout /iC:\D321B\ctd\processed_data_down\%1.cnv /pC:\D321B\ctd\psa_files\ASCII_Out2.psa /oC:\D321B\ctd\processed_data_down

Processing Path 2: 1m binned down and up cast processing for LADCP processing.

The 'processed_up_and_down' directory contains 1 m binned data for both the up and down casts as *.asc, *.cnv and *.hdr files. In the <psa_files> directory the file 'down-up.txt' used these Seabird commands to create the *.asc and *.cnv files from *.dat and *.con files. These files were created for LADCP processing. The routine calls were:

datcnv /iC:\D321B\ctd\CTD_4_LADCP\raw_data\%1.dat /cC:\D321B\ctd\CTD_4_LADCP\raw_data\%1.con /pC:\D321B\ctd\CTD_4_LADCP\psa_files\DatCnv.psa /oC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down

wildedit /iC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down\%1.cnv /pC:\D321B\ctd\CTD_4_LADCP\psa_files\WildEdit.psa /oC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down

wildedit /iC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down\%1.cnv /pC:\D321B\ctd\CTD_4_LADCP\psa_files\WildEdit.psa /oC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down

alignctd /iC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down\%1.cnv /pC:\D321B\ctd\CTD_4_LADCP\psa_files\AlignCTD.psa /oC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down

celltm /iC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down\%1.cnv /pC:\D321B\ctd\CTD_4_LADCP\psa_files\CellTM.psa /oC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down

filter /iC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down\%1.cnv /pC:\D321B\ctd\CTD_4_LADCP\psa_files\Filter.psa /oC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down

loopedit /iC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down\%1.cnv /pC:\D321B\ctd\CTD_4_LADCP\psa_files\LoopEdit.psa /oC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down

derive /iC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down\%1.cnv /cC:\D321B\ctd\CTD_4_LADCP\raw_data\%1.con /pC:\D321B\ctd\CTD_4_LADCP\psa_files\Derive.psa /oC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down

binavg /iC:\D321B\ctd\CTD_4_LADCP\processed_up_and_down\%1.cnv /pC:\D321B\ctd\CTD_4_LADCP\psa_files\BinAvg_up_down.psa /oC:\D321B\ctd\processed_up_and_down

asciiout /iC:\D321B\ctd\processed_up_and_down\%1.cnv /pC:\D321B\ctd\CTD_4_LADCP\psa_files\ASCII_Out3.psa /oC:\D321B\ctd\processed_up_and_down

Processing Path 3: Raw 24Hz data for QC plotting only.

The 'processed_data' directory contains 24 Hz data for both the up and down casts as *.asc, *.cnv and *.hdr files. In the <psa_files> directory the file '24.txt' used these Seabird commands to create the *.asc and *.cnv files from *.dat and *.con files. The routine calls were:

datcnv /iC:\D321B\ctd\raw_data\%1.dat /cC:\D321B\ctd\raw_data\%1.con /pC:\D321B\ctd\psa_files\DatCnv.psa /oC:\D321B\ctd\processed_data.

wildedit /iC:\D321B\ctd\processed_data\%1.cnv /pC:\D321B\ctd\psa_files\WildEdit.psa /oC:\D321B\ctd\processed_data

wildedit /iC:\D321B\ctd\processed_data\%1.cnv /pC:\D321B\ctd\psa_files\WildEdit.psa /oC:\D321B\ctd\processed_data

alignctd /iC:\D321B\ctd\processed_data\%1.cnv /pC:\D321B\ctd\psa_files\AlignCTD.psa /oC:\D321B\ctd\processed_data

celltm /iC:\D321B\ctd\processed_data\%1.cnv /pC:\D321B\ctd\psa_files\CellTM.psa /oC:\D321B\ctd\processed_data

asciiout /iC:\D321B\ctd\processed_data\%1.cnv /pC:\D321B\ctd\psa_files\ASCII_Out1.psa /oC:\D321B\ctd\processed_24hz_t2t1_c2c1

4.2.3 Plotting:

The following plots were created within Matlab for each CTD cast

- Raw 24Hz data: pressure, T2-T1, C2-1 and d(pressure)/d(scan) – all plotted against scan number for visual data quality control
- 1 m binned downcast data: vertical profiles of T2-T1 and C2-C1
- 1 m binned downcast data: vertical profiles of T1, salinity (using C1), sigma-theta, DO (mg/l), fluorescence, beam attenuation (1/m)
- 1 m binned downcast data: T/S plot with isopycnal overlays.

4.2.4 Comments:

Comparison between the two temperature and two conductivity 24Hz data streams on the SS CTD suggested that the primary temperature and primary conductivity sensors functioned well for the duration of the cruise. Therefore on all casts the primary temperature and conductivity sensors where used during the processing steps outlined

above. For qualification of these comments with respect to the performance of the CTD in the rosette frame, see §4.4.

CTD Cast Number	Comment
006	Salinity spikes in 1m binned downcast between 5m and 15m
008	SBE logging PC crashed during upcast, files 8a and 8b created
009	Temperature spikes in 1m binned downcast between 5m and 15m
015	Surface (top 18m) – very low salinity values
019	First Ti cast: all channels very noisy @ ~1200m
020	Salinity spikes in 1m binned downcast between 10m and 15m
022	Second Ti cast: Temperature very noisy around 1200m and 1800m
024	Salinity spikes in 1m binned downcast between 0m and 16m
027	Salinity spikes in 1m binned downcast between 765m and 766m
028	Salinity spikes in 1m binned downcast between 765m and 766m
032	Salinity spikes in 1m binned downcast between surface and 16m
034	Salinity spikes in 1m binned downcast between surface and 14m
035	No bottles fired: Salinity spikes in 1m binned downcast between surface and 15m
039	Salinity spikes in 1m binned downcast between surface and 14m
048	No bottles fired: Salinity spikes in 1m binned downcast between surface and 18m
049	No bottles fired
052	Salinity spikes in 1m binned downcast between surface and 14m

Table 4.1. Comments on Individual CTD Casts

4.3 Ellett line sections summary

Marie Porter, UEA and Toby Sherwin, SAMS

Most of the planned Extended Ellett Line stations were completed. However, Stas 11G and 12G were abandoned due to bad weather, Stas 10G to 9G were relocated about 5 nm to the north of their planned positions (Stas 10Ga to 8Ga) and Stas 2G and 3G were abandoned due to pressure of time. All these stations were on the Scottish Shelf.

The pre-calibrated Extended Ellett Line CTD data have been imported into Surfer and gridded using a Krigging routine before plotting.

	θ (ºC)	S	O_2 (µmol kg^{-1})	
Labrador Sea Water, LSW	3 - 3.5	34.8 - 34.9	270 - 280	Fogelqvist *et al.* (2003)
Northeast Atlantic Deep Water, NEADW	2 - 3	34.95 - 35.0	270 - 280	Fogelqvist *et al.* (2003)
Iceland-Scotland Ridge Overflow Water, ISROW				
Northeast Atlantic Water, NEAW	8 - 10	35.2 - 35.4	265 - 270	Fogelqvist *et al.* (2003)

Table 4.2 The principle water masses in the Iceland Basin

Relatively cool and fresh Iceland-Scotland Ridge Overflow Water (potential temperature, θ ~ 5ºC, S = 35.1) can be seen travelling along the deeper part of the Iceland Shelf slope, at a depth of about 1000 m. Further south, and beneath it at a

depth of about 1500 m, can be seen the fresher LSW, whilst at the seabed at 61º 30' N lies Northeast Atlantic Deep Water. The upper part of the water column, particularly north of 62º N, appears occupied by Northeast Atlantic Water. At the surface at 62 ºN θ = 12.39 ºC and *S* = 35.22, whilst further north at 63.14 ºN as might be expected it was a little cooler and fresher (θ = 12.24 ºC and *S* = 35.04). Dissolved oxygen levels reflect this distribution in the upper and lower parts of the water column, but at a depth of about 800 m at 62 ºN there is a significant minimum with low values of about 7.2 mg l^{-1}, which rises to 600 m at 63.14 ºN (see Figs 4.2 and 4.3).

(The contours south of 62º N should be ignored since the most southerly station was sampled using the sensor on the titanium frame, which was subsequently shown to be faulty).

The surface waters of the Hatton Basin were noticeably warmer and saltier than in the Iceland Basin (θ = 14.01 º C, *S* = 35.40 at 16.00 º W, Fig. 4.5). The θS plots indicate that the water in the Hatton Basin is almost identical to that in the Rockall Trough different from that in the Iceland Basin. For a particular salinity Hatton Bank water was about 1º C warmer. This implies that the diffuse northern end of the sub-Polar front lay between Stas IB5 and IB16. The lowest dissolved oxygen levels of the cruise (6.4 mg l^{-1}) were found in the basin at about 820 m, and there was a very noticeable decline of dissolved oxygen with depth from a level of about 7.8 mg l^{-1} at 580 m. There were noticeable mixed layers, both at the surface and at the seabed.

The distribution of temperature and salinity in the Rockall Trough appears unremarkable where the typical surface temperature and salinity at CTD cast 27 (57.30 º N, 10.38 º W) were θ = 14.09 º C and *S* = 35.37. The salinity minimum on this cast was about was 34.91 at ~1930 m, indicative of Labrador Sea Water in the Rockall Trough. There is a tendency for water below about 1000 m to be cooler and saltier on the Rockall side then on the Scottish side.

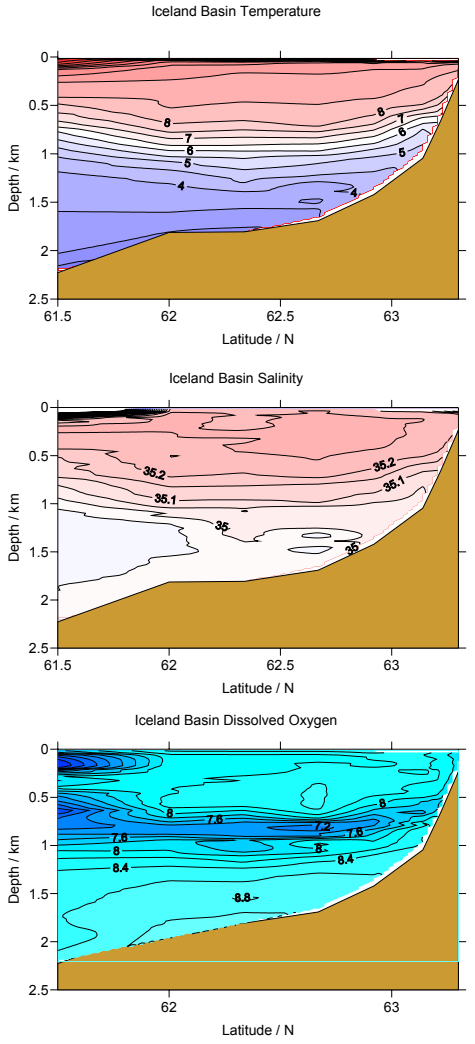


Figure 4.2. Sections from the central Iceland Basin (LHS) rising along 20º W onto the Iceland Shelf. Colours and contour levels may be different to those for the Rockall Trough. Dissolved oxygen in mg l^{-1}. Ignore dissolved oxygen contours south of 62 ºN

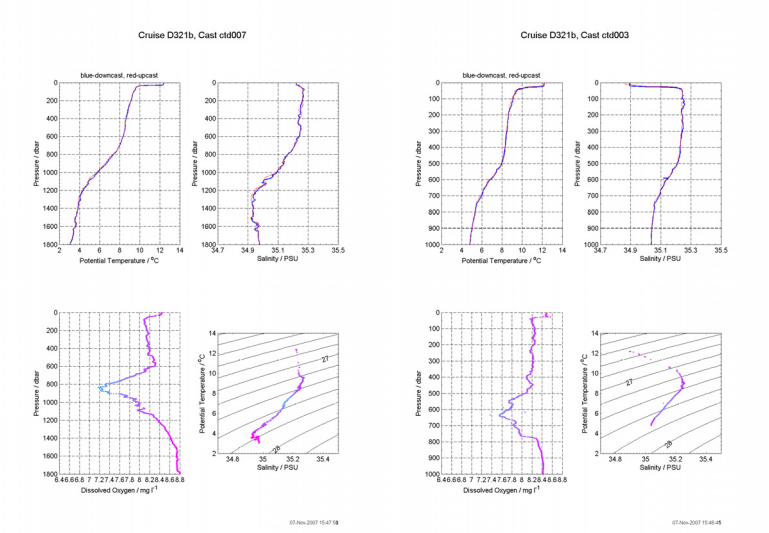


Figure 4.3. Uncalibrated profiles from CTD cast 3 (63.14 ºN, 19.91 ºW) over the Iceland shelf edge and CTD cast 7 (62.00 ºN, 19.99 ºW) in the Iceland Basin. Note the different depth scales. The colours on the θ*S* and dissolved oxygen plots indicate the dissolved oxygen values.

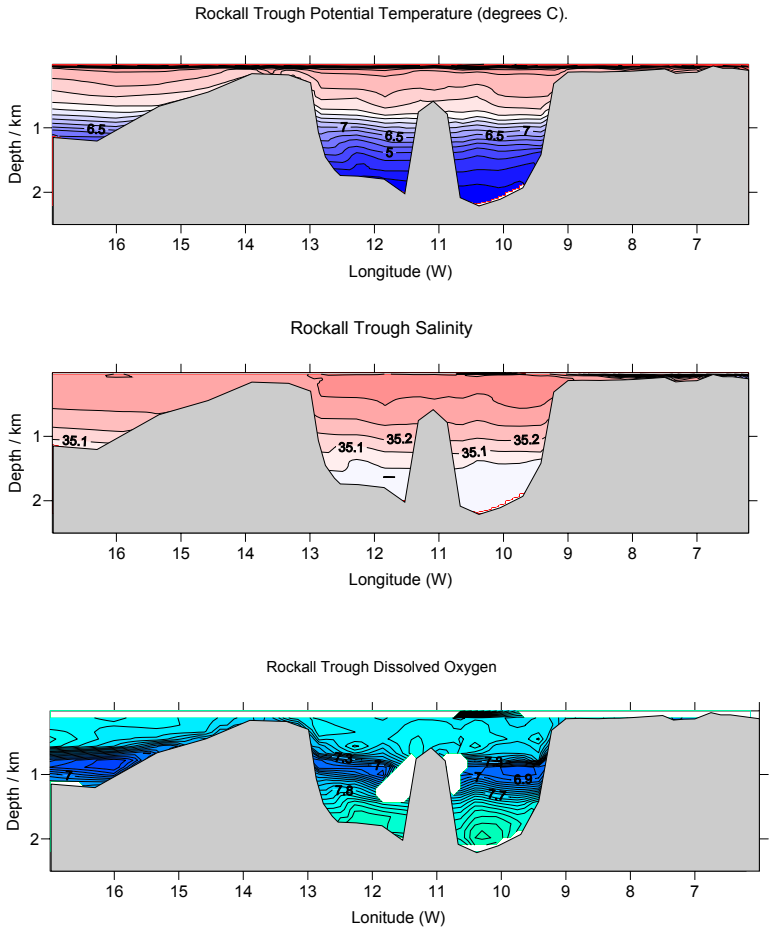


Figure 4.4. Section of the basic parameters across the Hatton Basin and eastward onto the Scottish Shelf. The oxygen minimum is very noticeable throughout the section.

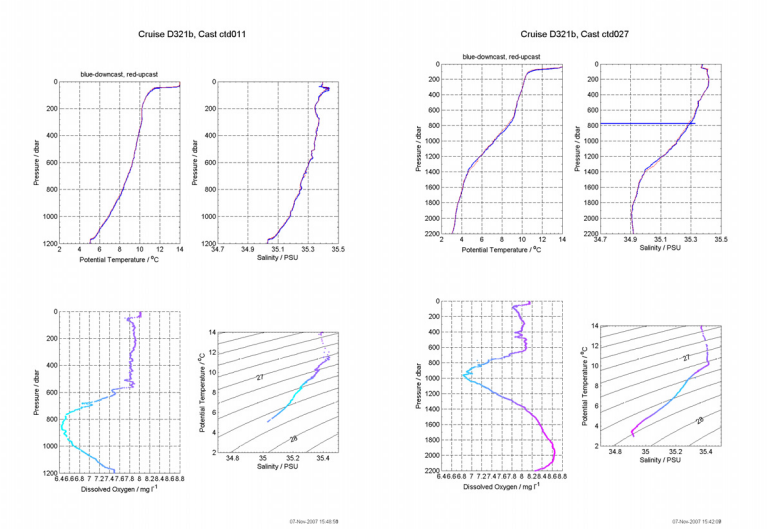


Figure 4.5. Uncalibrated profiles from CTD cast 11 (58.50 ºN, 16.00 ºW) in the Hatton Basin and CTD cast 27 (57.30 ºN, 10.38 ºW) in the Rockall Trough. Note the different depth scales. The colours on the θ*S* and dissolved oxygen plots indicate the dissolved oxygen values.

4.4 Performance of the CTD Rosette sampling system on Discovery cruise D321b

Toby Sherwin, SAMS

4.4.1 Introduction

On cruise D321b temperature and salinity profiles using the main (stainless) frame were measured using two standard Seabird 911plus CTD sensor systems. Both CTDs were located within and near the bottom of the rosette frame (see Fig. 4.1) which held 24 × 20 litre Niskin water sampling bottles. During deployment of the CTD the data were filtered/sub-sampled and displayed on the operator's screen; bottles were fired during the ascent. The descent and ascent speeds reached a maximum of 60 m / min during long stretches below the upper 100 m.

D321b took place in the northern North Atlantic in late August and early September 2007 and experienced normal weather and wave conditions for that time of year.

Discovery is the longest serving of the present NERC research ships with an overall length of 90 m and beam of 14 m. The CTD is deployed from amidships on the starboard side using a winch that does not have a functioning heave compensation system.

4.4.2 The quality of CTD observations

During profiling it was noticed that the CTD did not produce a regular profile of temperature (or salinity). Instead there were regular 'blips' in the profile, which on the down cast always appeared in the positive sense, so that the temperature sensor

always read higher than the expected value. An example of such a trace, taken from cast 27 at station M in the Rockall Trough, is shown in Fig. 4.6. Standing beside a monitor displaying the trace of the CTD as it descended it was apparent that these 'blips' were associated with the rolling of the ship in a swell. Since the winch system has no heave compensation these rolls will be communicated to the CTD which hence will experience a regular variation in its rate of descent. The nature of the effect of rolling on the water circulating in and around the frame under these circumstances was discussed by Sherwin (2006). Essentially, a large CTD frame will drag water down with it as it descends, and changes in the rate of descent are likely to cause sensors located in and on the frame to sample some this water rather than the ambient water. Hence the blips are always in the sense of warmer water during the descent (and in the sense of colder water during the recovery). The effect is thus to apply a warming bias to observations made by sensors attached to the frame.

4.4.3 The impact of CTD surging on temperature observations

The effect of CTD surging could be mitigated, if it were statistically random, by taking averages over sufficiently long periods of time. However, its one-sidedness inevitably means that neither averaging nor filtering will remove it from the record. The impact of surging was investigated with a small routine that recreated the approximately correct record which might have been measured if the surging had not occurred. This was done by dividing the observed record into short sections of typically 2 to 4 seconds in length, noting the lowest temperature (and its depth) in each section and then linearly interpolating between these points. A deep (Sta. M) and a shallow (Sta. 6G) profile were then selected for further examination to provide a first estimate of the likely magnitude of the error induced by surging. The results are summarised in Table 4.3. From this it can be seen that the bias can range from 1/10th to a few milli- degrees depending the stratification and extent of the water column being investigated.

Sta. M	**Depth range (m)**	**Raw temp (°C)**	**Corrected temp (°C)**	**Bias (°C)**
Thermocline	35 – 85	12.875	12.776	0.1
Full depth	10 – 2200	6.856	6.852	0.004
Sta. 6G				
Thermocline	25 – 36	13.266	13.183	0.08
Full depth	10 – 36	13.653	13.613	0.04

Table 4.3. Mean temperatures averaged over selected depth ranges, and their errors

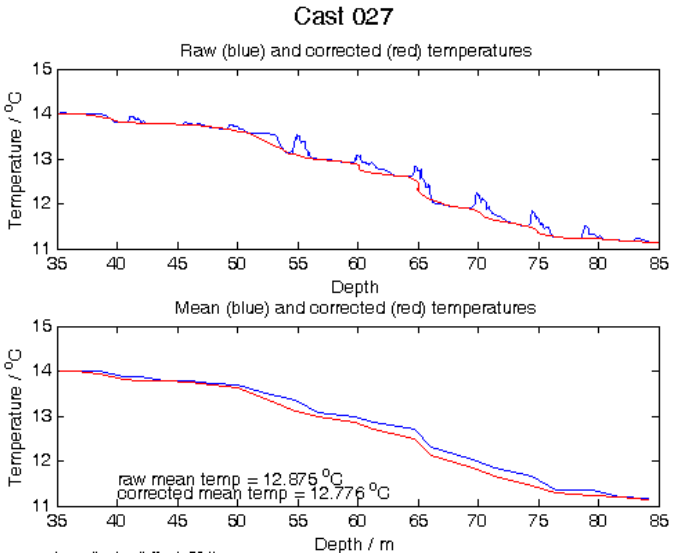


Figure. 4.6. Example of a raw (blue) and corrected (red) profile from the seasonal thermocline in the Rockall Trough. Upper panel – raw data; lower panel – 4 second averages of the raw data. Although the data are presented on a depth axis, linear interpolation of the corrected data was performed against time, which is why the red curve is not a straight line.

4.4.4 Conclusion

It is not the purpose of this brief investigation to provide a precise assessment of the quality of all the temperature profiles measured during D321b. It is likely that suitable averages of the raw data will be acceptable for many purposes although, for some cases, such as climate (and possibly water mass) studies further investigations along the lines used here are recommended to determine the significance of any bias.

This investigation has concentrated on the warming bias observed due to CTD surging during down casts. It is apparent from the data that a similar cooling bias occurs during the up cast.

The question of whether there is an overall warming or cooling of the casts over very large length scales due to water trapping has not been investigated. It is recommended that statistical tests be conducted on a large number of the casts to see if there are any significant differences between the mean temperature observed during up and down casts. If this turns out to be the case then there may be a suspicion that there may be a further apparent background warming to be accounted for. This study could start with the stations in the Wyville Thomson Basin where several up casts were run without stopping.

This investigation has been limited to temperature measurement only, but it is to be expected that salinity and other variables will be affected in the same way. A systematic bias in salinity measurements could be of major concern for water mass and climate studies.

4.4.5 Postscript

The problem with CTD surging introducing a bias in the observations was only noticed near the end of the Ellett line run when it became apparent that the profiles being displayed by the CTD system exhibited an obvious saw-tooth trace. It turned out that the displayed data were only a derivative of the full dataset. Whilst the display looked realistic on deep casts, on shallow casts the vertical separation between individual points on the display was sufficiently large to show the effect of surging.

It was only after discovering the extent of CTD surging did we then learn that the primary CTD sensor was not mounted on the LADCP fin, as had been expected, but was embedded inside the frame. On another occasion it is quite possible that the problem of temperature biasing on the CTD system would have gone unnoticed.

During most of D321b the only CTD monitor displaying data was the one close to the technician, and it showed a degraded dataset whilst the slave monitor was turned off. In addition most watch leaders spent their time processing data, or undertaking other activities, whilst the CTD was in the water. NMF technicians had full control of the CTD, taking it through from setting it up before deployment, to controlling it during the up- and down- casts and resetting the bottles when all the samples had been taken.

With hindsight, this way of working is not satisfactory from a scientific point of view because it leads to the separation of the technician from the science and the scientist from the act of collecting data. Watchkeepers, who are very often physical oceanographers, need to monitor the CTD at all times by setting the slave monitor to whatever configuration they feel gives them the best insight into the physical nature of the water beneath them. Technicians and scientists need to work together and employ their collective knowledge, skills and experience to ensure that the highest quality data are being collected at every cast.

5 Salinity calibration

Toby Sherwin (SAMS, also PI)

On most CTD casts three rosette bottles were sampled for salinity calibration purposes. At each rosette bottle three sample bottles were used (one from each of three crates). The bottles and caps were rinsed three times, the necks and caps dried and a stopper inserted in the neck. The samples were subsequently read in the on board constant temperature laboratory by an NMFSS technician using a Guildline Autosal 8400B salinometer.

The CTD rosette bottles were fired on the up casts at depths that were chosen where the water column appeared to be vertically mixed. Before firing the rosette bottle the CTD was stopped for at least two minutes. The *in situ* CTD bottle values were calculated using the Seabird 911*plus* routines described in the CTD processing report.

The results for the two frames are shown on the accompanying figures:

i) The CTD on the stainless frame. A total of 191 salinity samples gave rise to 64 data points. Figs 5.1 and 5.2 show the final derived calibration values following the removal of 4 outliers for both primary and secondary sensors, and

ii) The CTD on the titanium frame. A total of 54 salinity samples gave rise to 16 data points. Fig. 5.3 shows the final derived calibration values following removal of 2 outliers.

Given that the conductivity cell on the CTD frame was below the Niskin bottles, and given the concerns about CTD surging expressed elsewhere in this report, the true worth of these calibration coefficients is unknown. However, they indicate that both CTDs performed as expected. Since both coefficients of proportionality are close to 1, most of the correction to the observed values is given by the offset which are O(±0.1) units. No explanation is offered for the size of these offset values, which are close to the standard errors of the regression analyses, and it is not possible to discriminate between environmental and instrumental factors. In the case of the stainless CTD the offset changed from +0.1208 to -0.0573 following the removal of one anomalous data point, which suggests that the error in the offset is of order 0.1 units.

