RRS Discovery cruise D308

Report on the recovery and redeployment of RAPID-WAVE moorings and bottom pressure recorders in the north-west Atlantic

24 July-15 August 2006

Miguel Ángel Morales Maqueda
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PERSONNEL

Ship's crew

Master	Roger Chamberlain
Chief Officer	John Mitchell
Second Officer	Malcolm Graves
Third Officer	Katie Rumbold
Chief Engineer	George Parkinson
Second Engineer	James Bills
Third Engineer	Tony Healy
Third Engineer	John Harnett
ETO/elec.	Robert Masters
Shipboard Catering Manager	Keith Curtis
Chef	Peter Lynch
Assistant chef	Wilmot Isby
Steward	Peter Robinson
CPO Scientific	Steve Smith
CPO (Deck)	Ian Thomson
Seaman PO (Deck)	Steve Day
Motorman	Carl Moore
Seaman	John Dale
Seaman	Mark Moore
Seaman	Robert Spencer
Seaman	Trevor Whiteside
Eng. Cadet	Steven McNair

Scientific crew

Chris Barnard	UKORS, computing
Rory Bingham	POL, CTD sampling
Dave Childs	UKORS, moorings
Peter Foden	POL, bottom pressure recorders, inverted echo sounders
Miguel Maqueda	POL, principal scientist
Dougal Mountifield	UKORS, CTD and computing
Jeff Pugh	POL, bottom pressure recorders, inverted echo sounders
Kevin Smith	UKORS, moorings
Ian Waddington	UKORS, moorings
Steve Whittle	UKORS, TLO, moorings

Ship's agent

Paul Aitken
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60 Water Street
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INTRODUCTION

The RRS Discovery cruise 308 (D308) was the fourth field campaign of the project RAPID-WAVE (West Atlantic Variability Experiment), funded by the NERC Rapid Climate Change thematic programme (RAPID). The project leaders are Chris Hughes (Proudman Oceanographic Laboratory), Richard Williams (University of Liverpool) and David Marshall (University of Reading). John Toole (Woods Hole Oceanographic Institution, WHOI) and John Loder (Bedford Institute of Oceanography) are international collaborators in the project.

RAPID-WAVE aims at investigating how signals associated with changes in the Atlantic meridional overturning circulation propagate along the Atlantic deep western boundary current. As part of the project, two cruises took place in 2004. In the first one (27 April-6 May 2004, RV Oceanus, OC 401, WHOI), a line of 6 Bottom Pressure Recorders (BPR) was deployed in an operation area approximately located at 36.5 N 67.5 W. In the second one (5-24 August 2004, RRS Charles Darwin, CD160), two additional lines of 6 BPRs and 5 CTD moorings each were deployed on the continental shelf break approximately south of St. John's and southeast of Halifax, respectively. Figure 1 shows the location of the BPRs and moorings deployed during CD160.

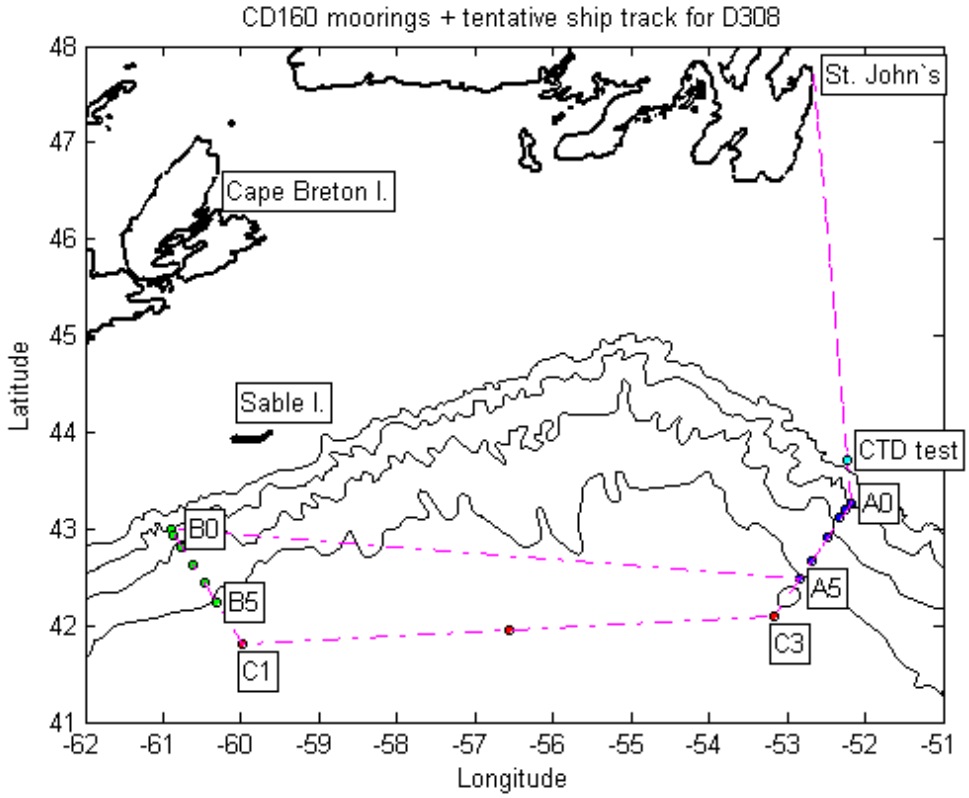


Figure 1: Locations of the BPRs and moorings deployed during CD160 (line A: blue circles; line B: green circles). CTD stations were carried out at each BPR/mooring site during CD160 (with the exclusion of A4, A5 and B0) and D308 (all sites). In D308, three additional CTD casts were performed along line C (red circles) plus at CTD test as indicated on the map. Also shown in the figure is the intended ship track for D308. Bathymetric contour: 1000 m.

The third cruise of this RAPID project took place in April 2006 with the recovery and redeployment of BPRs along the WHOI line (5-15 April 2006, RV Oceanus, OC 421, WHOI). Only two of the six BPRs originally deployed on this line could be recovered. However, these two instrumens were redeployed together with three new ones.

The aim of D308 was to recover and redeploy the BPRs and moorings deployed in 2004 along the St. John's and Halifax lines. In conjunction with the recovery/redeployment operations, CTD casts were planned to be carried out and to include helium, tritium and oxygen sampling (for calibration of the CTD oxygen sensor). Measurement of tritium-helium ratios provides estimates of ventilation age up to about 20 year and is therefore very useful for inferring timescales of water-mass age and tracer transport by the Atlantic deep western boundary current. As detailed below, the cruise encountered mixed success as regards the recovery of instruments: only 50% of the BPRs and 20% of the moorings could be retreived. All planned CTD casts and sampling operations were completed.

The last two cruises of the Rapid-WAVE project will take place in 2008, when BPRs and moorings from all three lines will be recovered. There is the possibility that RAPID-WAVE might be funded beyond this point through the second phase of the RAPID Programme, in which case instruments will be redeployed on at least two of the three lines.

Miguel Ángel Morales Maqueda

CRUISE DIARY[1]

MIGUEL ÁNGEL MORALES MAQUEDA
Proudman Oceanographic Laboratory

Friday 21st July, Julian day 202

St. John's. UKORS and POL crews all onboard the Discovery. Preparation of mooring, BPR and CTD equipment. Chemistry laboratory set up for He-^{3}H and O_2 sampling.

Saturday 22nd July, Julian day 203

St. John's. Continue the preparation of equipment and instruments for the cruise. Computing and data logging facilities set up.

Sunday 23rd July, Julian day 204

St. John's. Preparations for the cruise.

Monday 24th July, Julian day 205

St. John's.

11:30-17:15Z. Loaded 190 tonnes of Marine Gas Oil at bunker berth.

18:00Z. Left St. John's. Overcast, calm.

22:30Z. Navigation, surfmet and echosounder on.

23:30-06:30Z. Cruising at 7-8 knots on account of thick fog. Water depth: 60-70 m.

Tuesday 25th July, Julian day 206

Alternative fog and sunny spells.

11:30Z. Cruise briefing in the main laboratory with short talks by the Master and the PSO. It was agreed to give all times for operations in GMT (Z time) and that measurement stations would be numbered according to the Discovery scheme. Our first station was to be 16003. The first operation in that station (mooring recovery, say) to be denoted by 16003-1, the second operation to be denoted 16003-2, and so forth. The PSO was asked to create a short plan for scientific operations every two days or so and to communicate it to the CPO scientific and the Bridge. A copy of the plan to be deposited in the coffee shop for general information.

13:30Z. The Precision Echo Sounder (PES) fish was deployed.

[1] The Master's diary can be found in Appendix I.

20:30-21:30Z. A test CTD cast was carried out in relatively shallow waters (753 m) to a depth of 550 m before reaching the first station of line A. Location of cast: 43 43.1N 052 14.0W.

21:45Z. Steaming to position A1. Ian Waddington wanted to establish acoustic contact with mooring on A1. Communication established with first mooring on the early morning of 26th July.

22:00Z. Problems with too high temperature in the Cold Temperature laboratory (CTLab) were solved. CTLab ready to carry out salinity sampling.

Wednesday 26th July, Julian day 207

01:35Z. Acoustic communication with mooring on site A1.

Overcast, a gentle breeze. Fair weather for mooring and BPR recovery operations.

11:30Z. Moved over to position A0 overnight. Peter Foden and Jeff Pugh released BPR on A0.

12:30Z. BPR A0 recovered. Position 43 15.9N 052 11.6W.

13:20Z. Mooring A1 was given repeated release commands but did not seem to respond. After a number of trials to recover it, it was decided to move to BPR position A1, recover this BPR first and then come back to the mooring position for recovery of the mooring.

15:19Z. BPR on site A1 located and released.

16:00Z. BPR A1 onboard. Position: 43 12.2N 052 15.1W.

16:20Z. Steamed to site A2 hoping to recover mooring and BPR at that location before darkness. The plan was to return to mooring site A1 in the morning of 27th July to recover the mooring line on that site.

17:30-01:45Z. The mooring on A2 could not be localised. The mooring was released blindly at 20:00Z. Search carried on until 01:45 on 27th July.

Thursday 27th July, Julian day 208

02:10 Returned to site A1 to recover mooring A1.

03:00-5:45Z. Ian Waddington made every effort to ping mooring A1 but was unsuccessful. The surmise was that the mooring had eventually responded to the blind release commands sent the previous day and was now adrift at the surface. Drift was expected to be towards the southeast (i.e. toward position A2) at a speed of about 0.5 knots. The Bridge was asked to return to position A2 and, once there, engage in diverse search patterns to try and intercept the presumed drifting mooring.

Fair weather, good visibility.

8:30Z. Started a 1-mile box centred in A2 searching for mooring A1.
11:30Z. Moved to the southeast of site A2 to start search grid for mooring A1. End point of the search grid to be close to A1 position.

15:30Z. Abandoned search for A1 mooring near A1 position.

15:20-19:00Z. Reached BPR position A2 and started recovery. The BPR did not respond and was given a blind release signal.

19:00Z. The BPR on site A2 was not found. Station was abandoned. Proceeded to station A3.

20:30Z. At station A3. Failed to make contact with the BPR at A3. The mooring on this site was not responding either.

21:30-00:30Z. Site A3. A CTD cast was carried out in which an acoustic release similar to the ones used in the moorings was clamped to the CTD frame. This was in order to allow Ian Waddington to test the acoustic equipment and find out whether the inability to communicate with the moorings was due to failure of instruments onboard. CTD cast to 3150 m at 42 54.3N 052 28.8W. No problem was found during the cast.

Friday 28th July, Julian day 209

01:00Z. In case the A3 mooring location was inaccurate, it was decided to start a search pattern: the plan was to move from site A3 to site 4 in a grid during the night and ping the mooring along the way. Discovery expected to reach site A4 after dawn.

Fair weather, a gentle breeze, good visibility. (Weather conditions were the only consistently positive factor during the cruise.)

8:30Z. Site A4. The search for the A3 mooring during the night failed to yield any fruits and so it was abandoned. At this point, Ian Waddington started to suspect that our problems with the moorings might be caused by either faulty acoustic releases or exhausted batteries. Although these acoustic releases have been successfully used many times before in other cruises, the ones deployed during CD160 in both lines A and B were entirely new and came all from the same batch provided by the supplier, the surmise being that they all perhaps share the same defect, whatever it might be. Also the alkaline batteries used in the moorings are known to be less reliable than lithium batteries and they might have drained out.

9:30-10:30. Site A4. Searched for mooring and BPR at this site. No luck. Decided to head for site A5.

12:00-13:30Z. Site A5. No sign of the mooring or BPR on this site either. We were planning to drag for the mooring on this site, but the length of cable we had (6000 m)

was insufficient for dragging at this depth. Search aborted. Steve Whittle suggested to go back to site A2 and drag for the shallower mooring there, in the hope of recovering some of its instruments, which would be useful for deployment on line B.

17:30Z. Site A2. Ian Waddington and Steve Whittle contacted the ship's agent in St. John's and requested 2000 m of dragging wire to add to that already onboard. It was agreed that the Discovery would return to St. John's on Sunday to collect the extra wire. The initial idea of dragging on site A2 was abandoned and it was decided to carry out three CTD cast on sites A2, A1 and A0 before heading for St. John's.

18:00-21:00Z. CTD cast on A2 to 2785 m. Position 43 07.9N 052 23.6W.

23:00-01:30Z. CTD cast on A1 to 2205 m. Position 43 13.4N 052 16.5W.

Saturday 29th July, Julian day 210

03:50-05:50Z. CTD cast on A0 to 1770 m. Position 43 15.7N 052 11.2W.

6:30Z. Completed all three CTD casts at stations A2, A1, and A0. Sailing to St. John's to fetch dragging wire. ETA in St. John's: Sunday 30th July 8:30-10:30Z.

Sunday 30th July, Julian day 211

Beautiful day, as per usual in this cruise.

10:00-11:00Z. Seaward of The Narrows, St. John's Harbour. Completed loading 4 coils of wire (500 m each) from launch "Innovation". Rendezvous ended. Sailing to site B0.

Monday 31st July, Julian day 212

Calm, sunny.

The underway data processing software, kindly provided by Michael Meredith for this cruise, was finally set up. The software (gyrocompass, bestnav, ashtech, gps4000, echosounding and surface meteorology and thermosalinograph) worked without any major problem and proved of great help during the remaining of the cruise. ETA to site B0: 6:30Z on Tuesday, 1st August.

18:45Z. An emergency drill and boat muster took place. While in muster station, two dolphins approached the ship and then disappeared underneath the hull. Jeff Pugh also pointed out the spray from the blow hole of a whale less than one cable away from the ship.

Tuesday 1st August, Julian day 213

Calm, sunny, a gentle breeze.

6:45-9:00Z. Site B0. A CTD cast was carried out to 1710 m. Position 43 00.3N 060 55.4W.

10:30Z. The BPR on this position was localised and released.
11:30Z. BPR recovered.

12:00Z. Deployment of a lander BPR on B0. Position 42 59.9N 060 54.6W.

13:45Z. Site B1. The mooring at this site was located, given a release command, and tracked coming up to the surface, albeit very slowly.

13:50-14:20Z. Mooring B1 recovered.

15:15Z. BPR B1 released from bottom.

16:15Z. BPR B1 onboard.

16:45Z. Deployment of a lander BPR on B1. Position 42 55.6N 060 51.7W.

18:36Z. Site B2. Mooring located and released.

18:50-19:50Z. Mooring B2 recovered.

21:35Z. BPR B2 located and released from bottom.

22:50Z. BPR B2 onboard.

23:00-02:00Z. CTD cast at B2 to 2680 m. Position 42 49.4N 060 46.3W.

Wednesday 2nd August, Julian day 214

02:00Z. CTD cast at B2 finalised.

08:30Z. Site B3. Mooring was not located but an attempt was performed at releasing it blindly.

10:30Z. Brief thunderstorm. Fog.

11:30Z. It was noted that the position of the mooring recorded in the CD160 cruise report was about 4 miles apart from that of the BPR. Under the assumption that an error had been committed when recording or writing down the mooring position, it was decided to move closer to the BPR position and to try to relocate the mooring there. The attempt was unsuccessful. The ship was quickly repositioned four miles to the north of the nominal BPR B3 location, hoping that, if the mooring had indeed been released, it would be possible to sight it in that area, as surface drift was roughly toward the north with a speed of about half a knot. This attempt was also unsuccessful.

14:25Z. Back at the B3 BPR position. BPR located and released.

16:10Z. B3 BPR onboard. Proceeding to station B4.

16800:19:30Z. Station B4. Neither mooring nor BPR at this location could be located. Abandoned site B4 and proceed to site B5.

20:50Z. Station B5. Mooring not responding

21:50Z. BPR was contacted. Too late for recovery, though. It was decided to try and recover the BPR the following morning it tomorrow, then move to site B3 for dragging.

23:00-23:30Z. CTD cast started and cancelled. The reason for the cancellation was that the Simrad echosounder (used by the CTD operator to prevent the CTD frame to accidentally hit the seabed) operates at the same frequency (10 MHz) as the BPR transducer on this site, causing the BPR to send a return signal for each echosounder ping. Peter Foden was concerned that this could cause damage to the BPR electronics and thus jeopardize its recovery.

Thursday 3rd August, Julian day 215

8:30Z. BPR at B5 was sent the release command, but it remained at the bottom. After about two hours of waiting for the instrument to come to the surface, it was decided to abandon recovery and to start dragging for both the mooring and BPR at this location.

11:30Z. Dragging operations commenced: preparation of dragging gear on deck.

13:30Z. Started paying dragging wire.

20:45Z. Unsuccessful mooring recovery. Started recovering dragging wire.

Friday 4th August, Julian day 216

1:30Z. All dragging wire in board.

2:25Z. Started CTD cast at site B5 to 4100 m. Position 42 13.1N 060 16.6W.

5:30Z. CTD in board. Proceeded to site B3.

10:50Z. Site B3. Started dragging for mooring on this site.

19:30Z. Magnificent train of cloud waves to be seen toward the west. The cloud structure persisted for more than 1 hour.

22:30Z. Dragging on B3 ended without success.

22:40-01:50Z. CTD cast on B3 to 3310 m. Position 42 38.4N 060 41.0W.

Figure 2: Cloud wave observed on the 4th August at around 19:30Z. The cloud formation appeared above the eastern horizon, was made of 10-11 well defined nodes spanning all together about 130 degrees in the horizontal. The cloud wave could be seen very clearly for about one hour.

Saturday 5th August, Julian day 217

10:50Z. Drag on site B4 starts. Paying wire.

21:15Z. Drag on Site B4 aborted: a link broke and 3000 m of dragging wire was lost (see Appendix II).

22:30Z. Deployment of a 500 m mooring with two current meters (50 m and 500 m from bottom) to monitor local currents for a period of 24 hours, aiming at finding out whether currents in the area are strong enough to cause displacement of the moorings.

Sunday 6th August, Julian day 218

Glorious, sunny day.

9:30Z. Site B2. Deployment of a lander BPR. Position 42 49.177N 060 46.482W.

11:50-13:45Z. CTD cast 2660 m on site B2. Position 42 50.0N 060 46.7W. During the previous cast on B2 we omitted to obtain a near bottom sample. The cast was carried out to collect this sample, no other bottles were fired.

14:40-17:30Z. Site B1. Another CTD cast to 2180 m. Position 42 55.4N 060 51.9W.

21:50-02:20Z. Site B4. Last CTD sampling cast on line B. Cast to 3660 m. Position 42 25.7N 060 26.2W. Microcats to be deployed in the moorings were lowered on the CTD frame for calibration.

Monday 7th August, Julian day 219

9:50-11:10Z. Recovery of mooring deployed on Saturday on B4 (two current meters). The current meters indicate weak currents (6 cm).

14:00Z. Site B5. Dragging for BPR on this site for the rest of the day.

00:20Z. Dragging for BPR B5 abandoned. BPR was not recovered.

Tuesday 8th August, Julian day 220

Some clouds, calm, slight breeze.

00:30-04-40Z. Site B5. CTD cast to calibrate microcats for moorings, as the previous calibration on Sunday 6th August went wrong. Cast to 4020 m. Position 42 15.1N 060 18.0W.

14:35Z. Deployment of mooring on B5 (2CTDs, 3CDs and 1 BPR). Position 42 12.59N 060 18.85W.

19:20Z. Deployment of lander BPR on site B4. Position 42 26.50N 060 28.20W.

Wednesday 9th August, Julian day 221

Alternative cloudy and clear, mild wind.

13:05Z. Deployment of mooring on B3 (2 CTs, 2 CTDs, 1 CM and 1 BPR). Position 42 36.026N 060 37.514W.

21:50-01:45Z. CTD cast on C1 to 4560 m. Position 41 48.0N 060 00.0W.

Thursday 10th August, Julian day 222

Another beautiful, sunny, calm day.

12:15Z. Sailing to C2 for CTD cast. The ship's core cable was streamed for spooling correction. This operation lasted several hours and slightly slowed the ship down.

18:10-22:00Z. Station C2. CTD frame in the water to 4760 m. Position 41 57.3N 056 34.0W.

Friday 11th August, Julian day 223

Hazy, hardly any wind, surface wave breaking, just a gentle swell.

11:30-15:30Z. Station C3. CTD cast to 4910 m. Position 42 06.0N 053 09.3W.

21:30Z Station A3. Deployment of a 500-m, two-current-meter mooring for 24 hours survey. The idea here is to complement the survey carried out on B4 at a slightly shallower depth within the depth interval 3000-4000 m, where the slope is gentler than at shallower depths, but still quite large. Position 42 55.30N 052 29.70W.

21:50-01:00Z. Station A3. CTD cast to 3150 m. Position 42 55.7N 052 28.5W.

Saturday 12th August, Julian day 224

Sunny, calm, very gentle breeze.

9:30-13:10Z Station A5. CTD cast to 4080 m. Position 42 29.1N 052 50.2W.

15:00-18:00Z Station A4. CTD cast to 3630 m. Position 42 39.9N 052 38.7W.

18:45Z. Emergency drill and boat muster.

21:50Z Temporary mooring on A3 onboard.

22:00-01:00Z Echosounding survey (with hull mounted echosounder, as the PES fish was taken inboard after the recovery of the mooring).

21:30-???. End-of-cruise party in the bar lasting till the wee hours.

Sunday 13th August, Julian day 225

More good weather. Sailing to St. John's.

20:30Z. Surfmet, navigation, echosounder off. This is the end of the cruise for the purpose of data collection.

Monday 14th August, Julian day 226

09:00Z. Arrival in St. John's. End of cruise.