(Note in proof: see TJS for the most recent calibration report)

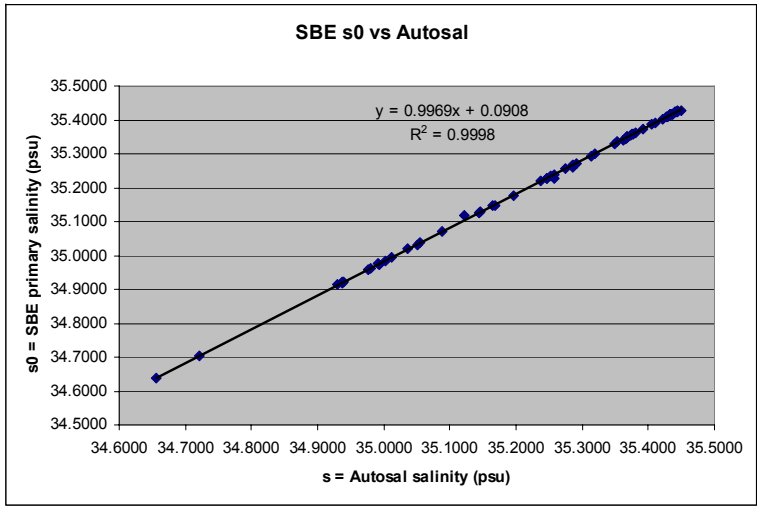


Figure 5.1.The regression curve for the stainless frame CTD (primary sensor)

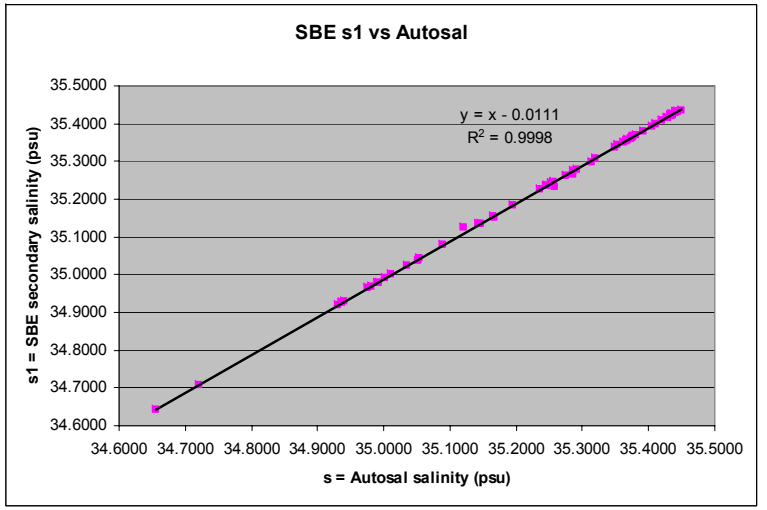


Figure. 5.2. The regression curve for the stainless frame CTD (secondary sensor)

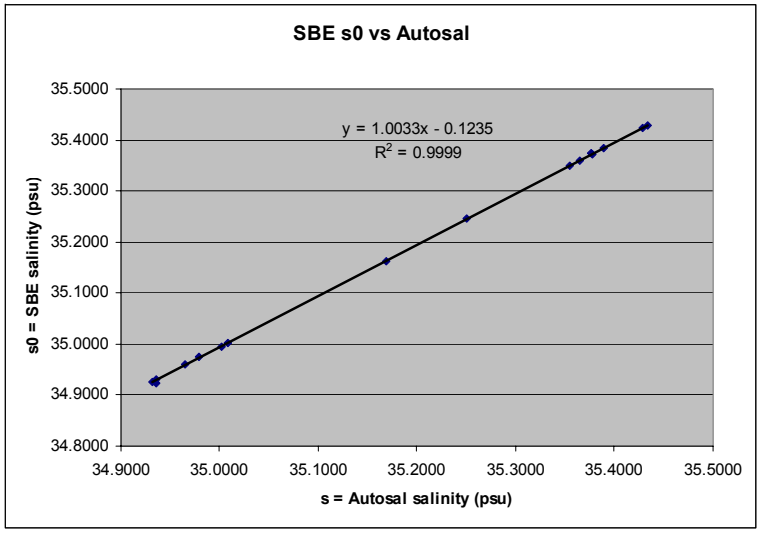


Figure 5.3. The regression curve for the titanium frame CTD.

6 Dissolved oxygen calibration

Jörg Frommlet, NOCS

(PIs: Toby Sherwin and John Allen)

6.1 Introduction

Dissolved oxygen measurements were required to calibrate the oxygen sensors on the stainless steel, and the titanium CTD frame. To do this, Niskin bottles from various depths were sampled regularly spread throughout the sampling period. The depths were chosen based on observed minima and maxima in the oxygen profile. From each of the sampled CTD casts 3 Niskin bottles were chosen. The dissolved oxygen concentrations were determined in triplicate measurements using a Winkler titration technique and used as reference values for the calibration of the two CTD oxygen sensors.

6.2 Method

Sampling – Oxygen samples were drawn off first from the CTD Niskin bottles. To sample, a piece of rubber tubing, approximately 10cm long, was attached to the Niskin bottle nozzle. Before the samples were drawn any air in the tube was displaced by opening the valve of the Niskin bottle. The tube was then lowered to the bottom of the sampling bottles and the samples were taken without creating bubbles. The water was allowed to overflow the bottle until it had been flushed by approximately 3 times the volume of water required to fill it. During this time the temperature of the water was measured by inserting the probe of a handheld electronic thermometer.

Sample processing and Winkler titration – Samples were fixed directly after collection by adding 1 ml of manganese chloride (600g/l solution) followed by 1ml of alkaline iodide (320g/l sodium hydroxide solution mixed with 600g/l sodium iodide solution). Both solutions were added using automatic dispensers the tip of the dispenser being inserted to just below the water level to prevent bubbles being introduced into the sample. The lids were placed on the bottles making sure no bubbles were trapped and the bottles were thoroughly shaken. A precipitate of manganese (II) and (III) hydroxides formed. The precipitate was given 2 hours to settle before the samples were shaken again. After another 2 hours the lids were taken off, 1ml sulphuric acid (280ml/l sulphuric acid solution) was added and the samples were stirred on the Dissolved oxygen Analyser (DOA) using a magnetic stirring bar. Samples were stirred until the precipitate had disappeared and a clear yellow iodine solution had formed. The pipette from the automated burette was lowered into the solution and the titration was started. The automated burette slowly added a sodium thiosulphate solution (25g/l solution) until the iodine solution had been reduced to a colourless iodide and tetrathionate solution. The amount of titre required was used to calculate the amount of dissolved oxygen in the sample in µmoles per litre. The CTDs that were sampled for dissolved oxygen are listed in the CTD log sheets (ref).

Data analysis – Calculations of the average and standard deviation were based on triplicate measurements. The corresponding values from the oxygen sensors were taken from the processed bottle files from the upcast. For this the sensor data was first transformed from mg/l to µmoles/l. The data was plotted against each other and a regression analysis was performed.

6.3 Results and Discussion

The oxygen concentrations recorded by the stainless steel sensor and the 54 discreet samples measured by Winkler titration are shown in Fig. 6.1 (Data for titanium frame not shown). Figure 6.2 shows the difference between the O_2 concentrations as determined by the Winkler titration and the sensor on the stainless steel frame (Data for titanium frame not shown). The data was plotted over time to show any drift of the data during the cruise. No drift could be observed.

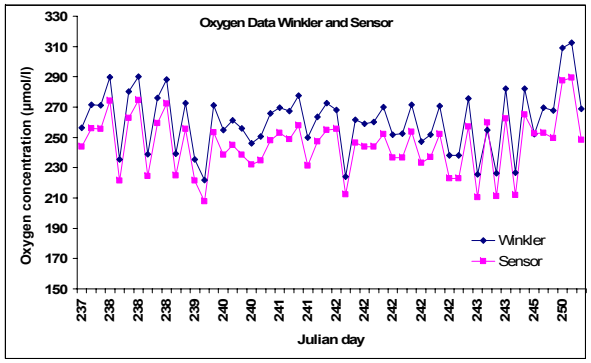


Figure 6.1. Oxygen concentrations of 54 samples measured by Winkler titration and corresponding data from bottle files of processed CTD data.

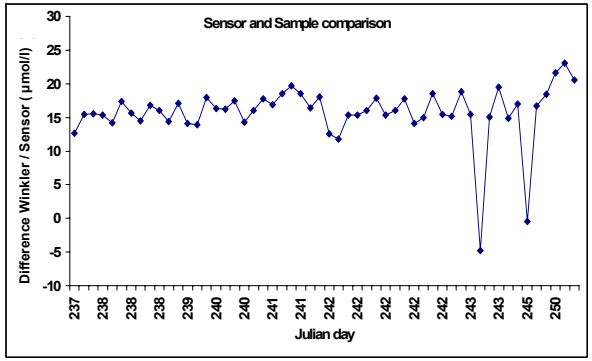


Figure 6.2. Difference between oxygen concentrations measured by Winkler titration and sensor readings.

The relationship between the measurements of the O_2 sensors of the stainless steel and the titanium CTD frame with the discreet samples measured by Winkler titration are shown in Figs 6.3 and 6.4, respectively. The regression between the data from the stainless steel frame with the Winkler titration had a R^2 of 0.9577 showing a good linear relation between the measurements. The slope of 0.9142 showed that the O_2 concentrations determined by the Winkler titration were usually slightly higher than the corresponding sensor readings. The equation for the regression line in Fig. 6.3 provides a useful term to calibrate the sensor. However, the O_2 sensor on the titanium frame did not work at all and no calibration term could be determined. The oxygen data collected with the titanium frame during D321b has therefore to be excluded from the oxygen data set. The most likely reason for the observed fault is a tear in the membrane of the oxygen sensor which has to be replaced before the instrument is used again.

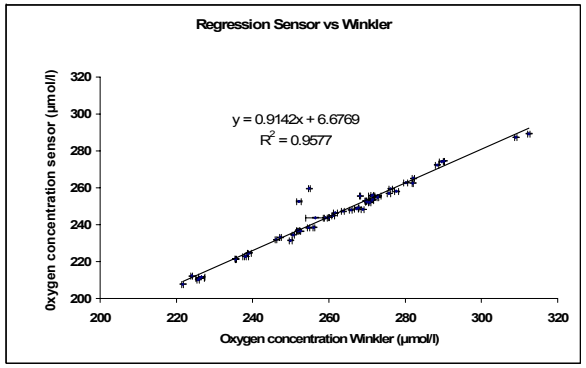


Figure 6.3. Plot of oxygen concentrations measured by Winkler titration versus the data from the oxygen sensor of the stainless steel CTD.

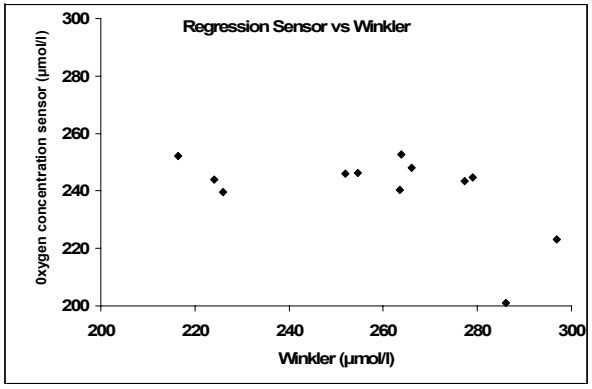


Figure 6.4. Plot of oxygen concentrations measured by Winkler titration versus the data from the oxygen sensor of the titanium CTD.

7 Lowered ADCP (LADCP) Processing

Emily Venables, SAMS (PI Toby Sherwin)

Lowered Acoustic Doppler Current Profiler (LADCP) data were obtained from every CTD cast for which the stainless steel frame was used. Two 300 kHz RDI 'Workhorse' LADCPs were deployed on the frame, the Master being the downward looking instrument and the Slave the upward.

All profiles were processed by the end of the cruise using 'Visbeck' v7 Matlab routines. They were combined with CTD data to provide accurate information on vertical velocity of the frame through the water, and with the ship's navigation data to calculate its exact position in the water using the ship as a reference.

During the cruise the Visbeck processing suite was investigated further in order to understand its workings, but no parameters were changed and there were no warnings during the processing that gave cause for concern.

Apart from the titanium casts, the only other casts omitted were CTD 030 (refer to table of CTD casts) as the LADCP did not run, and CTD 048/049 as these casts were combined.

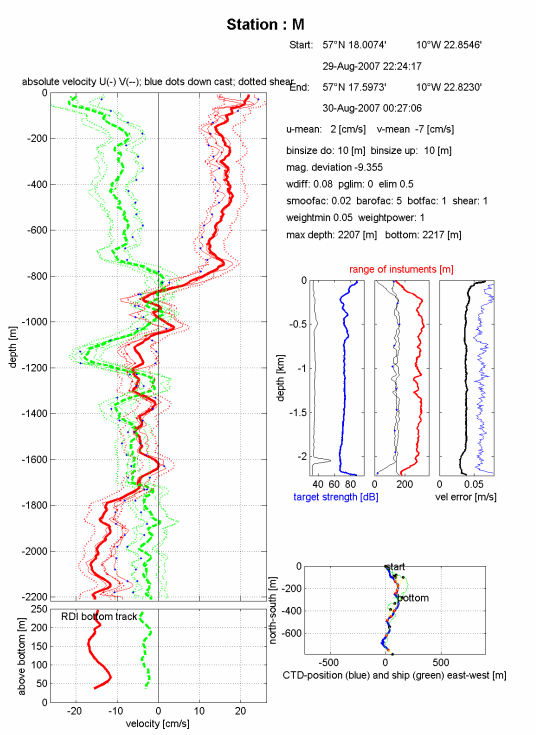


Figure 7.1 An example of velocity and shear profiles output by the processing software.

8 Turbulence Microstructure

Mark Inall, SAMS (also PI)

A Sea and Sun Technology shear and temperature microstructure profiler was deployed at the stations detailed in Table 8.1. The instrument was a MSS090 profiler (SN 034), modified for 4000m maximum water depth operation. The MSS90 measures velocity shear, temperature (fast response, and slow response), conductivity, pressure and package acceleration at 380Hz. These data provide an estimate of the turbulence kinetic energy dissipation within the water column. The MSS90 was deployed from a winch mounted on the gunnel of the starboard quarter. One thousand meters of neutrally buoyant Kevlar cored conducting cable on the winch enabled the MSS90 to be profiled down to a maximum depth of 801m, although a more typical depth was 630m. The maximum depth of each profile depended on the weather conditions and the ship's speed through the water (typically 0.5 kts, but occasionally 0.75 to 1 kts as steerage and sea conditions demanded). A total of 104 profiles where completed.

Sensor Configuration:

Fast Response Temperature: Thermometrics FP07
Pressure: Keller PA8-400
Shear 1: ISW 6079
Shear 2: ISW 6081
Temperature: ISW Pt100
Conductivity: ADM 7polig
Acceleration: ADXL203

Start Time	Stop Time	Station Name	Water Depth	File name range	Comments
3/9/07 05:39	4/9/07 06:23	M800W	~850m	D3210006 to D3210051	25 hour yoyo station near M800W minilog mooring
4/9/07 19:37	4/9/07 22:37	WT2	~1050m	D3210053 to D3210059	Six profiles at station WT2, profile 0056 aborted due to line tangle
5/9/07 03:11	5/9/07 06:08	WT4	~1200m	D3210060 to D3210065	Six profiles at station WT4
5/9/07 10:49	5/9/07 13:53	WT6	~1200m	D3210066 to D3210071	Six profiles at station WT6
5/9/07 21:35	6/9/07 23:17	M800E	~850m	D3210072 to D3210109	25 hour yoyo station near M800E minilog mooring

Table 8.1 MSS034 Deployment Details.

Figure 8.1: MSS034 profiler, winch and Mark Inall on starboard quarter of *RSS Discovery*

MSS090 Data Processing

Data quality was checked by examining raw profiles of pressure, fast response temperature, and both shear channels. Full processing of the data will be undertaken post-cruise. Raw data in ascii format will be banked with BODC. Processed data are available from the data originator on request.

9 Moorings

9.1 Minilog Mooring

Emily Venables, SAMS (PI), Paul Provost, NMFSS

A series of 41 Minilog-T temperature sensors was deployed as a short term mooring, firstly on the western (M800W) and then the eastern (M800E) end of the northern Wyville Thomson Ridge (Table 9.1). Data were collected over a 25 hour period at each station in order to observe the change in height of the thermocline over a tidal cycle.

Station	Latitude	Longitude	Date In	Time In
M800E	60º34.810'N	08º17.606'W	03/09/07	0049
M800W	60º01.877'N	06º27.329'W	05/09/07	2049

Table 9.1 Minilog mooring details

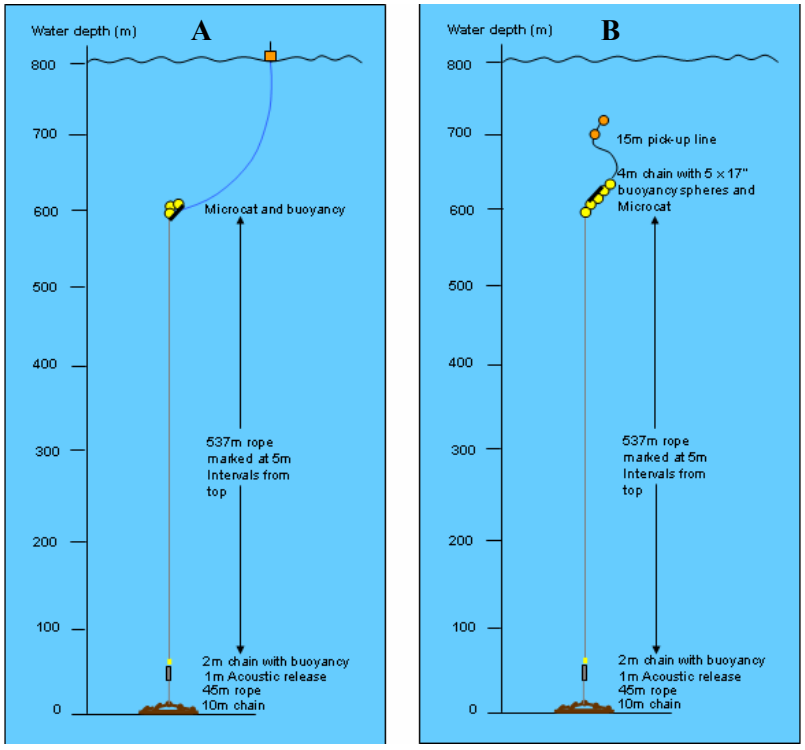


Figure 9.1. Mooring design for a) M800W and b) M800E.

Moorings were designed as illustrated in Fig. 9.1. The first mooring, deployed at M800W, had a Dahn buoy attached as a surface float, but due to knockdown by the strong currents, it sank and had to be cut away to avoid fouling the ship. For the second deployment, at M800E, subsurface buoyancy alone was used. A Microcat (SBE-37 MP) was placed at the top of the marked rope so that pressure measurements could be used to measure the knockdown of the mooring. Pressure recordings show that the mooring at M800W suffered significantly from knockdown, and supposedly the resultant added drag from the sunken dahn buoy. Over the deployment period a >400m variation in depth of the Microcat was observed. The pressure readings from the Microcat at M800E, however, varied by only 3m, indicating that the mooring was much less affected by currents.

A CTD dip was done prior to choosing the Minilog depths so as to confirm the depth of the thermocline at M800W. At M800E an XBT was used for the same purpose as conditions were too bad to deploy the CTD.

Minilogs of various storage capacities were distributed along the marked section of rope, with 20 instruments at 5m intervals over the 100m covering the main thermocline. 5 instruments at 10m intervals covered the 50m sections above and below this. The remaining instruments were spaced at 20m intervals as indicated in Table 9.2.

All Minilogs and the Microcat were successfully uploaded before the end of the cruise, with the exception of 4791A which would not communicate with the reader.

Figure 9.2: Minilog mooring operations

Station: M800W					Station: M800E	
Distance from top of marked rope (m)	Water depth(m)	Minilog ID	Size (bit/k)	Sample Interval (s)	Distance from top of marked rope (m)	Water depth(m)
95	300	2188E	12/16	30	135	340
115	320	2195E	12/16	30	155	360
135	340	2196E	12/16	30	175	380
155	360	2194E	12/16	30	195	400
175	380	2186E	12/16	30	215	420
195	400	2189E	12/16	30	235	440
215	420	2191E	12/16	30	245	450
225	430	2197E	12/16	30	255	460
235	440	2108	12/32	15	265	470
245	450	2425	12/32	15	275	480
255	460	2408	12/32	15	285	490
260	465	2427	12/32	15	290	495
265	470	2104	12/32	15	295	500
270	475	2105	12/32	15	300	505
275	480	2423	12/32	15	305	510
280	485	2107	12/32	15	310	515
285	490	2111	12/32	15	315	520
290	495	2106	12/32	15	320	525
295	500	6178E	12/64	15	325	530
300	505	6177E	12/64	15	330	535
305	510	6176E	12/64	15	335	540
310	515	7334E	12/64	15	340	545
315	520	6175E	12/64	15	345	550
320	525	2424	12/32	15	350	555
325	530	2420	12/32	15	355	560
330	535	2426	12/32	15	360	565
335	540	4482	12/32	15	365	570
340	545	2112	12/32	15	370	575
345	550	4476	12/32	15	375	580
350	555	2110	12/32	15	380	585
355	560	5591E	12/32	15	385	590
365	570	5592E	12/32	15	395	600
375	580	5593E	12/32	15	405	610
385	590	2187E	12/16	30	415	620
395	600	0144E	12/16	30	425	630
405	610	2193E	12/16	30	435	640
415	620	0148E	12/16	30	455	660
435	640	2185E	12/16	30	475	680
455	660	0147E	12/16	30	495	700
475	680	4791A	8/8	30	515	720
495	700	4789A	8/8	30	535	740

Table 9.2: Minilog ID, position on mooring and water depth for the two Minilog mooring stations.