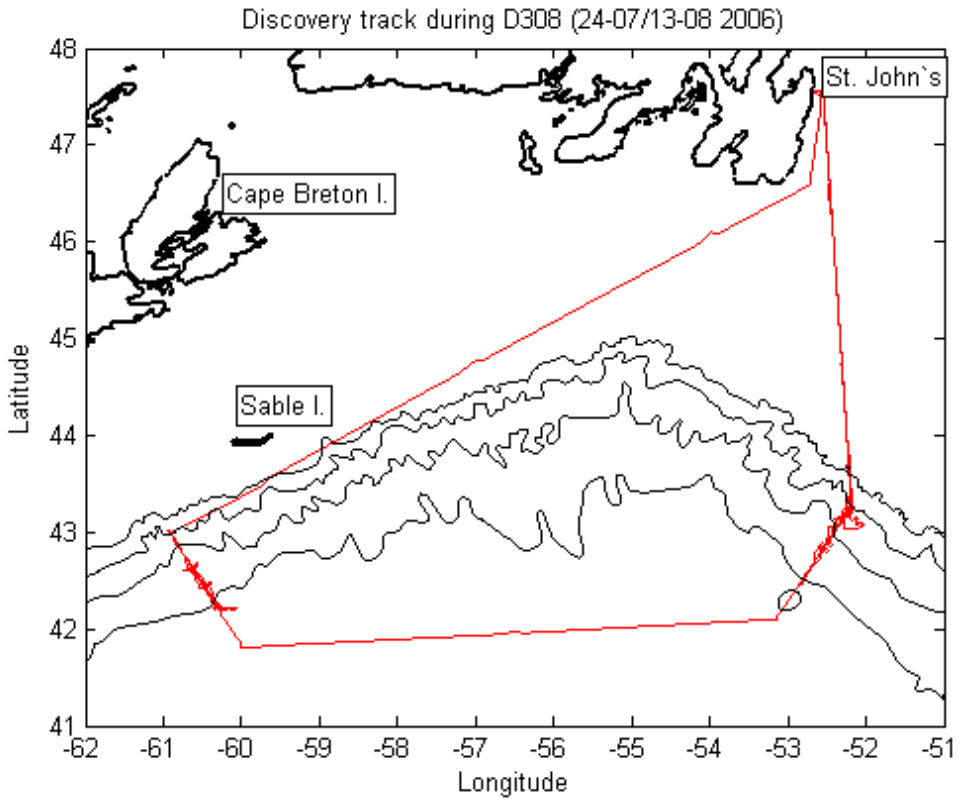


Figure 3: Discovery track during cruise D308. Bathymetric contour: 1000 m.

Bottom Pressure Recorder/Inverted Echo Sounder Recoveries and Deployments

Peter Foden and Jeffrey Pugh
Proudman Oceanographic Laboratory

Cruise Objective

To recover and re-deploy 12 self-contained, pop-up landers to measure bottom pressure and temperature, at each of the sites 0A to 5A and 0B to 5B. Originally deployed two years ago during cruise CD160 on the RRS Charles Darwin.

Details of CD160 (2004) BPR deployments

0A BPR:	43º 15.74'N,	52º 11.26'W,	20:58,	6/8/04 (Jday 219),	1809m unc.
1A BPR:	43º 11.90'N,	52º 14.96'W,	14:17,	7/8/04 (Jday 220),	2225m unc.
2A BPR:	43º 06.71'N,	52º 19.54'W,	20:35,	7/8/04 (Jday 220),	2716m unc.
3A BPR:	42º 54.87'N,	52º 29.05'W,	13:42,	8/8/04 (Jday 221),	3220m unc.
4A BPR:	42º 40.02'N,	52º 40.82'W,	22:43,	10/8/04 (Jday 223),	3666m unc.
5A BPR:	42º 28.66'N,	52º 50.36'W,	10:59,	11/8/04 (Jday 224),	4120m unc.
0B BPR:	42º 59.84'N,	60º 54.58'W,	17:13,	18/8/04 (Jday 231),	1838m unc.
1B BPR:	42º 55.64'N,	60º 51.63'W,	20:16,	18/8/04 (Jday 231),	2217m unc.
2B BPR:	42º 49.16'N,	60º 46.44'W,	23:02,	18/8/04 (Jday 231),	2714m unc.
3B BPR/IES:	42º 37.21'N,	60º 36.73'W,	16:29,	21/8/04 (Jday 234),	3222m unc.
4B BPR:	42º 26.44'N,	60º 28.26'W,	18:21,	19/8/04 (Jday 232),	3665m unc.
5B BPR/IES:	42º 13.86'N,	60º 18.40'W,	19:07,	20/8/04 (Jday 233),	4098m unc.

Note that depths stated above are as recorded (uncorrected) by the ship's EA500 echo sounder: these overestimate the true depth, since the system assumes a constant sound speed of 1500 m/s. In choosing deployment sites, Carter's tables were used to correct to actual depths. Times above are GMT.

RapidLander description

The lander consists of two 13" Vitrovex spheres in orange hard hats. The hard hats are bolted together end-to-end and there is an acoustic transducer on the top sphere and a release plate at the bottom, which can be bolted to the steel tri-pod ballast frame with corrodible bolts.

The bottom sphere contains three lithium battery packs and is slightly positively buoyant. The upper sphere contains the sea level sensor, electronics and Benthos release; it provides the majority of the buoyancy to bring the package to the surface on recovery. There is a radio beacon which is triggered by release and transmits continuously until the batteries expire.

The instrumentation consists of a Digiquartz 10,000 psi pressure sensor operating continuously, the pressure and temperature frequency outputs are counted over 15 minute intervals and the data stored to flash disk. On two instruments at sites, 3B and 5B, additional instrumentation has been added to provide an Inverted Echo Sounder (IES) function. An extra circuit board containing a CF2 PC card and 1 Gigabyte flash card provides a 12 kHz to 8 kHz 'chirp' every four hours. The acoustic return from

the surface is digitised and stored to flash. About 50,000 samples are recorded for each second's worth of signal received. These measurements will give travel times for the chirp to travel to the sea surface and back down to the IES again, a measurement of dynamic sea height and also density structure.

Figure 4: One of the BPRs recovered during D308. The two orange hard hats contain a Vitrovex sphere each.

The release mechanism consists of a modified NOC 'fizz-block'; it is a burn wire mechanism that consists of a loop of solid inconel wire that secures the end of a lever that holds a fastening in place between the bottom of the lander and the tri-pod ballast frame. By passing a current between the burn wire and another electrode the wire loop can be dissolved and the lever released which in turn detaches the lander from the ballast frame.

Lander recovery

After the BPR has been located acoustically using the transponder, the lander can be separated from the ballast weight by sending an acoustic release command. On receipt of the command the burn wire is energised and begins to dissolve, this can take between 10 and 50 minutes, depending on temperature, salinity and depth. The burn wire loop is sleeved except for a section at the bottom of the loop. This concentrates burning to the area supporting the end of the release lever; when burning is complete the lever drops down and the buoyancy of the lander lifts it away from the ballast frame.

The ascent rate has been found to be almost exactly 1 m/sec. allowing the ascent time to surface to be reliably predicted.

On the surface the two orange hard hats can be readily spotted, the 6 metre stray line grappled, and the lander brought on board with the assistance of the starboard crane.

Figure 5: A BPR just before being hauled aboard.

Lander deployment

The landers are deployed using the starboard crane and the ship's release hook. The lander is lowered into the water and when the weight comes off the release hook the lander is released and free falls to the sea bed. The lander can be tracked to the sea bed using the Benthos Deck Unit connected to a PC, which runs a software program providing a waterfall display of the track to the bottom. When the lander contacts the sea bed the display goes vertical indicating a safe descent and landing. All deployments are monitored safely down to the sea bed. GPS position, depth and barometric pressure are all recorded at deployment.

Observations

Recoveries started with site 0A at line A on 26/7/06 (JD207). Landers RL08 and RL09 at 0A and 1A respectively, were recovered without problems. There was minimal growth on the plastic housings but signs of corrosion on some but not all of the stainless nuts and bolts holding the hard hats together. The landers were spotted very quickly when on the surface and radio beacons worked but not used for location. Data loggers were running and all battery packs in good order.

After this good start, there was unfortunately no acoustic response from the BPRs at the remainder of the sites on line A. (2A, 3A, 4A and 5A) Landers RL10, RL11, RL12 and RL 13 were presumed lost. Release commands were transmitted 'blind' at 2A and the appropriate length of time waited for possible release and surfacing, but visual or RF sighting. No release commands were transmitted at the other remaining sites, to allow possible later visits and interrogation.

Site 0B of line B was visited on 1/8/06 (JD213) and the BPR was recovered with no problems. BPRs at 1B, 2B and 3B were also subsequently recovered without

incident. Recovery of the BPR at 3B was a particularly interesting because was also fitted with an Inverted Echo Sounder instrument.

Figure 6: Deployment of a Lander BPR.

All instruments were fully operational when brought inboard except for the BPR at 1B, this instrument had a slight leak from the pressure sensor feed-through pipe. A small amount of sea water had dripped onto the data logger board, stopping it and also flattening the logger battery pack. Data was still present on this logger and the leak damage had occurred approximately 18 months into the deployment. We were particularly lucky to get this BPR back because there was also a huge (200 mm diameter) area of spalling where internal stress had caused a glass piece about 0.5 mm thick to peel away. A smaller piece of glass spalling was also present on the lower hemisphere close to the equatorial area.

The BPRs at sites 4B and 5B were not recovered. There was no contact with the BPR at 4B at all but the BPR at 5B could be easily contacted and was monitored going through it's release cycle on the Benthos acoustic deck unit. The burn wire had definitely burnt through but no lift off from the sea bed was observed.

Deployments

In view of the mooring and BPR losses at lines A and B, it was agreed to consolidate all instrumentation on line B, as this is the closest line to Oceanographic facilities in Halifax.

Two newly constructed BPR landers were deployed at sites 0B and 1B, and two recovered and refurbished landers deployed at 2B and 4B. BPRs in aluminium tubes were mounted directly on the two moorings deployed at 3B and 5B. A metal tripod attached to the mooring release and resting on the ballast weight (two wagon wheels) has two plastic brackets supporting the BPR tubular case.

Details of D308 (2006) BPR deployments

0B BPR/RL22 42º 59.90'N, 60º 54.58'W, 12:00, 1/8/06 (Jday 213), 1822m unc.
1B BPR/RL21 42º 55.63'N, 60º 51.68'W, 16:46, 1/8/06 (Jday 213), 2212m unc.
2B BPR/RL16 42º 49.18'N, 60º 46.49'W, 10:45, 6/8/06 (Jday 218), 2704m unc.
3B BPR/NOC 42º 35.98'N, 60º 37.51'W, 13:06, 9/8/06 (Jday 221), 3255m unc.
4B BPR/RL08 42º 26.47'N, 60º 28.24'W, 19:19, 8/8/06 (Jday 220), 3655m unc.
5B BPR/NOC 42º 12.56'N, 60º 18.79'W, 14:35, 8/8/06 (Jday 220), 4102m unc.

NB The positions for the NOC moorings are for when the anchor weight was released into the water and not the absolute position of the mooring on the sea bed.

Summary

Out of the six BPRs recovered, three showed signs of very recent oil weep on the pressure feed-throughs, one had leaked a small amount of sea water and the other two showed no sign of leakage at all, either oil or sea water from the buffer pipe. The fittings that did show oil leaks looked like they had only just started since oil was not present on the logger board below. It is possible that oil began to come through the pipe fitting only during the BPR ascent, accounting for the fact that oil had not dripped onto the board immediately below the pipe. All pressure ports had been pressure tested to 400 Bars at POL, prior to deployment.

It is presumed that the other non-recovered BPRs must have suffered similar leakage problems, causing internal electronic damage and therefore no acoustic contact with them. The problem is definitely pressure deployment time related, evidenced by the

recovery of all landers at the lower depth sites (1800m and 2200m) at lines A, B and at line W (the Woods Hole line) earlier in the year. Simple modifications to the pressure feed-through plumbing will solve the pipe leakage problem, resulting in a low-cost, reliable lander with long term capability.

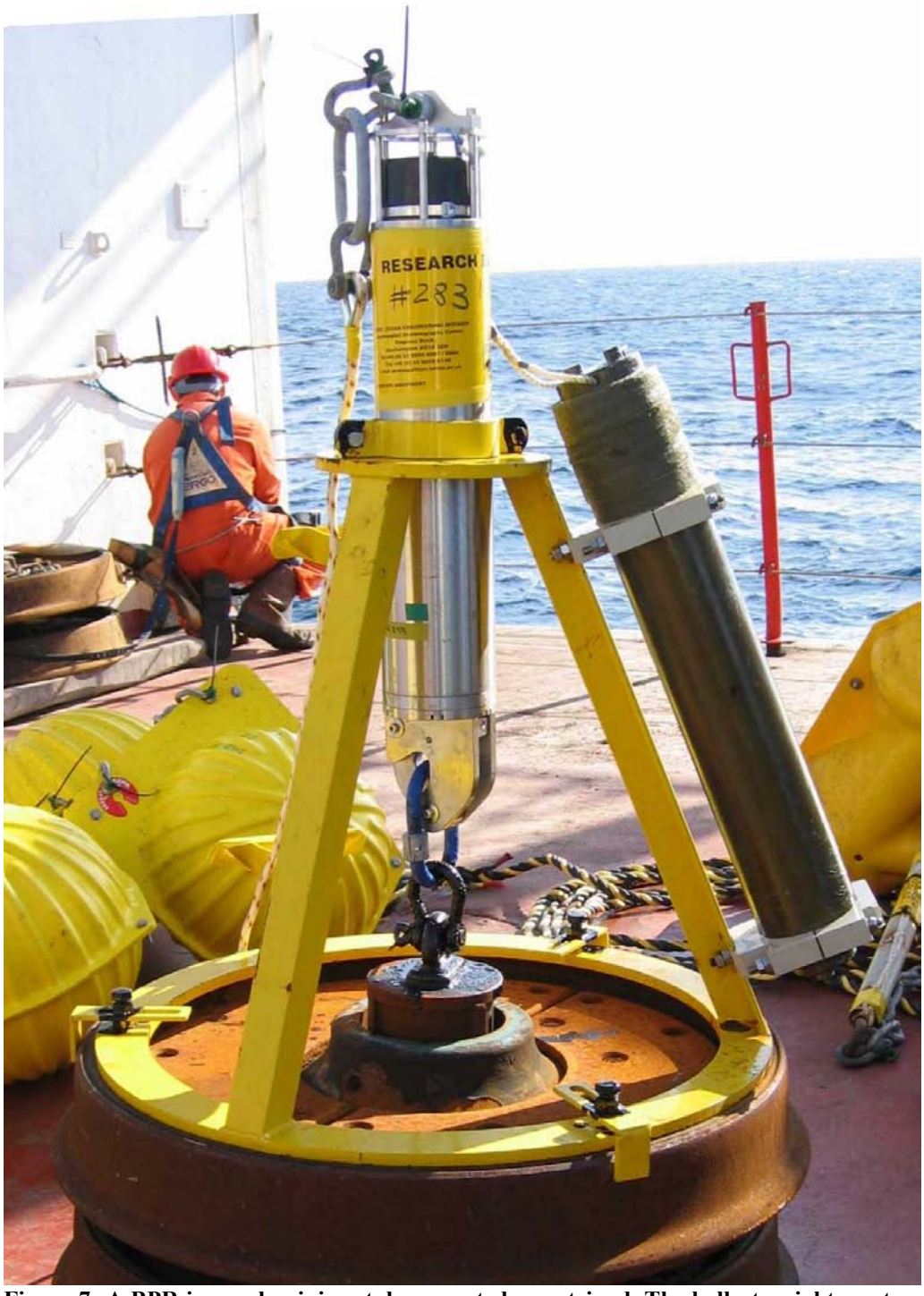


Figure 7: A BPR in an aluminium tube mounted on a tripod. The ballast weight are two wagon wheels.

Overall, the lander vehicle has performed extremely well and has proved to be easy to prepare, deploy and recover. The six recovered BPR landers have provided over 12 instrument years of data plus a two year IES record.

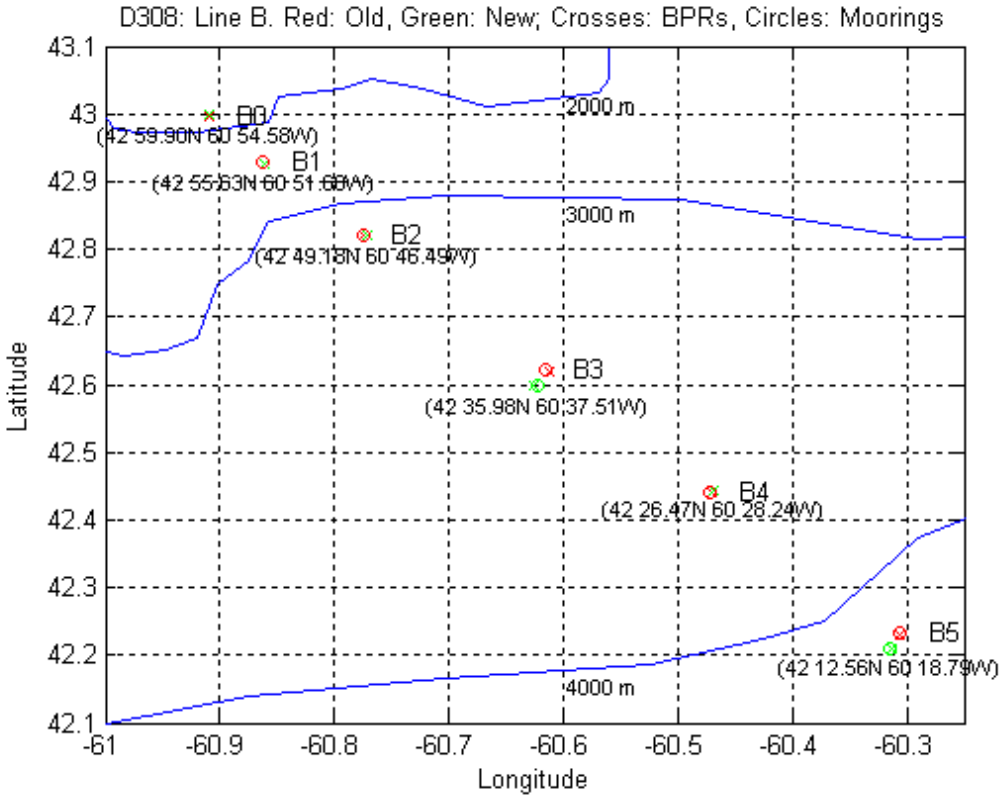


Figure 8: Location of D308 instruments along line B. Red symbols denote instruments deployed during CD160; green ones denote instruments deployed during D308. Circles and crosses denote moorings and BPRs, respectively. The latitude-longitude positions of the D308 BPRs is also indicated.

Mooring recoveries and redeployments

Ian Waddington and the onboard mooring team
National Oceanography Centre

Objective - To recover and re-deploy 10 moorings of the WAVE array .

Achievements – Only 2 moorings were recovered and only 2 moorings deployed for long term measurement .

LINE 1A to 5A – No moorings recovered .
Erratic acoustic replies only returned from mooring 1 A eventually failing totally.
No detection of acoustics at sites 2A to 5A.

LINE 1B to 5B – Moorings 1B and 2 B only recovered . No detection of acoustics at sites 3B to 5B.
Dragline attempts with no result.

SURVEY Moorings.
Two survey moorings were deployed for approximately 24 hours on lines A and B. These moorings were equipped with current meters to establish local current regime . Good data was recovered and no extraordinary currents were noted .

LINE B deployments

Moorings were deployed at sites B3 and B5 . These moorings used tripod BPR anchors . Deployment was buoy first – anchor last and the moorings were observed acoustically to the seabed.
An additional current meter is included at B3 to provide long term current data for future deployments.
Moorings were carefully navigated in using acoustic transpond function to establish best known position and to ensure mooring securely anchored to seabed.

Operational

Acoustics

As will be shown the acoustic release signal was initially questioned as to reception onboard . However with numerous tests and successful deployments and recoveries of the Survey moorings and B3 and B5 navigation there was no problem with receiving an acoustic signal from an AR861.

Acoustic test was made on the 25th July testing the Ixsea deck systems at short range – 357m – good replies using the PES single element.
A repeat test was carried out 26th July at site 2A with good response to an AR861 mounted on the CTD frame to 3165 metres range. Waterfall display tested with good reception displayed using the 10 khz beacon.

August 6th 2006
On passage remove PES davit plug degrease and dry out.
Open up junction box on stbd bulkhead on deck – wet inside with some corrosion – wd40 then degrease and thorough dry out . Check PES seems much improved – outgoing TT801 signal now "crisper" and bottom echoes of outgoing signal clearly heard on TT801.

CTD station AT B2 01 to 02 August 2006
Release tests –

AR861 # 310	RANGING	2425M 2425M 2440M 2446M TX 14C6
	RELEASE	2607M 2609M REL 2652M 2658M REL
AR861 # 311	RANGING	249M 2495M 2505M 2516M TX 14C7
	RELEASE	2688M 2691M REL 2690M 2690 M REL
AR861# 252	RANGING	2563M 2574M 2578M
	RELEASE	2705M 2708M REL 2711M 2711 M REL

ALL TESTS COMPLETED AT BOTTOM OF CTD CAST AS ABOVE. All signals good .
AR.s from B1 and B2 performed perfectly good signals received throughout - all command functions fully tested .