9.2 ADCP moorings

Two ADCP mooring activities were undertaken, both on the Wyville Thomson Ridge, a recovery and a deployment, with the deployment preceding the recovery. The details are given in Table 9.3:

Event	Date	Time	Sta	Latitude	Longitude	Depth	
48	02 Sep	1700	EG3	60 14.71 N	09 00.76 W	1280	ADCP deployment
49	02 Sep	1815	EG2	60 15.04 N	08 54.50 W	1200	ADCP recovery

Table 9.3 ADCP mooring locations

9.2.1 Deployment

The instrument deployed was SAMS 75 kHz Long Ranger S.N. 9201. A summary of the instrument configuration is given below:

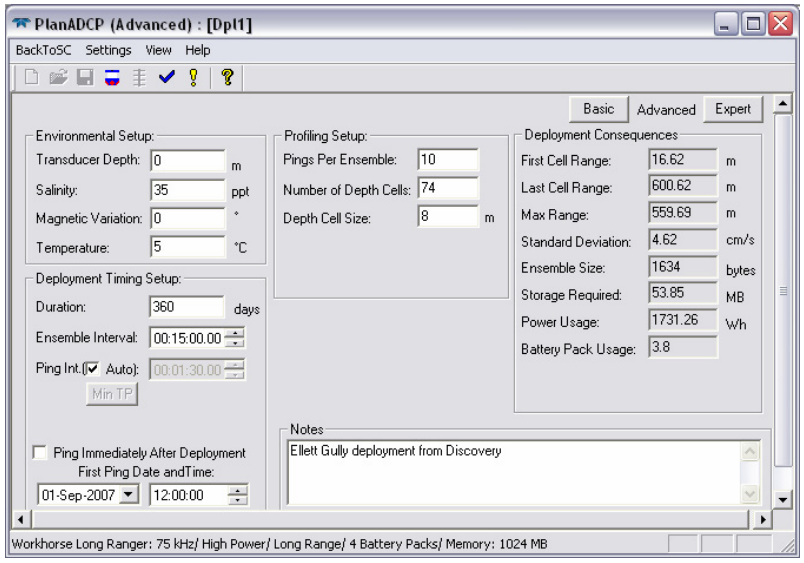


Figure 9.3. Display of deployed ADCP parameters

The deployment mooring comprised:

- 850 kg anchor
- 10 m 1/2" grade 80 long link chain
- galvanised link
- Ixsea Acoustic Release AR861 B2S s/n 321 (this is important because there is a similar release AR661 that also has the s/n 321 which we didn't use)
- 10m 1/2" grade 80 long link chain
- swivel
- Floatation Technologies 38" syntactic ADCP collar/float
- 10m 20mm polyester rope
- 17" benthos glass sphere

The build sheet for the acoustic release is given below:

BUILD SHEET

TYPE	:	**AR 861 B2S**	Date of Manufacture	:	
S/N	:	**321**	Customer	:	**SOC**
P/N	:		Representative	:	
Function	:	**Acoustic Release**	Job file	:	
Modification	:		Customer approval	:	

TECHNICAL SPECIFICATIONS:

ELECTRONIC BOARD				ELECTRONIC SPECIFICATIONS		
Reference	**Rev**	**Function**	**S/N**	Transmit width	:	**10** ms
392 2001	**3.0**	AR 8x1 Board Firmware: PROM (U6) - ET8_V2.2 FPGA (U38) - REC_V1.0/3.3V PROM (U32) - EM_V1.0 FPGA (U33) - EM_V1.0/3.3V		Transmit level Pinger rate Pinger duration after release FR0 FR1 CAF PINGER	: : : = = = =	**191** ± 4 dB ref 1µPa at 1 m **2** s **3** mn **09.0** kHz **10.5** kHz **12.0** kHz **12.0** kHz

FUNCTIONAL SPECIFICATIONS:

Function / Code	TT801/ TT701/ TT301	TT201	Sequence
ARM	**14D1**	**N.A.**	⇒ CAF
Lock-Out time = 4s			
Active time = 20s			
The following acoustic codes must be preceded by an ARM code			
RELEASE	**1455**	**N.A.**	⇒ CAF ⇒ CAF
RELEASE WITH PINGER	**1456**	**N.A.**	⇒ CAF ⇒ CAF ⇒ PINGER
PINGER ON	**1447**	**N.A.**	⇒ CAF ⇒ PINGER
PINGER OFF	**1448**	**N.A.**	⇒ CAF
DIAGNOSTIC	**1449**	**N.A.**	⇒ CAF_1 ⇒ CAF_2

N.A. : Not applicable

OTHER SPECIFICATIONS

Power configuration	:	**3**	banks of	**6**	serie LR20 cells	**ALKALINE**
		1	bank of	**1**	6LR61 cell	**ALKALINE**
Power distribution	:	**3**	banks of	**6**	LR20 cells :	standby-power-motor
		1	bank of	**1**	6LR61 cell :	motor safety
Option	:	**xxxx**				

DIAGNOSTIC Measure (s) : **t**(CAF_2) **- t**(CAF_1) **- 3**s (**13**s with horizontal position) with **t** in second
Cells Voltage (V) : DIAGNOSTIC Measure x 4.1

SUB-ASSEMBLIES and PART NUMBERS

SUB-ASSEMBLY	P/N	REV
AR 861 B2S	**392 9100**	**1**
LOWER END-PLATE	**312 9401**	**2**
RELEASE HOOK	**257 9601**	**1**
TRANSDUCER ON UNS END-PLATE	**200 1111**	**1**
INTERNAL STRUCTURE	**201 9301**	**2**
ELECTRONIC BOARD	**385 2010F**	**3.0**

9.2.2 Recovery

The recovered instrument had been originally deployed during *Discovery* cruise D312. The internal file report (Table 9.4) and summary plot (fig. 9.4) indicated that it had worked satisfactorily.

```
C:\Mooring_data\wtr_2006_07\WRT06000.000
File Size 21,254,055 bytes
BB/WH Ensemble Length 1428 bytes
System Frequency: 76.8 kHz
1st Bin 16.69 m, Bin Size 8.00 m
No. Bins 64, Pings/Ens 23, Time/Ping 01:18.26
First Ensemble 00000001 06/10/28 14:33:08.49
Last  Ensemble 00014878 07/09/03 13:03:08.49 NVRAM Data in File
Average Ensemble Interval 00:05:35.59

C:\Mooring_data\wtr_2006_07\WRT06000.000
File Size 21,254,055 bytes

Data Structure BB/WH/OS
Ensemble Length 1428 bytes
Data Types 0000 0080 0100 0200 0300 0400

Firmware Version 16.12

System Frequency 76.8 kHz
Convex
Sensor Configuration #1
Transducer Head Attached TRUE
Orientation UP
Beam Angle 20 Degrees
Transducer 4 Beam Janus

Real Data

CPU Serial Number: BD 00 00 02 48 8D 7C 09

High Power  (CQ) 0
Trigger     (CX) 0

False Target(WA) 50 counts
Band Width  (WB) 1
Cor. Thres. (WC) 64 counts
Err Thres.  (WE) 2000 mm/s
Blank       (WF) 7.04 m
Min PGood   (WG) 0
Ref Layer   (WL) 1, 5 first bin, last bin
Mode        (WM) 1
Bins        (WN) 64
Pings/Ens   (WP) 23
Bin Size    (WS) 8.00 m

Head Align  (EA)  0.00 degrees
Head Bias   (EB)  0.00 degrees
Coord Xform (EX) 11111 Earth Coordinates Using Tilts, 3 Beam Solutions, and Bin Mapping
Sens Source (EZ) 1111111 cdhprst
Sens Avail       0111101 cdhprst

Time/Ping   (TP) 01:18.26
```

Hardware 4 Beams
Lag 13 elements
Code Reps. 5
Lag Length 1.93 m
Xmt Length 9.37 m
1st Bin 16.69 m

BT Pings/Ens (BP) 0
BT Ens Delay (BD) 0
BT Cor.Thres. (BC) 0 counts
BT Eval. Thres. (BA) 0 counts
BT PG Thres. (BG) 0
BT Mode (BM) 0
BT Err Thres. (BE) 0 mm/s
BT Max Range (BX) 0 dm

First Ensemble 00000001 06/10/28 14:33:08.49
Last Ensemble 00014878 07/09/03 13:03:08.49
Extra Data in File 8,271 bytes
NVRAM Data Set TRUE

Table 9.4. ADCP recovery report

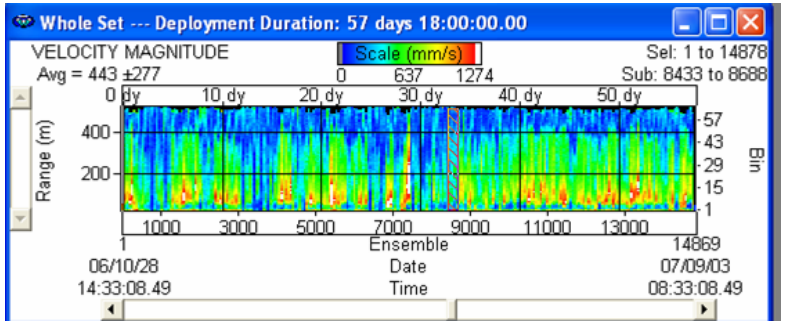


Figure 9.4 Summary of velocities observed by recovered ADCP

10 Marine Chemistry

Tim Brand (PI: Toby Sherwin)

10.1 Dissolved Inorganic Nutrients

10.1.1 Introduction

The basic water column dissolved nutrients, ammonia, phosphate, silicate (reactive silica) and nitrate were analyzed from CTD casts along the extended Ellett line (incl. Iceland basin) and within Wyville Thompson Basin. Depths for the samples were chosen to correspond with those of the chlorophyll and primary productivity studies (Thomalla, this report) down to 125 m and at depths below this which coincided with changes in water mass identified by the TS and dissolved oxygen characteristics from the CTD casts. Samples were taken from the conventional steel framed CTD and the Ti frame used for trace iron studies (Nielsdottir, this report). The CTD consisted of *Seabird* electrical instrumentation and 24 20l *Ocean Test Equipment* bottles operated and maintained by NMF staff.

Samples were collected in 250 mls acid cleaned polythene bottles directly from the CTD spigots without the use of a tube. Samples were always analyzed within 24 hours of collection and stored in a fridge prior to analysis. Measurement was conducted using a Lachat *Quik Chem 8000* flow injection autoanalyser using the manufacturers recommended methods: Ammonia, 31-107-06-1-B; Orthophosphate, 31-115-01-1-G; Silicate, 31-114-27-1-A and Nitrate/Nitrite, 31-107-04-1-A.

Samples were measured in triplicate to identify instrument precision. Standards were prepared in deionised water and the samples were run in a carrier stream of deionised water. Salt correction of the result was performed by running a small number of Low Nutrient Sea Water samples (OSIL, http://www.osil.co.uk, Batch LNS 16, Salinity 35) during each sample batch run and the mean result was subtracted from sample results. Salt correction was also, initially, conducted by running a small selected number of collected samples using a limited number of reagents. Removal of a critical reagent prevents coloration but record the refraction trace due to the pulse of the saline sample in the DI water carrier. The reagents that were withdrawn from the carrier stream are as follows:

Ammonia: Sodium hypochlorite

Phosphate: Ammonium molybdate

Silicate: Tin chloride/hydroxylamine hydrochloride

Nitrate: N-(1-naphthyl)-ethylenediamine (NED)

It was found that both methods of salt correction gave a very similar result (within 5% of each other) and the reagent withdrawal method was no longer used after day 6 of the cruise.

The instrument performed generally well although suffered from a temporary rotary valve failure on the phosphate manifold after day 3 of the cruise. The valve was replaced with the spare. The CdCu column was replaced after day 4 of the cruise after it was noted that there was a loss of sensitivity below 5µM NO3 leading to a poor correlation coefficient of the standards. The column was brand new from the

manufactures prior to the cruise and normally a newly Cu coated Cd column should last around a thousand samples.

10.1.2 Preliminary observations of CTD nutrient profiles

Nutrient concentration profiles of the extended Ellett Line including the Iceland Basin stations are shown in the accompanying figures.

Nutrients (NO3, SiO2 and PO4) were generally depleted within the surface layer above the thermocline (~30 m) with silicate often below detection (<0.1μM). Nitrate never showed complete removal from the upper layer, whilst phosphate often reduced to low but measurable concentrations, ~0.1μM. Ammonia was generally high (~1μM) at the base of surface layer resulting from zooplankton grazing of the phytoplankton and subsequent excretion. Below the thermocline nitrate, silicate and phosphate increased in concentration. The highest recorded nitrate concentrations were found in the northern Iceland basin stations whilst the highest silicate concentrations are seen to occur in the Rockall Trough to the east of the Anton Dorn seamount. At the northern Iceland Basin stations IB22 to IB16 at depths between 1000 and 1500m ammonia levels increased above normal deep water values to around 0.4μM. shown.

The range of nutrient concentrations found on the extended Ellett line transect are shown in the below.

Ammonia/ium	0 – 2μM
Phosphate	0 - 2 μM
Reactive silica/silicate	0 - 26 μM
Nitrate	1 - 23 μM

A comprehensive list of CTD stations with depths chosen for nutrient analysis is shown in the CTD water column parameter log shown in the appendices. A summary of that information is shown in Table 10.1.

10.1.3 Particulate organic carbon and nitrogen

The basic parameters of particulate organic carbon and nitrogen were collected by filtration of water collected form the CTD casts. Water samples were filtered using the NOC 12 port filtration rig supplied with 2 Millipore diaphragm pumps generating approximately a third to a half atmosphere vacuum. Filtration was carried out on 25mm diameter Whatman GF/F filters that had been pre-combusted at 500C. Between 1 and 2 litres of sample were filtered depending upon particulate loading. Samples were initially taken from each depth captured by the CTD bottles. However this proved to be time consuming for the manpower available so it was decided to concentrate efforts in the surface samples (< 125 m water depth) coinciding with the chlorophyll samples (Thomalla, this report, Chap. 19). Deep water particulate organic carbon and nitrogen samples continued to be collected on the Ti CTD casts to allow future comparison of trace iron–carbon relationship. (Nielsdottir, this report). Filter samples were stored in vented Petri slide dishes kept at -20°C in. The filters will be analyzed using a *Costech* catalytic oxidation elemental analyzer upon return to SAMS.

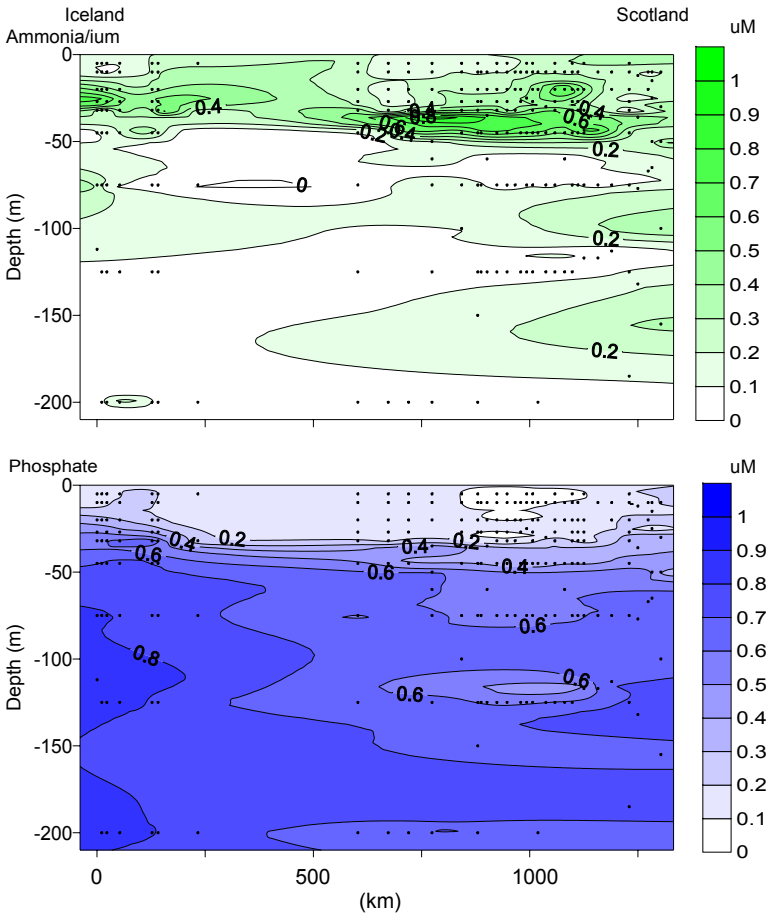
Full details of samples collected can be found in the water column parameter log in Appendix 2.

Station	Event No	CTD Cast	CTD Fe Ti	Nutrient depths sampled	Station	Event No	CTD Cast	CTD Fe Ti	No. of depths sampled
IB23s	1	1	Fe	8	EG3	47	46	Fe	14
IB22s	2	2	Fe	12	M800E	50	47	Fe	1
IB21s	3	3	Fe	14	T800W	55	50	Ti	15
IB20s	4	4	Fe	14	WT1	57	51	Fe	11
IB19s	5	5	Fe	16	WT3	59	52	Fe	9
IB18s	6	6	Fe	16	WT5	61	53	Fe	12
IB16	8	8	Ti	12					
IB16x	9	9	Fe	6					
IB5	10	10	Fe	14					
IB4	11	11	Fe	13					
IB3	12	12	Fe	12					
IB2	13	13	Ti	12					
A	15	15	Fe	8					
C	18	17	Fe	12					
D	19	18	Fe	8					
E	20	19	Ti	11					
F	21	20	Fe	14					
G	22	21	Fe	12					
H	23	22	Fe	12					
I	24	23	Fe	8					
J	25	24	Fe	9					
K	26	25	Fe	11					
L	27	26	Ti	11					
M	28	27	Fe	12					
N	29	28	Fe	12					
O	30	29	Ti	12					
P	31	30	Fe	13					
Q	32	31	Fe	9					
R	33	32	Fe	7					
15G	35	34	Fe	3					
13G	38	37	Fe	4					
9G	40	39	Fe	9					
7G	42	41	Fe	4					
5G	44	43	Fe	3					
4G	45	44	Fe	5					
1G	46	45	Fe	5					

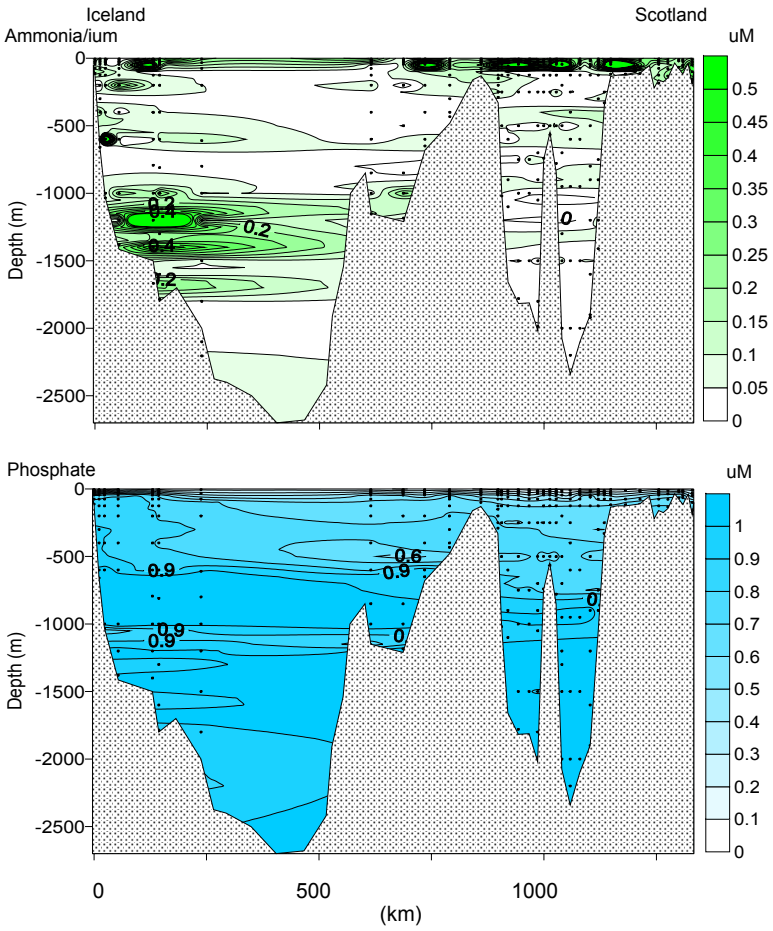
Table 10.1. CTD stations used for nutrient analysis

For the record: 450 samples were analyzed in triplicate for nutrients

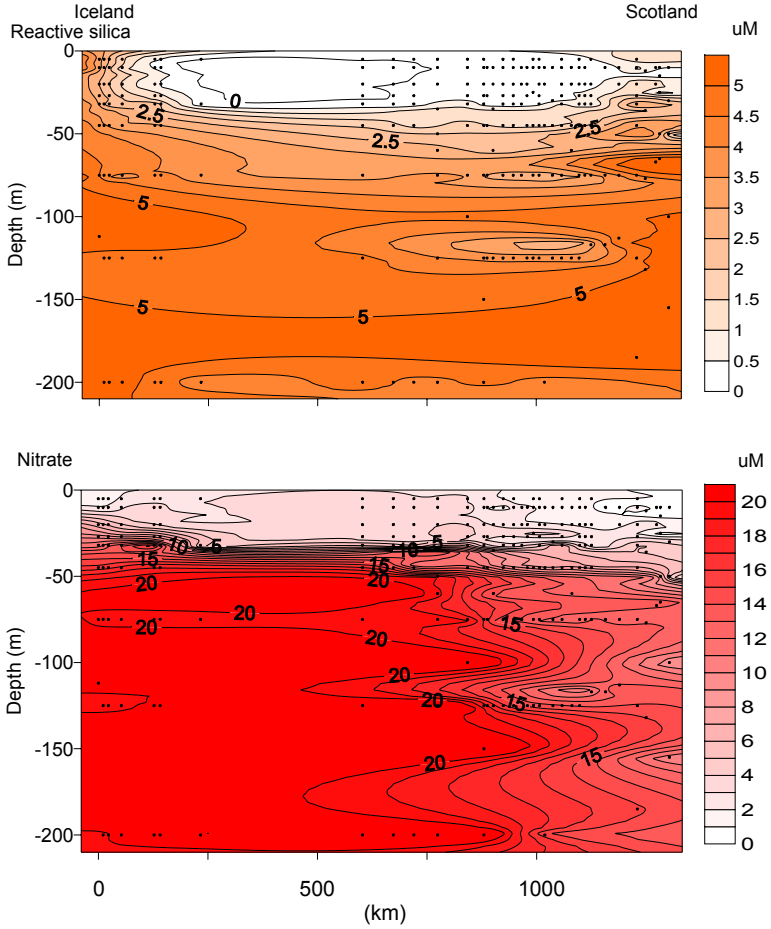
Dissolved ammonia/ium and phosphate concentrations along the extended Ellett line to 200m water depth, August 2007



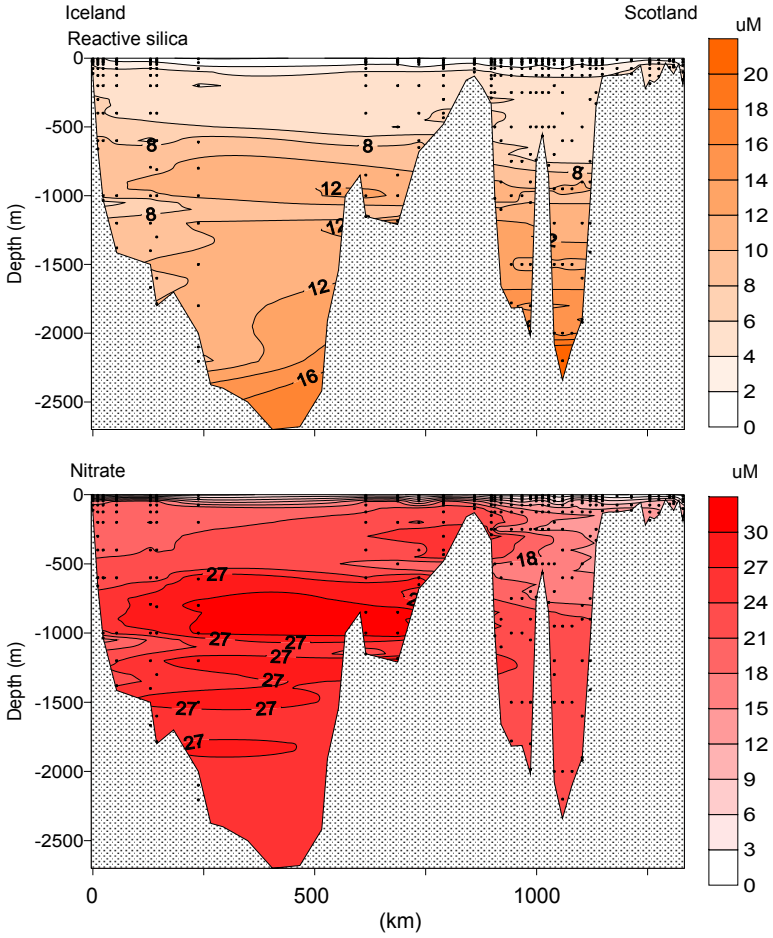
Dissolved ammonia/ium and phosphate concentrations along the extended Ellett line, August 2007



Dissolved reactive silica and nitrate concentrations along the extended Ellett line to 200m water depth, August 2007



Dissolved reactive silica and nitrate concentrations along the extended Ellett line, August 2007



11 Bacterial Isolations

Kimberley M^c Kendrick, (PI: Andrew Mearns-Spragg)

Aquapharm Biodiscovery Ltd, European Centre for Marine Biotechnology

11.1 Objective:

To isolate marine bacteria from seawater samples gathered from a range of locations and depths along the Ellett line and the Wyville Thomson Ridge in the North Atlantic.

11.2 Method:

25 to 50 ml aliquots of seawater from samples gathered using the CTD Niskin bottle rosette were transferred to sterile 50 ml centrifuge tubes and refrigerated at between 1º and 3ºC before processing. All samples save those from station Q were processed within 6 hours of sampling and most were processed within 1 hour. Samples were taken wearing gloves and in the minimum time possible.

Petri dishes containing either high or low nutrient agar were labelled with the station and bottle numbers of the samples to be plated as well as dilution factor and incubation temperature. A 100 µl aliquot of each sample was then either used neat or diluted 10-fold before being spread onto the appropriate plate, left to be absorbed for 15 minutes and the plate then inverted and stored in the appropriate conditions. Each sample was spread onto 2 or 3 media types and duplicate plates were incubated at ambient temperature and at between 1 and 3ºC.

11.3 Equipment:

All plating work was carried out in a Class I Biological Safety Cabinet and using sterile disposable spreaders and pipette tips. Settle plates left open in the Safety Cabinet while sample processing was being carried out did not show any growth of contaminants for the duration of the cruise.

Station	Depths plated (m)
IB21S	1005, 600, 125, 27, 5
IB20S	1380, 125, 27, 10, 5
IB18S	1785, 125, 27, 20 5
IB4	1184, 1000, 850, 500, 200, 125, 75, 45, 32, 27, 20, 10, 5
IB1	133, 75, 60, 45
E	1620, 1400, 1300, 1100, 900, 600, 125, 60, 35, 20, 10
I	740, 500, 250, 125, 75, 45, 32, 27, 20, 10, 5
M	2200, 2000, 1500, 950, 600, 400, 250, 125, 75, 45, 30, 10
Q	330, 250, 125, 75, 45, 32, 27, 20, 10, 5
9GA	185, 125, 75, 45, 32, 27, 20, 10, 5
EG3	1220, 1000, 900, 750, 500, 300, 125, 75, 45, 32, 27, 20, 10, 5
M800W	825
T800W	754, 660, 493, 353, 150, 45, 32, 27, 20, 10, 5
WT1	870, 600, 400, 250, 125, 75, 50, 30, 20, 10
WT5	1155, 1000, 800, 700, 600, 500, 200, 100, 50, 20, 10

Table 11.1 Sampling Summary – 132 water samples from 15 stations

11.4 Preliminary Results:

Room temperature high and low nutrient plates showed between 3 and 25 colony types within one week of plating at most depths sampled. Plates incubated at 1 to 3ºC had very few colonies on the earliest plates by the end of the cruise and will require a longer incubation time before analysis.