Mooring Recovery attempts

LINE A

DAY 207 26th July 2006
MOORING 1A
Approaching site 0135h
Tx 14C1 + 1449 DIAGNOSTICS
0135h 2896.7m ? 43 11.555 52 14.284 no telemetry
0143h 2751.9m ? 43 11.6937 52 14.4581 vertical 23.1v – wrong
TX 14C1 + 1449
1300+20 3795m Poor telemetry erratic values
1301 2685m vertical 6.3v
1315h 2241m TX REL 1455 43 13.135 52 14.983
1316h 2233m REL confirm
1316+30h 2223m poor replies switch on pinger to get display on w/fall
PING ON – No signal seen on w/fall
PING OFF – No confirmation
1336h 2702 ? erratic replies – no telemetry
1337 2561? Erratic and errors – no telemetry
1357h 2725m 145degO/C for close approach
1358h 2716m 43 11.8506 52 14.578
1400h A/C 090 deg unreliable replies
1403+30s 227 deg No replies
1410h 328 deg No replies
1414+30s 2773m? 43 11.5302 52 15.1449
NOT RISING
At BPR site
1443h 2810m Vertical 11.2v ?
1443h 2810m Rel OK
1501h 2810m 14C1+14C1
NOT RISING
If on surface then release signal will be lost as only 1m deep
DAY 208 JULY 27TH
RETURN APPROACH SITE
TX 14C1 + 1449 NO REPLIES – PASS OVER SITE HEADING NE
0410 TURN BACK TO NOMINAL POSITION – NO REPLIES
0513h Approach at 2.5 kts TX 14C2 + 14C2
NO REPLIES – either released or failed
ASSUME RELEASED AND ADRIFT – OR STUCK DOWN AND ACOUSTICS FAILED
– STEAM SEARCH PATTERN – initially with TX then visual – excellent visibility
NO CONTACT – EITHER NOT SIGHTED OR NOT ON SURFACE **– NO DETECTION EITHER WAY.**

DAY 207 26th July 2006
MOORING 2A
MOVE OFF TO 2A –TO CHECK ACOUSTICS
TX 14C2 + 14C2
1808h steaming through site – NO REPLIES – progress down slope
1819h a/c 315deg NO REPLIES
TX REL – BLIND FIRE
1MILE SEARCH BOX VISUAL AND ACOUSTIC
SURVEY TRACK DOWN AND ALONG SLOPE
TX 14C2 + 14C2
DAY 208 JULY 27TH
0045h END OF SURVEY TRACK
0205 RETURN TO NOMINAL POSITION TX 14C2 + 14C2
RUN CHECKS ON DECK UNITS AND USE HULL TRANSDUCERS
NO REPLIES

MOORING 3A DAY 208 JULY 27TH

PROCEED TO SITE 3A
VISUAL WATCH KEPT ON PASSAGE for 2A
2046h at BPR SITE wd 3210m TX 14C3 + 14C3 NO CONTACT
DRIFT ACROSS SITE WHILST ATTEMPTING BPR RELEASE
NO REPLIES
2128h **ACOUSTICS TEST**
In order to verify acoustics deck unit correct operations – deep ctd
3165m max depth
Both deck units and fish tested for full function using AR861 #253
Pinger switched on and waterfall tested – leads swapped to EA500 sig out for improved display
Check pallet settings and use default as best – adjust and check attenuator OK
Haul onboard TEST VERIFIES CORRECT OPERATION OF DECK SYSTEMS
DAY 209 – JULY 28TH 2006
COMMENCE SEARCH PATTERN FOR 3A USING ACOUSTICS
TX 14C3 + 1449 TT801#013 WITH PES FISH
Increasingly looking like release failures or well off site – no detection

DAY 209 – JULY 28TH 2006

Steam down to 4A – no replies – not detected.
Pattern search

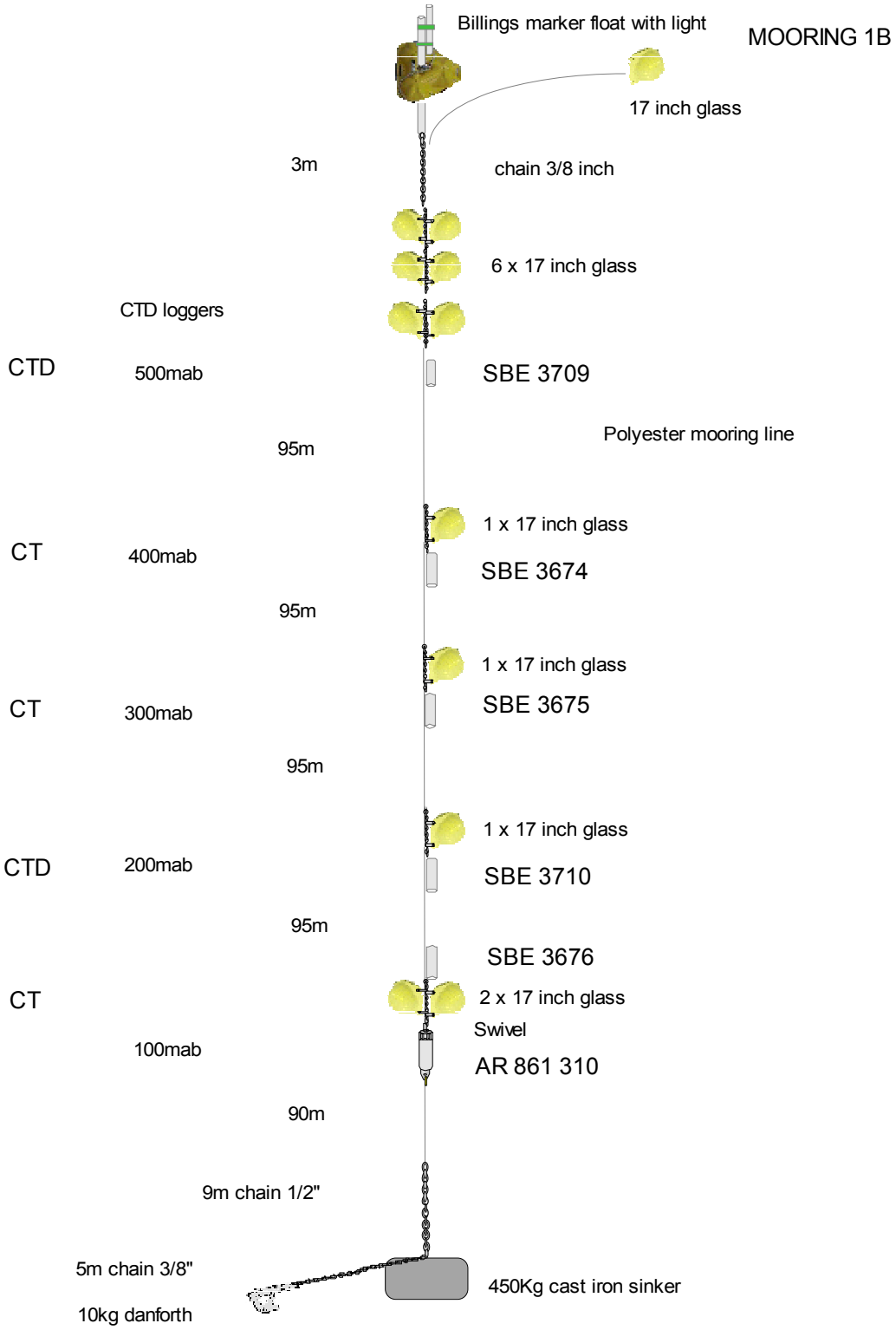
Steam down to 5A – no replies – not detected

LINE B
Day 213 – August 1st 2006

Proceed site B1 – Mooring recovery
1305 gmt First range attempt – 8727m – 2358m
tx release – 1806m – 900m – rel ok
continue tx release at 1 minute intervals
6844m – 7663m rel ok
Very noisy seeming like electrical break through from PES
PES Ping OFF
2319m 1794m no rel
2300m 2214m no rel
1888m
1898m
1895m
1889m Ship stopped – mooring released
2162m
Switch to overside transducer amidships – transmit in REL mode
1718m no rel
1709m no rel
1619m no rel
1610m no rel
Good reliable ranges to 702m when mooring sighted 200m starboard bow
Conventional smooth recovery some tangling but nothing serious
All onboard 1402 LT

Mooring parts stripped and secured – proceed to recover BPR

NOTE THE RELEASE HOOK DROPPER HAD SWUNG AROUND SO VIOLENTLY IT HAD RE-ENGAGED THE RELEASE DROP CAM ARM.
This would account for the non-confirmation of rel after initial as cam jammed into place by dropper.

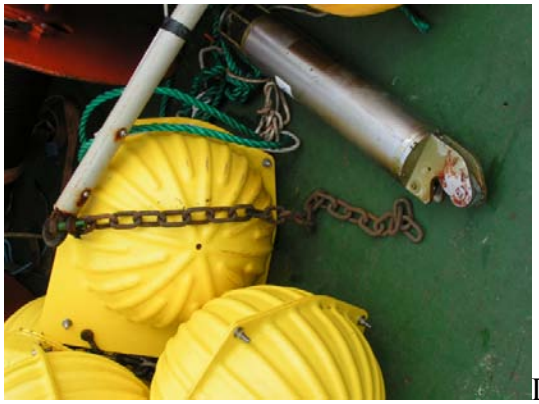


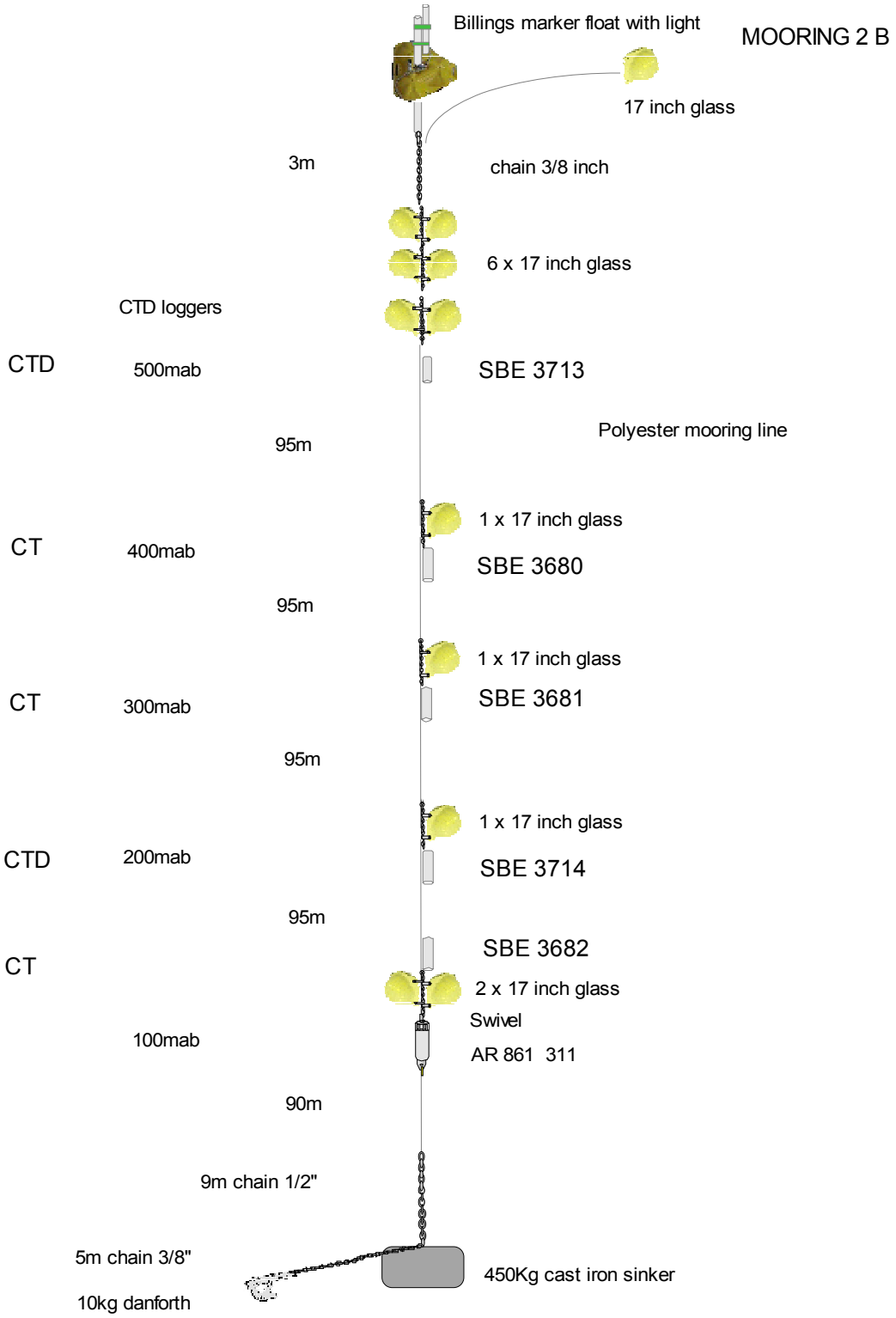
MOC mooring for CD160
POL ver. 1.1 AT SEA
MOORING 1B

Mooring 1B as recovered
Day 213 – August 1st 2006
Proceed to B2 –
First interrogation – August 1st 2006
1832h 2693m
1835h 2408m tx REL
REL confirmed
2349m
2212m
2202m
2062m
1992m 1841h
Continue tracking up and use overside transducer for final stages
1051m 1850h
787m 1853h
626m 1855h Sighted off starboard bow 200m

On waiting for mooring to rise it could be seen mooring very tangled up .
Approach release double sphere buoyancy and grappled – Darwin boys
1915h grapnel
Mooring got around rudder at mid single sphere – freed off by cutting away
Mooring then recovered from bottom up starting at 1934h with SBE 3714 on deck
Low loads
Top buoyancy , marker buoy and SBE came onboard as one tangled mass

NOTE THE RELEASE HOOK DROPPER HAD SWUNG AROUND SO VIOLENTLY IT HAD RE-ENGAGED THE RELEASE DROP CAM ARM AS B1 .
This would account for the non-confirmation of rel after initial as cam jammed into place by dropper.
All on deck 1952h


Drop arm and hook
Note the hook has swung completely around jamming the drop arm back into cocked



MOC mooring for CD160
POL ver. 1.1 AT SEA
MOORING 2B

Mooring 2B as recovered

Acoustic releases – full service and overhaul –

AR861 #310
Battery packs all at 8.59v
Motor battery at 9.26v
All instrument cleaned , greased and new batteries
Battery packs all at 9.65v
Motor battery 9.6v

AR861 #311
Battery packs all at 8.55v
Motor battery at 9.03v
All instrument cleaned , greased and new batteries
Battery packs all at 9.65v
Motor battery 9.6v
This hook assembly had hard corrosion products from release link which were polished out .

Hook condition on recovery - some staining from release link and slimy growth on surfaces

Hook when opened up in lab - note no cleaning has been done - staining is from release link. All mechanism operates freely .

01 to 02 August 2006

RECOVER BPR AT B2 – CALM SEAS BRIGHT LIGHT

CTD station AT B2

Release tests –

AR861 # 310	RANGING	2425M 2425M 2440M 2446M TX 14C6
	RELEASE	2607M 2609M REL 2652M 2658M REL
AR861 # 311	RANGING	249M 2495M 2505M 2516M TX 14C7
	RELEASE	2688M 2691M REL 2690M 2690 M REL
AR861# 252	RANGING	2563M 2574M 2578M
	RELEASE	2705M 2708M REL 2711M 2711 M REL

ALL TESTS COMPLETED AT BOTTOM OF CTD CAST AS ABOVE

All signals good .

AR.s from B1 and B2 performed perfectly good signals received throughout - all command functions fully tested .

Day 214 – August 2nd 2006

At site B3 – boxed around – strange ranges and intermittent noise – echo sounder generated – when ping off all clear and quiet .
Searched nominal position then proceeded to BPR position which should according to mooring rough notes be mooring position . Release not sent at site .
4 mi steam

On arrival at B3 no replies/contact – steamed immediately North 1 mile and used dunker to interrogate – in case mooring had released from this site and was drifting North /North East at 1/2kt – no replies – steamed a further 1 mile NE and repeat no replies – steamed 1 mile north and repeat –no replies . Steam a further 1 mile north east on visual then turn and head back to BPR using visual in case mooring had surfaced . No contact was established on return to site .

Proceed B4
On site interrogations – no contacts
Tried and tested all acoustics – all OK – it was possible to hear clearly the echo return of the outgoing TT801 signal from the seabed .
Release not sent at site .

Proceed B5
On site interrogations – no contacts
Release not sent at site .

BPR contacted – pop up held back as dark approaching .
Check 12khz reception on TT801 audio with single element and waterfall from BPR – TT801 audio good out and back if window open on deck unit during txm of Benthos good detection of 12khz
Waterfall good out – poor back and noisy background .

DRAGLINE OPERATIONS

No successful dragline recovery was achieved – with no acoustic signal
From the moorings the operation was carried out "blind"

Dragline lost on **Day 217 August 5th** see below – precluded any further dragging operations .

Due to the complete failure to recover any mooring from Line A the Discovery set course for ST Johns to pick up Dragging Wire . Day 211 – July 30th 2006 wire craned aboard from boat transfer .

This wire was necessary due to the short length of the main Trawl Warp after a Trawl loss earlier in the year .

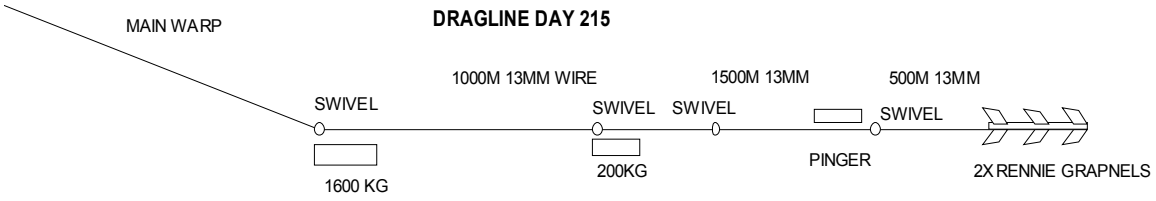
As it is not possible to wind on wire to the trawl winch on Discovery the only recourse was to utilise the 2 available deck systems . The Lebus auxiliary portable winch and the mooring Double Barrel Capstan . As these winches are load restricted the dragging wire has to be a combination of 13mm and 10mm steel wire . 3000 metres of warp were thus able to be deployed in addition to the remaining trawl warp from the main Trawl winch.

At the deepest site B5 this line length was only just long enough and a careful watch had to maintained at all times to ensure the dragline section stayed on the seabed . Much lighter clump weights and grapnel arrangements had to be used as the deck winches were only just capable of hauling the system and if the mooring had been recovered then there had to adequate winching capability to recover the mooring load including anchor .

Trawl Warp available 6525 metres trawl
Dragline available 3000 metres – 1000m 13mm and 2000m 10mm

Day 215 August 3rd
5B
Deploy Dragline 1327 gmt PINGER B2 – 1 sec interval
6525 metres trawl warp paid out – half of bottom layer left on drum
Drag pattern – Along slope deploy then up slope/down slope triangle – no contact

Hauling tensions
2046 commence haul at 50m /min
2107 wo 5686 4.5 to 5.2t
2112 wo 5492 5.7 to 6.12t hauling 1.5tonne along seabed
2127 wo 4850 6.7t
2148 wo 3949 5.5t
2208 wo 3092 5.0 to 5.7t observed as wave motion when comparing
2214 wo 2855 5.9t to shipborne wave recorder
2236 wo 1858 3.9 to 5.1t
2242 wo 1623 3.6 to 4.5t
2303 wo 711 3.5 to 4.2t



Recovered inboard

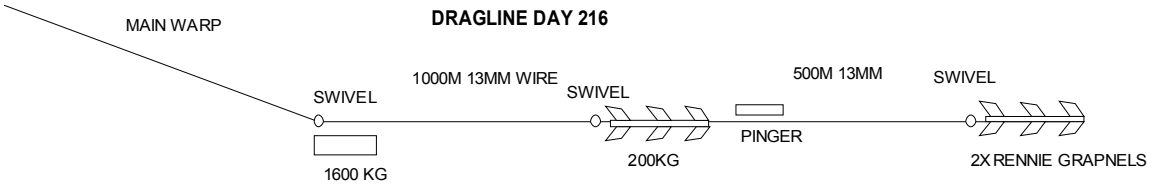
In line master links from D304 dragline on 13mm badly deformed – all replaced during haul in with Gunnebo 16-8 and 13-8 at upper end and 10-8 in 10mm wire
Pinger securing spring latch badly bent unable to open latch – levered open to remove pinger .
Lebus winch angle UP to A frame when A frame fully in causes plankton roller to snap and wire to take on tight angle on upper frame of reeving gear. For future needs new heavy duty roller assembly . For this cruise hauling on Lebus only with A frame out to relieve any bend or contact on the reeving gear .

Stopper used – Carpenters stopper – ships supply – attached to Lebus winch lifting pad eye .

10mm drag wire very lively – more swivels to be added to relieve this twisting for next drag .
On recovery white mud on grapnels and chain – small piece of shredded fibre line in pinger .
All dragging gear had been on seabed and was in good condition.

Day 216 August 4th
On site at B3 – acoustics check using 14C8 – no contact
Check drag position – incorrect on wrong drag site (Mooring site) with dragline fully deployed to end of 13mm and attached to warp –1218 gmt tow at 4kts to B3 BPR site
B3 Dragline using BPR best position
42 37.205N 60 36.725W
Commence
Calm conditions – shortened dragline for depth and to conserve 1500m for deeper water
All dragline deployed – streamed and then a reverse course U sweep across site with dragline grapnels hauled across nominal position
With 1.5tonne chain in water load 2.74 tonne
1458 payout 80 m/min 1.8kts 2.12tonne
1502 payout 70 m/min 1.9kts 2.5 tonne
1535 6519m wo 3.55tonne
1545 increase tension 5.45 tonnes
Loads 4,7 to 5.5 tonnes laying out dragline
1640 turning
1918 4467m wo 3.5tonne Hauling in 50m/min
1932 3871m wo 3.7tonne
2051 1951m wo 4.3tonne Hauling in 50m/min
All inboard 2215 gmt – brown sticky clay with grit

All dragging gear had been on seabed and was in good condition.

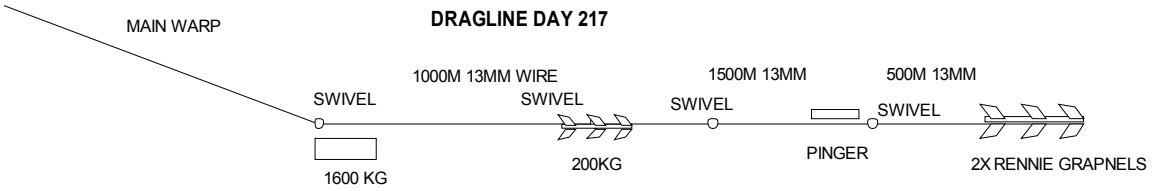


Day 217 August 5th

Deploy complete dragline for depth

1452- Abeam of mooring 3666m wd 3.5 tonne (not towing)
1511- Towing 036 deg 5.15 tonne - towing
1608- Commence turn 3596m wd A/C 4.86 tonne – towing
1620- Turn complete – increase to 3kts 280deg
1650- oc 278 3kts tow astern – approaching dragline pinger
1700 – A/C no slope change on pinger
1752 – A/C
1800 – oc 090 going slowly away from pinger
1835 – final course 000
1912 – hauling – hove to – 50m / min – 3.17t
2005 – pinger moving towards - 5.22t
2013 – pinger approach steady – 5.8 t

On change over from full speed to hand slow speed – line banged and then went slack all load lost-
When bitter end recovered at end of trawl warp there was just a swivel – failure of Gunnebo master link underwater – cause unknown



SURVEY MOORINGS

A design was made onboard to deploy Survey moorings in order to establish a short term current record at each line .
Moorings are as below – data was recovered from the instruments and downloaded and plotted onboard .