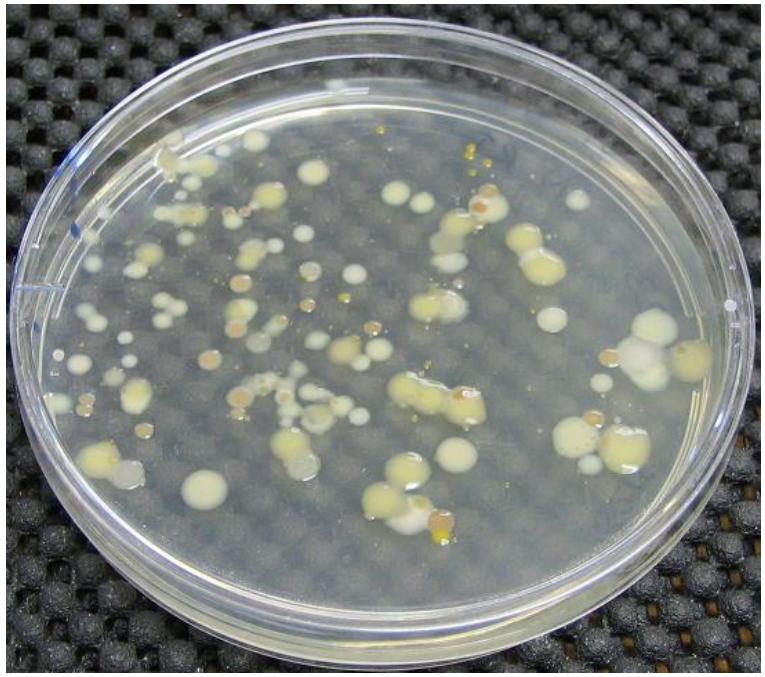


Figure 11.1: IB21S 5m High Nutrient Ambient 9 days' growth

12 HPLC and Flow Cytrometry

Simone Sauer,NOCS (PI Denise Smythe-Wright)

12.1 HPLC Samples

Water samples for HPLC (High Performance Liquid Chromatography) analysis were collected from 3 - 6 different depths (5m -133m) from 24 CTD stations (~150 samples). Various volumes of waters (1000 – 2000 ml) were filtered onto GF/F filters (pore-size 0.7µm) and frozen immediately with liquid nitrogen. The filters were then stored in the freezer at -80°C. HPLC analysis of the pigments will be carried out back in the laboratory.

Station	5m	10(11)m	15m	20m	25(27)m	32(30)m	45(44)m	50(51)m	60m	67(65)m	75m	100(101)m	125(133)m
IB23S	0			0		0	0				0		0
IB18S	0	0		0		0	0				0		
IB17S	0	0		0		0	0				0		
IB16X	0	0		0		0	0				0		
IB4	0	0		0		0	0				0		
IB1	0						0		0		0		0
A	0	0		0		0	0				0		
B	0	0		0		0	0				0		
F	0	0		0		0	0				0		
I	0	0		0		0	0				0		
J	0	0			0		0				0		0
K	0	0		0		0	0				0		
N	0					0					0		0
P	0	0		0		0	0				0		
Q	0	0		0		0	0				0		
R	0	0		0		0	0				0		
9GA	0	0		0		0					0		
5G		0		0						0			
4G	0	0	0		0			0		0			
1G		0				0		0			0	0	
EG3	0	0		0		0	0				0		
T800W	0	0		0	0	0	0						
WT1		0		0		0		0			0		0
WT5		0		0				0				0	

Table 12.1 Sampling stations and depths

12.2 Microscopy and Flow Cytometry Samples

Preserved samples of phytoplankton (~150 samples) were collected from 3 light depths from 24 CTD stations. Samples were preserved with 1 - 2% acidified Lugol's solution and 20% buffered formalin solution and stored in 150ml brown, tightly stopped bottles until further analysis with light microscopy in the laboratory.

Flow cytometry samples have been taken from the same depths and same station. 0.01 – 0.02ml filtered formalin (filtered with 0.2µm filter) was added to each sample in 1.8ml vials and stored at -20°C in the freezer for further analysis back in the laboratory.

Station	5m	10(11)m	20m	25(27)m	32(30)m	45m	50(51)m	60m	67(65)m	75m
IB23S	0				0					0
IB18S	0				0					0
IB17S	0				0					0
IB16X	0				0					0
IB4	0				0					0
IB1	0					0		0		
A	0				0					0
B	0				0					0
F	0				0					0
I	0				0					0
J	0			0						0
K	0				0					0
N	0				0					0
P	0				0					0
Q	0				0					0
R	0				0					0
9GA	0				0					0
5G		0	0						0	
4G	0			0					0	
1G		0			0		0			
EG3	0				0					0
T800W	0			0		0				
WT1		0			0					0
WT5		0	0				0			

Table 12.2 Sampling stations and depths

13 Active chlorophyll fluorescence measurements (FRR fluorometry)

Daria Hinz (PI Mark Moore)

13.1 Introduction

Active chlorophyll *a* fluorescence is a non-invasive method of probing phytoplankton photophysiology by providing information on the functioning of photosystem II within the photosynthetic apparatus (Kolber et al. 1998; Suggett et al. 2005). Changes in biophysical parameters measured by active fluorescence techniques can then be used to infer the factors influencing phytoplankton growth in situ, including nutrient and light availability/stress (e.g. Greene et al. 1994). During D321b, the FAST*tracka*™ I was used to record both continuous underway measurements and discrete samples from bioassay experiments. The FAST*tracka*™ I uses the Fast Repetition Rate (FRR) technique and was manufactured by Chelsea Technologies Group (CTG) (UK). It performed according to previous experience (Moore et al. 2005; 2006).

13.2 Underway measurements on ships non-toxic supply

A CTG FAST*tracka*™ I FRRf was connected to the ships non-toxic supply within the bottle annex in order to monitor the physiological state of photosystem II (PSII) within the surface phytoplankton population throughout the study area. Saturation of variable chlorophyll fluorescence was performed using 100 flashlets of 1.1µs duration with a 2.3µs repetition rate. Subsequent relaxation of fluorescence was monitored using flashlets provided at 98.8µs spacing, giving a total relaxation protocol length of around 2ms. Fouling of the optics was known to occur during the previous cruise, D321a, but did not occur during this cruise due to daily cleaning of the optical surfaces. It should be noted, however, that high flash response values were observed for the underway measurements starred below, even with the gain set to its lowest possible value. The causes of this heightened response will need to be assessed. The data were stored internally on the instrument and downloaded every day during the cleaning step (Table 13.2).

Data will be analyzed at a later date using custom software in a Matlab™ environment.

	Start date	Start time	End date	End time	Gain
UW22	24/08	17:44	25/08	16:07	1
UW23	25/08	16:27	26/08	17:11	1
UW24	26/08	17:22	27/08	18:28	1
UW25	27/08	18:41	28/08	15:37	4
UW26	28/08	15:58	29/08	23:04	4
UW27	29/08	23:17	30/08	16:18	1
UW28	30/08	16:28	31/08	15:42	1
UW29	31/08	15:54	01/09	18:52	1
UW30*	01/09	19:01	02/09	14:52	1
UW31*	02/09	15:08	03/09	18:42	1
UW32*	03/09	19:31	04/09	17:11	1
UW33*	04/09	17:24	05/09	18:40	1
UW34	05/09	18:47	06/09	17:14	1
UW35	06/09	17:20	07/09	15:06	1

Table 13.1 Underway sampling files, dates and times. * indicates that flash response values were higher than flash values.

13.3 Discrete measurements of samples from bioassays

Daria Hinz, Maria Nielsdóttir

Discrete samples from one Fe addition bioassays were run through a second FAST*tracka*™ I FRRf after being allowed to relax in the dark for >30 minutes (Table 13.2). Data will be analyzed using custom codes within Matlab™.

	Sampling location	Sampling method	Start date	End date
E05	61.099 N to 61.036 N -19.507 W to -19.472 W	Tow Fish	27th August	3rd September

Table 13.2 Sampling method, location, and dates for bioassay experiment.

13.4 Heme

Daria Hinz, Maria Nielsdóttir, Martha Gledhill

Between 2 and 3.5 liters from three CTD casts was filtered onto 25 mm Whatman GF/F ® glass microfibre filters for heme, a protein that has been suggested as a potential marker for Fe (Table 13.3). The filters were placed in 1.5 ml eppendorf tubes and frozen at -80°C for later analysis by Dr. Martha Gledhill, NOCS.

CTD number	Volume filtered (L)	Depths sampled (m)
IB19	2	5, 10, 20, 27, 32, 45
IB5	3.5	5, 10, 20, 27, 32, 45, 75
R	3.5	5, 10, 20, 27, 32, 45, 75

Table 13.3 Sampling locations, volumes, and depths for heme.

References

Greene, R.M., Kolber, Z., Swift, D.G., Tindale, N.W. and Falkowski, P.G. (1994) Physiological limitation of phytoplankton photosynthesis in the eastern equatorial Pacific determined from variability in the quantum yield of fluorescence. Limnol. Oceanogr. 39 1061-1074

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14 Iron biogeochemistry in the high latitude North Atlantic

Maria C. Nielsdóttir (PI) and Daria Hinz

14.1 Introduction

Iron, as an essential component of the photosynthetic system, is of major importance for aquatic photosynthetic organisms Due to the insolubility of Fe(III) the concentration of iron in oxygenated seawater is extremely low (<0.5 nM in the open ocean). The main sources of iron to the euphotic zone are from deep waters and atmospheric dust.

There are very few measurements of iron in the North Atlantic, a region of crucial importance to deep-water formation. The lack of measurements of iron in the world's ocean hampers the development of high accuracy global carbon cycle models.

Observations made in the Irminger Basin in 2002 and in the Icelandic basin in 2004 showed that in late summer there was a residual nitrate level and low levels of Chlorophyll-*a* biomass in the upper waters and study of the phytoplankton with Fast Repetition Rate Fluorometry (FRRF), showed a state of poor physiological condition.

It is now hypothesised that Fe could be a seasonally limiting element in the high latitude North Atlantic.

In order to test this hypothesis, iron and associated biological variables were determined on the Extended Ellet-line cruise in August-September 2007. The Extended Ellett-line consists of a series of stations from the Scottish continental shelf to Rockall and all the way to Iceland. Furthermore, nutrient addition bioassay experiments were carried out. Iron was added to the bottles and the physiological condition (Fv/Fm) was examined with FRRF, and compared with control bottles.

14.2 Sampling

Samples for dissolved iron, iron speciation and total iron were sampled from the Titanium CTD.

Station	Date	Location
IB19	26.08.07	Iceland Basin
IB2	28.08.07	Iceland Basin
E	28.08.08	Ellett-Line
H	29.08.07	Ellett-Line
L	29.08.07	Ellett-Line
O	30.08.07	Ellett-Line
T800W	04.09.07	Faroe-Shetland Channel

Table 14.1 Sampling locations

Each station was sampled for 10-12 horizons in addition to a surface sample from the tow fish.

14.3 Method

Samples for dissolved iron will be analysed back at NOC,S with the Flow Injection Chemiluminescence method by Obata 1995 and modified by de Jong 1998. The samples for total iron will be analysed in 6-8 months time by the Flow Injection method. The samples for iron speciation will be analysed with cathodic stripping voltammetry.

14.4 Nutrient addition bioassay experiment

Maria Nielsdóttir, Daria Hinz, Mark Moore, Eric Achterberg

Nutrient addition bioassay experiments were performed to investigate the inter-dependence of iron (Fe) and light availability on phytoplankton physiology, growth and nutrient drawdown. Experiments were similar in design to those performed during D285 (CROZEX).

Strict controls were required to avoid contamination of incubation containers and sampled water. Incubations were performed in acid washed 4.5 l polycarbonate bottles. Bottle filling and all manipulation steps including spiking and sub-sampling were performed within the dedicated Class-100 air filtered clean container. Samples were collected from the trace metal clean sampling fish (E05). Following filling, bottles were sealed with Parafilm, then double bagged before being incubated on deck at 33 or 4.5% of the above water irradiance and at sea surface temperature.

One experiment was carried out over a course of seven days. The plan was to break down the experiment on day 6 but due to bad weather the experiment was extended a day. Samples for POC/PON, HPLC, taxonomy, chlorophyll, nutrients, FRRF and iron were sampled at the setup and at the end of the experiment. FRRF and nutrients were subsampled day 2 and 4.

Further analysis will be carried out at NOCS.

15 Microbial Diversity

Ross Holland, NOCS

15.1 Instruments Used

Becton Dickinson FACSCalibur Flow Cytometer

Tecan Miniprep 60 Liquid Handling Robot

15.2 CTD Sampling

A range of CTD casts as outlined in table (1) were sampled for flow cytometric analysis. Casts were analysed for changes in bacterioplankton and picophytoplankton community structure and abundance with depth, with particular emphasis on the stations of the Ellett Line between Reykjavik, Iceland and the Inner Hebrides, UK. Subsequent stations during the cruise were physics-focused, and time restraints, water availability and depth precluded intensive biological sampling.

In addition to standard flow cytometric analysis, a greater volume of sample was drawn from surface bottles and bottles perceived to be at, or close to the deep chlorophyll maximum. These additional samples were passed through a range of filters of increasing pore size before flow cytometric analysis in order to size fractionate the flow cytometrically resolved communities and provide a means of correlating mean side scatter and size of cell, and to improve estimations of biomass for each resolved population. Pore sizes used were:

0.1µm 0.2µm 0.4µm 0.6µm 0.8µm 1µm 1.2µm 2µm 5µm 8µm 10µm

Data were analysed on bivariate dotplots using Cellquest software (Becton Dickinson, Oxford, UK). Picophytoplankton communities were resolved on plots of Side Scatter against Red Fluorescence (Chlorophyll autofluorescence), and synechococcus populations were resolved on plots of Side scatter against orange fluorescence (phychoerythrin autofluorescence.) Bacterioplankton and viral populations were resolved on plots of side scatter against green fluorescence. The DNA stain Sybr green was used to stain the nucleic acids of bacterioplankton cells prior to flow cytometric analysis.

Station	Bottle	Depth	Size Fractionation
IB23s	23	5	
IB23s	20	10	
IB23s	17	20	
IB23s	14	27	
IB23s	11	32	
IB23s	8	45	
IB23s	5	75	
IB23s	2	112	
IB22s	10	200	
IB22s	12	125	
IB22s	14	75	
IB22s	16	45	
IB22s	18	32	
IB22s	20	20	
IB22s	22	10	
IB22s	24	5	

Station	Bottle	Depth	Size Fractionation
IB21s	8	125	
IB21s	10	75	
IB21s	12	45	
IB21s	14	32	
IB21s	16	27	
IB21s	19	20	
IB21s	21	10	
IB21s	24	5	
IB20	8	125	
IB20	10	75	
IB20	12	45	
IB20	14	32	
IB20	16	27	
IB20	18	20	
IB20	20	10	
IB20	24	5	

Station	Bottle	Depth	Size Fractionation
IB19s	8	200	
IB19s	10	125	
IB19s	12	75	
IB19s	14	45	
IB19s	16	32	
IB19s	18	27	
IB19s	20	20	
IB19s	22	10	
IB19s	24	5	
IB18s	8	200	
IB18s	10	125	
IB18s	12	75	
IB18s	14	45	
IB18s	16	32	
IB18s	18	27	
IB18s	20	20	
IB18s	22	10	
IB18s	24	5	
IB17s	8	200	
IB17s	10	125	
IB17s	12	75	
IB17s	14	44	
IB17s	16	32	
IB17s	18	27	
IB17s	20	20	
IB17s	22	22	
IB17s	24	10	
IB16x	2	125	
IB16x	5	75	
IB16x	8	45	
IB16x	11	32	
IB16x	14	27	
IB16x	17	20	
IB16x	20	10	
IB16x	23	5	
IB5	8	203	
IB5	10	127	
IB5	12	78	
IB5	14	47	x
IB5	16	34	
IB5	18	29	
IB5	20	23	
IB5	22	12	
IB5	24	8	x
IB4	5	200	
IB4	8	125	
IB4	10	75	
IB4	12	45	x
IB4	14	32	
IB4	16	27	

Station	Bottle	Depth	Size Fractionation
IB4	18	20	
IB4	20	10	
IB4	22	5	x
IB3	8	200	
IB3	10	125	
IB3	11	75	
IB3	14	45	x
IB3	16	32	
IB3	18	27	
IB3	20	20	
IB3	21	10	
IB3	23	5	x
A	2	100	
A	4	75	
A	6	75	
A	8	45	x
A	10	32	
A	14	27	
A	16	20	
A	20	10	
A	22	5	x
G	8	200	
G	9	175	
G	10	125	
G	11	75	
G	13	45	x
G	15	32	
G	17	27	
G	19	20	
G	21	10	
G	23	5	x
F	6	250	
F	8	125	
F	10	75	
F	12	45	x
F	14	32	
F	16	27	
F	18	20	
F	20	10	
F	22	5	x
I	4	252	
I	5	127	
I	6	77	
I	8	47	x
I	10	34	
I	14	29	
I	16	22	
I	20	12	
I	22	7	x
N	8	125	

Station	Bottle	Depth	Size Fractionation
N	11	75	
N	13	45	x
N	15	32	
N	18	27	
N	19	20	
N	21	10	
N	23	5	x
P	7	127	
P	8	77	
P	10	48	x
P	12	34	
P	14	29	
P	18	22	
P	20	12	
P	24	7	x
R	2	117	
R	4	75	
R	8	45	x
R	10	32	
R	14	27	
R	18	20	

Station	Bottle	Depth	Size Fractionation
R	20	10	
R	22	5	x
4G	2	65	
4G	6	50	x
4G	8	25	
4G	10	15	
4G	14	10	
4G	18	5	x
EG3	125	125	
EG3	75	75	
EG3	32	32	x
EG3	27	27	
EG3	20	20	
EG3	10	10	
EG3	5	5	x
T800w	13	45	x
T800w	15	33	
T800w	17	28	
T800w	19	20	
T800w	21	11	
T800w	23	5	x

Table 15.1. CTDs and bottles sampled for Flow Cytometric Analysis.

15.3 Underway Sampling

In addition to CTD sampling, there were two periods of underway sampling during times of low CTD activity. Samples were drawn once every half an hour from the ships non-toxic seawater supply by a Tecan Miniprep 60 liquid handling robot and analysed flow cytometrically for studies of picophytoplankton and bacterioplankton community composition. The first period of underway sampling was between 13:30 (GMT) on August 24th 2007 and 06:30 (GMT) on August 26th 2007. The Second period of underway sampling was between 19:00 (GMT) on 3rd September 2007, and 02:30 (GMT) on 6th September.

16 Molecular analysis of phytoplankton communities in the North Atlantic

Andrea Baker, Harriet Harden-Davies, Rachel Gibson. NOCS (PI: Debora Iglesias-Rodriguez)

The objectives of this cruise were to investigate the molecular ecology of phytoplankton in the North Atlantic by collecting water samples for the extraction of DNA and RNA.

Specifically, samples collected for DNA analysis will used to investigate the diversity and distribution of bioluminescent dinoflagellates and also to look at the general diversity of microbial communities across the Ellett line. Samples collected for RNA analysis will be used to study the expression of bioluminescent genes in natural communities. We also aimed to study the virus community across the Ellett line, with the view to isolating viruses and studying virus community dynamics.

Comprehensive sampling for all three parameters, viruses, DNA and RNA, was carried out on the CTD casts which were deployed at 'dawn' along the Ellett line. The 'dawn' casts were selected as these were the stations where most of the biological measurements were being taken, including primary productivity. Seven CTD casts were sampled for these, with 4 depths being analysed, typically 5 M, 25 M (deep chlorophyll maximum), 75 M and 125 M.

In addition to this, samples were collected for DNA analysis across a transect of the Ellett line for phytoplankton diversity studies. An extra 13 CTD stations were sampled from, and again 4 depths were sampled.

Underway water was also sampled throughout the cruise at 6 positions, again for DNA/RNA analysis and viruses, but also for the collection of samples to preserve for single cell PCR studies (Table 16.1).

Date (da/mo/yr)	Time (GMT)	Latitude	Longitude	Max depth (M)
26/08/07	13:54	62°20.076 N	19°50.851 W	1681
27/08/07	13:24	59°48.861 N	17°59.110 W	2660
28/08/07	12:58	57°39.882 N	13°53.833 W	139
02/09/07	09:17	60°16.126 N	09°01.930 W	1064
03/09/07	08:45	60°35.163 N	08°17.425 W	804
05/09/07	08:48	60°15.850 N	06°50.408 W	1178

Table 16.1. Underway water sampled during the course of the Ellett line cruise for molecular analysis.

16.1 DNA Sampling

2 litres of water were vacuum filtered through 0.45 µm membrane filters (Millipore). Filters were frozen at –80 °C and stored until analysis back at the N.O.C.

16.2 RNA sampling

2 litres of water were vacuum filtered through 0.45 µm membrane filters (Millipore). 1 ml of RNA later (Ambion) was added to each of the filters and was incubated overnight at 4 °C. These were then transferred to –80 °C and were stored until analysis at N.O.C.

16.3 Virus Sampling

5 litres of water were vacuum filtered through 0.45 µm membrane filters (Millipore). The filtrate was then concentrated using tangential flow filtration with a 30 kDa cut off (Vivaflow, Sartorius) to 20 ml. 3 x 1 ml of the virus concentrate was stored at 4 °C for virus isolation at N.O.C. 6 x 1 ml aliquots were stored at –80 °C for DNA/RNA analysis back at the N.O.C.

Sampling for single cell PCR analysis

10 litres of water were vacuum filtered through 10 µm membrane filters (Millipore). Material was washed off the filters by pipetting, using 2 ml Ethanol and was stored at –20 °C until analysis at N.O.C.

17 Phytoplankton Samples

Andrew Reynolds, Andrea Veszelovszki (PI: Keith Davidson)

Natural water samples were collected at certain stations at the depth of 10 metres and at some stations at chlorophyll maxima from CTD Niskin bottles into a 250 ml sample bottle.

From each seawater sample 100 ml was measured and poured into a small amber bottle containing 1 ml of 100 % concentration of Lugol's iodine. This formed a fixed solution with a concentration of 1 % of Lugol's iodine.

The fixation process was carried out on deck in a well ventilated position.

The fixed samples were stored in a wooden crate and will be taken back to SAMS for further analysis.

Station	Date	Time	Sample depth (m)	Latitude	Longitude	Bottom depth (m)
F	29/08/07	03:57	10	57° 30.58 N	12° 15.05 W	1799
I	29/08/07	12:30	10	57° 27.94 N	11° 18.94 W	750
M*	29/08/07	00:27	10	57° 18.02 N	10° 22.85 W	2208
N	30/08/07	04:16	10	57° 14.04 N	10° 02.97 W	2099
Q	30/08/07	13:14	10	57° 02.96 N	09° 13.17 W	320
R	30/08/07	14:35	10	56° 59.99 N	08° 59.92 W	125
14G	30/08/07	21:08	10	56° 48.48 N	08° 09.95 W	124
13G	30/08/07	22:30	10	56° 48.98 N	08° 59.97 W	116
10GA	31/08/07	03:15	10	56° 48.47 W	07° 30.08 W	82
10GA	31/08/07	03:15	35	56° 48.47 W	07° 30.08 W	82
9GA	31/08/07	05:26	10	56 47.90 N	07° 20.91 W	151
8GA	31/08/07	06:59	10	56° 48.81 N	07° 10.71 W	138
7G	31/08/07	08:15	10	56° 44.10 N	07° 00.04 W	134
6G	31/08/07	10:00	10	56° 43.98 N	06° 00.01 W	37
5G	31/08/07	11:07	10	56° 43.97 N	06° 35.94 W	71
4G	31/08/07	12:24	10	56° 43.99 N	06° 26.85 W	71
1G	31/08/07	14:54	10	56° 40.02 N	06° 07.82 W	133

***** At this station the volume of sample taken was 50 ml.

Table 17.1 Phytoplankton sampling stations

18 Photosynthetic Picoeukaryote Ecology

Amy Kirkham (Supervisor – Dave Scanlan) University of Warwick

18.1 DNA, RNA and FISH (Fluorescent in situ hybridisation)

A CTD was sampled each day to provide water for size fractionation through a 3µm prefilter, before harvesting cells on a 0.45µm filter (for future DNA and RNA extraction at Warwick) or, after prefiltration, samples were fixed using paraformaldehyde for an hour before harvesting on a 0.2µm filter (for FISH - to be completed on return to Warwick). 20L of water was collected from each of 5or 6 depths from each CTD used (table 1), of this 3-7L was used for DNA filters, 7-15L was used for RNA filters and 100ml-1L was used for FISH filters. These samples will be used to determine the community structure and diversity of photosynthetic picoeukaryotes present.

18.2 ^{13}C uptake experiments

On 3 occasions during the cruise large volumes were taken either from a CTD from the DCM or from the surface underway supply for use in ^{13}C uptake experiments. This involved incubation of 10L of water with 5% ^{13}C labelled sodium bicarbonate for 0, 3 and 6 hours in duplicate. Samples were processed by collection of cells using cell-traps which were flash frozen and stored for further analysis. 200ml was used for total primary production analysis both with and without a 3µm prefiltration step. Filters were also taken for future community analysis by FISH, as described above.

18.3 BAC libraries

On 3 occasions, 20L was taken from CTDs from surface and DCM levels and concentrated using cell traps for future metagenomic analysis by a new PhD student at Warwick.

18.4 Clone libraries

On several occasions, 1-2L of water from CTDs and underway water was concentrated using cell traps for future flow sorting for work on the efficiency of clone library techniques.

18.5 Cultures

At the end of the cruise 200ml water was taken from the underway supply and prefiltered through a 3µm filter before adding nutrient medium suitable for the picoeukaryote class chrysophyceae. Hopefully, in future this will be used to isolate Chrysophyte members for characterisation.