Prepare Survey Mooring – 2006/27 Day 217 LINE B
RCM 11 526 ON AT 2130 GMT RCM 11 514 ON AT 2135 GMT
Steam off safe distance – commence deploy
Release tested for full function on deck – ok
Check release as soon as in water 73m range on tt801 in lab using pes
2229 – Release in water – 42 27.011N 60 25.796W
2230 Anchor way – 42 27.0405N 60 25.8036W
Monitor descent using A9 + A9
2233 615m
2236 1138m
2239 1628m 163m/min 2.7m/sec
2241 1948m 160m/min 2.6m/sec
2243 2268m 160m/min 2.6m/sec
2244 2430m
2251 On seabed 3556m

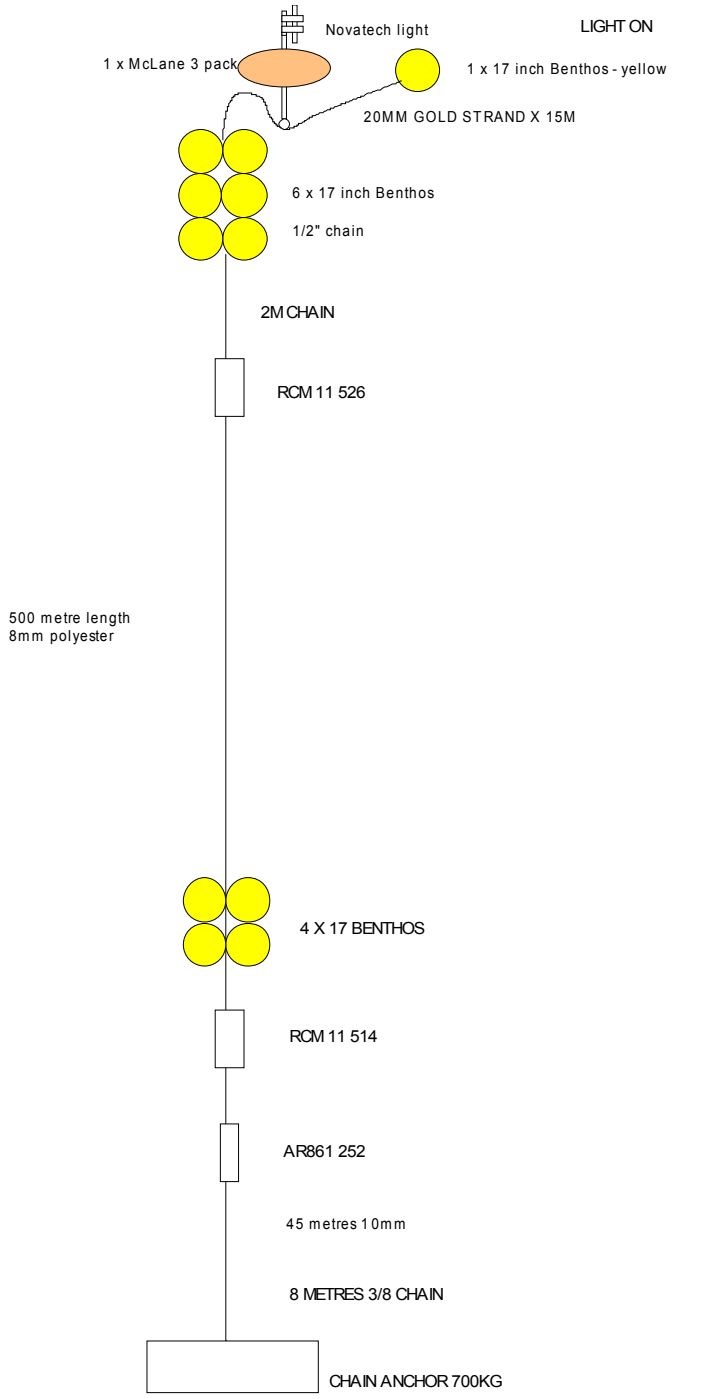
Steam fixing triangle –

Best positions – 2324 gmt 3558m 42 26.824N 60 25.773W
3588m beam 42 27.06N 60 25.26W
Day 218 0000gmt 3551m over lay position
0005 gmt 3551m 42 27.04N 60 25.76W
Diagnostics check Vertical – 9.6V All ok – proceed

Day 219

Recover Survey Mooring 2006/27

0949 tx 14A9
0949H 3640M
0950H 3639M
0952H 3649M
0953H 3533M MOORING RELEASED
0954H 3452M **RISE RATE 81 METRES / MIN**



SURVEY MOORING 2006/27
DAY 217 DEPLOY
42 27.0405N 60 25.8036W 2230GMT
DAY219 RECOVER SURFACE 1025 GMT

1007H 2329M
1018H 1685M
1024H 1314M
SURFACE 1025H RANGE
1193M 42 21.57 N 60 25.72W
CONTINUE RANGING TO CHECK NEAR SURFACE RESPONSE
1140M
1109M
1023M
998M
982M
943M
929M

ALL MOORING INBOARD BY 1110 GMT
RCM 11 526 OFF AT 1124GMT RCM11 514 OFF AT 1133GMT

Day 223 11th August

Deploy Survey Mooring - Line A 2006/30
Acoustic release AR252 checked on deck 1945 gmt diagnostics Horizontal - 9.6v
Deployed buoy first anchor freefall
2105 Commence deploy
2108 RCM in water
2123+ 30s Anchor away 42 55.27160N 52 29.69973W 3219m UCM
2124 154
2125 330
2128 154
2125 330 176 m/min
2128 851 - 866
2129 1002 - 1017
2134 1715 150m/min
2136 2094
Move off to ctd position as mooring descends
At ctd position

2148+30s		3470	Seabed	
2150		3477	Seabed	
2151		3483	3484	Vertical 9.6v
2151	repeat	3485	3486	Vertical 9.6v
2152		3486	3487	Vertical 9.6v

Day 224
Recover Survey Mooring at A line

2024 gmt	No response	
2025 gmt	3212m	3197m water depth

Poor responses

2030 gmt	TX REL sequence	
2030 gmt	2992m	No Confirms
2034 gmt	2839m	Rising
2035 gmt	2774 - 2766m	
2036 gmt	2686m	Rising 90m /min
2039 gmt	2452 - 2444m	
2048 gmt	1633m	
2050 gmt	1504m	

Seen on surface starboard side

Recovered at second run in - surface lines tangled
RCM 11 caught up in surfaced 6 pack
All inboard safely

LONG TERM MOORING DEPLOYMENTS

Mooring 2006/28 SITE B5

Mooring finalised on deck - release link on tripod removed from release and coated with pvc tape to limit possible electro-chemical reactions between release hook and link.

Deployment buoy first - 6 pack lifted over by crane - 4 pack and 2 pack by hand - rails down throughout . Deploying speed 1 kt in calm conditions.
Payout of 500 metre lengths polyester from bins by hand overside. Instruments clamped on during payout.

On completion of payout to 4 pack the line was cleated off with the 4 spheres on deck .Towing then commenced downslope to mooring site at 2.5 kts. 1318 gmt
Slow tow with course alteration at 1338 gmt to move downslope.

1348 + 58s GMT Tripod released for descent.
42 12.58775N 60 18.84473W

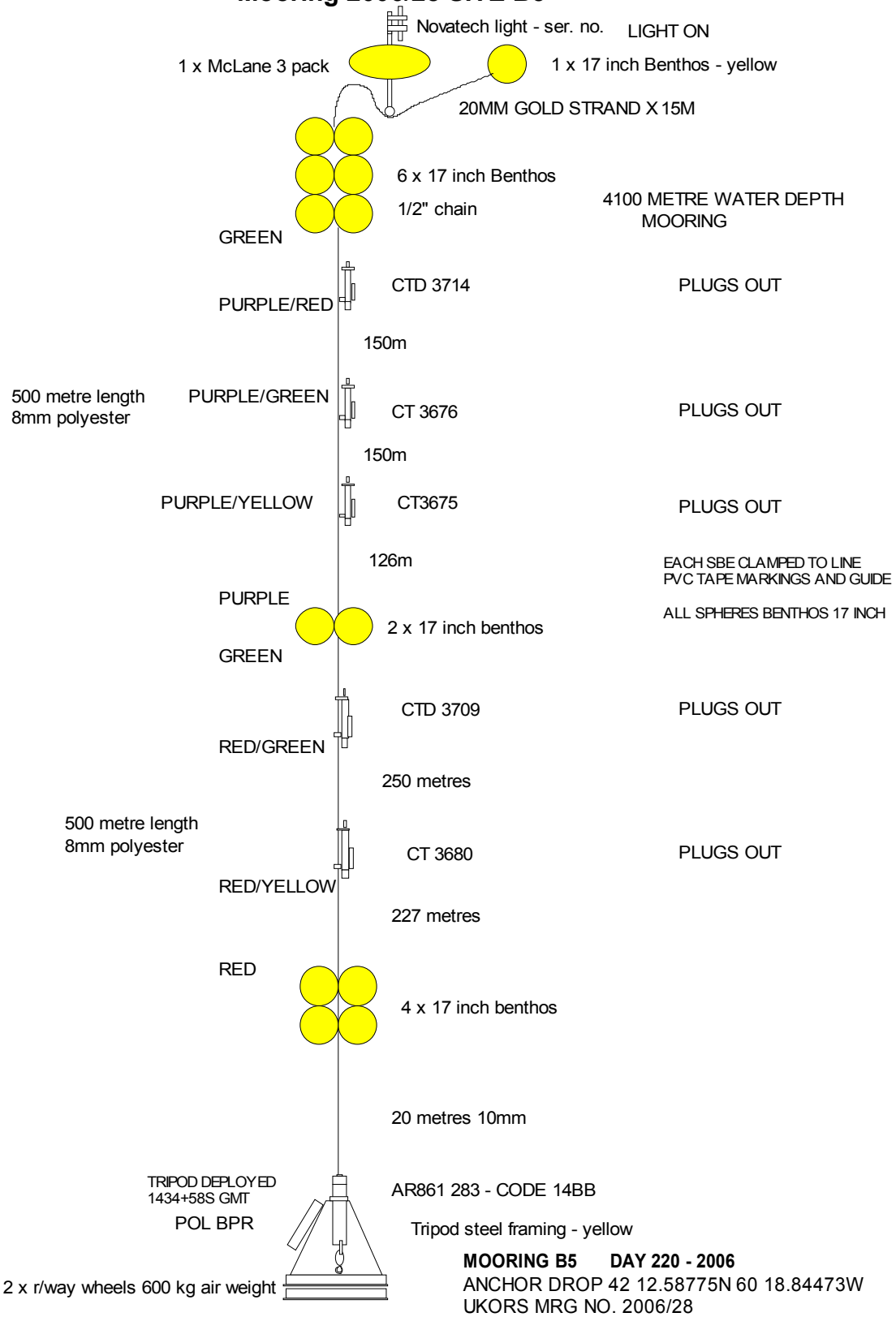
Monitor descent rate and arrival velocity at seabed - check verticality .

Run a navigation box around drop site at 1/2 mile and transpond to mooring release.
Subsequent position fix obtained from ranging.

42 12.596N 60 18.859W from bridge track plotter.

Course then steamed over mooring drop site to confirm position and verticality.
Proceed to B3 - making ranging trials on AR to a reliable range of 7600 metres slant range using TT801 013 and PES single element.

Mooring 2006/28 SITE B5



MOORING B5 DAY 220 - 2006

ANCHOR DROP 42 12.58775N 60 18.84473W

UKORS MRG NO. 2006/28

Mooring B5 descent to seabed

GMT	Slant Range (m)	Descent rate (m/min)
1437	424	
1438	588	164
1439	740	162
1440	888	148
1441	1006	118
1442	poor replies	
1444	1341	
1445	1435	94
1458	2638	
1459	2732	94
1513	4019	
1513+30s	4062	
1514	4128	
1515	4135	Arrival on seabed
1529	4194 - 4196 vertical 9.4v	
1529+30s	4207 - 4210 vertical 9.3v	
1530+30s	4234 - 4237 vertical 9.3v	

Survey box

GMT	Slant Range (m)	Comment
1537	4267	4 kts
1540	4269	
1542	4288	
1547	4316	
1547+20s	4306 - 4303	
1548+20s	4277 - 4274	
1549	4262 - 4260	
1552	4221	
1552+30s	4214	
1553+30s	4213	
1554+20s	4212	Closest approach
1555	4213	
1603	4223 - 4221	
1606	4184	
1609	Poor returns	
1610	4196 - 4197	Closest approach
1613	4234 - 4236	
1614	A/C	

1620	4254 - 4253	
1621	4246 - 4244	
1622+30s	4233 - 4232	
1623	4230	Closest approach
1625	4232 - 4232	
1625+30s	4236 - 4237	

Turn from Survey square closest approach over deploy position

1627	4245 - 4243	
1632	4142 - 4141	
1633	4126	
1634	4122 - 4121	
1635	4119 - 4118	
1636	4118 - 4118	
1637	4120 - 4120	
1638	noise - 4123	
1639	4129 - 4130	

Slant range checks steaming away to B4

1646+30	4257m	Steaming 8kts
1657	5060 - 5075	
1702	5896 - 5930	
1704	6333 - 6365	Steaming 10kts
1708	7154 - 7193	
1711	7640 - 7683	Reliable reception limit
1712	No replies	
1712+30s	8082 - no reply	Occasional replies
	No reply - 8226m	Very intermittent

ACOUSTIC RELEASE AR861 283

FUNCTIONAL SPECIFICATIONS

Function / Code	TT801/ TT701/ TT301	TT201	Sequence
ARM	**14BB**	**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 ⇒ PINGER	**1456**	**N.A.**	⇒ CAF ⇒ CAF
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

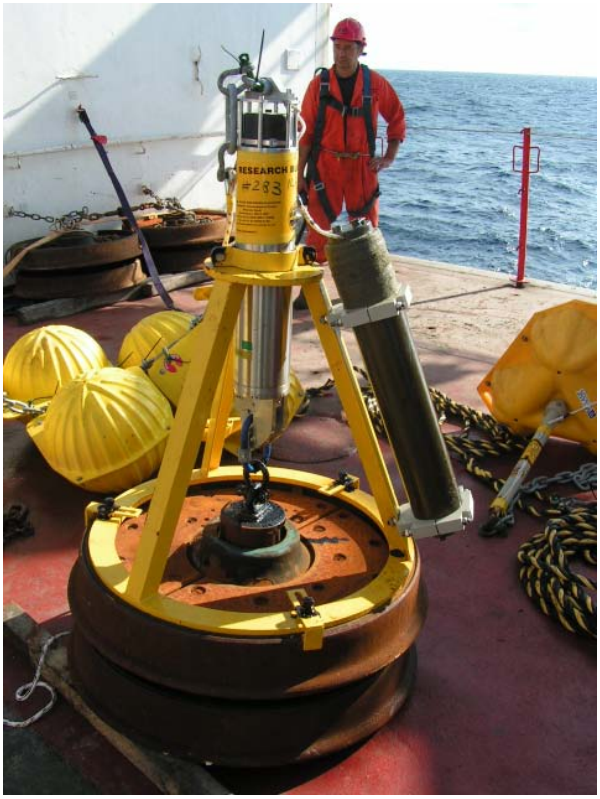
Day 221 August 9th

Deploy mooring Site B3 - 2006 / 29

Mooring site B3 deployment method was as mooring site B5 .

Buoy first - Anchor last - freefall
Acoustic release monitored throughout descent .
Mooring navigated in by boxing subsequent to mooring confirmation on seabed .

On completion of navigating the mooring course was then set over the revised position to check the position and mooring status . With verticality being indicated course was then set for ctd position.

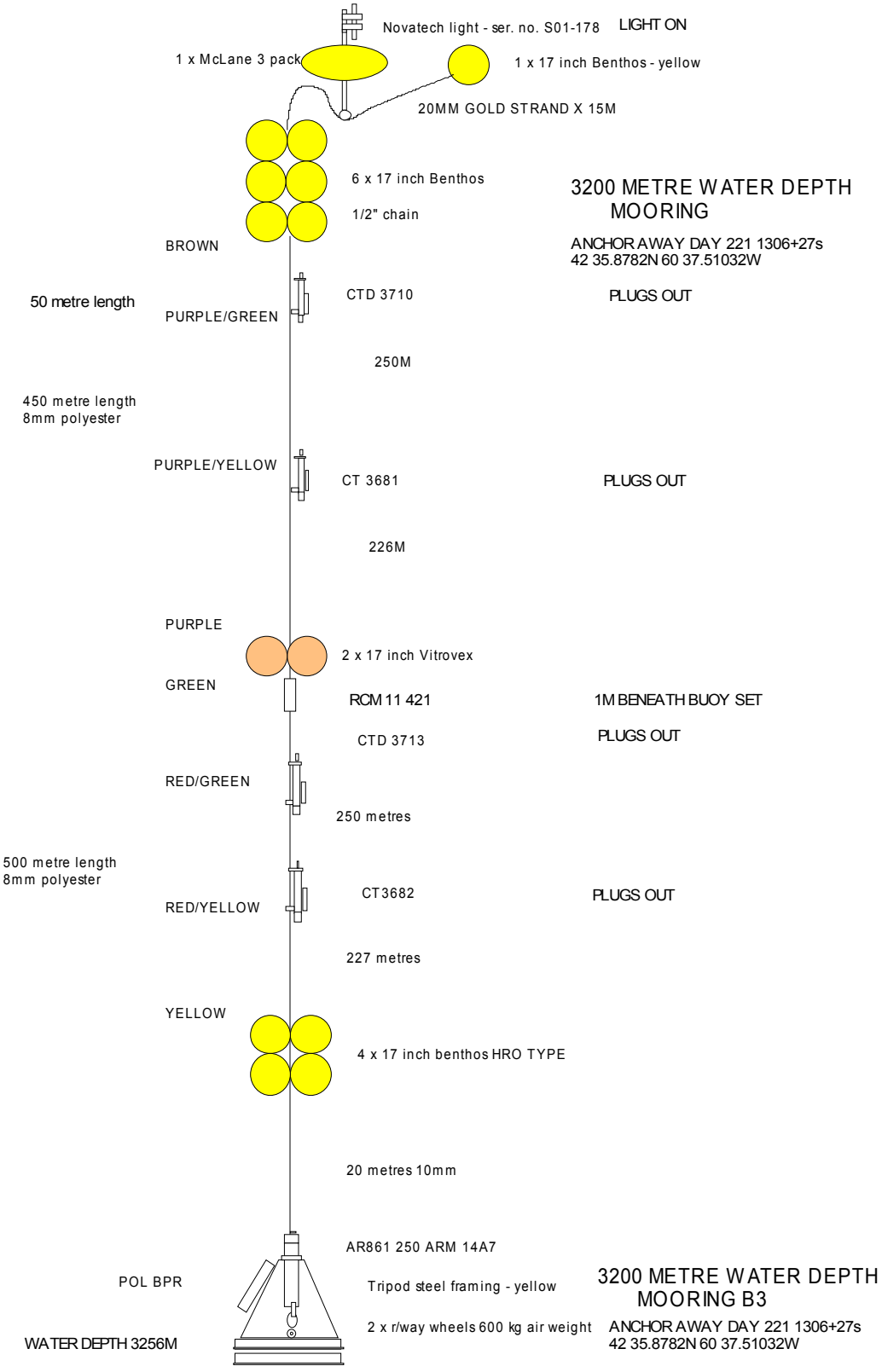


AR861 BPR TRIPOD ANCHOR - NOTE CHANGES MADE TO RELEASE LINK ASSEMBLY - TAPED OVER WITH 3 LAYERS OF HEAVY DUTY PVC TAPE - SHACKLE AND PADEYE AT ANCHOR COATED WITH OPEN GEAR GREASE ALL NUTS/BOLTS COATED GEAR GREASE.

CLOSE VIEW OF RLEASE MECHANISM - SEE ALSO THE ADDITION OF A MODIFIED ANODE TO THE RELEASE LINK - THIS IN DIRECT CONTACT WITH THE LINK NOT INSULATED BY TAPE . MOORING B5

ON MOORING B3 MECHANISM COATED WITH MOLY 55 TO FURTHER REDUCE ELECTROLYTIC REACTION AT LINK / HOOK ASSEMBLY - HEAVY GEAR GREASE APPLIED AT SHACKLE AND PAD EYE .