Date	Time	Station	Depths	Activities
25 Aug 07	0230	IB23S	5m 10m 20m (DCM) 32m 45m 112m	DNA, RNA
26 Aug 07	0330	IB21S	5m 10m 20m 32m 45m 125m	DNA, RNA FISH (32m and shallower)
27 Aug 07	0330	IB16X	5m 10m 20m 32m 45m 125m	DNA, RNA
28 Aug 07	0200	IB4	5m 10m 20m 32m 45m 125m	DNA, RNA
29 Aug 07	0330	F	5m 10m 20m 32m 45m 125m	DNA, RNA FISH (20m and shallower)
30 Aug 07	0400	N	5m 10m 20m 32m 45m 125m	DNA, RNA FISH (20m and shallower)
30 Aug 07		P	5m 20m	BAC libraries
31 Aug 07		9GA	5m 10m 20m 32m 45m	DNA FISH (20m and shallower)
31 Aug 07		5G	20m	^{13}C experiment
02 Sep 07			Underway 5m	BAC libraries Clone libraries
02 Sep 07	1645	EG3	5m 10m 20m 32m 45m	DNA, RNA FISH (20m and shallower)
03 Sep 07	0900		Underway 5m	^{13}C experiment
04 Sep 07	0900	T800W	5m 10m 20m 32m 45m	DNA, RNA FISH (32m and shallower) Clone libraries
05 Sep 07	0900		Underway 5m	^{13}C experiment
06 Sep 07	0900		Underway 5m	DNA Clone library
06 Sep 07	1605		Underway 5m	Cultures

Table 18.1 Sample stations

19 Phytoplankton New and Regenerated Production.

Sandy Thomalla, Lena Gieschen and Mike Lucas (Principle Investigator)

19.1 Objectives

1. To measure phytoplankton new and regenerated production using ^{15}N-NO_3, ^{15}N-NH_4 and ^{13}C tracers.
2. To assess Redfield C:N fixation rates from dual-labelling (^{13}C, ^{15}N) experiments

19.2 General Approach and Methods

Uptake measurements were made from seven CTD stations along the Ellet line (see Table 19.1 for station positions). *In situ* profile measurements of dual labelled (13C + 15N) light and dark nitrate uptake and C fixation were carried out at six light depths (55, 33, 14, 7, 4.5 and 1%). At each of these depths, ammonium uptake and regeneration was also measured.

New production, nitrate and ammonium uptake and carbon fixation.

Dual-labelled light and dark nitrate (15-NO3, 13C-bicarbonate) and ammonium uptake (15N-NH4) incubations were conducted at the 6 light depths in 2.0L polycarbonate bottles from dawn till dusk (~ 10 hours). Simulated *in situ* temperatures were maintained by flushing the incubators with surface seawater Light and dark bottles were inoculated with both 15N (0.1µmol $K^{15}NO3$ / 100µl) and 13C spikes (4.2507g sodium bicarbonate / 100ml Milli Q water) to achieve 15N-NO3 and 13C enrichments of ~10 and 4% respectively. Ammonium uptake bottles were spiked with 0.1µmol $^{15}NH_4Cl$ / 100µl to also achieve an enrichment of ~10%. After incubation, samples were filtered onto pre-ashed GF/F filters; stored frozen (at -20°C) prior to measuring 15N and 13C enrichment on a mass spectrometer at NOC.

Nitrate and ammonium measurements were determined on-board by Tim Brand using a Lachat Quick-Chem 8000 flow injection autoanalyser. Ammonium samples were also frozen at -20^{o}C for analysis at NOC using the orthophthaldialdehyde (OPA) fluoresence protocol.

Ammonium regeneration

Isotopic dilution NH_4^+ regeneration experiments were conducted to correct for $^{14}NH_4^+$ re-cycling in the $^{15}NH_4^+$ incubation bottles. Immediately after spiking the 2L NH_4^+ uptake bottles, exactly 1L was recovered from each and promptly filtered through a 25mm Whatman GF/F filter to collect 900ml filtrate for transfer into 6 x 1.0L glass Schotte bottles. Depending on the ambient ammonium concentration, either 50 or 100µmol of NH_4Cl solution (10µmol / ml) was added to each of these bottles as a "carrier" prior to freezing the samples at –20°C. This sample provided the time zero NH_4^+ regeneration concentration (R0). The GF/F filter from this sample was stored at -80°C and retained for later HPLC analyses. At the end of the 12hr incubation period, a further 900ml filtrate was recovered from the NH_4^+ uptake filtration to measure ^{15}N isotopic dilution (Rt). Carrier (50/75µl) was added and the Rt sample was frozen as before. The aqueous NH_4^+ will be

recovered onto GF/F filters by diffusion and the isotopic composition (and dilution) measured by mass spectrometry at NOC as before.

19.3 In situ 15N Productivity Stations

Station Name	Latitude	Longitude	Julian Day
IB 23S	63° 19.20	20° 12.70	237
IB 21S	63° 08.26	19° 54.71	238
IB 16X	61° 05.93	19° 30.91	239
IB 4	58° 29.92	16° 00.25	240
I	57° 30.75	12° 15.07	241
N	57° 14.39	10° 02.97	242
9G	56° 48.35	07° 20.87	243

Table 19.1 Station details

20 Total Chlorophyll Measurements

Sandy Thomalla, Lena Gieschen and Mike Lucas (Principle Investigator)

20.1 Objectives and methodology

1. To measure total chlorophyll-a concentrations along the Ellett line and in the Faeroe Bank Channel

Total chlorophyll samples were taken from 4 to 8 depths in the surface 125m (see Fig. 20.1 for station positions). Total chlorophyll-a was measured fluorometrically on board ship using a TD-700 Turner Designs fluorometer, calibrated with fresh chlorophyll standard (Sigma, UK) and set up to measure chlorophyll-a in the presence of chlorophyll-b following Welschmeyer (1994). Particulate matter in the samples was recovered by filtering 200 ml of seawater through glass fibre filters (Whatman GF/F) which were then stored in 90% acetone at -20°C overnight to extract pigments prior to reading on the Turner Designs fluorometer.

20.2 Results

The chlorophyll-a distribution for the Ellett line is shown in figure 2. Chlorophyll concentrations measured on D321a for stations IB6 to IB12 have been incorporated into the section. Highest chlorophyll concentrations of ~6mg.m^{-3} were found in surface waters just off the coast of Scotland. Higher chlorophyll concentrations (~1-2 mg.m^{-3}) were also found off the coast of Iceland and near Rockall. Low chlorophyll concentrations were found in surface waters of the Iceland Basin. Chlorophyll concentrations below 50m were less than 0.2mg.m^{-3} except on the Scottish shelf where concentrations of 0.4 mg.m^{-3} extended to ~200m.

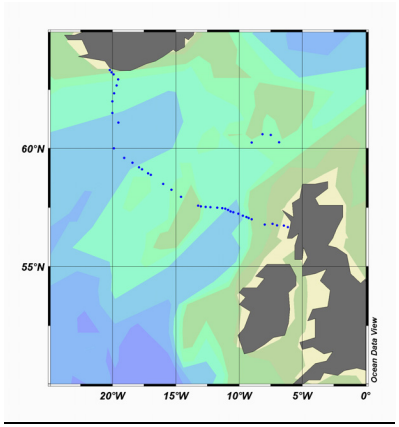

Figure 20.1. Station positions for chlorophyll-a measurements along the Ellett line from Iceland to Scotland and in the Faeroe Bank Channel.

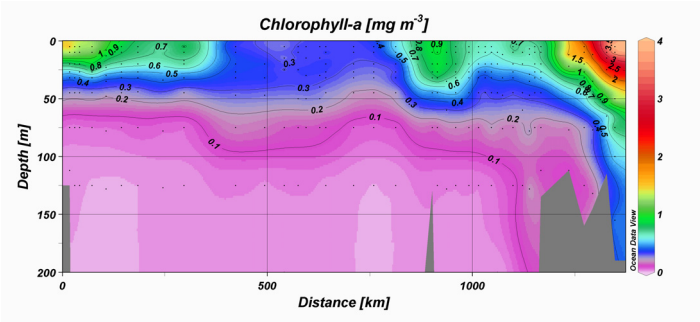

Figure 20.2. A section of the Ellett line from Iceland to Scotland showing chlorophyll-a concentrations (mg.m^{-3})

21 Computing report

Martin Bridger

21.1 Logged Data (RAW)

GPS_4000Trimble Navigator 4000*Techsas
Lat=lat
Lon=lon
Gndcourse =hdg
Gndspeed = hvel

Logged but not used:

Alt	Nbseen	HDOP	PDOP
Prec	Nbused	VDOP	

GPS_G12Fugro G12 GPS*LevelB
Type

Svc	Lon	Smg	Hdop
Utc	Alt	Vvel	Vdop
Lat	Cmg	Pdop	Tdop

GPS_ASHAshtec Attitude Detection Unit 2*Techsas & *LevelB

Sec	Hdg	Mrms
Lat	Pitch	Brms
Lon	Roll	Attf

WINCHCable Monitoring System*LevelB

Cabltype	Rate	Btension	Angle
Cablout	Tension	Comp	

EA500D110kHz Echo Sounder*Techsas

Depth	Rpow	Angfa	Angps

GYRONMEAGyrocompass*Techsas
Heading

LOG_CHFChernikeef Log (EM LOG)*Techsas & *LevelB

Speedfa	Speedps

SURFMETSurface and Meteorological Instruments*Techsas & *LevelB

Temp_h	Trans	Speed	Ptir
Temp_m	Pres	Direct	Stir
Cond	Ppar	Airtemp	
Fluo	Spar	Humidity	

21.2 Data Logging

*Techsas Logged on Techsas Logger (Replacment to Level A & B)
*LevelB Data was logged using the previous generation LevelA and LevelB

21.2.1 Processed Data (PRO)

RELMOVInputs: GYRONMEA, LOG_CHF
Output: RELMOV

Vn	Ve	Pfa	Pps

BESTNAVinputs: RELMOV, GPS_4000, GPS_G12, GPS_ASH
Output: BESTNAV

Lat	Cmg	BESTDRF	Kve
Lon	Smg	Vn	
Vn	Dist_run	Ve	
Ve	Heading	Kvn	

WINDCALCinputs: bestnav, surfmet*
Outputs: pro_wind

Abswspd(knots)	Abswdir

PROTSGinputs: surfmet
Output: protsg

Temp_m	Cond	Sigmat
Temp_h	Salin	

PRODEPinputs: EA500D1
Output: PRODEP

Uncdepth	Cordepth	Cartarea

•Some temporary files were created to aid data editing. SURFTMP is an editing copy of SURFMET
•RAWDEP is a editing copy if EA500D1, FILTDEP and AVEDEPTH are used in depth processing, see below.
All data processing was done on Sun Workstation 'Level C' using RVS data format and RVS data processing tools. Data was converted from NetCDF where necessary.

21.3 Data Integrity

Gaps in data of more than 60 seconds
GPS_4000
GPS_ASH
LOG_CHF
GYRONMEA
SURFMET

21.4 Cruise Data Archive

The cruise DVD(s) contains the following files:

RVS data files.
These are located in raw_data and pro_data, which refer to raw data from instruments and processed data that is derived from the raw data files e.g. pro_wind, protsg etc…

SBWR
Data files from the Shipborne Wave Recorder.

Techsas/NetCDF
NetCDF files logged on Techsas
Techsas/NMEA
NMEA files logged on Techsas

Ascii
All Cruise Data in ascii text format

Plots
Any plots and graphs produced during the cruise.

Weather
Weather charts from the Met Office sorted by type and date.

Misc
TSG water samples compared measured using Autosal compared to TSG Salinity with protsg.

Daily Data Processing
Data logged by was converted to RVS formatted files. The files converted were: position (log), gyro and log (Chernikeef). To convert the data we used the nclistit command e.g.
Nclistit [file to convert] – titsil –o [target stream] [variable list]
Bestnav: Takes navigation inputs from multiple navigation files and generates a continuous navigation file.
Relmov: Calculates the relative motion of the ship from gyro and log data.
Pro_wind: Used to derive absolute wind speed and direction from relative wind speed and direction, course and speed made good, and ships heading
Protsg: Used to derive Salinity from Surfmet Data.

Depth Processing
The following process was applied to the echo sounder data stream EA500D1.
copyit –v0 –l1 ea500d1 rawdep depth
Copies depth data with depth greater than 1m to working file rawdep, which was then manually edited to remove spikes and other obviously bad data.

Movfilt –o –kGOOD 21 rawdep filtdep depth
Applies a moving window filter to the rawdep file for values that are good.
Average –o 1m filtdep avedepth depth
Calculates average depth data and placed in 1 minute bins.
Prodep (menu driven)
Performs Carter Area Correction on the depth data from avedepth.

Backups
Daily backups of data were taken throughout the duration of the cruise. Two tapes were used to ensure that data was retained for a period of 48 hours.

Data Cleaning
Data was manually edited to flag out bad data. Each variable is given a status flag of:
20=REJECT
30=SUSPECT
50=GOOD
A value of less than 50 indicates that it is suspect value and is likely to have been flagged out or rejected.

PCO2
The PML PCO2 was continuously running throughout the cruise. The D321B.paf and log files are located in the PCO2 folder of the cruise DVD.

Surfmet (Continuous Surface Water and Meteorological Measurements)
Surfmet consists of thermosalinograph (temperature, conductivity) Transmissometer, Fluorometer, and remote temperature sensor connected to the ships non-toxic system in the wet lab.
Meteorological instruments are located on the fore mast. They consist of Port and Starboard PAR and TIR sensors. A temperature and humidity sensor. Wind speed and direction sensors, and a barometric pressure sensor.
For more information about sensors used please refer to the file:
<D321B Surfmet Instrument List.doc>

TSG Calibration.
Water samples were taken twice daily during the cruise to establish a relationship between the thermosalinograph and a standardised Autosal located in the constant temperature lab. The results of this calibration can be found in the file: D321B_Autosal_Protsg.xls
Log sheets of water samples, cleaning and maintenance can be found in the files: TSG Maintenance Log.pdf TSG Salinity Logsheet.pdf

The file Surfmet Cal Coefficients.doc contains information about the calibration coefficients entered into the Surfmet computer and used for the protsg processing routine. Protsg.cal.rtf is the actual calibration file protsg uses.

22 NOC Sensors Report

22.1 CTD system configuration

Jeff Bicknell, NMFSS

Comments on the overall performance of the CTD and Rosette system combined are given in Chapters 4 to 7.

22.1.1 Stainless frame

1) 61 CTD casts were undertaken during D321b. Two systems were employed, the main large-volume water sampling arrangement was a NOC 24-way stainless steel frame system, (s/n SBE CTD 01), and the initial sensor configuration was as follows (a copy of the Sea-Bird configuration file is attached):

Sea-Bird 9plus underwater unit, s/n 09P-24680-0636
Sea-Bird 3P temperature sensor, s/n 03P-4782, Frequency 0 (primary)
Sea-Bird 4C conductivity sensor, s/n 04C-3258, Frequency 1 (primary)
Digiquartz temperature compensated pressure sensor, s/n 83008, Frequency 2
Sea-Bird 3P temperature sensor, s/n 03P-4383, Frequency 3 (secondary)
Sea-Bird 4C conductivity sensor, s/n 04C-2164, Frequency 4 (secondary)
Sea-Bird 5T submersible pump, s/n 05T-4166, (primary)
Sea-Bird 5T submersible pump, s/n 05T-3086, (secondary)
Sea-Bird 32 Carousel 24 position pylon, s/n 32-37898-0518
Sea-Bird 11plus deck unit, s/n 11P-19817-0495

2) The auxiliary input initial sensor configuration was as follows:

Sea-Bird 43 dissolved oxygen sensor, s/n 43-0619 (V0)
Benthos PSA-916TD altimeter, s/n 1040 (V2)
Chelsea MKIII Aquatracka fluorometer, s/n 88-2050-095 (V3)
Chelsea MKII Alphatracka transmissometer, s/n 161/2642/002 (V7)

3) Additional instruments:

Ocean Test Equipment 20L ES-120B custom water samplers
Sonardyne HF Deep Marker beacon, s/n 234002-002
NOC 10 kHz acoustic bottom finding pinger, s/n B8
NOC Sea-Bird BreakOut Box, s/n BO119201
RDI Workhorse Monitor 300kHz LADCP, s/n 5415 (downward-looking, Master)
RDI Workhorse Monitor 300kHz LADCP, s/n 9191 (upward-looking, Slave)
NOC RDI Workhorse aluminium battery pack pressure case, s/n WH001

22.1.2 Titanium frame

4) The second CTD system was a NOC 24-way titanium frame system, (s/n SBE TITA 02), and the initial sensor configuration was as follows (a copy of the Sea-Bird configuration file is attached):

22.1.3

Sea-Bird 9plus underwater unit, s/n 09P-24680-0637
Sea-Bird 3P temperature sensor, s/n 03P-4592, Frequency 0 (primary)
Sea-Bird 4C conductivity sensor, s/n 04C-3272, Frequency 1 (primary)
Digiquartz temperature compensated pressure sensor, s/n 79501, Frequency 2
Sea-Bird 5T submersible pump, s/n 05T-3002, (primary)
Sea-Bird 32 Carousel 24 position pylon, s/n 32-34173-0493
Sea-Bird 11plus deck unit, s/n 11P-19817-0495

6) The auxiliary input initial sensor configuration was as follows:

Sea-Bird 43 dissolved oxygen sensor, s/n 43-0363 (V0)
Tritech PA200T altimeter, s/n 6196-112522 (V2)
Chelsea MKIII Aquatracka fluorometer, s/n 88-2960-160 (V3)
Chelsea MKII Alphatracka transmissometer, s/n 07-6075-01 (V7)

7) Additional instruments:

Ocean Test Equipment 10L ES-110B trace metal-free water samplers, s/n's 1 through 24
Sonardyne HF Deep Marker beacon, s/n 245116-001
NOC Sea-Bird BreakOut Box, s/n B19109T

22.1.4 Salinometer and FRRF

1) Autosal salinometer--- A total of 341 salinity samples were taken from CTD casts and from the underway seawater system for calibration purposes. The instrument details are as below:

Guildline Autosal 8400B, s/n60839 installed in Constant Temperature Laboratory, Autosal set point 21C.

2) Fast Repetition Rate Fluorometers---Two instruments were utilized for laboratory experiments, and the configurations are as follows:

Chelsea FRRF, s/n 182042, mounted in Deck Lab for discrete sampling.
Chelsea FRRF, s/n 05-5335-001, installed in Water Bottle Annex for flow-through sampling.

22.2 CTD configuration files

22.2.1 Stainless frame

Date: 08/24/2007

ASCII file: C:\Program Files\Sea-Bird\Seasave-Win32\D321\D321StS\Data\0636_LegB.con

Configuration report for SBE 911/917 plus CTD

Frequency channels suppressed : 0
Voltage words suppressed : 0
Computer interface : RS-232C
Scans to average : 1

Surface PAR voltage added : No
NMEA position data added : Yes
Scan time added : Yes

1) Frequency, Temperature

Serial number : 4782
Calibrated on : 12 Apr 07
G : 4.34970408e-003
H : 6.36138880e-004
I : 2.06317624e-005
J : 1.70008023e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

2) Frequency, Conductivity

Serial number : 3258
Calibrated on : 27 March 07
G : -1.03662178e+001
H : 1.32445756e+000
I : -2.75753669e-004
J : 7.14302235e-005
CTcor : 3.2500e-006
CPcor : -9.57000000e-008
Slope : 1.00000000
Offset : 0.00000

3) Frequency, Pressure, Digiquartz with TC

Serial number : 83008
Calibrated on : 13 May 2005
C1 : -4.093335e+004
C2 : -1.005887e-001
C3 : 1.104120e-002
D1 : 3.017600e-002
D2 : 0.000000e+000
T1 : 2.992572e+001
T2 : -3.202788e-004
T3 : 3.724670e-006
T4 : 2.870340e-009
T5 : 0.000000e+000
Slope : 1.00001000
Offset : -0.17810

AD590M : 1.285370e-002
AD590B : -8.337660e+000

4) Frequency, Temperature, 2

Serial number : 4383
Calibrated on : 1 May 2007
G : 4.39869631e-003
H : 6.55457848e-004
I : 2.42493473e-005
J : 2.01233663e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

5) Frequency, Conductivity, 2

Serial number : 2164
Calibrated on : 1 May 2007
G : -9.68392592e+000
H : 1.33451849e+000
I : -2.19870201e-003
J : 2.19768663e-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 : 0619
Calibrated on : 5 October 2006
Soc : 3.5470e-001
Boc : 0.0000
Offset : -0.5018
Tcor : 0.0014
Pcor : 1.35e-004
Tau : 0.0

7) A/D voltage 1, Free

8) A/D voltage 2, Altimeter

Serial number : 1040
Calibrated on : Repaired December 2006

Scale factor : 15.000
Offset : 0.000

9) A/D voltage 3, Fluorometer, Chelsea Aqua 3

Serial number : 088095
Calibrated on : 4 January 2007
VB : 0.363700
V1 : 2.074900
Vacetone : 0.377800
Scale factor : 1.000000
Slope : 1.000000
Offset : 0.000000

10) A/D voltage 4, PAR/Irradiance, Biospherical/Licor

Serial number : 10
Calibrated on : 23 mar 05
M : 0.48682800
B : 1.03027600
Calibration constant : 100000000000.00000000
Multiplier : 1.00000000
Offset : 0.00000000

11) A/D voltage 5, PAR/Irradiance, Biospherical/Licor, 2

Serial number : 9
Calibrated on : 23 March 05
M : 0.44355800
B : 1.65846000
Calibration constant : 100000000000.00000000
Multiplier : 0.99990000
Offset : 0.00000000

12) A/D voltage 6, Free

13) A/D voltage 7, Transmissometer, Chelsea/Seatech/Wetlab CStar

Serial number : 161/2642/002
Calibrated on : 4 September 1996
M : 19.2670
B : -0.5010
Path length : 0.250

22.2.2 Titanium frame

Date: 08/24/2007

ASCII file: C:\Program Files\Sea-Bird\Seasave-Win32\D321\D321TiT\Data\0637_LegB.con

Configuration report for SBE 911/917 plus CTD

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

1) Frequency, Temperature

Serial number : 4592
Calibrated on : 14 April 2007
G : 4.38590755e-003
H : 6.39597212e-004
I : 2.14364451e-005
J : 1.80080861e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

2) Frequency, Conductivity

Serial number : 3272
Calibrated on : 5 April 2007
G : -1.01034392e+001
H : 1.31482969e+000
I : 2.75724611e-004
J : 3.95146235e-005
CTcor : 3.2500e-006
CPcor : -9.57000000e-008
Slope : 1.00000000
Offset : 0.00000

3) Frequency, Pressure, Digiquartz with TC

Serial number : 79501
Calibrated on : 22 SEP 06
C1 : -6.052595e+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 : 3.417041e-006
T4 : 4.126500e-009
T5 : 0.000000e+000
Slope : 0.99982000
Offset : -1.32950
AD590M : 1.293660e-002
AD590B : -9.522570e+000

4) Frequency, Free

5) Frequency, Free

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

Serial number : 0363
Calibrated on : 21 June 2007
Soc : 3.2750e-001
Boc : 0.0000
Offset : -0.6392
Tcor : -0.0004
Pcor : 1.35e-004
Tau : 0.0

7) A/D voltage 1, Free

8) A/D voltage 2, Altimeter

Serial number : 6196-112522
Calibrated on : 25 July 2005
Scale factor : 15.000
Offset : 0.000

9) A/D voltage 3, Fluorometer, Chelsea Aqua 3

Serial number : 088160
Calibrated on : 21 June 07
VB : 0.136200

V1 : 2.144200
Vacetone : 0.181800
Scale factor : 1.000000
Slope : 1.000000
Offset : 0.000000

10) A/D voltage 4, PAR/Irradiance, Biospherical/Licor

Serial number : 03
Calibrated on : 23 Dec 04
M : 0.45712800
B : 1.72492100
Calibration constant : 100000000000.00000000
Multiplier : 1.00000000
Offset : 0.00000000

11) A/D voltage 5, PAR/Irradiance, Biospherical/Licor, 2

Serial number : 04
Calibrated on : 12 Jan 07
M : 0.44797700
B : 1.63480500
Calibration constant : 100000000000.00000000
Multiplier : 0.99960000
Offset : 0.00000000

12) A/D voltage 6, Free

13) A/D voltage 7, Transmissometer, Chelsea/Seatech/Wetlab CStar

Serial number : 07-6075-001
Calibrated on : 22 May 07
M : 19.7915
B : -0.1979
Path length : 0.2