MOORING B3 DEPLOYED DAY 221



UKORS MOORING NO. 2006/29
1241 GMT 42 34.911N 60 37.191 3624M TOWING 1.5KTS
1303 GMT 42 35.96N 60 37.500 SLOWING TO DEPLOY ANCHOR SYSTEM

Mooring B3 descent to seabed

GMT	Slant Range (m)	Descent rate (m/min)
1306+27s	ANCHOR AWAY	42 35.9782N 60 37.51032W 3256 UCM
1308	308 - 323	
1309	448 - 463	
1310	592 - 607	140 - 144
1318	1611 - 1621	
1319	1710 - 1721	100
1323	2014 - 2024	
1324	2108 - 2118	92
1328	2468	
1329	2679	
1336+24s	3927 - 3928	vertical ON SEABED
1340	3301	VERTICAL - 9.6V

SHIP POSITION AT ANCHOR ON SEABED 42 35.978N 60 37.510W

1355	O/C 076	3348
1402	A/C	
1404	220 DEG COMMENCE SURVEY TRACK	

NAVIGATING IN MOORING

GMT		Slant Range (m)	COMMENTS
1413	220 DEG	3426	
1414		3425	CLOSEST APPROACH
1414+50s		3428	42 35.41N 60 36.97W
1416		3428	
1417		3451	
1418	235 DEG	3470	
1420		3515	
1421		3535 - 3539	
1422		3563 - 3566	
1423		3603 - 3605	
1424	A/C	3656 - 3658	
1425	327 DEG	3662 - 3662	
1426		3646 - 3643	
1432		3552 - 3552	CLOSEST APPROACH

1434		3553 - 3554	
1435		3560 - 3560	
1436		3568 - 3570	
1444	A/C	3861 - 3867	
1459		3671 - 3671	
		3669 - 3669	
		3669 - 3666	

NAVIGATING IN MOORING

GMT		**Slant Range (m)**	**COMMENTS**
1500		3663 - 3663	CLOSEST APPROACH
1501	A/C	3647 - 3644	
1502	A/C	3605 - 3605	
1504		3555 - 3552	
1509		3477 - 3477	
		3477 - 3477	CLOSEST APPROACH
1510		3477 - 3477	42 36.53N 60 37.26W
1511		3478 - 3479	
1512	A/C		
1517		3438 - 3438	
1518		3437 - 3437	CLOSEST APPROACH
1519		3438 - 3438	42 36.29N 60 36.77W
1534		3284	
1535		3282	
1536		3281	

FROM INTERSECTS ON SHIPS TRACK PLOTTER BEST RE NAV POSITION

		42 35.832N	60 37.361W
1536	CLOSEST ACOUSTIC	42 35.826N	60 37.399W

RCM 11

Cruise Number D308 421

Mooring number 2006/29 Date

Mooring Location Lat Long

Instrument Depth

Deployment Time

Channels	Data
1	*Reference 461*
2	*Speed*
3	*Direction*
4	*Temperature*
5	*Conductivity*
6	*Pressure*
7	
8	
9	*Tilt*

Recording Interval minutes	120
Number of Channels	6 selected
Off/On/Burst	On
Temperature Range	Arctic -3 to +5.92C
Conductivity Measurement range	20-40mS/cm
Ensemble number	300

Range change cond cell at sea

USE D300 CALIBRATIONS

DSU Checks

Clock Check	GMT	X	DSU Serial Number	**14386**
	Local		DSU clock set	**Yes**
			DSU Check	**Passed**

Time on DAY 220 2300 GMT 120 MINUTE SAMPLE

DAY 221 TIME CHECK 10-05 GMT 48 WORDS 7.16 VOLT A1M BATTERY Li

Instrument serial number	421
Reference reading	868
Electronic Board number	249

Sensors	Type	Serial number	Range
Doppler Current sensor	*3820*	*477*	
Temperature sensor	*3621*	*1790*	Arctic-3to5.92
Conductivity Cell	*3919*	*124*	20-40mS/cm
Pressure sensor	*3815E*	*980*	

note range change of cond sensor at sea

D300 CAL TO APPLY

Visual and Mechanical Checks

1. Epoxy coating intact X

2. No corrosion, O-ring groove pressure case	X
3. No corrosion, other parts	X
4. Zinc anode installed	X
5. Pressure sensor oil filled	X

Performance test

to be conducted twice with resistance loop set to 70 then 150 ohms

70 Ohms

channel no	Reading	Cal. Cross check
1	868	
2	663	
3	461	
4	1023	
5	1023	
6	34	
7		
8		
9		

150 Ohms

channel no	Reading	Cal. Cross check
1	868	
2	664	
3	58	
4	1023	
5	554	
6	34	
7		
8		
9		

FOR THIS EXPERIMENT ONLY 6 CHANNELS ARE SELECTED TO EXTEND BATTERY LIFE

ACOUSTIC RELEASE - AR861 250

FUNCTIONAL SPECIFICATIONS

Function / Code	TT801/ TT701/ TT301	TT201	Sequence
ARM	**14A7**	**N.A.**	Þ CAF Lock-Out time = 4s
			Active time = 20s
The following acoustic codes must be preceded by an ARM code			
RELEASE	**1455**	**N.A.**	Þ CAF CAF
RELEASE WITH PINGER	**1456**	**N.A.**	Þ CAF Þ CAF PINGER
PINGER ON	**1447**	**N.A.**	Þ CAF Þ PINGER
PINGER OFF	**1448**	**N.A.**	Þ CAF
DIAGNOSTIC	**1449**	**N.A.**	Þ CAF_1 Þ CAF_2

N.A. : Not applicable

FURTHER NOTES ON TEMPORARY CURRENT METER MOORING DEPLOYMENT AND RECOVERY

IAN WADDINGTON
National Oceanography Centre

MIGUEL ÁNGEL MORALES MAQUEDA
Proudman OceanographicLaboratory

The failure to recover most of the moorings in lines A and B and the absence of evident damage in the two moorings retrieved at stations B1 and B2, the only ones we managed to bring back on board, prompted us to explore the possibility that anomalously strong currents at depth might have caused the lost moorings to shift from their initial position, or be perhaps damaged by excessive stress.

Trying to clarify these points, the UKORS mooring team carried out two short surveys of the deep current at stations B4 (5 August at 22:10 to 7 August at 11:09) and A3 (11 August at 21:03 to 12 August at 21:51)[2]. The temporary current meter moorings consisted in two Aanderaa RCM 11 current meters located at approximately 50 m and 550 m from the seabed. A schematic of the mooring array is shown below. Also shown are time series and vector plots of the measured currents. Maximum measured currents were on the order of 10 cm/s, which seem too small to have perturbed the moorings in any major way. A visible tidal component is observed for all current time series (see figures below). It is somewhat surprising that near-bottom currents at B4 were, on average, directed toward the northeast, rather than toward the southwest, and that the currents at 550 m above the seabed had a strong upslope component, both unrepresentative of the north Atlantic deep western boundary. However, the time series are too short to ascribe much significance to this result.

[2] The times indicate the beginning of deployment and end of recovering, respectively.

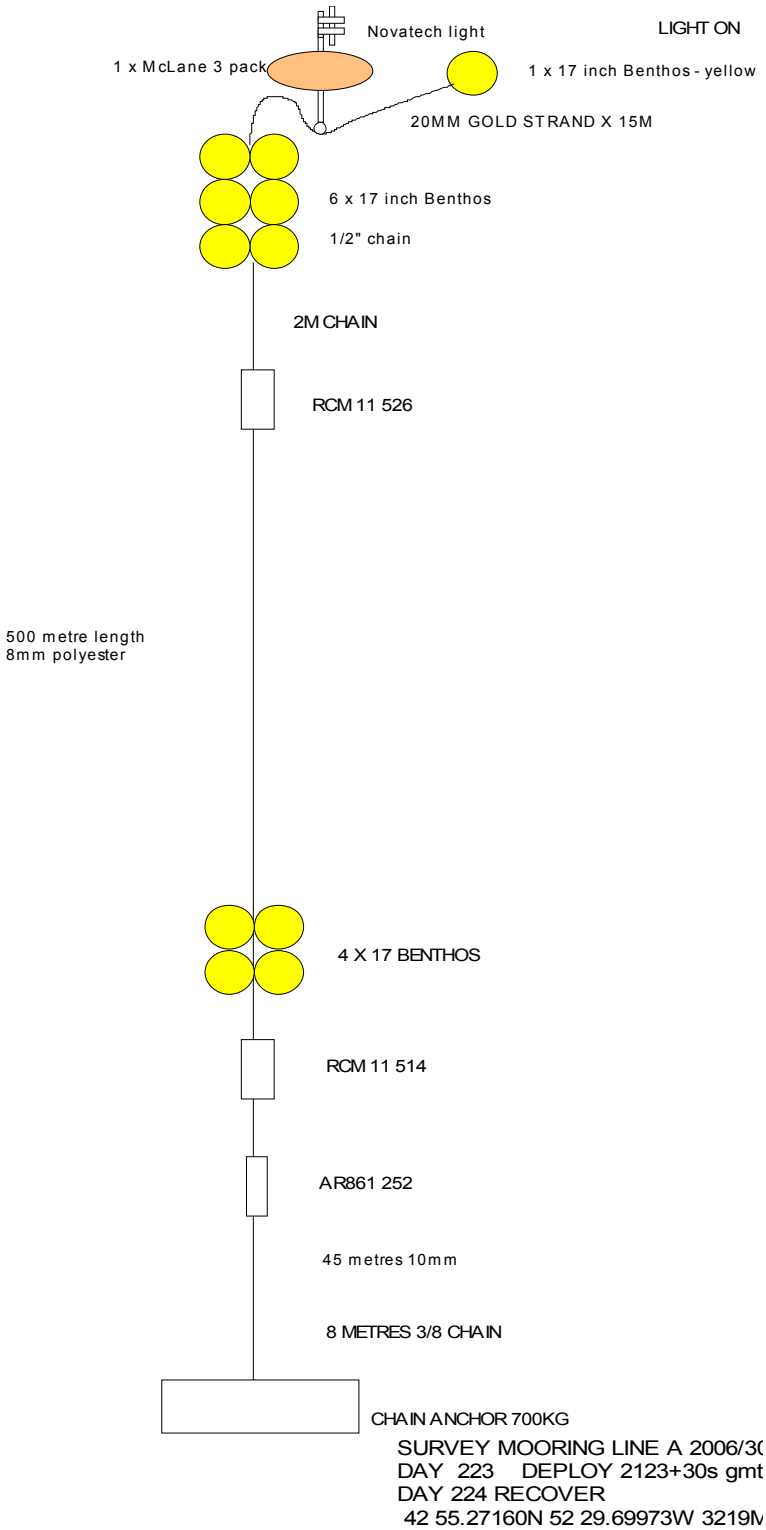


Figure 9: Schemetic of temporary current meter array deployed in stations B4 and A3.

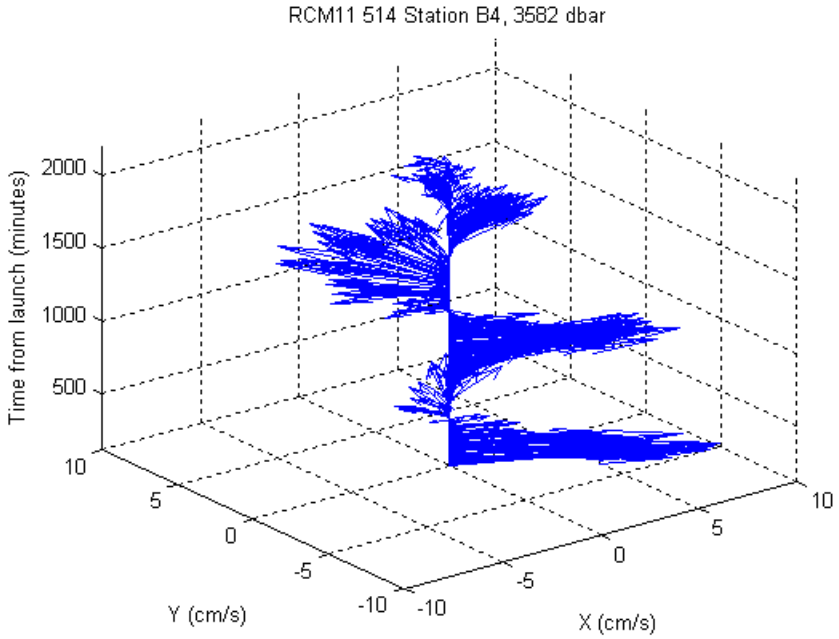


Figure 10: Time series of near-bottom velocity vectors at station B4 (5/8-7/8 2006).

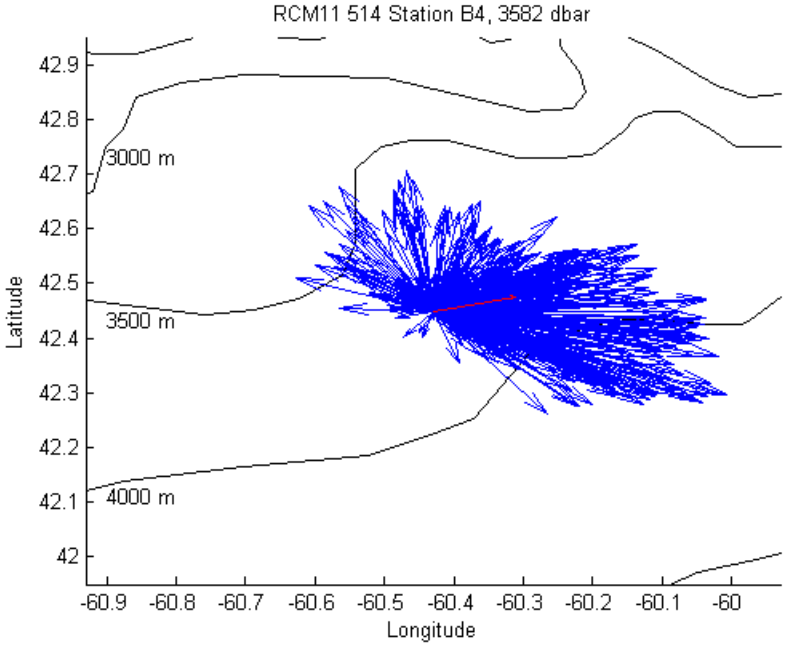


Figure 11: Near-bottom velocity vectors at station B4 (5/8-7/8 2006). The red arrow represents the average current over the sampling period.

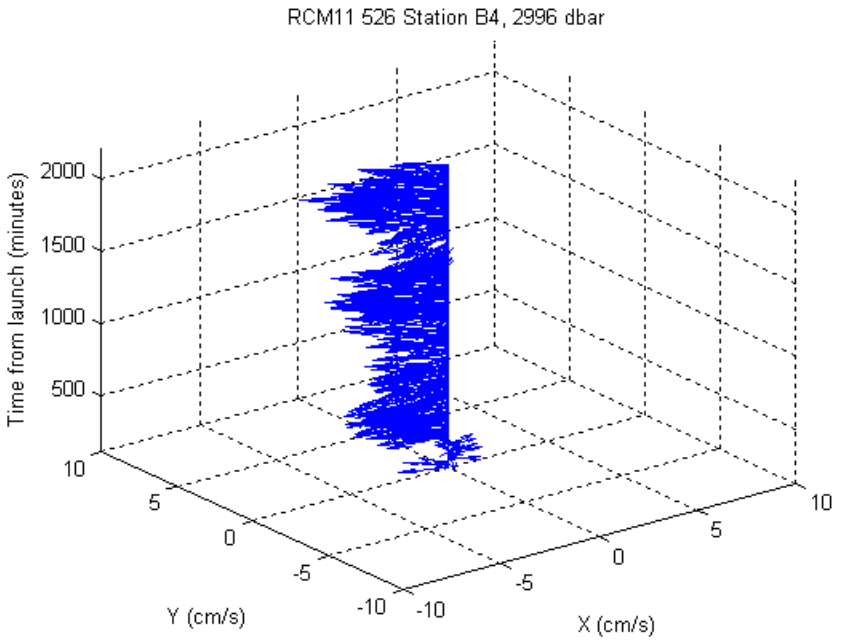


Figure 12: : Time series of velocity vectors 550 m above the seabed at station B4 (5/8-7/8 2006).

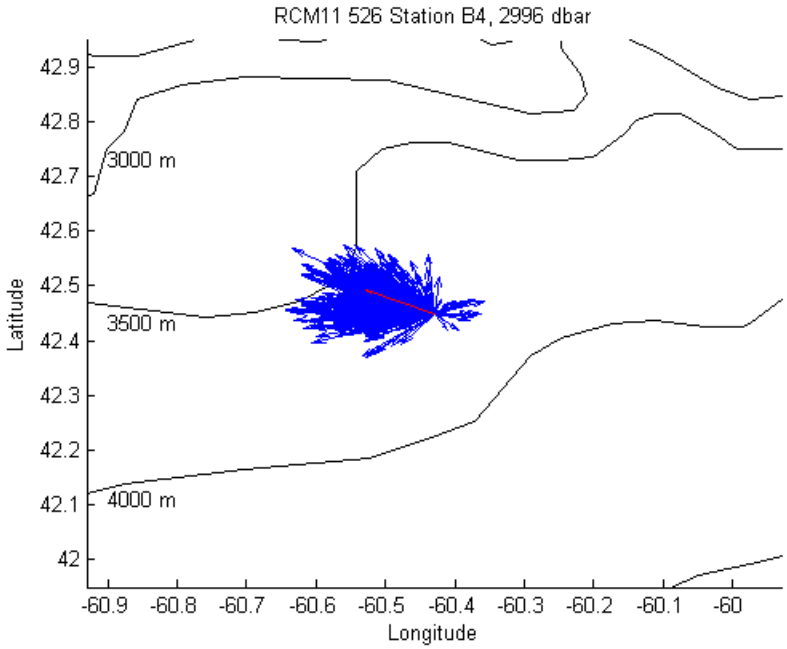


Figure 13: Velocity vectors 550 m above the seabed at station B4 (5/8-7/8 2006). The red arrow represents the average current over the sampling period.

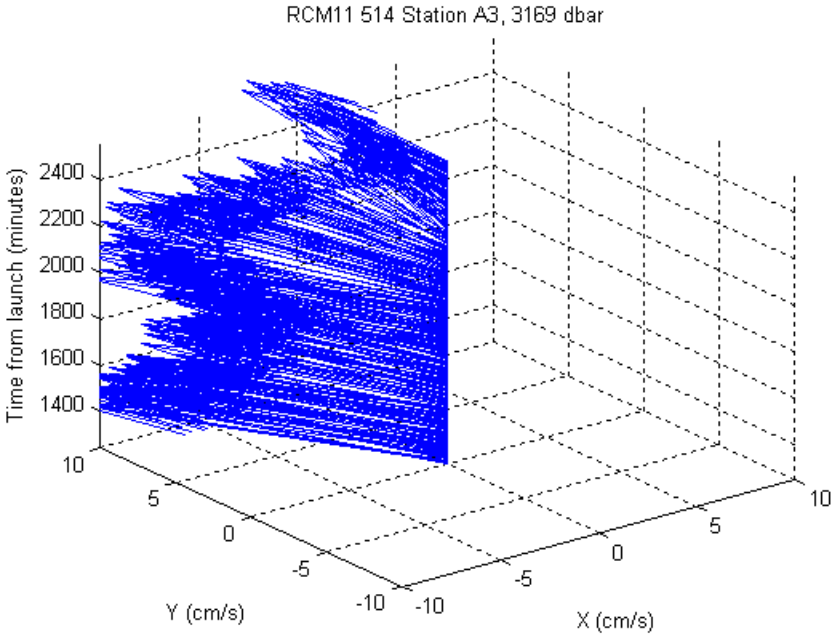


Figure 14: Time series of near-bottom velocities at station A3 (11/8-12/8 2006).

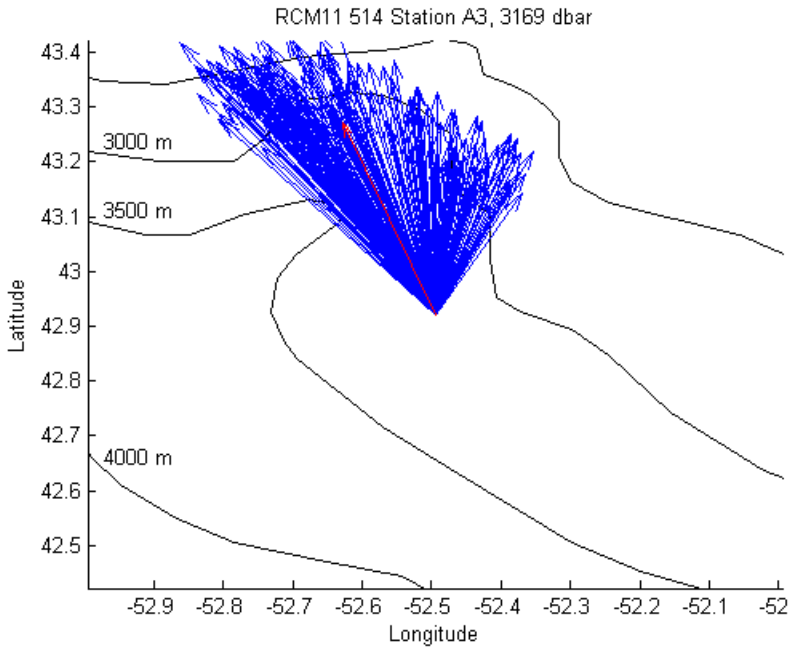


Figure 15: Near-bottom velocity vectors at station A3 (11/8-12/82006). The red arrow represents the average current over the sampling period.

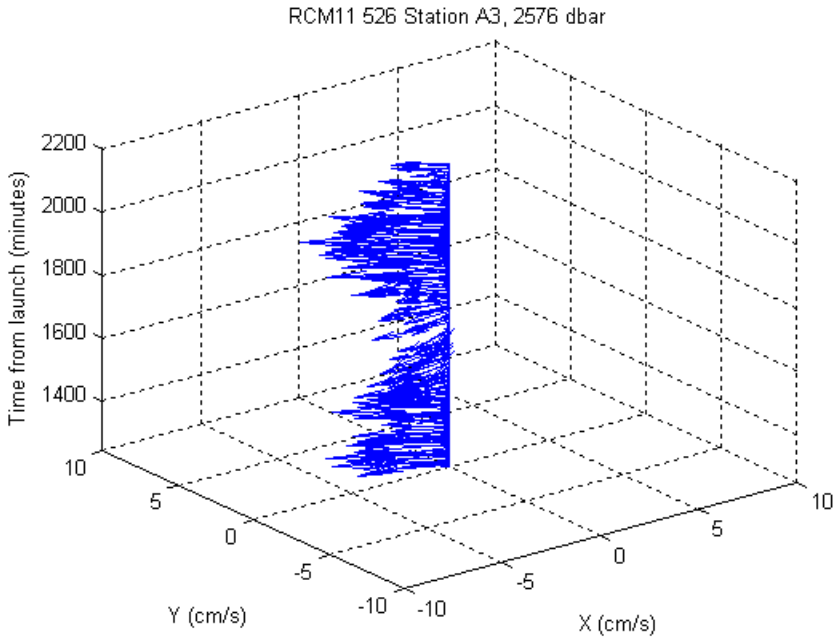


Figure 16: Time series of velocities 500 m above the seabed atstation A3 (11/8-12/8 2006).

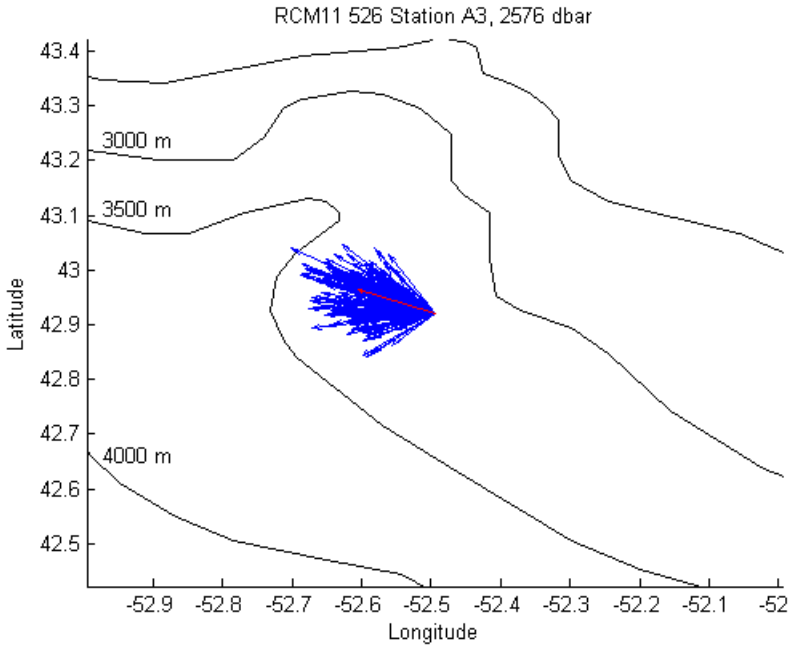


Figure 17: Velocity vectors 500 m above the seabed at station A3(11/8-12/8 2006). The red arrow represents the average current over the sampling period.

Investigation report on mooring losses

Ian Waddington
National Oceanography Centre

LINE 1A to 5A – No moorings recovered .
Erratic acoustic replies only returned from mooring 1 A eventually failing totally.
No detection of acoustics at sites 2A to 5A.

LINE 1B to 5B – Moorings 1B and 2 B only recovered . No detection of acoustics at sites 3B to 5B
Dragline attempts with no result .

Mooring losses were very high for this experiment giving cause for concern as to the survival of all other moorings deployed throughout this and subsequent time periods.

On Discovery 309/10 Cape Farewell immediately following this exercise. All the moorings were recovered with no losses of equipment . Mooring design and materials were very similar for Cape Farewell and the heavy loss array WAVE.

The most significant difference between the two arrays was the extended 2 year deployment period of the WAVE array when compared to the 1year Cape Farewell duration.

Inspection of the two recovered WAVE moorings showed no significant corrosion in any recovered part. In actual fact mechanical condition was better than expected .

Careful testing and examination of the two recovered Ixsea AR861 releases showed no problems – battery voltages were high,mechanisms all rotated freely.

The only evidence of corrosive products was seen at the release hook assembly where significant rust products were seen on the drop hook . This was from the release link.

Conclusion

With so little real evidence recovered from the mooring array and no failed moorings recovered by dragging operations the supposition is :

1. Acoustic release battery failure – this could account for lack of acoustic detection.
2. Mooring failure at or below the release link – with accelerated corrosion of the link during the extended 2 year duration.
3. An unknown physical event moving the moorings a great distance from the deployment sites.

Rectification and recommendations

The acoustic release battery failure could be only due to premature failure of the batteries or increased battery drain. To guard against this more stringent testing of the batteries and releases is required. This will be adopted as a matter of course from this point on with careful monitoring of the battery drain of all releases during preparation procedure.

Corrosion of the release link requires a revised release link assembly. Presently a revised stainless dual link assembly is under test on The RAPID MOC moorings. As an interim the release links at WAVE are increased material sizes , fitted with protective anodes. These links also wrapped with pvc tape and grease to guarantee isolation from the Ixsea release mechanism reducing galvanic action.

WAVE present and future deployments

The present WAVE moorings use acoustic releases thoroughly tested as above and the release links are modified to reduce the prospect of corrosion .

One mooring incorporates a recording current meter to investigate local current conditions .

It would be useful to recover the two moorings within a one year time frame to check performance of the moorings and to look at the recorded current meter data .

From this and with the advances being made on the release links and procedures it should be possible to assess the viability of the ongoing mooring array and whether a 2 year time frame is desirable or not .

Ian Waddington 30th October 2006

NMF – SEA SYSTEMS – INSTRUMENTATION

DOUGAL MOUNTIFIELD
Sensors & Moorings Group
National Marine Facilities
National Oceanography Centre, Southampton

1. CTD Operations

A total of 20 CTD casts at 16 stations were undertaken on the cruise including one test cast to 550m (CTD000), all of which used the stainless steel frame. There were no major operational issues with the CTD suite during the cruise. The deepest cast was to 4910m.

1.1. Stainless Steel CTD Frame

The stainless steel frame configuration was as follows:

Sea-Bird 9/11 *plus* CTD System
Sea-Bird SBE32 24 way rosette pylon
24 by 10L Ocean Test Equipment External Spring Water Samplers
Sea-Bird 43 Oxygen Sensor
Chelsea MKIII Aquatracka Fluorometer
Chelsea MKII Alphatracka 25cm path Transmissometer
Wetlabs BBRTD Back Scatter Sensor
NMF LADCP Pressure Case Battery Pack
RD Instruments Workhorse 300 KHz Lowered ADCP (downward-looking master configuration)
RD Instruments Workhorse 300 KHz Lowered ADCP (upward-looking slave configuration)
Tritech or Benthos Altimeters (Tritech only fitted for test cast CTD000)
Sonardyne Beacon

The pressure sensor is located 30cm from the bottom of the water samplers, and 119 cm from the top of the water samplers.

1.1.1 Stainless Steel CTD Frame Instrument Configuration

The Sea-Bird CTD configuration for the stainless steel frame was as follows:

SBE 9 *plus* Underwater unit s/n 09P-37898-0782
Frequency 0—SBE 3P Temperature Sensor s/n 03P-4489 (primary)
Frequency 1—SBE 4C Conductivity Sensor s/n 04C-2407 (primary)
Frequency 2—Digiquartz Temperature Compensated Pressure Sensor s/n 94756

Frequency 3—SBE 3P Temperature Sensor s/n 03P-4490 (secondary)
Frequency 4—SBE 4C Conductivity Sensor s/n 04C-2450 (secondary)
SBE 5T Submersible Pump s/n 05T-3962
SBE 5T Submersible Pump s/n 05T-3965
SBE 32 Carousel 24 Position Pylon s/n 32-0344
SBE 11 *plus* Deck Unit s/n 11P-19817-0495

The auxiliary A/D output channels were configured as below:

V1 --- SBE 43 Oxygen s/n 43B-0612
V2 --- Benthos Altimeter s/n 1040
V3 --- Chelsea MKIII Aquatracka Fluorometer s/n 88-2960-160 (088160)
V4 --- Unused – usually used for PAR
V5 --- Unused – usually used for PAR
V6 --- WetLabs Back Scatter Sensor BBRTD s/n 169R
V7 --- Chelsea MKII Alphatracka 10cm path Transmissometer s/n 04-4223-001

The additional self-logging instruments were configured as follows:

RDI Workhorse 300 KHz Lowered ADCP (downward-looking master configuration) s/n 1881
RDI Workhorse 300 KHz Lowered ADCP (upward-looking slave configuration) s/n 5414

The LADCPs were powered by the NMF battery pack s/n WH001 installed on the CTD frame.

1.1.2. Stainless Steel CTD Frame Deployment Notes

The main Seabird instrument configuration file for this frame was '0782_main.con'. This was used by the master PC with an NMEA navigation feed. The logging PC's running Seabird Seasave were set to synchronise their clocks with the GPS NTP timeserver once a day, but both units have considerable clock drift - +/- 15 secs in one hour. Seabird Seasave software was configured to index time from the NMEA $GPRMC nav feed and the NMEA lat/lon data was appended to each scan line to provide a further means of synchronisation with ship data.

The bottom cap of Bottle #17 did not close properly during cast CTD012, also Bottle #11 did not close on cast CTD015. These were both caused by the bottle landyard getting caught on a ferrule and were unavoidable.

PAR sensors were requested at the cruise planning stage and were available as stated in the supply agreement (S/N's 1, 8 & 12). However, due to the requirement to work deeper than 500m UWIRR and DWIRR PAR sensors were not used at all during the cruise.

A spare 24-way Stainless Steel frame and a complete suite of spare instruments were available on board, but due to the high reliability of the CTD system on the cruise, use of spares was not required.

A Tritech altimeter was trialled on the test cast (CTD000) but did not give a bottom contact even when approx 30m from the seabed. Hence a Benthos unit was fitted and worked successfully for the whole cruise. There were no other instrument changes on the CTD package during the cruise.

A sensor information sheet (Sensor Information D308.doc) and calibration & instrument history sheets were included in the main cruise archive in electronic format (Adobe Acrobat & Microsoft Word). Also a rough diary "Instrumentation Diary.txt" was supplied. Copies of all log sheets were supplied to the PSO in addition to the originals that he will supply to BODC.

CTD001 was solely for acoustic release tests and no water samples were taken, and the LADCPS were not run. CTD007 was aborted at approximately 450m during the downcast due to operational time constraints, hence no water samples were taken. CTD010 was a repeat cast at station 2B to obtain Helium & Tritium samples that were omitted on the earlier cast at this site. Hence no other samples were drawn from this cast. Cast CTD013 was for SBE37 Microcat calibration only and no bottles were fired. However LADPCs were run as normal.

Cast Number	Station	Max Depth m	Cast Number	Station	Max Depth m
CTD000	CTDTEST	550	CTD010	2B REPEAT	2660
CTD001	3A AR TEST	3150	CTD011	1B	2180
CTD002	2A	2785	CTD012	4B	3660
CTD003	1A	2205	CTD013	5B SBE37	4020
CTD004	0A	1770	CTD014	1C	4560
CTD005	0B	1710	CTD015	2C	4760
CTD006	2B	2680	CTD016	3C	4910
CTD007	5B ABORT	Approx 450	CTD017	3A	3150
CTD008	5B	4100	CTD018	5A	4080
CTD009	3B	3310	CTD019	4A	3630

Table 1 – CTD cast summary

1.1.3. RDI Workhorse LADCP Configuration

Two LADPCs were deployed opportunistically on the CTD frame. As no particular configuration was requested the units were run using command files from a previous cruise (D300).

Each deployment terminal session was logged to a file with the naming convention WHM_nnn.log for the master, and WHS_nnn.log for the slave, where nnn was the CTD cast number. The data files were named as D308M_nnn.000 for master and D308S_nnn.000 for the slave, where nnn was the LADCP deployment number. The LADPCs were run on all casts apart from CTD001 which was solely for acoustic release tests. Hence from cast 002 onwards the LADCP data filename is one number behind the log filename, for example, cast CTD003 has LADCP log filename WH*_003.log and data filename D308*_002.000.

Prior to each cast, after starting the log file, the LADCPs were woken up then the following pre-deployment commands typed by hand:

Tt?, rn?, rs?, cb411, ps0, pa.

Then the following command files were sent (slave first):

Master (WHM_D308.txt)

```
CR1
CF11101
EA00000
EB00000
ED00000
ES35
EX11111
EZ0111111
TE00:00:01.00
TP00:01.00
LD111100000
LF0500
LN016
LP00001
LS1000
LV250
LJ1
LW1
LZ30,220
SM1
SA001
SW05000
CK
CS
```

Slave (WHS_D308.txt)

```
CR1
CF11101
EA00000
EB00000
ED00000
ES35
EX11111
EZ0111111
TE00:00:01.00
TP00:01.00
LD111100000
LF0500
LN016
LP00001
LS1000
LV250
LJ1
```

```
LW1
LZ30,220
SM2
SA001
ST0
CK
CS
```

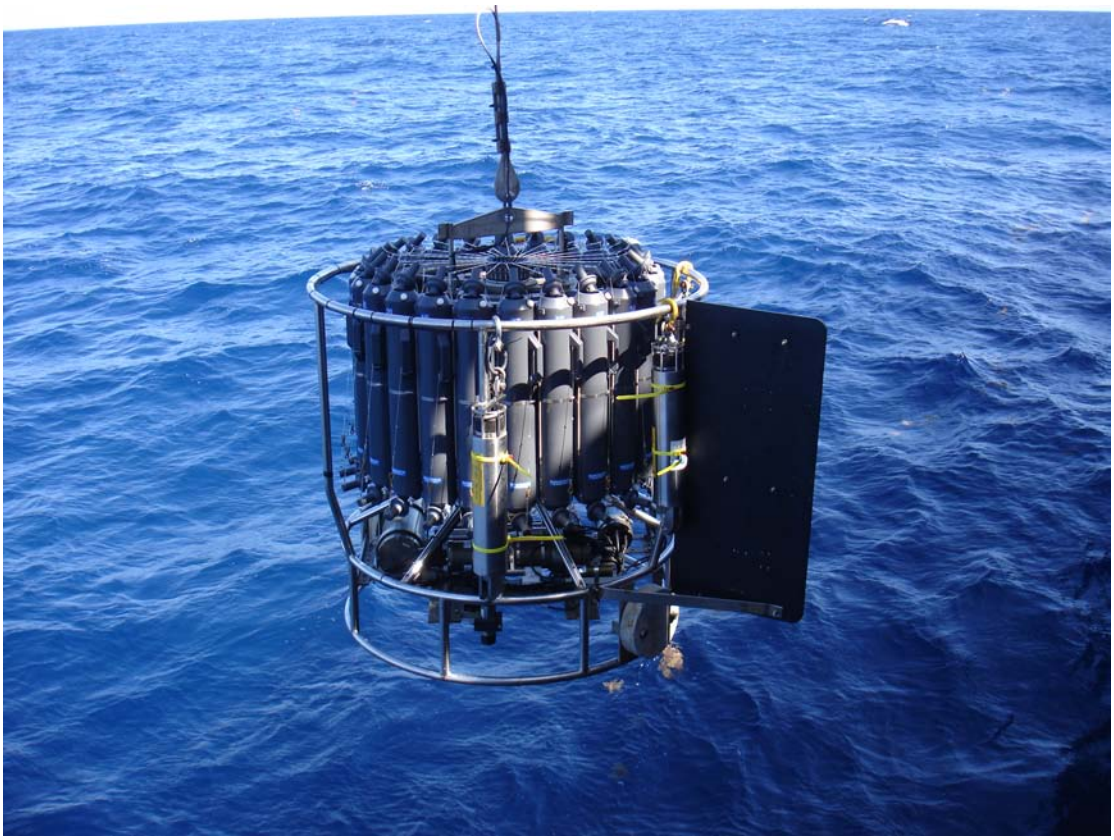


Figure 18: Deployment of CTD on station C2 (10th August 2006).

3. Salinometry

As requested, the PSO and one member of the science party were trained in sampling for salinities and subsequently running them on the laboratory salinometer.

Initially a Guildline Autosal 8400B salinometer with s/n: 60839 was used. However halfway through the first crate of samples it developed a vacuum problem which prevented correct operation. A spare unit with s/n: 65764 was setup and after allowing 24 hrs for stabilisation, this unit ran all remaining samples with no problems.

Approximately 384 salinity samples were taken from CTD niskin bottles, and 24 samples from the underway TSG non-toxic seawater supply. There was a sampling error on CTD004 with bottle 16 sampled twice (sample 587 & 588) and bottle 24 not sampled. The rough log sheet for

this cast was annotated to this effect. Sample bottle 894 was found to be empty when processing on the salinometer. Crate 39 was erroneously run with Softsal bottle numbers 1-24 instead of 956-979.

CTD DATA PROCESSING

MIGUEL ÁNGEL MORALES MAQUEDA AND RORY BINGHAM
Proudman Oceanographic Laboratory

CTD data on D308 was processed following the same procedure as in cruise CD160 (see Mike Meredith's CD160 Cruise Report; also Appendix III). The processing was done with a combination of SeaBird (SBEDataProcessing-Win32_V5_37e) and Matlab routines.

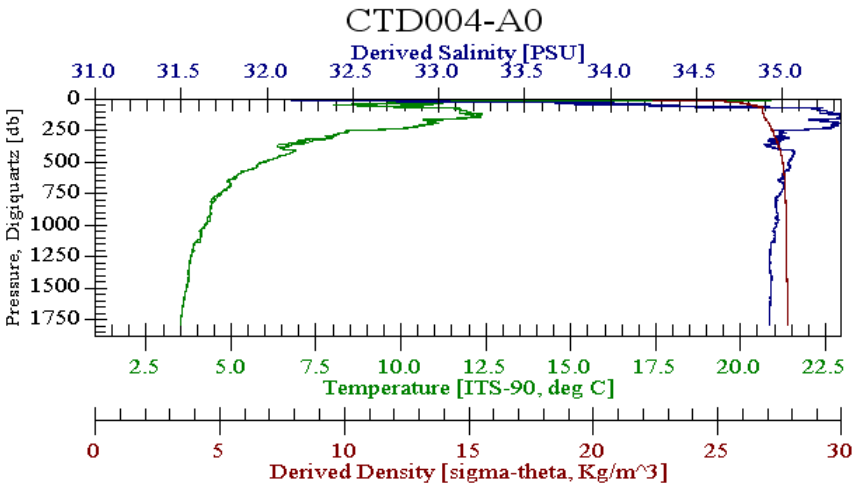
Input files were:

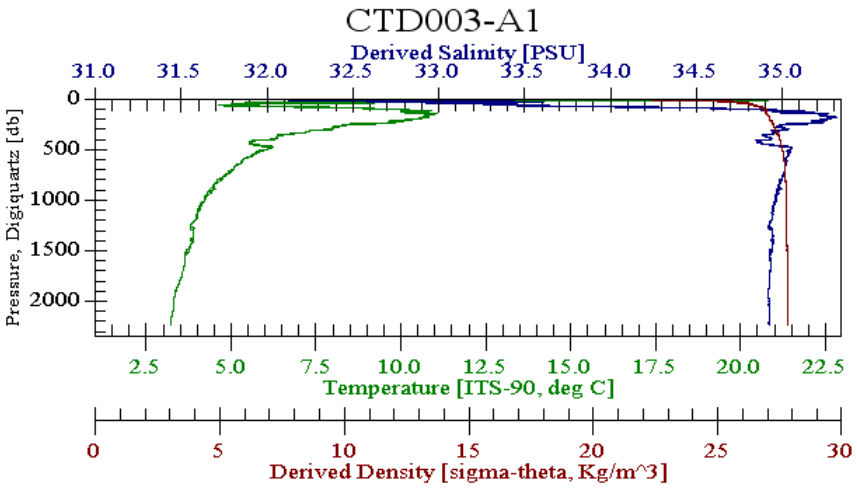
1. CTDXXX.con: configuration file
2. CTDXXX.dat: data file
3. CTDXXX.hdr: header file
4. CTDXXX.bl: bottle file
5. CTDXXX.sam: salinity sample file

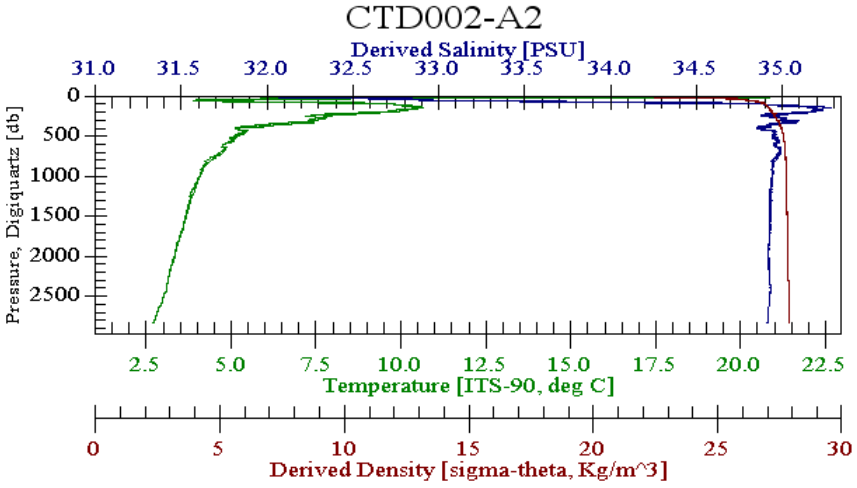
The procedure to retrieve, analyse and archive the data was as follows.

1. SeaBird routines: **datcnv, filter, align, celltm, loopedit, wildedit** (if needed)
2. Matlab routines: **ctdread, editctd, offpress, makebot, readsal, addsal, setsalflag, salplot, salcal, salcalapp, splitcast, gridctd, fill_to_surf**

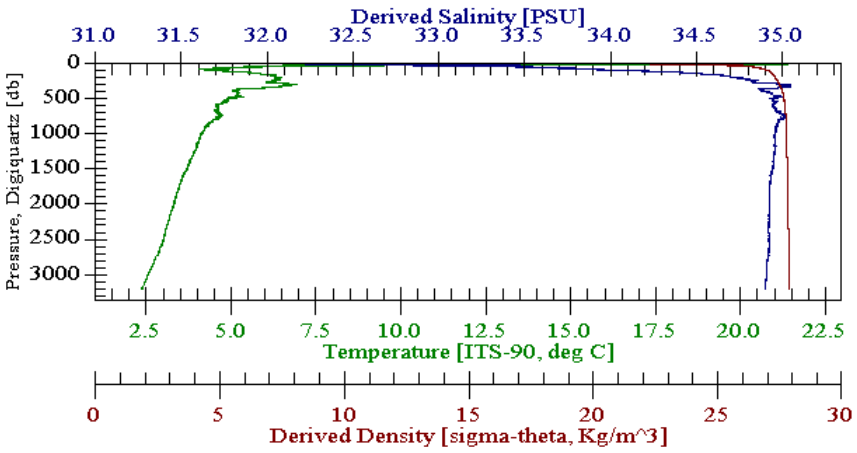
Uncalibrated temperature, salinity and potential density profiles for the D308 cruise stations are shown below.