Appendix 1

D321b Event Log

Event No.	Date	Start Time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments
1	25/08/07	0210	0236	IB23S	63 19.05	20 12.57	125	CTD001	
2	25/08/07	2225	2332	IB22S	63 12.96	20 04.10	668	CTD002	
3	26/08/07	0105	0214	IB21S	63 08.25	19 54.71	~1000	CTD003	
4	26/08/07	0448	0619	IB20S	62 55.20	19 32.90	1398	CTD004	
5	26/08/07	1257	0448	IB19S	62 40.08	19 39.86	1681	CTD005	
6	26/08/07	1257	1434	IB18S	62 19.99	19 30.11	1798	CTD006	
7	26/08/07	1702	1809	IB17	62 00.00	19 59.70	1800	CTD007	
8	26/08/07	2202	2212	IB16	61 30.07	19 59.96	2220	CTD008	Titanium - very poor data
9	27/08/07	0340	0405	IB16X	61 05.93	19 30.91	2435	CTD009	Shallow dawn cast
10	27/08/07	0240	0236	IB5	63 19.05	20 12.58	125	CTD010	
11	28/08/07	0100	0220	IB4	58 29.92	16 00.49	1186	CTD011	
12	28/08/07	0525	0622	IB3	58 15.12	15 20.16	655	CTD012	
13	28/08/07	0928	1015	IB2	57 57.01	14 34.88	441	CDT013	Titanium
14	28/08/07	1304	1325	IB1	57 39.93	13 53.90	137	CTD014	
15	28/08/07	1452	1525	A	57 34.99	13 38.13	110	CTD015	
16	28/08/07	1530	1547	A	57 35.00	13 38.00	116	NET001	
17	28/08/07	1748	1748	B	57 34.02	13 19.89	173	CTD016	
18	28/08/07	2004	2000	C	57 32.94	13 00.01	290	CTD017	
19	28/08/07	2045	2153	D	57 32.54	12 52.32	1020	CTD018	
20	28/08/07	2252	0025	E	57 32.00	12 37.97	1636	CTD019	Titanium
21	29/08/07	0357	0357	F	57 30.58	12 15.05	1799	CTD020	
22	29/08/07	0744	0721	G	57 29.40	11 50.72	1787	CTD021	
23	29/08/07	0830	1026	H	57 29.01	11 31.89	2014	CTD022	Titanium
24	29/08/07	1230	0750	I	57 27.94	11 18.94	750	CTD023	

Event No.	Date	Start Time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments
25	29 Aug	1345	1436	J	57 29.96 N	11 05.04 W	574	CTD024	
26	29 Aug	1632	1735	K	57 23.91 N	10 51.86 W	785	CTD025	
27	29 Aug	1852	2050	L	57 22.06 N	10 40.00 W	2098	CTD026	Titanium frame
28	29 Aug	2220	0027	M	57 18.02 N	10 22.85 W	2208	CTD027	
29	30 Aug	0224	0416	N	57 14.04 N	10 02.97 W	2099	CTD028	
30	30 Aug	0645	0840	O	57 08.88 N	09 41.79 W	1925	CTD029	Titanium frame
31	30 Aug	0959	1125	P	57 05.91 N	09 24.94 W	1404	CTD030	
32	30 Aug	1232	1314	Q	57 02.96 N	09 13.17 W	320	CTD031	
33	30 Aug	1435	1509	R	56 59.99 N	08 59.92 W	125	CTD032	
34	30 Aug	1616	1638	S	56 56.94 N	08 46.96 W	119	CTD033	
35	30 Aug	1750	1822	15G	56 52.23 N	08 29.84 W	122	CTD034	
36	30 Aug	1920	1942	T	56 49.65 N	08 19.76 W	129	CTD035	
37	30 Aug	2040	2108	14G	56 48.48 N	08 09.95 W	124	CTD036	
38	30 Aug	2200	2230	13G	56 46.98 N	08 59.97 W	116	CTD037	
39	31 Aug	0248	0315	10GA	56 48.47 N	07 30.08 W	82	CTD038	
40	31 Aug	0456	0526	9GA	56 47.90 N	07 20.91 W	185	CTD039	
41	31 Aug	0640	0659	8GA	56 48.81 N	07 10.71 W	138	CTD040	
42	31 Aug	0815	0838	7G	56 44.10 N	07 00.04 W	134	CTD041	
43	31 Aug	0950	1001	6G	56 43.98 N	06 00.01 W	37	CTD042	
44	31 Aug	1040	1107	5G	56 43.97 N	06 35.94 W	71	CTD043	
45	31 Aug	1200	1224	4G	56 43.99 N	06 26.85 W	71	CTD044	
46	31 Aug	1420	1454	1G	56 40.02 N	06 07.82 W	133	CTD045	
47	02 Sep	1507	1655	EG3	60 14.83 N	09 00.78 W	1250	CTD046	Release test
48	02 Sep	1700	1725	EG3	60 14.71 N	09 00.76 W	1280	MOOR1	ADCP deployment
49	02 Sep	1815	1900	EG2	60 15.04 N	08 54.50 W	1200	MOOR2	ADCP recovery

Event No.	Date	Start Time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments
50	02 Sep	2227	2310	M800W	60 32.95 N	08 11.41 W	845	CTD047	
51	02 Sep	2344	0049*	M800W	60 32.95 N	08 11.41 W	799	MOOR3	Minilog mooring deployment
52	03 Sep	0330	0410	M800W	60 36.21 N	08 17.33 W	797	CTD048	Yoyo CTD
53	03 Sep	0413	0453	M800W	60 35.76 N	08 17.48 W	797	CTD049	Yoyo CTD
54	03 Sep	0539	0705*	M800W	60 34.67 N	08 15.24 W	780	MSP001	* 25 h experiment; ended 04 Sep
55	04 Sep	0800	0926	T800W	60 34.92 M	08 08.12 W	799	CTD050	Titanium frame
56	04 Sep	1311	1450	M800W	60 32.95 N	08 11.41 W	799	MOOR4	Minilog mooring recovery
57	04 Sep	1730	1830	WT1	60 34.20 N	07 29.90 W	1066	CTD051	
58	04 Sep	1937	2318	WT2	60 27.98 N	07 24.00 W	1098	MSP002	
59	05 Sep	0036	0134	WT3	60 23.18 N	07 14.71 W	1050	CTD052	
60	05 Sep	0311	0640	WT4	60 19.32 N	07 03.29 W	1151	MSP003	
61	05 Sep	0830	0923	WT5	60 15.76 N	06 50.59 W	1179	CTD053	depth uncorrected
62	05 Sep	1049	1353	WT6	60 13.1 N	06 37.7 W	1200	MSP004	
63	05 Sep	1911	-	M800E	60 01.75 N	06 22.74 W	960	XBT	
64	05 Sep	1930	2049	M800E	60 01.86 N	06 27.31 W	798	MOOR5	Minilog mooring deployment
65	05 Sep	2135	2356*	M800E	60 01.86 N	06 27.31 W	1200	MSP005	* 25 h experiment; ended 06 Sep
66	07 Sep	0145	0312	PA9	60 10.03 N	06 09.87 W	1219	CTD054	
67	07 Sep	0417	0520	PA8	60 07.03 N	06 16.71 W	1165	CTD055	
68	07 Sep	0417	0520	PA7	60 04.11 N	06 23.12 W	1077	CTD056	
69	07 Sep	0810	0853	M800E	60 02.02 N	06 25.26 W	964	CTD057	
70	07 Sep	0910	1018	M800E	60 01.86 N	06 27.31 W	798	MOOR6	Minilog mooring recovery
71	07 Sep	1100	1131	PA6	60 01.23 N	06 30.24 W	464	CTD058	
72	07 Sep	1220	1256	PA5	59 58.07 N	06 36.97 W	325	CTD059	
73	07 Sep	1340	1417	PA4	59 55.08 N	06 43.52 W	614	CTD060	
74	07 Sep	1537	1653	PA2	59 49.21 N	06 56.87 W	1031	CTD061	

Appendix 2

D321b CTD Log Sheets

D321b CTD log sheet

Station	IB23S	Date	25/08/07
Event	1	Time	02:02
CTD no.	001	Depth	125

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla	PP
1	24	1	5	02:33	X	X													
2	23	2	5	02:33							X	X			X			X	X
3	22	3	5	02:33			X	X	X										
4	21	4	10	02:31															
5	20	5	10	02:31							X	X			X			X	X
6	19	6	10	02:31			X	X	X										
7	18	7	20	02:29	X	X													
8	17	8	20	02:29							X	X			X			X	X
9	16	9	20	02:29			X	X											
10	15	10	27	02:28															
11	14	11	27	02:27							X	X						X	X
12	13	12	27	02:27			X	X											
13	12	13	32	02:26															
14	11	14	32	02:26							X	X						X	X
15	10	15	32	02:26			X	X							X				
16	9	16	45	02:24	X	X													
17	8	17	45	02:24							X	X			X			X	X
18	7	18	45	02:24			X	X	X	X									
19	6	19	75	02:21	X	X													
20	5	20	75	02:21							X	X						X	
21	4	21	75	02:21			X	X											
22	3	22	112	02:18	X	X													
23	2	23	112	02:18							X	X			X			X	
24	1	24	112	02:17			X	X	X										
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy	Sandy

D321b CTD log sheet

Station	IB22S	Date	25/08/07
Event	2	Time	22:29
CTD no.	002	Depth	668

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla
1		1	662	22:47			X	X										
2		2	663	22:47														
3		3	602	22:50			X	X						X			X	
4		4	603	22:51														
5		5	402	22:56			X	X										
6		6	403	22:57														
7		7	302	23:01			X	X						X			X	
8		8	304	23:01														
9		9	204	23:05			X	X										
10		10	204	23:06							X	X						
11		11	126	23:09			X	X									X	X
12		12	128	23:10							X	X						
13		13	76	23:13			X	X						X				X
14		14	78	23:14							X	X						
15		15	45	23:16			X	X										X
16		16	45	23:17							X	X						
17		17	33	23:19			X	X										X
18		18	32	23:19							X	X						
19		19	20	23:21			X	X										X
20		20	21	23:22							X	X						
21		21	10	23:23			X	X										X
22		22	10	23:24							X	X						
23		23	7	23:25			X	X										X
24		24	6	23:25							X	X						
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	IB21S	Date	26/08/07
Event	3	Time	01:01
CTD no.	003	Depth	1028

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Sal	Chla	PP
1		1	1005	01:33			X	X					X				X		
2		2	1000	01:34			X	X											
3		3	600	01:43			X	X					X				X		
4		4	400	01:48			X	X											
5		5	200	01:53			X	X											
6		6	125	01:56	X														
7		7	125	01:56					X				X				X		
8		8	125	01:57			X	X			X	X						X	
9		9	75	02:00					X										
10		10	75	02:00			X	X			X	X						X	
11		11	45	02:02	X														
12		12	45	02:02			X	X			X	X						X	X
13		13	32	02:04	x														
14		14	32	02:04			X	X			X	X						X	X
15		15	27	02:06															
16		16	27	02:06			X	X			X	X	X					X	X
17		17	20	02:07	X	X													
18		18	20	02:08					X	X									
19		19	20	02:08			X	X			X	X						X	X
20		20	10	02:10	X	X													
21		21	10	02:10			X	X			X	X						X	X
22		22	5	02:11	X	X													
23		23	5	02:12					X				X						
24		24	5	02:12			X	X			X	X						X	X
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria	Sandy		Sandy

D321b CTD log sheet

Station	IB20S	Date	26/08/07
Event	4	Time	04:34
CTD no.	004	Depth	1400

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Pico plankton	Bact isolations	DO	HPLC	Fe	Salinity	Chla	Heme
1	1	1	1380	05:19			X	X					X				X		
2	2	2	1200	05:24			X	X											
3	3	3	1000	05:30			X	X									X		
4	4	4	600	05:39			X	X											
5	5, 6, 7, 8 or 9	5	400	05:46			X	X											
6	10	6	200	05:51			X	X									X		
7	11	7	125	05:54														X	
8	12	8	125	05:55			X	X			X	X	X						
9	?	9	75	?														X	
10	13	10	75	05:58			X	X			X	X							
11	14	11	45	06:00														X	
12	15	12	45	06:00			X	X			X	X							
13	16	13	32	06:02														X	
14	17	14	32	06:02			X	X			X	X							
15	18	15	27	06:03														X	
16	19	16	27	06:04			X	X			X	X	X						
17	20	17	20	06:05														X	
18	21	18	20	06:05			X	X			X	X							
19	22	19	10	06:07														X	
20	23	20	10	06:07			X	X			X	X	X						
21	24	21	5	06:09															
22	25	22	5	06:09															
23	26	23	5	06:09														X	
24	27	24	5	06:09			X	X			X	X	X						
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy	Daria

D321b CTD log sheet

Station	IB19S	Date	26/08/07
Event	5	Time	08:23
CTD no.	005	Depth	1681

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla	Heme
1		1	1667	08:59			X	X						X			X		
2		2	1402	09:05			X	X											
3		3	1202	09:11			X	X											
4		4	1002	09:17			X	X									X		
5		5	792	09:24			X	X						X					
6		6	602	09:29			X	X											
7		7	402	09:35			X	X						X			X		
8		8	204	09:40			X	X			X	X							
9		9	128	09:43			X	X											
10		10	128	09:44							X	X						X	
11		11	78	09:47			X	X											
12		12	78	09:47							X	X						X	
13		13	48	09:50			X	X											
14		14	48	09:50							X	X						X	X
15		15	35	09:52			X	X											
16		16	35	09:52							X	X						X	X
17		17	29	09:54			X	X											
18		18	30	09:54							X	X						X	X
19		19	23	09:56			X	X											
20		20	23	09:56							X	X						X	X
21		21	13	09:57			X	X											
22		22	13	09:58							X	X						X	X
23		23	7	09:59			X	X											
24		24	8	09:59							X	X						X	X
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy	Daria

D321b CTD log sheet

Station	IB18S	Date	26/08/07
Event	6	Time	12:53
CTD no.	006	Depth	1798

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla
1		1	1785	13:35			X						X				X	
2		2	1600	13:41			X							X				
3		3	1300	13:47			X											
4		4	1000	13:54			X											
5		5	810	14:00			X							X			X	
6		6	600	14:06			X											
7		7	400	14:11			X							X				
8		8	200	14:16			X				X	X						
9		9	125	14:19			X										X	
10		10	125	14:19							X	X	X					X
11		11	75	14:21			X											
12		12	75	14:22							X	X			X			X
13		13	45	14:23			X											
14		14	45	14:24							X	X			X			X
15		15	32	14:25			X											
16		16	32	14:25							X	X			X			X
17		17	27	14:26			X						X					
18		18	27	14:26							X	X						X
19		19	20	14:28			X											
20		20	20	14:28							X	X	X		X			X
21		21	10	14:29			X											
22		22	10	14:29							X	X			X			X
23		23	5	14:30			X											
24		24	5	14:30							X	X	X		X			X
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	IB17S	Date	26/08/07
Event	7	Time	16:55
CTD no.	007	Depth	1800

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla
1		1	1800	17:46													X	
2		2	1600	17:54										X				
3		3	1300	18:02													X	
4		4	1000	18:11														
5		5	810	18:17										X			X	
6		6	600	18:23														
7		7	400	18:30										X				
8		8	200	18:35							X	X						
9		9	125	18:39														
10		10	125	18:39							X	X						X
11		11	75	18:43														
12		12	75	18:43							X	X			X			X
13		13	44	18:45														
14		14	44	18:46							X	X			X			X
15		15	32	18:47														
16		16	32	18:48							X	X			X			X
17		17	27	18:49														
18		18	27	18:49							X	X						X
19		19	20	18:51														
20		20	20	18:51							X	X			X			X
21		21	10	18:53														
22		22	10	18:53							X	X			X			X
23		23	5	18:54														
24		24	5	18:55							X	X			X			X
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	IB16S	Date	26/08/07
Event	8	Time	22:17
CTD no.	008	Depth	2220

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla
1	008-1	1	2205	23:00												X		
2	008-2	13	2205	23:00			X							X			X	
3	008-3	2	2101	23:05												X		
4	008-4	14	2102	23:05			X											
5	008-5	3	1794	23:13												X		
6	008-6	15	1794	23:13			X											
7	008B-1	4	1507	23:25												X		
8	008B-2	16	1506	23:26			X							X				
9	008B-3	5	1204	23:33												X		
10	008B-4	17	1205	23:34			X											
11	008B-5	6	1002	23:39												X		
12	008B-6	18	1002	23:40			X										X	
13	008B-7	7	800	23:45												X		
14	008B-8	19	800	23:46			X											
15	008B-9	8	609	23:51												X		
16	008B-10	20	609	23:52			X							X				
17	008B-11	9	127	00:03												X		
18	008B-12	21	127	00:03			X										X	X
19	008B-13	10	77	00:06												X		
20	008B-14	22	78	00:07			X	X										X
21	008B-15	11	34	00:10												X		
22	008B-16	23	34	00:10			X	X										X
23	008B-17	12	7	00:12												X		
24	008B-19	24	7	00:13			X	X										X
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	IB16X	Date	27/08/07
Event	9	Time	03:38
CTD no.	009	Depth	2435

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla	PP
1		1	125	03:49	X													X	
2		2	125	03:49					X		X	X							
3		3	125	03:49															
4		4	75	03:52											X			X	
5		5	75	03:52					X		X	X							
6		6	75	03:52															
7		7	45	03:54	X										X			X	X
8		8	45	03:54							X	X							
9		9	45	03:55															
10		10	32	03:56	X										X			X	X
11		11	32	03:56							X	X							
12		12	32	03:57															
13		13	27	03:58														X	X
14		14	27	03:58							X	X							
15		15	27	03:58															
16		16	20	04:00	X										X			X	X
17		17	20	04:00					X	X	X	X							
18		18	20	04:00															
19		19	10	04:01	X										X			X	X
20		20	10	04:02							X	X							
21		21	10	04:02															
22		22	5	04:03	x										X			X	X
23		23	5	04:03					X		X	X							
24		24	5	04:03															
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy	Sandy

D321b CTD log sheet

Station	IB5	Date	27/08/07
Event	10	Time	19:29
CTD no.	010	Depth	1152

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla	Heme
1		1	1143	20:06			X										X		
2		2	1002	20:10			X							X					
3		3	853	20:15			X							X					
4		4	854	20:16															
5		5	602	20:22			X												
6		6	403	20:28			X										X		
7		7	402	20:29										X					
8		8	203	20:34			X				X	X					X		
9		9	127	20:38															
10		10	127	20:39			X	X			X	X						X	
11		11	78	20:42															
12		12	78	20:42			X	X			X	X						X	X
13		13	47	20:45															
14		14	47	20:45			X	X			X	X						X	X
15		15	34	20:48															
16		16	34	20:48			X	X			X	X						X	X
17		17	29	20:50															
18		18	29	20:50			X	X			X	X						X	X
19		19	23	20:52															
20		20	23	20:52			X	X			X	X						X	X
21		21	13	20:54															
22		22	12	20:55			X	X			X	X						X	X
23		23	7	20:56															
24		24	8	20:56			X	X			X	X						X	x
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy	Daria

D321b CTD log sheet

Station	IB4	Date	28/08/07
Event	11	Time	01:02
CTD no.	011	Depth	1186

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Sal	Chla	PP
1		1	1184	01:30			X						X				X		
2		2	1000	01:35			X						X						
3		3	850	01:39			X						X				X		
4		4	500	01:47			X						X						
5		5	200	01:53			X				X	X	X						
6		6	125	01:56	X														
7		7	125	01:56					X				X				X		
8		8	125	01:57				X			X	X						X	
9		9	75	01:59					X				X		X				
10		10	75	01:59				X			X	X						X	
11		11	45	02:01	X														
12		12	45	02:01			X	X			X	X	X		X			X	X
13		13	32	02:04	X														
14		14	32	02:04			X	X			X	X	X		X			X	X
15		15	27	02:05			X	X							X				
16		16	27	02:05							X	X						X	X
17		17	20	02:06	X								X						
18		18	20	02:06					X	X	X	X			X				
19		19	20	02:07			X	X										X	X
20		20	10	02:08	X						X	X	X						
21		21	10	02:08			X	X							X			X	X
22		22	5	02:09	X						X	X							
23		23	5	02:09					X				X		X				
24		24	5	02:10			X	X										X	X
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria	Sandy		Sandy

D321b CTD log sheet

Station	IB3	Date	28/08/07
Event	12	Time	05:18
CTD no.	012	Depth	655

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla
1		1	650	05:41			X										X	
2		2	650	05:41														
3		3	600	05:45			X											
4		4	600	05:45														
5		5	400	05:51			X											
6		6	400	05:51														
7		7	200	05:56			X											
8		8	200	05:56							X	X						
9		9	125	05:59			X	X										
10		10	125	05:59							X	X						
11		11	75	06:02			X	X	X		X	X						
12		12	75	06:02														
13		13	45	06:04			X	X										
14		14	45	06:04							X	X						
15		15	32	06:06			X	X	X									
16		16	32	06:06							X	X						
17		17	27	06:08			X	X	X									
18		18	27	06:08							X	X						
19		19	20	06:09			X	X										
20		20	20	06:09							X	X						
21		21	10	06:11			X	X										
22		22	10	06:11							X	X						
23		23	5	06:13			X	X	X									
24		24	5	06:13							X	X						
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	IB2	Date	28/08/07
Event	13	Time	09:22
CTD no.	013	Depth	441

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla
1		1	433	09:43												X		
2		13	433	09:43			X	X						X			X	
3		2	400	09:45												X		
4		14	400	09:45			X							X				
5		3	300	09:49												X		
6		15	300	09:49			X	X										
7		4	200	09:52												X		
8		16	200	09:53			X										X	
9		5	125	09:55					X							X		
10		17	125	09:56			X	X						X				X
11		6	75	09:58					X							X		
12		18	75	09:59			X											X
13		7	60	10:00												X		
14		19	60	10:00			X											X
15		8	50	10:02												X		
16		20	50	10:02			X	X										X
17		9	35	10:04												X		
18		21	35	10:04			X	X										X
19		10	20	10:06												X		
20		22	20	10:06			X	X	X								X	X
21		11	10	10:08												X		
22		23	10	10:08			X	X										X
23		12	5	10:09														
24		24	5	10:10			X	X	X									X
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	IB1	Date	28/08/07
Event		Time	12:57
CTD no.	014	Depth	139

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla
1		1	133	13:15					X				X	X	X		X	
2		2	133	13:15														
3		3	75	13:18					X				X	X			X	
4		4	75	13:18											X			
5		5	60	13:20									X	X	X			
6		6	60	13:20														
7		7	45	13:22					X				X		X		X	
8		8	45	13:22														
9		9	5	13:25														
10		10	5	13:25					X						X			
11																		
12																		
13																		
14																		
15																		
16																		
17																		
18																		
19																		
20																		
21																		
22																		
23																		
24																		
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	A	Date	28/08/07
Event	15	Time	14:56
CTD no.	015	Depth	100

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	Chla	Nutrients	P.O.C.	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	HPLC	Fe	Salinity
1		1	100	15:08				X						X
2		2	100	15:09						X	X			
3		3	100	15:09		X	X							
4		4	75	15:11	X			X		X	X			
5		5	75	15:11										X
6		6	75	15:11		X	X			X	X			
7		7	45	15:14	X									
8		8	45	15:14						X	X			
9		9	45	15:14		X	X					X		
10		10	32	15:16	X			X		X	X			
11		11	32	15:16								X		
12		12	32	15:16		X								
13		13	27	15:18								X		
14		14	27	15:18	X					X	X			
15		15	27	15:18		X	X							
16		16	20	15:20						X	X			
17		17	20	15:21										
18		18	20	15:21		X								
19		19	10	15:22								X		
20		20	10	15:23						X	X			
21		21	10	15:23		X	X					X		
22		22	5	15:24				X		X	X			
23		23	5	15:24								X		
24		24	5	15:24		X								
			Analyst		Sandy	Tim	Tim	Andrea	Andrea	Ross	Ross	Simone	Maria	

D321b CTD log sheet

Station	B	Date	28/08/07
Event	17	Time	17:10
CTD no.	016	Depth	173

Firing Seq.	Rosette Pos^{n}	Depth (m)	Time (GMT)	Chla	D/RNA P.P.E.	F.I.S.H.	Nutrients	P.O.C.	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	HPLC	Fe	Salinity
1	1	170	17:26												
2	2	170	17:26												
3	3	75	17:30												
4	4	75	17:30										X		
5	5	45	17:32												
6	6	45	17:33										X		
7	7	32	17:34												
8	8	32	17:35										X		
9	9	20	17:36												
10	10	20	17:36										X		
11	11	10	17:38												
12	12	10	17:38										X		
13	13	5	17:39										X		
14	14	5	17:39												
15	15	5	17:40												
16	16	5	17:40												
17	17	5	17:40												
18	18	5	17:40												
19	19	5	17:40												
20	20	5	17:40												
21	21	5	17:41												
22	22	5	17:41												
23	23	5	17:41												
24	24	5	17:41												
		Analyst			Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Simone	Maria	

D321b CTD log sheet

Station	C	Date	28/08/07
Event	18	Time	19:00
CTD no.	017	Depth	293

Firing Seq.	Rosette Pos^{n}	Depth (m)	Time (GMT)		Chla	F.I.S.H.	Nutrients	P.O.C.	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	HPLC	Fe	Salinity
1	1	290	19:25				X	X							X
2	2	290	19:29												
3	3	250	19:29				X								
4	4	250	19:29												
5	5	200	19:32				X	X							
6	6	200	19:33												
7	7	150	19:35				X								
8	8	150	19:35												
9	9	125	19:38		X		X	X							
10	10	125	19:38												
11	11	75	19:41		X		X								
12	12	75	19:41												
13	13	45	19:43		X		X								
14	14	45	19:44												
15	15	32	19:46		X		X	X							
16	16	32	19:46												
17	17	27	19:47		X		X								
18	18	27	19:48												
19	19	20	19:49		X		X								
20	20	20	19:49												
21	21	10	19:51		X		X	X							
22	22	10	19:51												
23	23	5	19:52		X		X								
24	24	5	19:52												
			Analyst		Sandy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Simone	Maria	