CTD004-A0
Derived Salinity [PSU]
31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0
Pressure, Digiquartz [db]
0 250 500 750 1000 1250 1500 1750
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
Temperature [ITS-90, deg C]
0 5 10 15 20 25 30
Derived Density [sigma-theta, Kg/m^3]

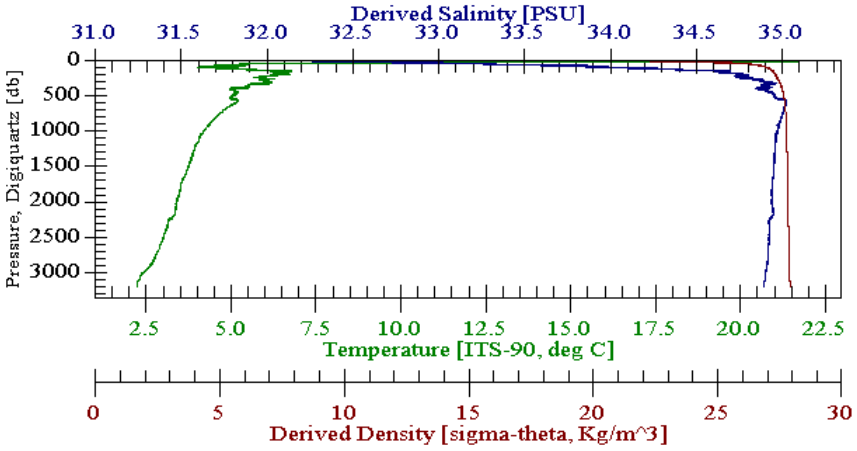

CTD003-A1
Derived Salinity [PSU]
31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0
Pressure, Digiquartz [db]
0 500 1000 1500 2000
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
Temperature [ITS-90, deg C]
0 5 10 15 20 25 30
Derived Density [sigma-theta, Kg/m^3]


CTD002-A2
Derived Salinity [PSU]
31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0
Pressure, Digiquartz [db]
0 500 1000 1500 2000 2500
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
Temperature [ITS-90, deg C]
0 5 10 15 20 25 30
Derived Density [sigma-theta, Kg/m^3]

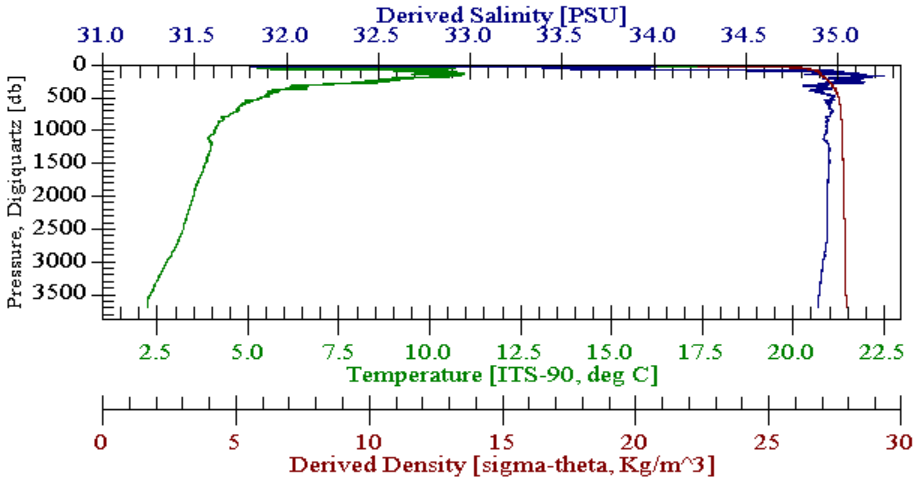
CTD001-A3

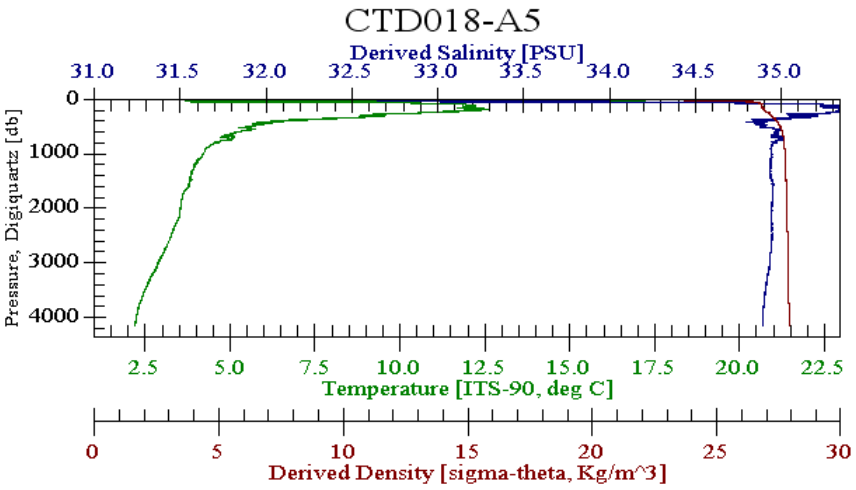


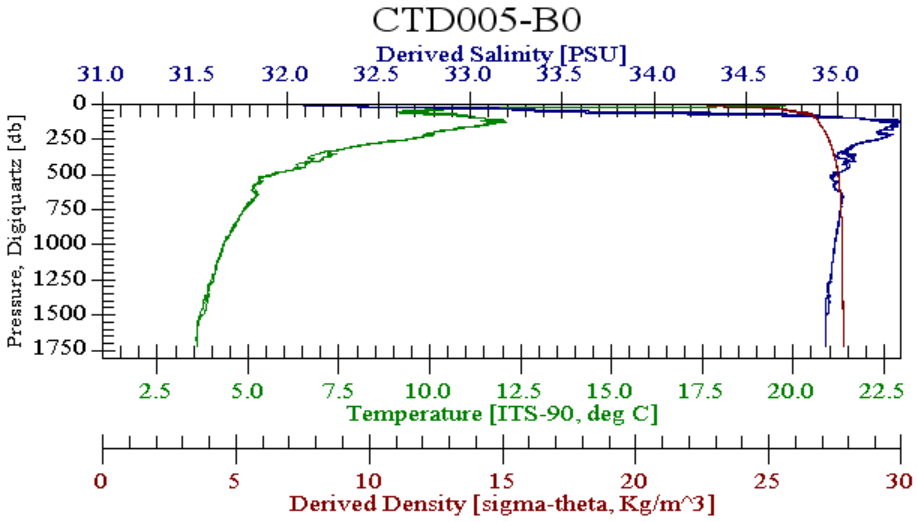
CTD017-A3

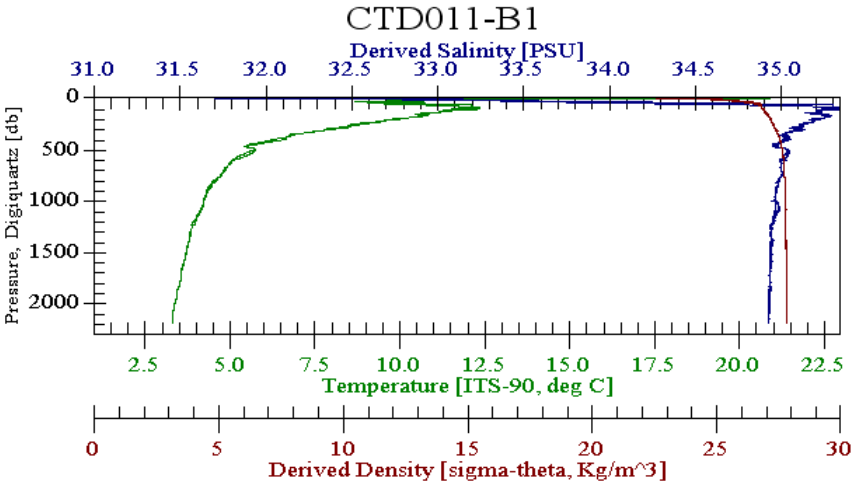


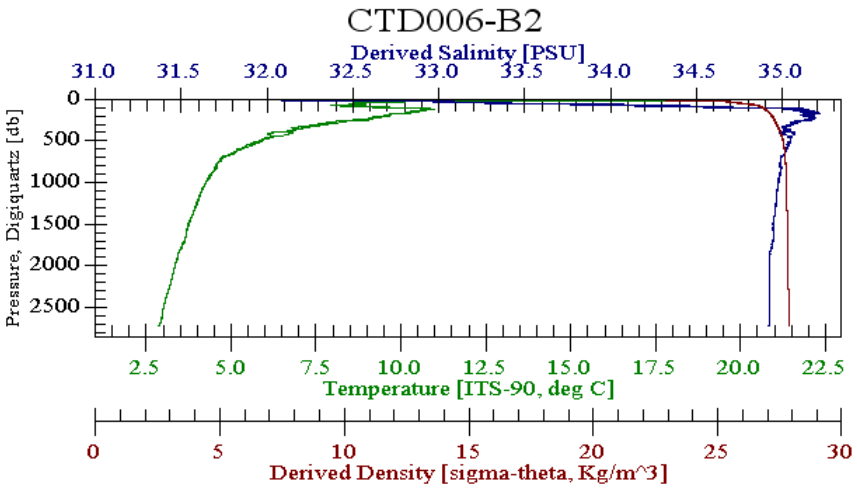
CTD019-A4

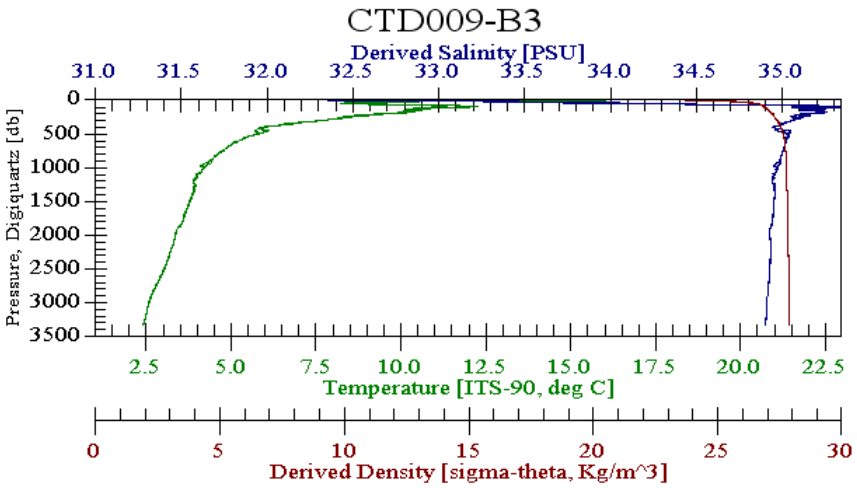


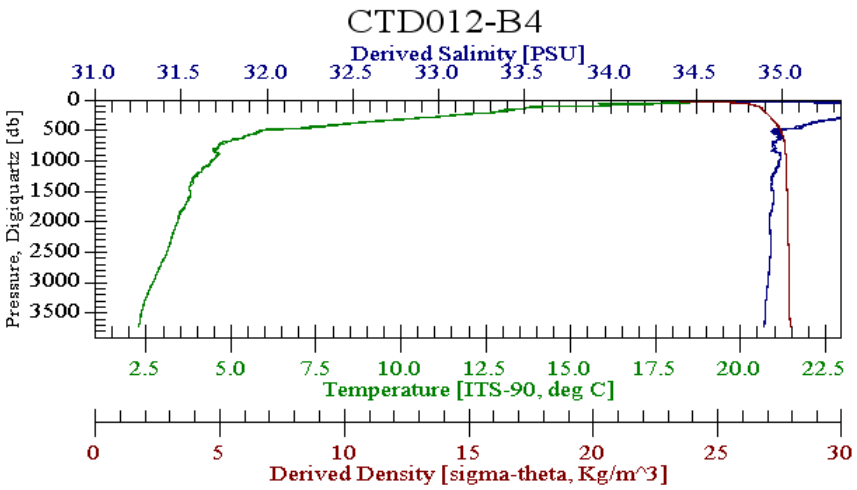

CTD018-A5
Derived Salinity [PSU]
31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0
Pressure, Digiquartz [db]
0 1000 2000 3000 4000
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
Temperature [ITS-90, deg C]
0 5 10 15 20 25 30
Derived Density [sigma-theta, Kg/m^3]

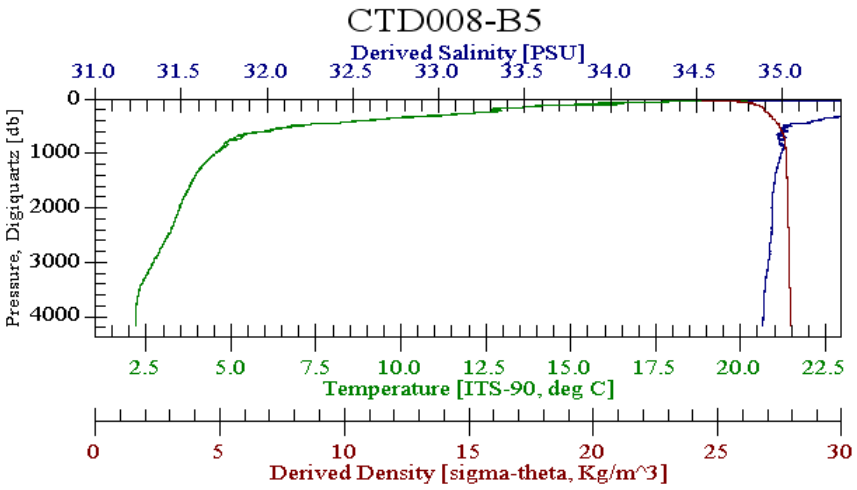

CTD005-B0
Derived Salinity [PSU]
31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0
Pressure, Digiquartz [db]
0 250 500 750 1000 1250 1500 1750
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
Temperature [ITS-90, deg C]
0 5 10 15 20 25 30
Derived Density [sigma-theta, Kg/m^3]

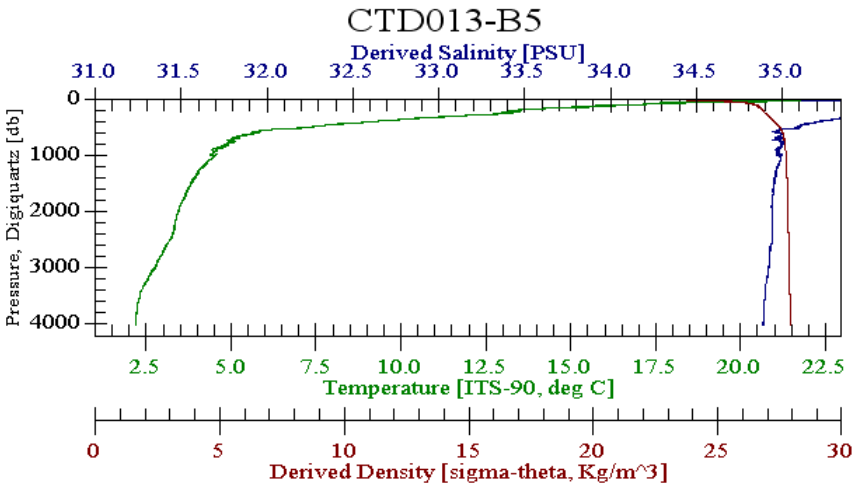

CTD011-B1
Derived Salinity [PSU]
31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0
Pressure, Digiquartz [db]
0 500 1000 1500 2000
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
Temperature [ITS-90, deg C]
0 5 10 15 20 25 30
Derived Density [sigma-theta, Kg/m^3]


CTD006-B2
Derived Salinity [PSU]
31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0
Pressure, Digiquartz [db]
0 500 1000 1500 2000 2500
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
Temperature [ITS-90, deg C]
0 5 10 15 20 25 30
Derived Density [sigma-theta, Kg/m^3]


CTD009-B3
Derived Salinity [PSU]
31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0
Pressure, Digiquartz [db]
0 500 1000 1500 2000 2500 3000 3500
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
Temperature [ITS-90, deg C]
0 5 10 15 20 25 30
Derived Density [sigma-theta, Kg/m^3]


CTD012-B4
Derived Salinity [PSU]
31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0
Pressure, Digiquartz [db]
0 500 1000 1500 2000 2500 3000 3500
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
Temperature [ITS-90, deg C]
0 5 10 15 20 25 30
Derived Density [sigma-theta, Kg/m^3]


CTD008-B5
Derived Salinity [PSU]
31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0
Pressure, Digiquartz [db]
0 1000 2000 3000 4000
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
Temperature [ITS-90, deg C]
0 5 10 15 20 25 30
Derived Density [sigma-theta, Kg/m^3]


CTD013-B5
Derived Salinity [PSU]
31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0
Pressure, Digiquartz [db]
0 1000 2000 3000 4000
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
Temperature [ITS-90, deg C]
0 5 10 15 20 25 30
Derived Density [sigma-theta, Kg/m^3]

Tracer sampling

Miguel Ángel Morales Maqueda and Rory Bingham
Proudman Oceanographic Laboratory

Each of the CTD casts was sampled for tracers. Six samples for oxygen concentration for calibration of the CTD oxygen sensor were drawn from the Niskin bottles and sample analysis was carried out immediately after each CTD cast.

Samples for tritium were drawn into 2-litre glass bottles containing argon. The bottles were filled with sea water, leaving a 3-6 cm gap for sample expansion. Argon is heavier than air and so, upon taking the samples, the space between the water and the bottle lid remained filled with argon. Samples for helium-3 where stored in clampled copper-tube samplers with a capacity of about 1 decilitre. Tritium and helium samples were boxed for shipping back to the UK for laboratory analysis. Depending on depth, between 10 and 16 Niskin bottles from each station were sampled for tritium and helium, with a sampling strategy designed to emphasise the bottom and surface waters.

Tritium-Helium Sampling

13 stations with total number of bottles: **16x4+15x4+14x1+13x2+11x2=186 bottles**

a) Halifax Section B

B5 4.1 km depth: 4100, 3900, 3700, 3500, 3300, 3100, 2800, 2500, 2000, 1500, 1000, 500, 200, 100, 10
15 depths + 1 duplicate at random depth = 16 bottles, duplicate: 2500 m

B4 3.6 km depth: 3600, 3400, 3200, 3000, 2700, 2600, 2300, 2000, 1500, 1000, 500, 200, 100, 10
14 depths + 1 duplicate at different random depth= 15 bottles, duplicate: 2700 m

B3 3.4 km depth: 3400, 3200, 3000, 2800, 2600, 2400, 2200, 2000, 1500, 1000, 500, 200, 100, 10
14 depths + 1 duplicate … = 15 bottles, duplicate: 2400 m

B2 2.8 km depth: 2600, 2400, 2200, 2000, 1800, 1600, 1400, 1000, 500, 200, 100, 10
12 depths + 1 duplicate … = 13 bottles, duplicate: 2000 m

B1 2.4 km depth: 2200, 2000, 1800, 1600, 1400, 1000, 500, 200, 100, 0
10 depths + 1 duplicate … = 11 bottles, duplicate: 1400 m

b) Grand Banks Section A

A5 4.4 km depth: 4100, 4000, 3800, 3600, 3300, 3100, 2500, 2000, 1500, 1000, 500, 200, 100, 0

14 depths + 1 duplicate …= 15 bottles, duplicate bottle: 1500 m

A4 3.6 km depth: 3600, 3400, 3200, 3000, 2800, 2600, 2300, 2000, 1500, 1000, 500, 200, 100, 0
14 depths + 1 duplicate …= 15 bottles, duplicate bottle: 2600 m

A3 3.2 km depth: 3200, 3000, 2800, 2600, 2400, 2200, 2000, 1500, 1000, 500, 200, 100, 0
13 depths + 1 duplicate …= 14 bottles, duplicate bottle: 500 m

A2 2.8 km depth: 2800, 2600, 2400, 2200, 2000, 1800, 1500, 1000, 500, 200, 100, 0
12 depths + 1 duplicate …= 13 bottles, duplicate: 2800 m

A1 2.0 km depth: 2000, 1800, 1600, 1400, 1200, 1000, 500, 200, 100, 0
10 depths + 1 duplicate …= 11 bottles, duplicate: 1800 m

c) Stations beyond the continental shelf break Section C

C1 4.5 km depth: 4500, 4300, 4100, 3900, 3700, 3500, 3000, 2500, 2000, 1500, 1000, 500, 200, 100, 0
15 depths + 1 duplicate …= 16 bottles, duplicate: 3900 m

C2 4.5 km depth: 4500, 4300, 4100, 3900, 3700, 3500, 3000, 2500, 2000, 1500, 1000, 500, 200, 100, 0
15 depths + 1 duplicate …= 16 bottles, duplicate bottle: 3700 m

C3 4.5 km depth: 4500, 4300, 4100, 3900, 3700, 3500, 3000, 2500, 2000, 1500, 1000, 500, 200, 100, 0
15 depths + 1 duplicate …= 16 bottles, duplicate bottle: 2000 m

COMPUTING, SHIP-BORNE INSTRUMENTATION & DATA ARCHIVING

CHRIS BARNARD
On behalf of Ship Systems Group
National Marine Facilities Division
National Oceanography Centre, Southampton

RVS LEVEL ABC System

The LEVEL ABC system is a system comprised of multiple components that can be adjusted and altered to suit the needs of the cruise in progress. The system is due to be retired due to its age and the difficulty in acquiring spares. The ABC system is created of 3 tiers:

- Level A - The Level A's role in the system is to acquire the data from an instrument, parse the data stream into the necessary format to be recorded by the level B and also place a timestamp on each piece of data. The instruments are connected to the Level A's via RS-232 and are also connected to the level B in the same way. This allows simple interrogation of messages when attempting to track a problem with the system.

- Level B - The level B is sent all data from the Level A's and allows you to view all the data as it is coming in. The Level B allows the backup of the data to magnetic disks which are backed up on the Level C in compressed Zip format. The Level B transmits the data to the Level C and the data is parsed directly into the RVS data files that we use now. All data, errors, comments can be viewed for each individual instrument.

- Level C - The level C system is a Sun Solaris 10 UNIX Workstation discovery1 also known as ABCGATE. The RVS software suite is available on this machine. This suite of software allows the processing, editing and viewing of all data within the RVS data files. This system also has monitors that allow us to ensure that the level C is receiving data from the level B.

The Level A's acquire their timestamp from a Radio code GPS Clock that is distributed via the RVS Master / Slave Clock System.

The ABC system still remains the main data logging format for the ship, this is being run in parallel with the new Ifremer Techsas Sensor Acquisition System. This system is currently being proven and a database of drivers being built to enable us to interface with the instruments on board.

This system will then become the primary system for data logging.

For this cruise the Level A system were used to log:

1) Trimble GPS 4000 DS Surveyor (gps_4000)
2) Ashtec ADU-2 multi antenna GPS with attitude (gps_ash)
3) Ashtec GPS G12 integral to the FUGRO Seastar DGPS receiver (gps_g12)
4) Ashtec GG24+ GPS/Glonass Receiver (gps_glos)
5) Simrad EA500 Precision Echo Sounder (ea500d1)
6) NMFD Surface-water and Meteorology instrument suite (surfmet)
7) NMFD Winch Cable Logging And Monitoring CLAM (winch)

A Master Clock jump occurred on day 212 at 01:12 GMT. A reset of all level A's was performed in order to allow them to continue parsing and time stamping correctly. The gps_ash requires a reconfiguring of its data port to allow it to send data to the level A. Due to the time of night that this error occurred it was not noted for sometime.

The data loss to all level A feeds excluding the gps_ash was from:
06 212 0108 – 06 212 0110

The gps_ash lost more data due to problems with reconfiguring the data port. The data loss for the ashtec was:
06 212 010931 – 06 212 013802

The ether link for the level B – C connection failed on day 222 at around XXXXXXXX. The Ethernet Link was re-established using the Level B "Link – Ether" command. No data loss occurred as the Level B backs up all data to Hard Disk until they can be transmitted across to the Level C, this is displayed on the Level B as a Link Backlog.

There were no other significant losses of data however there are time gaps in some files due to GPS dropout and also the issue of the instruments sometimes sending signals slightly faster than a second and so a time gap of 1 second occurring on the next message.

It should be noted that due to the cruise being a moorings recovery cruise the ea500d1 Simrad Precision Echo Sounder was deactivated on multiple occasions for fears that it would interfere with BPR and Moorings acoustic messages.

Ifremer Techsas System

The Ifremer data logging system is the system that will inevitably replace the existing Level A + B system while for the most part the Level C will remain as the main system for outputting, viewing and editing the acquired data.

The Techsas software is installed on an industrial based system with a high level of redundancy. The operating system is Red Hat Enterprise Linux Edition Release 3. The system itself logs data on to a RAID 0 disk mirror and is also backed up from the Level C using a 200GB / 400GB LTO 2 Tape Drive. The Techsas interface displays the status of all incoming data streams and provides alerts if the incoming data is lost. The ability exists to broadcast live data across the network via NMEA.