D321b CTD log sheet

Station	D	Date	28/08/07
Event	19	Time	20:40
CTD no.	018	Depth	1020

Firing Seq.	Rosette Pos^{n}	Depth (m)	DO	F.I.S.H.	Nutrients	P.O.C.	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	HPLC	Fe	Salinity
1	1	1020	X										
2	2	1020											X
3	3	1020			X								
4	4	500	X										
5	5	500											X
6	6	500			X								
7	7	250	X										
8	8	250											X
9	9	250			X								
10	10	125											
11	11	125											
12	12	125			X								
13	13	75											
14	14	75											
15	15	75			X								
16	16	45											
17	17	45											
18	18	45			X								
19	19	27											
20	20	27											
21	21	27			X								
22	22	10											
23	23	10											
24	24	10			X								
		Analyst	Jorg	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Simone	Maria	

D321b CTD log sheet

Station	E	Date	28/08/07
Event	020	Time	22:48
CTD no.	019	Depth	1637

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	Chla	POC	Nutrients	Oxygen	Bacteria count	Phyto count	Heme	Bacteria isolations	Salinity	Phyto	Fe
1	1	1	1620	23:28											X
2	13	13	1620	23:28				X					X		
3	2	2	1620	23:29											
4	14	14	1620	23:29								X			
5	3	3	1400	23:35											X
6	15	15	1400	23:36								X			
7	4	4	1300	23:39											X
8	16	16	1300	23:40								X			
9	5	5	1100	23:45											X
10	17	17	1100	23:45		X	X					X	X		
11	6	6	900	23:51											X
12	18	18	900	23:51		X	X	X				X			
13	7	7	600	23:59											X
14	19	19	600	23:59		X	X					X	X		
15	8	8	125	00:10											X
16	20	20	125	00:10	X	X	X	X				X			
17	9	9	60	00:13											X
18	21	21	60	00:14	X	X	X					X			
19	10	10	35	00:15											X
20	22	22	35	00:16	X	X	X					X			
21	11	11	20	00:17											X
22	23	23	20	00:18	X	X	X					X			
23	12	12	10	00:19											X
24	24	24	10	00:19	X	X	X					X			
			Analyst		Sandy	Tim	Tim	Jorg	Ross	Ross	Daria	Kim		Keith D	Maria

D321b CTD log sheet

Station	F	Date	29/08/07
Event	21	Time	02:16
CTD no.	020	Depth	1799

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	Chla	Nutrients	P.O.C.	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	HPLC	F.I.S.H	Salinity
1		1	1780	03:02			X								X
2		2	1500	03:09			X								
3		3	1000	03:19			X								
4		4	750	03:25			X								X
5		5	500	03:31			X								
6		6	250	03:37			X				X	X			X
7		7	125	03:41	X		X	X							
8		8	125	03:41					X		X	X			
9		9	125	03:41		X									
10		10	75	03:44			X	X	X		X	X			
11		11	75	03:44		X							X		
12		12	45	03:47	X		X	X			X	X			
13		13	45	03:47		X							X		
14		14	32	03:49	X		X		X	X	X	X			
15		15	32	03:49		X		X					X		
16		16	27	03:50		X	X	X			X	X			
17		17	20	03:51			X	X							
18		18	20	03:52	X						X	X		X	
19		19	20	03:52		X							X		
20		20	10	03:53	X		X	X						X	
21		21	10	03:54		X									
22		22	5	03:55	X		X	X					X	X	
23		23	5	03:55					X						
24		24	5	03:55		X							X		
			Analyst		Amy	Sandy	Tim	Tim	Andrea	Andrea	Ross	Ross	Simone	Amy	

D321b CTD log sheet

Station	G	Date	29/08/07
Event	22	Time	05:27
CTD no.	021	Depth	1500

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	Chla	Nutrients	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	HPLC	Fe	Salinity
1		1	1500	06:22										
2		2	1500	06:22			y							y
3		3	1250	06:29										
4		4	1000	06:36			y							y
5		5	750	06:42		y	y							
6		6	500	06:49										
7		7	250	06:55		y	y							y
8		8	200	06:58						y	y			
9		9	175	06:59		y				y	y			
10		10	125	07:02			y			y	y			
11		11	75	07:05		X				y	y			
12		12	75	07:05			y							
13		13	45	07:07						y	y			
14		14	45	07:08			y							
15		15	32	07:10		y				y	y			
16		16	32	07:10			y							
17		17	27	07:11		y				y	y			
18		18	27	07:11			y							
19		19	20	07:14						y	y			
20		20	20	07:15			y							
21		21	10	07:16		y				y	y			
22		22	10	07:17			y							
23		23	5	07:18		y				y	y			
24		24	5	07:18			y							
			Analyst		Amy	Sandy	Tim	Andrea	Andrea	Ross	Ross	Simone	Maria	

D321b CTD log sheet

Station	H	Date	29/08/07
Event	23	Time	08:43
CTD no.	022	Depth	2014

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	Fe	Nutrients	P.O.C.	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	HPLC	Chla	Salinity
1		1	1986	09:20		y									
2		13	1985	09:21			y								y
3		2	1801	09:26		y									
4		14	1802	09:27			y								
5		3	1501	09:34		y									
6		15	1501	09:35			y								y
7		4	1052	09:45		y									
8		16	1052	09:45			y								
9		5	901	09:50		y									
10		17	901	09:50			y							y	
11		6	701	09:56		y									
12		18	701	09:56			y							y	
13		7	502	10:02		y									
14		19	502	10:02			y							y	y
15		8	252	10:09		y									
16		20	252	10:09			y	y						y	
17		9	77	10:15		y									
18		21	77	10:16	y		y	y						y	
19		10	34	10:19		y									
20		22	34	10:19	y		y	y						y	
21		11	22	10:21		y			y						
22		23	22	10:22	y		y	y	y					y	
23		12	12	10:23		y			y						
24		24	12	10:24	y		y	y	y					y	
			Analyst		Amy	Maria	Tim	Tim	Andrea	Andrea	Ross	Ross	Simone	Sandy	

D321b CTD log sheet

Station	I	Date	29/08/07
Event	24	Time	11:22
CTD no.	023	Depth	743

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	Chla	DO	Nutrients	Primary Production	D/RNA Dinos	Bacteria Isolations	Bacteria numbers	Phyto numbers	HPLC	Phyto	Salinity
1		1	740	11:49		X				X					X
2		2	741	11:49			X								
3		3	503	11:55			X			X					X
4		4	252	12:01		X	X			X	X	X			
5		5	127	12:06	X		X			X	X	X			X
6		6	77	12:09					X	X	X	X			
7		7	77	12:09	X								X		
8		8	47	12:11						X	X	X			
9		9	47	12:11	X		X	X	X				X		
10		10	34	12:13						X	X	X			
11		11	34	12:13	X			X					X		
12		12	34	12:14											
13		13	29	12:15						X					
14		14	29	12:15			X				X	X			
15		15	29	12:15	X			X							
16		16	22	12:17					X	X	X	X			
17		17	22	12:17	X		X	X					X		
18		18	22	12:17		X									
19		19	12	12:19						X					
20		20	12	12:19							X	X	X	X	
21		21	12	12:19	X		X	X							
22		22	7	12:21						X	X	X			
23		23	7	12:21	X			X	X				X		
24		24	7	12:21											
			Analyst		Sandy	Jorge	Tim	Sandy	Andrea	Kim	Ross	Ross	Simone	Keith	

D321b CTD log sheet

Station	J	Date	29/08/07
Event	25	Time	13:46
CTD no.	024	Depth	574

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	Bact isolations	Chla	Nutri.	P.O.C.	D/RNA Dinos	Bacteria numbers	Phyto numbers	HPLC	Phyto	Salinity
1		1	567	14:07			X							X
2		2	567	14:08										
3		3	500	14:10			X							
4		4	500	14:10										
5		5	250	14:16			X							X
6		6	250	14:17										
7		7	125	14:20		X								
8		8	125	14:21					X			X		
9		9	125	14:21			X	X						
10		10	75	14:23		X								X
11		11	75	14:23					X			X		
12		12	75	14:24			X	X						
13		13	45	14:26		X								
14		14	45	14:26					X			X		
15		15	45	14:26			X	X						
16		16	25	14:28		X								
17		17	25	14:28					X			X		
18		18	25	14:28			X	X						
19		19	10	14:30		X								
20		20	10	14:31					X			X		
21		21	10	14:31			X	X						
22		22	5	14:32		X								
23		23	5	14:32					X			X		
24		24	5	14:32			X							
			Analyst		Kim	Sandy	Tim	Tim	Andrea	Ross	Ross	Simone	Keith	

D321b CTD log sheet

Station	K	Date	29/08/07
Event	26	Time	16:26
CTD no.	025	Depth	785

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Sal	Chla
1		1	779	16:56			y										y	
2		2	500	17:04			y											
3		3	250	17:11			y										y	
4		4	125	17:16			y	y										
5		5	125	17:16					y									y
6		6	75	17:19			y	y										
7		7	75	17:19					y						y			
8		8	45	17:23			y	y										
9		9	45	17:23											y			y
10		10	45	17:23														
11		11	32	17:25			y	y										
12		12	32	17:25					y									y
13		13	32	17:25											y			
14		14	27	17:26			y											
15		15	27	17:27														y
16		16	27	17:27														
17		17	20	17:29			y								y			y
18		18	20	17:29														
19		19	20	17:29														
20		20	10	17:31			y	y										
21		21	10	17:31											y			y
22		22	10	17:31														
23		23	5	17:35			y		y						y			y
24		24	5	17:35														
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	L	Date	29/08/07
Event	27	Time	18:45
CTD no.	026	Depth	2098

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla
1		1	2050	19:39												X		
2		13	2050	19:39										X			X	
3		2	2000	19:42												X		
4		14	2000	19:43			X											
5		3	1500	19:54												X		
6		15	1500	19:54			X											
7		4	1300	20:00												X		
8		16	1300	20:01			X											
9		5	1200	20:05												X		
10		17	1200	20:05			X										X	
11		6	950	20:12												X		
12		18	950	20:13			X							X				
13		7	700	20:20												X		
14		19	700	20:21			X											
15		8	500	20:27												X		
16		20	500	20:27			X	X									X	
17		9	200	20:35												X		
18		21	200	20:35			X	X										X
19		10	45	20:41												X		
20		22	45	20:42			X	X										X
21		11	20	20:44										X		X		
22		23	20	20:44			X	X										X
23		12	10	20:46														
24		24	10	20:46			y	y										y
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	M	Date	29/08/07
Event	28	Time	22:23
CTD no.	027	Depth	2208

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto	Bact isolations	DO	HPLC	Fe	Salinity	Chla
1		1	2198	23:05			X										X	
2		2	2198	23:06									X					
3		3	2001	23:29			X											
4		4	2001	23:29									X					
5		5	1501	23:40			X						X				X	
6		6	1501	23:40														
7		7	951	23:53			X											
8		8	950	23:54									X					
9		9	601	00:02			X											
10		10	601	00:02									X					
11		11	401	00:08			X											
12		12	401	00:08									X					
13		13	252	00:13			X										X	
14		14	252	00:13									X					
15		15	126	00:17			X											
16		16	126	00:17									X					X
17		17	76	00:20			X											
18		18	76	00:20									X					X
19		19	47	00:23			X											
20		20	47	00:23									X					X
21		21	32	00:25			X											
22		22	32	00:25									X					X
23		23	12	00:27			X											
24		24	12	00:27								X	X					X
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Keith	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	N	Date	30/08/07
Event	29	Time	02:15
CTD no.	028	Depth	2099

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	pp	Salinity	Chla
1		1	2083	03:07													X	
2		2	2000	03:10			X											
3		3	1500	03:20			X											
4		4	1500	03:20														
5		5	950	03:33			X											
6		6	600	03:41			X											
7		7	400	03:46													X	
8		8	125	03:55					X									
9		9	125	03:56	X										X			
10		10	125	03:56			X	X	X		X	X						X
11		11	75	03:59							X	X			X			
12		12	75	03:59			X	X										X
13		13	45	04:01	X						X	X						
14		14	45	04:01			X	X								X		X
15		15	32	04:03	X						X	X						
16		16	32	04:03			X	X	X									
17		17	32	04:03											X	X		X
18		18	27	04:05			X				X	X				X		X
19		19	20	04:06	X	X					X	X						
20		20	20	04:06			X									X		X
21		21	10	04:08	X	X					X	X						
22		22	10	04:08			X	X								X		X
23		23	5	04:10	X	X	X		X		X	X			X			
24		24	5	04:10												X		X
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Sandy		Sandy

D321b CTD log sheet

Station	O	Date	30/08/07
Event	30	Time	06:46
CTD no.	029	Depth	1925

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla
1		1	1920	07:34												X		
2		13	1920	07:35			X										X	
3		2	1900	07:37												X		
4		14	1900	07:37			X											
5		3	1600	07:45												X		
6		15	1600	07:45			X											
7		4	1200	07:55												X		
8		16	1200	07:55			X											
9		5	900	08:03												X		
10		17	900	08:04			X											
11		6	800	08:08												X		
12		18	800	08:08			X											
13		7	500	08:15												X		
14		19	500	08:16			X	X									X	X
15		8	125	08:24												X		
16		20	125	08:25			X	X	X								X	X
17		9	60	08:28												X		
18		21	60	08:29			X	X	X									X
19		10	48	08:31												X		
20		22	45	08:32			X	X	X									X
21		11	20	08:34												X		
22		23	20	08:34			X	X										X
23		12	10	08:36												X		
24		24	10	08:36			X		X									X
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	P	Date	30/08/07
Event	31	Time	10:03
CTD no.	030	Depth	1404

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla
1		1	1410	10:32			X							X			X	
2		2	1200	10:38			X											
3		3	900	10:45			X							X			X	
4		4	710	10:50			X											
5		5	300	11:00			X							X			X	
6		6	125	11:05			X	X	X									
7		7	125	11:05							X	X						
8		8	75	11:08			X		X		X	X			X			X
9		9	75	11:08														
10		10	45	11:11			X	X			X	X			X			X
11		11	45	11:11														
12		12	32	11:13			X				X	X			X			X
13		13	32	11:13														
14		14	27	11:15			X	X			X	X						X
15		15	27	11:15														
16		16	27	11:16														X
17		17	20	11:17			X		X						X			X
18		18	20	11:18							X	X						
19		19	20	11:18														
20		20	10	11:19			X	X			X	X			X			X
21		21	10	11:20														
22		22	10	11:20														
23		23	5	11:22			X		X						X			X
24		24	5	11:22							X	X						
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	Q	Date	30/08/07
Event	32	Time	12:28
CTD no.	031	Depth	330

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla	Phytopl
1		1	330	12:45			X						X				X		
2		2	330	12:46															
3		3	330	12:46										X					
4		4	250	12:49			X						X				X		
5		5	250	12:50															
6		6	125	12:53									X						
7		7	125	12:54													X		
8		8	75	12:54					X					X					
9		9	75	12:57			X		X				X	X	X			X	
10		10	45	12:58															
11		11	45	13:00			X						X		X			X	
12		12	32	13:00															
13		13	32	13:01			X		X	X			X		X			X	
14		14	27	13:02															
15		15	27	13:03			X						X						
16		16	20	13:03														X	
17		17	20	13:05			X												
18		18	20	13:05									X						X
19		19	10	13:05											X			X	
20		20	10	13:07			X						X						
21		21	10	13:07											X			X	
22		22	5	13:08					X				X						
23		23	5	13:09											X			X	
24		24	5	13:09															
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy	K.D.

D321b CTD log sheet

Station	R	Date	30/08/07
Event	33	Time	14:35
CTD no.	032	Depth	125

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Sal	Chla	Heme
1		1	117	14:46			X	X						X			X		
2		2	117	14:46							X	X							
3		3	117	14:46														X	
4		4	75	14:49			X	X			X	X		X			X		X
5		5	75	14:49											X				
6		6	75	14:49					X									X	
7		7	45	14:51			X	X											X
8		8	45	14:52							X	X							
9		9	45	14:52					X						X			X	
10		10	32	14:53			X	X			X	X							X
11		11	32	14:54											X				
12		12	32	14:54														X	
13		13	27	14:55			X												X
14		14	27	14:56							X	X							
15		15	27	14:56														X	
16		16	20	14:57			X							X					X
17		17	20	14:57											X				
18		18	20	14:58					X		X	X						X	
19		19	10	14:59				X											X
20		20	10	14:59							X	X							X
21		21	10	14:59											X			X	
22		22	5	15:01			X		X		X	X							X
23		23	5	15:01											X				
24		24	5	15:01														X	
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria	Sandy		Daria

D321b CTD log sheet

Station	S	Date	30/08/07
Event	34	Time	16:12
CTD no.	033	Depth	119

Firing	Rosette	Bottle	Depth	Time	D/RNA	Chla	Nutrients	P.O.C.	D/RNA	Virus'	Bacteria	Phyto	HPLC	Fe	Salinity
Seq.	Pos^{n}	No.	(m)	(GMT)	P.P.E.				Dinos	Dinos	numbers	numbers			
1		1	120	16:26											X
2		2	120	16:26											
3		3	120	16:26											
4		13	5	16:33											X
5		14	5	16:34											
6		15	5	16:34											
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
			Analyst		Amy	Sandy	Tim	Tim	Andrea	Andrea	Ross	Ross	Simone	Maria	

D321b CTD log sheet

Station	15G	Date	30/08/07
Event	35	Time	17:50
CTD no.	034	Depth	122

Fire	Rosette	Bottle	Depth	Time	D/RNA	FISH	Nutri.	POC	D/RNA	Virus'	Bacteria	Phyto	Bact	DO	HPLC	Fe	Salinity	Chla
Seq	Pos^{n}	No.	(m)	(GMT)	P.P.E.				Dinos	Dinos	numbers	numbers	isolations					
1		1	117	18:07			X	X						X				
2		2	116	18:08													X	X
3		3	75	18:11			X	X						X				
4		4	75	18:11														X
5		13	75	18:16														
6		14	10	18:16										X				X
7		15	10	18:16			X	X										
8		16	10	18:17													X	X
9																		
10																		
11																		
12																		
13																		
14																		
15																		
16																		
17																		
18																		
19																		
20																		
21																		
22																		
23																		
24																		
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	14G	Date	30/08/07
Event		Time	20:50
CTD no.	036	Depth	124

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Chla	Phytopl
1		1	13	21:01												
2		13	13	21:01												X
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																
16																
17																
18																
19																
20																
21																
22																
23																
24																
			Analyst		Amy	Amy	Tim	Tim	Ross	Ross	Kim	Jörg	Simone	Maria	Sandy	K.D.

D321b CTD log sheet

Station	13G	Date	30/08/07
Event		Time	22:11
CTD no.	037	Depth	116

Fire Seq	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	FISH	Nutri.	POC	D/RNA Dinos	Virus' Dinos	Bacteria numbers	Phyto numbers	Bact isolations	DO	HPLC	Fe	Salinity	Chla
1		1	113	22:16			X	X						X				
2		2	112	22:16														X
3		3	77	22:20			X	X						X				
4		4	77	22:20														X
5		13	22	22:23			X	X										
6		14	22	22:24														X
7		15	12	22:25			X	X						X				
8		16	12	22:26														X
9																		
10																		
11																		
12																		
13																		
14																		
15																		
16																		
17																		
18																		
19																		
20																		
21																		
22																		
23																		
24																		
			Analyst		Amy	Amy	Tim	Tim	Andrea	Andrea	Ross	Ross	Kim	Jörg	Simone	Maria		Sandy

D321b CTD log sheet

Station	10GA	Date	31/08/07
Event	39	Time	02:48
CTD no.	038	Depth	82 m

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	Phyto	Nutrients	POC	Chla	Bacterial Isolations	Bacteria numbers	Phyto numbers	HPLC	Fe
1	1	1	35	03:06		X								
2	2	2	35	03:07										
3	13	13	10	03:08		X								
4	14	14	10	03:09										
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
			Analyst		Amy	K D	Tim	Tim	Sandy	Andrea	Ross	Ross	Simone	Maria

D321b CTD log sheet

Station	9GA	Date	31/08/07
Event	40	Time	04:52
CTD no.	039	Depth	185 m

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	F.I.S.H.	Nutrients	POC	Chla	Bacterial Isolations	Bacteria numbers	Phyto numbers	HPLC	PP
1	1	1	185	05:06										
2	2	2	185	05:06										
3	3	3	185	05:06			X			X				
4	4	4	125	05:09										
5	5	5	125	05:09			X			X				
6	6	6	125	05:10					X					
7	7	7	75	05:12										
8	8	8	75	05:12									X	
9	9	9	75	05:12			X	X	X	X				
10	10	10	45	05:14			X		X	X				X
11	11	11	45	05:14	X									
12	12	12	32	05:16			X		X	X				X
13	13	13	32	05:16									X	
14	14	14	32	05:16	X									
15	15	15	27	05:17			X		X	X				X
16	16	16	27	05:17										
17	17	17	20	05:18									X	
18	18	18	20	05:18			X		X	X				X
19	19	19	20	05:19	X	X								
20	20	20	10	05:20			X	X	X	X			X	X
21	21	21	10	05:20	X	X								
22	22	22	5	05:21			X		X	X				X
23	23	23	5	05:21									X	
24	24	24	5	05:21	X	X								
			Analyst		Amy	Amy	Tim	Tim	Sandy	Andrea	Ross	Ross	Simone	Sandy

D321b CTD log sheet

Station	8GA	Date	31/08/07
Event	41	Time	06:33
CTD no.	040	Depth	138 m

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	Phyto	F.I.S.H.	Nutrients	DO	Chla	Virus' Dinos	Bacteria numbers	Phyto numbers	HPLC	Fe
1		1	10	06:54										
2		2	10	06:54										
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
			Analyst		Keith	Amy	Tim	Jorg	Andrea	Andrea	Ross	Ross	Simone	Maria

D321b CTD log sheet

Station	7G	Date	31/08/07
Event	42	Time	08:18
CTD no.	041	Depth	134 m

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	Phyto	F.I.S.H.	Nutrients	DO	Chla	Virus' Dinos	Bacteria numbers	Phyto numbers	HPLC	Fe
1		1	132	08:24			X		X					
2		2	132	08:24										
3		3	77	08:28			X		X					
4		4	77	08:28										
5		13	36	08:31			X		X					
6		14	35	08:32										
7		15	12	08:34			X		X			X		
8		16	12	08:34										
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
			Analyst		Keith	Amy	Tim	Jorg	Andrea	Andrea	Ross	Ross	Simone	Maria

D321b CTD log sheet

Station	6G	Date	31/08/07
Event	43	Time	09:54
CTD no.	042	Depth	37 m

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	Phyto	F.I.S.H.	Nutrients	DO	Chla	Virus' Dinos	Bacteria numbers	Phyto numbers	HPLC	Fe	
1	1	1	13	09:58											
2	2	13	13	09:58	X										
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
			Analyst		Keith	Amy	Tim	Jorg	Andrea	Andrea	Ross	Ross	Simone	Maria	
			PI												

D321b CTD log sheet

Station	5G	Date	31/08/07
Event	44	Time	10:51
CTD no.	043	Depth	71 m

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	F.I.S.H.	Nutrients	DO	Chla	Virus' Dinos	Bacteria numbers	Phyto numbers	HPLC	Fe
1	1	1	67	10:55			X	X						
2	2	2	67	10:56									X	
3	3	3	23	11:00			X						X	
4	4	4	22	11:00										
5	5	5	22	11:00										
6	13	13	22	11:01										
7	14	14	23	11:01										
8	15	15	22	11:02										
9	16	16	13	11:03			X	X						
10	17	17	13	11:04									X	
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
			Analyst		Amy	Amy	Tim	Jorg	Andrea	Andrea	Ross	Ross	Simone	Maria

D321b CTD log sheet

Station	4G	Date	31/08/07
Event	45	Time	12:05
CTD no.	044	Depth	71 m

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	F.I.S.H.	Nutrients	DO	Chla	Virus' Dinos	Bacteria numbers	Phyto numbers	HPLC	Fe
1	1	1	65	12:12			X	X						
2	2	2	65	12:12							X	X		
3	3	3	65	12:13					X				X	
4	4	4	50	12:14			X							
5	5	5	50	12:14									X	
6	6	6	50	12:15					X		X	X		
7	7	7	25	12:17			X							
8	8	8	25	12:17							X	X		
9	9	9	25	12:17					X				X	
10	10	10	15	12:19			X				X	X		
11	11	11	15	12:19									X	
12	12	12	15	12:19					X					
13	13	13	10	12:20			X	X					X	
14	14	14	10	12:20							X	X		
15	15	15	10	12:21					X					
16	16	16	5	12:22										
17	17	17	5	12:23									X	
18	18	18	5	12:23					X		X	X		
19														
20														
21														
22														
23														
24														
			Analyst		Amy	Amy	Tim	Jorg	Andrea	Andrea	Ross	Ross	Simone	Maria

D321b CTD log sheet

Station	1G	Date	31/08/07
Event	46	Time	14:27
CTD no.	045	Depth	162

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	D/RNA P.P.E.	F.I.S.H.	Nutrients	DO	Chla	Virus' Dinos	Bacteria numbers	Phyto numbers	HPLC	Fe
1	1	1	155	14:38			X							
2	2	2	155	14:38										
3	3	3	155	14:38				X	X					
4	4	4	100	14:41			X							
5	5	5	100	14:41					X				X	
6	6	6	75	14:43									X	
7	7	7	75	14:44					X					
8	8	8	50	14:47			X							
9	9	9	50	14:47					X				X	
10	10	10	30	14:49			X							
11	11	11	30	14:49					X				X	
12	12	12	10	14:50			X							
13	13	13	10	14:51					X				X	
14	14	14	10	14:51				X						
15	15	15	5	14:52					X					
16														
17														
18														
19														
20														
21														
22														
23														
24														
			Analyst		Amy	Amy	Tim	Jorg	Andrea	Andrea	Ross	Ross	Simone	Maria

D321b CTD log sheet

Station	EG3	Date	02/09/07
Event	47	Time	15:07
CTD no.	046	Depth	1240

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	Bact isolations	Chla	Nutri.	D/RNA PPE	FISH PPE	Bacteria numbers	Phyto numbers	HPLC	DO	Salinity
1		1	1220	15:29			X							
2		5	1220	15:49	X									
3		6	1000	15:49	X		X							
4		7	1000	16:08										
5		8	900	16:08	X		X							
6		9	750	16:12	X		X							
7		10	750	16:18										
8		11	500	16:18	X		X							
9		12	300	16:25	X		X						X	
10		13	300	16:32										
11		17	125	16:32	X	X	X			X	X			
12		18	75	16:39	X	X	X	X		X	X	X		
13		19	45	16:42	X	X	X	X				X	X	
14		20	32	16:45	X	X	X	X		X	X	X		
15		21	27	16:47	X	X	X			X	X			
16		22	20	16:48	X	X	X	X	X	X	X	X		
17		23	10	16:50	X	X	X	X	X	X	X	X		
18		24	5	16:52	X	X	x	X	X	X	X	X	X	
19														
20														
21														
22														
23														
24														
			Analyst		Kim	Sandy	Tim	Amy	Amy	Ross	Ross	Simone	Jorg	

D321b CTD log sheet

Station	M800W	Date	04/09/07
Event	50	Time	22:31
CTD no.	047	Depth	845

Firing Seq.	Rosette Pos^{n}	Bottle No.	Depth (m)	Time (GMT)	Bact isolations	Chla	Nutri.	D/RNA PPE	FISH PPE	Bacteria numbers	Phyto numbers	HPLC	Phyto	Salinity
1		1	826	22:49			X			X				X
2		13	825	22:50										X
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
			Analyst		Kim	Sandy	Tim	Amy	Amy	Ross	Ross	Simone	Keith	

D321b CTD log sheet

Station	T800W	Date	04/09/07
Event	55	Time	08:00
CTD no.	050	Depth	799

Firing	Rosette	Bottle	Depth	Time	Bact	Chla	Nutri.	D/RNA	FISH	Bacteria	Phyto	HPLC	Fe	Salinity
Seq.	Pos^{n}	No.	(m)	(GMT)	isolations			PPE	PPE	numbers	numbers			
1		1	754	08:30	X		X						X	
2		2	712	08:33			X						X	
3		3	660	08:38	X		X						X	
4		4	640	08:44			X						X	
5		5	493	08:49	X		X						X	
6		6	420	08:53			X						X	
7		7	353	08:57	X		X						X	
8		8	250	09:01			X						X	
9		9	150	09:05	X		X						X	
10		10	75	09:08			X						X	
11		11	45	09:10									X	
12		13	45	09:11			X	X						
13		14	45	09:11	X	X		X		X	X	X		
14		15	32	09:13			X	X						
15		16	32	09:13	X	X		X	X	X	X	X		
16		17	27	09:15			X							
17		18	27	09:15	X	X				X	X	X		
18		12	20	09:17										
19		19	20	09:17		X	X	X		X	X	X		
20		20	20	09:18	X			X	X					
21		21	10	09:19		X		X		X	X	X		
22		22	10	09:19	X		X	X	X					
23		23	5	09:21		X		X		X	X	X		
24		24	5	09:21	y		y	Y	Y					
			Analyst		Kim	Sandy	Tim	Amy	Amy	Ross	Ross	Simone	Maria	

D321b CTD log sheet

Station	WT1	Date	04/09/07
Event	57	Time	17:31
CTD no.	051	Depth	1066

Firing	Rosette	Bottle	Depth	Time	Bact	Chla	Nutri.	P.O.C.	Virus'	Bacteria	Phyto	HPLC	Phyto	Salinity
Seq.	Pos^{n}	No.	(m)	(GMT)	isolations				Dinos	numbers	numbers			
1	4	5	870	18:06			Y							
2	5	6	870	18:06										
3	6	7	603	18:12			y							
4	7	8	596	18:13			Y							
5	8	9	400	18:17			y							
6	9	10	250	18:20			y							
7	16	17	125	18:22			y					Y		
8	17	18	75	18:24			y					Y		
9	18	19	50	18:25			y					y		
10	19	20	30	18:25			y					y		
11	20	21	20	18:26			y					y		
12	21	22	10	18:26			y					y		
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24				Kim										
					Kim	Sandy	Tim	Tim	Andrea	Ross	Ross	Simone	Keith	

D321b CTD log sheet

Station	WT3	Date	05/09/07
Event	52	Time	00:36
CTD no.	059	Depth	1050

Firing	Rosette	Bottle	Depth	Time	Bact	Chla	Nutri.	P.O.C.	Virus'	Bacteria	Phyto	HPLC	Phyto	Salinity
Seq.	Pos^{n}	No.	(m)	(GMT)	isolations				Dinos	numbers	numbers			
1	1	1	1010	01:02			Y							
2	2	5	1000	01:03			y							
3	3	6	800	01:07			y							
4	4	7	600	01:14			y							
5	5	8	380	01:19			y							
6	6	9	250	01:21			y							
7	7	10	125	01:24			y							
8	8	17	75	01:25			y							
9	9	18	50	01:26			y							
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
			Analyst		Kim	Sandy	Tim	Tim	Andrea	Ross	Ross	Simone	Keith	

*Grey: bottle did not close

D321b CTD log sheet

Station	WT5	Date	07/09/07
Event	61	Time	08:32
CTD no.	053	Depth	1179

Firing	Rosette	Bottle	Depth	Time	Bact	Chla	Nutri.	P.O.C.	Virus'	Bacteria	Phyto	HPLC	Phyto	Salinity
Seq.	Pos^{n}	No.	(m)	(GMT)	isolations				Dinos	numbers	numbers			
1	1	1	1155	08:56	X		X							
2	2	5	1000	09:00	X		X							
3	3	6	800	09:03	X		X							
4	4	7	700	09:05	X		X							
5	5	8	600	09:07	X		X							
6	6	9	500	09:08	X		X							
7	7	10	400	09:10	X		X							
8	8	11	200	09:13	X		X							
9	9	12	100	09:16	X	X	X					X		
10	10	13	50	09:17	X	X	X					X		
11	11	17	20	09:18	X	X	X					X		
12	12	18	10	09:18	X	X	X					X		
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
			Analyst		Kim	Sandy	Tim	Tim	Andrea	Ross	Ross	Simone	Keith	

APPENDIX 3

R.R.S. DISCOVERY

CRUISE TIMETABLE OF EVENTS D321B

Date	Time (UT)	Event
23/08/07	0834	Arrived Reykjavik from Cruise 321A
	0900-2100	Scientific personnel join vessel
24/08/07	1000	Familiarisation of Scientists and 1 Technician
	1030-1130	Final Pre sailing checks to all critical equipment and propulsion
	1150	Pilot on board
	1207	All gone and clear of berth
	1224	Pilot disembarks
	1236	FULL AWAY on passage – Engey Is LH. Bore 129˚ T x 1.38M Course 255˚ T
	1532	a/c to 169˚ T 64 06.2 N 022 58.8 W
	1630-43	Trace metal fish outboard 63 56.2 N 022 55.1 W
	1748	a/c to 119˚ T 63 46.1 N 022 48.3 W
25/08/07	0054	a/c to 032˚ T 63 11.7 N 020 24.5 W
	0155	Hove to on station IB23S
	0203-36	**Stn IB23S – CTD cast to 110 m 63 19.15N 020 12.92W**
	0216	PES Fish cast outboard
	0240	Set Course 240˚ T for next station
	0406	Vessel hove to in vicinity of Station IB22S 63 15.4 N 020 04.1 W HOVE to due to INCLEMENT WEATHER.
	1952	Re-locating – Weather improving somewhat – preparing for workings
	2215	Hove to on Station IB22S
	2228-2330	**Stn IB22S – CTD cast to 660 m 63 13.0N 020 04.1W**
	2336	Set Course 140˚ T for Station IB21S
26/08/07	0040	Hove to on Station IB21S - Awaiting Work being done on CTD.
	0108-0218	**Stn IB21S – CTD cast to 1003 m 63 08.5N 019 54.6W**
	0222	Set Course 147˚ T for Station IB20S
	0432	Hove to on Station IB20S - Awaiting Work being done on CTD.
	0446-0615	**Stn IB20S – CTD cast to 1380 m 62 55.4N 019 33.3W**
	0615	Set Course 191˚ T for Station IB19S
	0812	Hove to on Station IB19S - Awaiting scientists
	0825-1004	**Stn IB19S – CTD cast to 1665 m 62 40.0N 019 40.0W**
	1004	Set Course 193˚ T for Station IB18S
	1253	Hove to on Station IB18S
	1257-1433	**Stn IB18S – CTD cast to 1785 m 62 20.1N 019 50.5W**
	1436	Set Course 188˚ T for Station IB17
	1653	Hove to on Station IB17
	1655-1857	**Stn IB17 – CTD cast to 1800 m 61 59.6N 020 00.3W**
	1436	Set Course 180˚ T for Station IB16
	2206	Hove to on Station IB16
	2213-0014	**Stn IB16 – Titanium CTD to 2215 m 61 30.0N 020 00.0W**
27/08/07	0019	Set Course 150˚ T for Station IB16X
	0336	Hove to on Station IB16X
	0340-0404	**Stn IB16X – CTD cast to 125 m 61 06.0N 019 31.0W**
	0410	CTD inboard - Set Course 150˚ T for Station IB5
	1200	Position Latitude 60 00.3 N Longitude 018 15.4 W
	1800	Position Latitude 59 06.2 N Longitude 017 14.7 W
	1930	Hove to on Station IB5
	1932-2100	**Stn IB5 – CTD cast to 1157 m 58 52.4N 016 59.9W**
	2100	CTD inboard - Set Course 126˚ T for Station IB4

28/08/07	0048	Hove to on Station IB4
	0100-0214	**Stn IB4 – CTD cast to 1184 m 58 29.8N 016 00.5W**
	0220	CTD inboard - Set Course 125˚ T for Station IB3
	0518	Hove to on Station IB3
	0520-0617	**Stn IB3 – CTD cast to 650 m 58 15.2N 015 20.2W**
	0617	CTD inboard - Set Course 127˚ T for Station IB2
	0924	Hove to on Station IB2
	0926-1015	**Stn IB2 – Titanium CTD to 433 m 57 57.0N 014 34.9W**
	1015	CTD inboard - Set Course 128˚ T for Station IB1
	1300	Hove to on Station IB1
	1304-27	**Stn IB1 – CTD cast to 133 m 57 39.9N 013 53.9W**
	1352	CTD inboard - Set Course 125˚ T for Station A
	1453	Hove to on Station A
	1459-1528	**Stn A – CTD cast to 100 m 57 35.0N 013 38.6W**
	1538-48	Plankton nets deployed **(16315 B)**
	1550	Set Course 094˚ T for Station B
	1706	Hove to on Station B
	1710-43	**Stn B – CTD cast to 150 m 57 34.1N 013 20.1W**
	1743	CTD inboard - Set Course 096˚ T for Station C
	1908	Hove to on Station C
	1910-55	**Stn C – CTD cast to 200 m 57 33.0N 013 00.2W**
	1955	CTD inboard - Set Course 098˚ T for Station C
	2038	Hove to on Station D
	2045-2150	**Stn D – CTD cast to 1020 m 57 32.5N 012 52.3W**
	2150	CTD inboard - Set Course 092˚ T for Station E
	2247	Hove to on Station E
	2252-0023	**Stn E – Titanium CTD to 1620 m 57 32.0N 012 38.0W**
29/08/07	0032	CTD inboard - Set Course 097˚ T for Station F
	0215	Hove to on Station F
	0223-0359	**Stn F – CTD cast to 1780 m 57 30.7N 012 15.1W**
	0359	CTD inboard - Set Course 096˚ T for Station G
	0525	Hove to on Station G
	0527-0720	**Stn G – CTD cast to 1780 m 57 29.3N 011 51.0W**
	0720	CTD inboard - Set Course 096˚ T for Station H
	0831	Hove to on Station H
	0840-1028	**Stn H – Titanium CTD to 1985 m 57 29.0N 011 32.0W**
	1028	CTD inboard - Set Course 097˚ T for Station I
	1120	Hove to on Station I
	1128-1224	**Stn I – CTD cast to 740 m 57 27.9N 011 19.0W**
	1227	CTD inboard - Set Course 094˚ T for Station J
	1349	Hove to on Station J
	1351-1435	**Stn J – CTD cast to 567 m 57 26.8N 011 05.7W**
	1439-1536	Engine power problems – sorting them out – carry on Sampling
	1536	Set Course 111˚ T for Station K
	1630	Hove to on Station K
	1632-1738	**Stn K – CTD cast to 779 m 57 23.8N 010 52.1W**
	1741	CTD inboard - Set Course 106˚ T for Station L
	1840	Hove to on Station L
	1843-2050	**Stn L – Titanium CTD to 2050 m 57 22.1N 010 40.6W**
	2050	CTD inboard - Set Course 114˚ T for Station M
	2208	Hove to on Station M
	2220-0031	**Stn M – CTD cast to 2200 m 57 17.9N 010 22.7W**
30/08/07	0036	CTD inboard - Set Course 111˚ T for Station N
	0216	Hove to on Station N
	0224-0412	**Stn N – CTD cast to 2083 m 57 14.1N 010 02.9W**
	0412	CTD inboard - Set Course 115˚ T for Station O
	0640	Hove to on Station 0
	0645-0840	**Stn O – Titanium CTD to 1920 m 57 08.9N 009 42.8W**
	0840	CTD inboard - Set Course 108˚ T for Station P
	0950	Hove to on Station P

	1000-1125	**Stn P – CTD cast to 1410 m 57 05.9N 009 25.0W**
	1125	CTD inboard - Set Course 115˚ T for Station Q
	1227	Hove to on Station Q
	1232-1312	**Stn Q – CTD cast to 330 m 57 02.9N 009 13.5W**
	1318	CTD inboard - Set Course 113˚ T for Station R
	1435	Hove to on Station R
	1437-1505	**Stn R – CTD cast to 117 m 57 00.0N 009 00.0W**
	1509	CTD inboard - Set Course 117˚ T for Station S
	1612	Hove to on Station S
	1615-35	**Stn S – CTD cast to 100 m 56 56.83N 008 46.7W**
	1635	CTD inboard - Set Course 112˚ T for Station 15G
	1748	Hove to on Station 15G
	1758-1823	**Stn 15G – CTD cast to 100 m 56 52.5N 008 29.9W**
	1823	CTD inboard - Set Course 110˚ T for Station T
	1909	Hove to on Station T
	1912-40	**Stn T – CTD cast to 100 m 56 49.9N 008 19.8W**
	1940	CTD inboard - Set Course 110˚ T for Station 14G
	2030	Hove to on Station 14G
	2048-2106	**Stn 14G – CTD cast to 110 m 56 48.5N 008 09.9W**
	2106	CTD inboard - Set Course 105˚ T for Station 13G
	2156	Hove to on Station 13G
	2208-2230	**Stn 13G – CTD cast to 110 m 56 47.0N 008 00.0W**
	2230	CTD inboard - Set Course 105˚ T for Station 12G
	2345	Hove to on Station 12G – Assessing weather conditions
		Station cancelled due to inclement weather.
31/-8/07	0020	Vessel re-locating to east of Barra for Sheltered station work.
	0246	Hove to on Station 10Ga
	0258-0313	**Stn 10Ga – CTD cast to 76 m 56 48.46N 007 30.11W**
	0315	CTD inboard - Set Course 105˚ T for Station 9Ga
	0445	Hove to on Station 9Ga
	0450-0525	**Stn 9Ga – CTD cast to 185 m 56 48.06N 007 20.79W**
	0525	CTD inboard - Set Course 088˚ T for Station 8Ga
	0615	Hove to on Station 8Ga
	0640-57	**Stn 8Ga – CTD cast to 130 m 56 48.93N 007 10.11W**
	0657	CTD inboard - Set Course 132˚ T for Station 7G
	0800	Hove to on Station 7G
	0815-38	**Stn 7G – CTD cast to 130 m 56 44.10N 007 00.00W**
	0838	CTD inboard - Set Course 090˚ T for Station 6G
	0942	Hove to on Station 6G
	0950-1000	**Stn 6G – CTD cast to 35 m 56 44.00N 006 45.10W**
	1000	CTD inboard - Set Course 090˚ T for Station 5G
	1040	Hove to on Station 5G
	1042-1107	**Stn 5G – CTD cast to 65 m 56 44.00N 006 35.90W**
	1107	CTD inboard - Set Course 090˚ T for Station 4G
	1146	Hove to on Station 4G – Awaiting readiness of CTD
	1206-26	**Stn 4G – CTD cast to 65 m 56 43.96N 006 26.78W**
	1226	CTD inboard - Set Course 118˚ T for Mingary Bay and Rendezvous
	1308	a/c to 101˚ T 56 41.02 N 006 16.64 W
	1334	a/c to 081˚ T 56 40.25 N 006 09.02 W
	1353	RIB 'Tritonia' alongside for equipment transfer 56 40.40 N 006 05.30 W
	1357	Tritonia away and clear – Resuming programme
	1425	Hove to on Station 1G
	1427-56	**Stn 1G – CTD cast to 155 m 56 40.01N 006 07.97W**
	1447-1503	Adjusting buoyancy on Profiler.
	1456	CTD inboard
	1503	Set Course 281˚ T for the Wyville Thomson Ridge
	1630	a/c to 311˚ T Suil Ghorm bore 172 T @ 3.0 Miles
	1800	a/c to 355˚ T 56 54.50 N 006 17.30 W
	2058	a/c to 023˚ T 57 25.60 N 006 51.50 W
	2208	a/c to 062˚ T 57 37.60 N 006 42.00 W
	2338	a/c to 045˚ T 57 44.90 N 006 16.30 W
01/09/07	0047	a/c to 360˚ T 57 53.77 N 006 00.00 W

	0426	a/c to 319˚ T 58 30.62 N 006 00.00 W
	1245-1308	Hove to to recover TMS Fish 59 18.5 N 007 19.9 W
		Resuming Course and speed
	2100	a/c to 323˚ T 60 00.4 N 008 29.7 W
	2300	REDUCED SPEED due to inclement weather
02/09/07	0000	Position Latitude 60 10.4 N Longitude 008 44.1 W
	0745	Hove to – To wind and sea – bad weather 60 14.5 N 009 00.8 W
	1100	Deployed TMS Fish 60 17.2 N 009 04.0 W
	1200	Position Latitude 60 15.0 N Longitude 008 58.0 W
	1504	Hove to on Station EG3
	1510-1656	**Stn EG3 – CTD cast to 1220 m 60 14.9N 009 00.5W**
	1656	CTD inboard – preparing to deploy ADCP mooring
	1720-25	**ADCP EG3 mooring DEPLOYED 60 14.71N 009 00.76W**
	1815	Released mooring EG2 ADCP mooring
	1815-1900	manoeuvring to recover ADCP mooring EG2
	1900	EG2 ADCP mooring inboard 60 15.04 N 008 54.50 W
	2215	Hove to on Station M800W
	2228-2310	**Stn M800W – CTD cast to 865 m 60 32.9N 008 11.4W**
	2310	CTD inboard – preparing to deploy Minilog Mooring and Dhan buoy
	2344	Commenced deploying Minilog Mooring M800W
	2344-0049	**Minilog M800W mooring DEPLOYED 60 34.811N 008 17.61W (16349)**
03/09/07	0138	Hove to for Profiling station 60 34.6 N 008 15.4 W
	0140-0204	Profilier in water
	0204	Profiler inboard – winch problem 60 35.0 N 008 15.9 W
	0314	Hove to on Station MW
	0332-0450	**Stn MW – CTD cast to 750 m 60 32.9N 008 11.4W**
	0450	CTD inboard – preparing to re-deploy Profiler
	0535	Profilier in water 60 34.6 N 008 15.1 W
	1200	Position Latitude 60 36.0 N Longitude 008 19.6 W
	1900	Position Latitude 60 35.5 N Longitude 008 11.3 W
		Engaged in Profiling (16352)
04/09/07	0000	Position Latitude 60 36.5 N Longitude 008 16.3 W
	0705	Profiling Ends – Profiler inboard 60 37.2 N 008 09.8 W
	0806-0926	**Stn T800W – Titanium CTD to 880 m 60 35.9N 008 07.6W**
	0926-1010	Ctd Inboard – Sampling
	1103-1311	Standing off mooring until fog lifts
	1311	**Released Minilog M800W mooring**
	1311-1450	manoeuvring to recover Minilog M800W mooring
	1450	Minilog M800W mooring inboard 60 37.6 N 008 20.7 W **(16349)**
		Set Course 106 T to CTD Station WT1
	1730	Hove to on Station WT1
	1736-1832	**Stn WT1 – CTD cast to 1000 m 60 34.3N 007 28.5W**
	1832	CTD inboard – Set course for station WT2
	1930	Hove to on Station WT2 60 28.1 N 007 24.1 W
	1937-2318	**Stn WT2 – Microstructure Profiling throughout**
	2318	Profilier inboard – 60 23.4 N 007 30.3 W Set course for station WT3
05/09/07	0036	Hove to on Station WT3
	0039-0131	**Stn WT3 – CTD cast to 1010 m 60 23.4N 007 15.7W**
	0140	CTD inboard – Set course for station WT4
	0302	Hove to on Station WT4 60 19.2 N 007 03.3 W
	0311-0640	**Stn WT4 – Microstructure Profiling throughout**
	0640	Profilier inboard – 60 20.5 N 007 03.0 W
	0700	Set course for station WT5
	0800	Hove to on Station WT5 – All stopped due to excessive rolling
	0830-0924	**Stn WT5 – CTD cast to 1155 m 60 15.9N 006 50.4W**
	0936	CTD inboard – Set course for station WT6
	1040	Hove to on Station WT6 60 13.1 N 006 37.7 W
	1048-1436	**Stn WT6 – Microstructure Profiling throughout**
	1436	Profilier inboard – 60 14.8 N 006 38.9 W
	1606	Hove to on Station WT7 – All stopped due to excessive rolling

	1630	Set Course 150˚ T for mooring site – Tacking course due to rolling
	1800	a/c to 293˚ T 59 58.2 N 006 07.3 W
	1905	Approaching mooring site
	1911	**Stn M800E – XBT launched 60 01.7N 006 22.7W**
	1942-2049	**Minilog M800E mooring DEPLOYED 60 01.88N 006 27.33W**
	2049	Re-Positioning for the deployment of the Profiler
	2134	Profilier in water **(16360)** 60 01.5 N 006 23.3 W
06/09/07	0322	Profiler inboard 60 05.0 N 006 30.1 W - Vessel re-locating
	0445	Profilier in water 60 01.6 N 006 22.4 W
	1425	Profiler inboard 60 04.4 N 006 31.3 W - Vessel re-locating
	1528	Profilier in water 60 01.4 N 006 22.9 W
	2356	Profiler inboard 60 03.5 N 006 33.3 W
07/09/07	0016	Set course 063˚ T for station PA9
	0150	Hove to on Station PA9
	0155-0309	**Stn PA9 – CTD cast to 1200 m 60 09.9N 006 09.9W**
	0317	CTD inboard – Set course 231˚ T for station PA8
	0405	Hove to on Station PA8
	0408-0517	**Stn PA8 – CTD cast to 1130 m 60 07.1N 006 16.4W**
	0517	CTD inboard – Set course 230˚ T for station PA7
	0616	Hove to on Station PA7
	0622-0713	**Stn PA7 – CTD cast to 1060 m 60 04.0N 006 22.9W**
	0713	CTD inboard – Set course 230˚ T for station M800E
	0750	Hove to on CTD Station M800E
	0810-56	**Stn M800E – CTD cast to 950 m 60 02.1N 006 25.1W**
	0856	CTD inboard – Proceeding to recover mooring M800E
	0918	Standing off mooring
	0921	**Released Minilog M800E mooring**
	0926-1018	manoeuvring to recover Minilog M800E mooring
	1018	Minilog M800E mooring inboard 60 01.6 N 008 28.2 W
	1050	Hove to on Station PA6
	1100-34	**Stn PA6 – CTD cast to 460 m 60 00.9N 006 30.4W**
	1134	CTD inboard – Set course 228˚ T for station PA5
	1217	Hove to on Station PA5
	1225-55	**Stn PA5 – CTD cast to 320 m 59 58.8N 006 37.3W**
	1257	CTD inboard – Set course 220˚ T for station PA4
	1340	Hove to on Station PA4
	1344-1416	**Stn PA4 – CTD cast to 605 m 59 55.2N 006 44.1W**
	1419	CTD inboard – Set course 220˚ T for station PA2
	1530	Hove to on Station PA2
	1541-1647	**Stn PA2 – CTD cast to 1025 m 59 49.5N 006 57.0W**
	1615-45	Emergency muster and Man overboard procedures drill
	1654	PES fish inboard
	1654	CTD inboard –
	1654	**SCIENCE ENDS** Set course 160˚ T for Fairlie
08/09/07	0000	Position Latitude 58 44.2 N Longitude 006 09.6 W Continuing passage to Fairlie
09/09/07	0800 (prov)	ETA Fairlie

END OF REPORT