The storage method used for data storage is NetCDF (binary) and also pseudo-NMEA (ASCII). At present there are some issues on some data streams with file consistency between the local and network data sets for the ASCII files. NetCDF is used as the preferred data type as it does not suffer from this issue.

The Techsas data logging system was used to log the following instruments:

1) Trimble GPS 4000 DS Surveyor (converted to RVS format as gps_tech)
2) Chernikeef EM speed log (converted to RVS format as log_chf)
3) Ships Gyrocompass (converted to RVS format as gyronmea)
4) Simrad EA500 Precision Echo Sounder
5) NMFD Surface-water and Meteorology (SURFMET) instrument suite

Due to the instability of the software at present some data losses did occur. Mostly in the manner of 1 – 2 minutes of data loss.

There was a total systems crash on day 207 which resulted in the following data loss to gyronmea and log_chf which in turn creates gaps in relmov and bestnav.

- 06 207 18:15:46 to 06 207 23:32:16 - 5 hrs 16 minutes of data loss

Techsas also suffered 2 GUI crashes. This crash is not as serious as the system crash as the system remains logging. However if it were to stop suddenly it would be unknown to us and so the application needs to be restarted.

These losses of data due to reboot occurred at

- 06 211 22:43:11 – 06 211 22:44:43 - 1min 32 seconds of data loss.
- 06 224 23:25:56 – 06 224 23:27:04 - 1 min 8 seconds of data loss.

There was also an issue where the GPS receiver that is connected to the Techsas system lost all satellites and began to loose its time sync. This resulted in a backwards time.

This occurred at:

06 206 13:54:19 the time jumped backwards 14 seconds to 06 206 13:54:05

An odd error occurred with the Techsas system while I was looking straight at it from the other end of the room. The system seemed to be killed as if it had been CTRL+C at the terminal window. Techsas was reactivated right away. This occurred at:

06 220 11:09:31 – 06 220 11:10:25 – 54 Seconds of data lost

All of the issues outlined here have been sent to the Ifremer support team in an attempt to remove the issues that are currently being experienced with the system.

Techsas NetCDF to RVS Data Conversion

The EM log and Gyro data that was recorded by Techsas system was converted to RVS data file format to allow processing of navigation data by the relmov and bestnav applications. These data streams are critical to the processing of bestnav.

An in house application was used to handle the conversion of NetCDF files to the RVS format. This was then parsed back to the data file and was processed as normal. These 2 new applications being ncvars and nclistit.

These new binaries require to environment variables in order to function:

$NCBASE – the base for the nc system, set to /rvs/def9

$NCRAWBASE – the base for the raw data files, set to /rvs/pro_data/TECHSAS/D308/NetCDF

The existing $PATH variable must also include the path to the nc binaries, the path /rvs/def9/bin was appended to the $PATH variable.

The RVS data files log_chf and gyronmea were created as standard using the credit system. The data acquired and stored by Techsas was nclistit into the RVS data format once every day. Then the files were sub sequentially titsil into the RVS data file.
When being logged by Techsas the variable names differ to those that have been set within the gyronmea and log_chf and also the ones required to perform bestnav. These headers are replaced at the stage when the file is nclistit.

All Techsas data file names are in the format of YYYYMMDD-HHMMSS-name-type.category with the data/timestamp being the time the file was created by Techsas.

The files were each processed in the following way for this cruise:

nclistit 20060813-000001-gyro-GYRO.gyr - | sed s/head/heading > $DARAWBASE/gyro.225

At this stage the data is converted to the correct format and its header replaced by the header required by the RVS software suite.
Another issue with the conversion of the files to the RVS format is that the top timestamp is always outputted as 00 00/ 00:00:00. The file outputted with nclistit is then edited in VI in order to alter that timestamp to the correct time and day. This is done as it would not be imported into the RVS data format with this timestamp error.

The file is then passed to the titsil application which simply reads the data from the text file that was created and enters it as records in the RVS data file.

cat $DARAWBASE/gyro.225 | titsil gyronmea –

This command reads the gyro.225 file in the /rvs/raw_data directory and passes it to titsil for input in the gyronmea file. The – dictates that all variables will be included.

The TECHSAS system was set to create a new file for each day, however on days when errors occurred multiple files were created as that is normal practice for Techsas when it is restarted.

Fugro Seastar DGPS Receiver

The Fugro Seastar is the source of custom differential corrections based on its position fixed by its internal Ashtec G12 GPS module. It outputs corrections via RS-232 using the standards RTCM message. The message is distributed among all GPS receivers where they are used to compute their own DGPS positions.

During the cruise there was an issue with the loss of data from the gps_4000. When the gps_4000 was interrogated using HyperTerminal the same time and data was being sent. This was due to the Fugro not receiving any signals. This in turn meant that DGPS positions could not be calculated. The Trimble GPS 4000 was adjusted to allow it to function with or without differential information across RTCM. Allowing it to continue functioning and using the RTCM message when available.

The Seastar box was also forcibly set to work on AMSAT as it was noted that while on AutoScan the system would not lock onto AMSAT despite the signal being available. There was some loss of DGPS across the C line and also the gps_4000 data was lost for that hour where no RTCM messages were being received.

The message stuck to the same time at 20:46:29 and was restored at 21:42:43 when the On/AUTO setting was selected.

The Sea star box was continually switched between AMSAT and EASAT for the next hour to determine the best signal.

Trimble 4000 DS Surveyor

The Trimble 4000DS is a single antenna survey-quality advanced GPS receiver with a main-masthead antenna. It uses differential corrections from the Fugro Seastar unit to produce high quality differential GPS (DGPS) fixes. It is the prime source of scientific navigation data aboard RRS Discovery and is used as the data source for the ships display system (SSDS)

The Trimble as mentioned above would not output any new data fixes of DGPS as it was not receiving any differential corrections from the Fugro Seastar system. The device on day 221 was set to ON/AUTO meaning that the device would use the differential corrections when they are received and would continue to pass single GPS data while corrections were unobtainable.

This error was discovered while preparing to launch a CTD cast. The NMEA data is fed from the Trimble GPS 4000 and the CTD Sea Bird software would not start as there was no change in the time and data being received by it.

Ashtec ADU-2

This is a four antenna GPS system that can produce attitude data from the relative positions of each antenna and is often used to correct the VMADCP for ship motion. Two antennae are on the Bridge Top and two on the boat deck.
The Ashtec lost data during a Level A Master Clock jump. The Ashtec Level A must be reconfigured to support the correct Baud Rate when this occurs which causes a longer down time than that of other instruments. For more information see the section on the Level ABC system.

Ashtec GG24/GLONASS

The GG24 is the least reliable GPS receiver even though it can receive fixes from the Glonass system in addition to standard GPS. The Glonass is a combined gps receiver and Russian navigation system.

The Glonass ran continually through the entire cruise with no noticeable faults or bad data.

RDI Ocean Surveyor 75kHz Vessel Mounted ADCP (VMADCP)

Prior to the cruise the VMADCP data logger was replaced due to issues with network transfer of data. Each time a network transfer of the data was attempted the system would lock up causing losses of data that was being recorded at the time.

The new computer worked successfully throughout the entire cruise and data was backed up to the /data32/d308 share area. This was itself backed up on to the LTO 2 Tape Deck.

Chernikeef EM log

The Chernikeef EM log is a 2-axis electromagnetic water speed log. It measures both longitudinal (forward-aft) and transverse (port – starboard) ships water sped.

The EM log was not calibrated prior to the cruise and was reading at 1.3knots astern when alongside (-1.3 knots)

It should be noted also that while the transverse speed is visible on the chernikeef display it self (one is located on the bridge), the SpeedPS or transverse speed message is not being received by the Techsas or level A system. This issue was noted on the last cruise.

This taken from a previous cruise report:

The Chernikeef manual was consulted but was found to be out of date. The manual states theat the unit transmits a $VMVLW message for distance and $VMVHW for speed, but the log is actually sending $VMVLW and $VMVDS. The speed message was monitored and found to have erroneous 'N' fields after the speed fields that are the presumed cause of the message parsing failure. Refering to the $VMVLW definition these fields have the meaning of Nautical mile in the distance message. Why they are present in the speed message is not known as they are not prescribed by the NMEA standard for $VMVDS. It is assumed that this has been introduced by a firmware update to the EM log at some point in the recent past.

Simrad EA500 Precision Echo Sounder (PES)

Once clear of the port waters the PES fish was deployed and the EA500 configured to start bottom detect. Once a good bottom signal and depth value had been obtained the system was run continuously throughout the cruise. However due to the cruise nature the EA500 was turned off on a lot of occasions due to the following work:

- Moorings Release trials and attempt at retrieving moorings.

- BPR retrieval attempts.

The PES was found to have rather a lot of noise while trying to use it to communicate with the moorings and BPR's. This was due to an issue with the O ring on the junction box that had allowed water into the box itself. This was dealt with and the amount of noise on the pinger reduced dramatically. This did not affect the reception of pinger signals.

Regionally corrected data is produced by using Carter's Tables and is stored in the RVS data file 'prodep'

Surfmet System

This is the NMFD surface water and meteorology instrument suite. The surface water component consists of a flow through system with a pumped pickup at approx 5m depth. TSG flow is approx 25 litres per minute whilst fluorometer and transmissometer flow is approx 3 l/min. Flow to instruments is degassed using a debubbler with 40 l/min inflow and 10/l min waste flow.

The meteorology component consists of a suite of sensors mounted on the foremast at a height of approx 10m above the waterline. Parameters measured are wind speed and direction, air temperature, humidity and atmospheric pressure. There is also a pair of optical sensors mounted on gimbals on each side of the ship. These measure total irradiance (TIR) and photo-synthetically active radiation (PAR).

The pumps were switched on , on day 206.
During the cruise the Surfmet pumps were deactivated due to us returning to St Johns. The shutdown occurred at approximately 06 211 0054 and reactivation took place on 06 211 1209.
The pumps were finally switched off on day 225 around 23:00 GMT.

All instrument details are held in the data/raw/ship/d308/surfmet/instumentdetails folder
Along with all histories and cal sheets for the instruments.

Network Services

During the cruise there were no issues of any kind with the wired network system. Several technicians and scientists made successful use of the network and all systems were able to connect to the network.

Wireless network

The issue of wireless network on the Forecastle Deck is still an issue as was noted in the previous cruise. The issue is thought to be related to the Hub that the access point ("RADIO1") is connected too. The access point will need to be given a dedicated connection to the network avoiding this hub to re enable this service for the scientists on the forecastle deck.

E-mail system

The email system worked fairly well for the entire length of the cruise. Some issues were noticed when the ship was heading in an easterly direction. Email transfers would take a long time on these courses or not occur at all. There were normally 3 email transfers performed each day however most days there were more due to the issue of bad connections and also an issue with a large collection of mails in one users inbox which caused issues where long connection times would occur. The issue was reported to base and emails removed to allow normal transfer.

Data Storage

Two USB external hard drives are being use as a RAID 0 mirror hosted by Discovery3 at the /data32 export. The mirror uses the modern meta device commands available in Solaris 10. This increases storage robustness by providing another layer of redundancy at the online storage level. The maintenance and administration of the disk set is minimal and the performance more than adequate.

All cruise data except for the /rvs path were stored on this storage area. Access was given to scientists to some of the folders via Samba shares.

Level C data was logged to the discovery1 internal disk as was Techsas.

Data Backups

Backups of Level B data tapes were taken as required when the tapes became full, usually once every 2 days. These were archived compressed data files in /rvs/raw_data/levelb/Tape*.Z

Daily backups of the Level C data was done as a tar file to DLT tape. The following paths were included in the tar file:

/rvs/raw_data
/rvs/pro_data
/rvs/def7/control

/rvs/users

In addition to the redundancy provided by the RAID 0 pair, daily backups of the /data32 directory were done by a level 0 (full) ufsdump of a filesystem snapshot using fssnap to the LTO 2 tape. The whole disk was backed up not just current cruise data. The fssnap backing store was removed and deleted each day after completion of the ufsdump.
The LTO2 system was backed up on a daily basis in a rolling 4 tape system.

Data Archiving

The proposed data archive will consist of the following components.

1) Scientists data from data32, including all raw RVS data that had been extracted through matlab scripts.
2) All CTD data
3) All moorings data including trial moorings that were done.
4) All ADCP data
5) All TECHSAS NMEA data files.
6) All XBT data that was collected for Ifremer

All data was written to DVD with 4 copies made.
1 copy for BODC
1 copy for PSO
1 copy for RRS DISCOVERY
1 copy for return to NOC

Data was also held on the PSO's and another scientist's pc.

Cruise Site

At the request of the PSO a simple website was constructed and hosted on the ships Mac mini. The site was located on the Mac mini at the address http://macmini.discovery/~rvs/d308/ the website was handed to the PSO and will require some editing to enable it to work on other systems due to its creation using proprietary software called Rapid Weaver by RealMac software.

Routine underway data processing

Miguel Ángel Morales Maqueda and Rory Bingham
Proudman Oceanoraphic Laboratory

On D308, underway processing was done in essentially the same way as on the 2004 Charles Darwin Rapid cruise CD160, and the reader should consult Dr. Mike Meredith's report of this cruise for details (or see Appendix IV).

The treatment of navigation, echosounding and surface meteorology and thermosalinograph data was divided into two steps. In the first step, a UNIX script was used to invoke the RVS `listit` command, retrieve 24 hours of data corresponding to a given Julian day, and write the data to an ASCII file. In the second step, a series of Matlab routines were used to treat the data (e.g. de-spiking), make some plots, and archive the data in a master file.

The procedure to retrieve, analyse and archive the data was as follows.

1. UNIX scripts:
    a. Navigation
        i. Gyrocompass: **get_gyro**
        ii. Bestnav: **get_bestnav**
        iii. Ashtech: **get_gpsash**
        iv. GPS NMEA (not used on D308)
        v. GPS4000: **get_gps4000**
        vi. ADCP (not used on D308)
    b. Echosounding
        i. Simrad EA500: **get_ea500**
        ii. Prodep (not used on D308)
    c. Surface meteorology and thermosalinograph: **get_surfmet**
2. Matlab routines:
    a. Navigation
        i. Gyrocompass: **loadgyro, gyroall**
        ii. Bestnav**: loadbestnav, bestnavall**
        iii. Ashtech: **loadgpsash, gpsashall, gpsgyrmerge, gpsgyrclean, gpsgyredit, gpsgyrashaveall**
        iv. GPS NMEA (not used on D308)
        v. GPS4000: **loadgps4000, gps4000all**
        vi. ADCP (not used on D308)
    b. Echosounding
        i. Simrad EA500: **loadea500, cleanea500,ea500nav, ea500all**
        ii. Prodep (not used on D308)
    c. Surface meteorology and thermosalinograph: **loadsurfmet, cleansurfmet, truewind, surfmetnav, surfmetall**

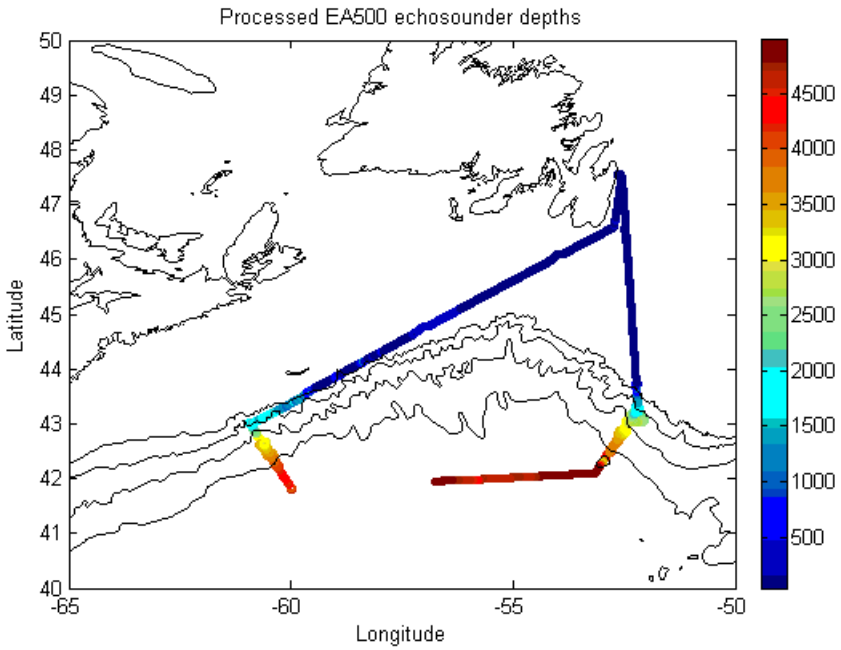


Figure 19: EA500 echosounder depths (in m) along the D308 cruise track. Processed using Carter's tables. Echosounder data was not retreived during the night from Julian day 221 to Julian day 222, hence the data gap between stations C1 and C2.

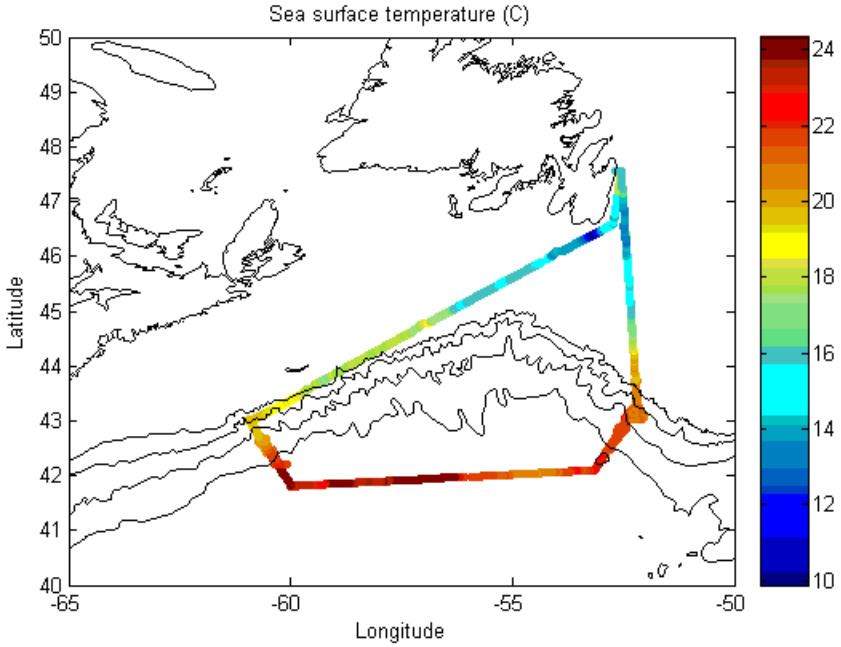


Figure 20: Uncalibrated sea surface temperature along the D308 cruise track.

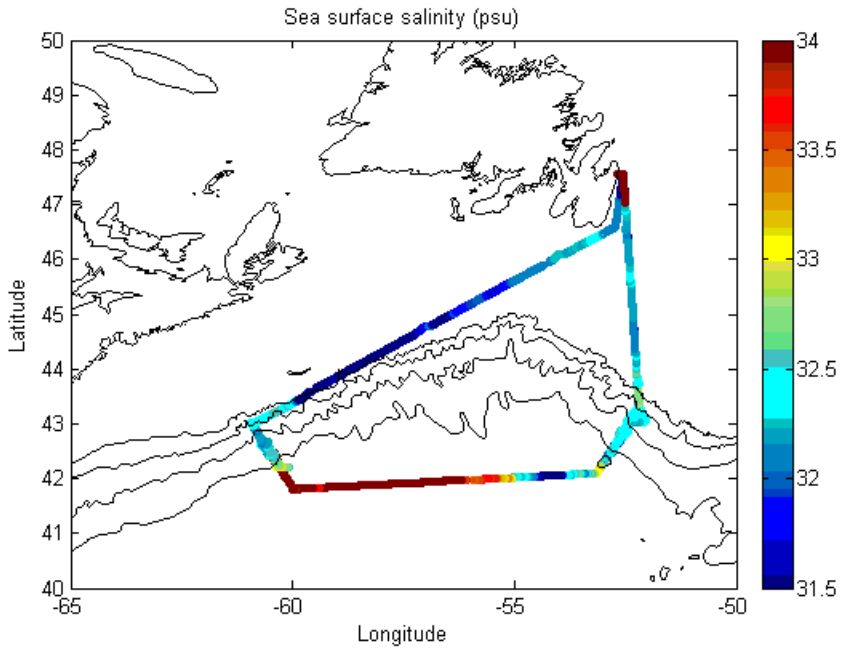


Figure 21: Uncalibrated sea surface salinity along the D308 cruise track.

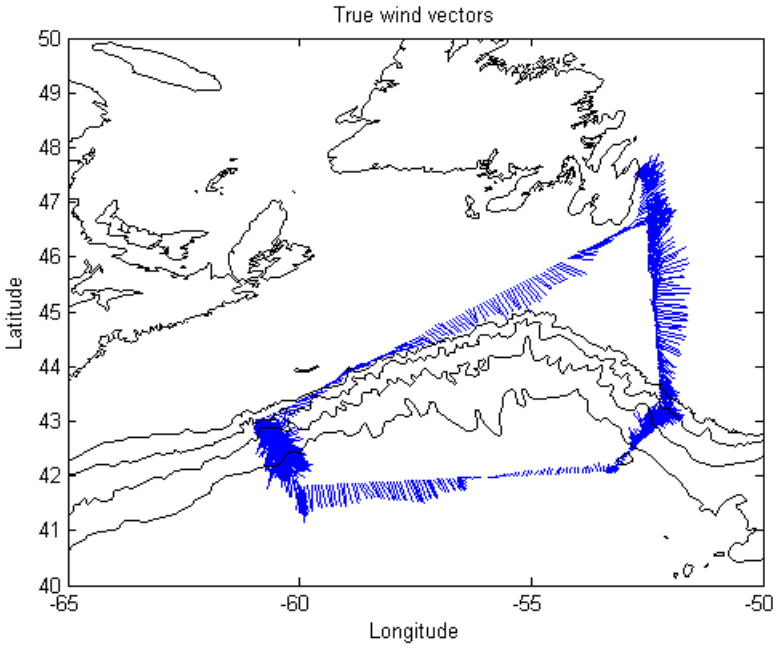


Figure 22: True wind vectors (corrected for ship's speed, heading and course) along the D308 cruise track.

CONCLUDING REMARKS

The aims of the cruise were to recover and redeploy 12 BPRs (two with IESs) and 10 CTD moorings, and to conduct CTD profiling and helium-tritium sampling at chosen sites. While we met complete success in our CTD and sampling operations, the recovery BPRs and moorings was problematic. Only six BPRs, one echo sounder and two moorings were recovered. Some of the causes for such a disappointing score were identified during the cruise (for example a leak through the pressure feed-through was likely responsible for the loss of some of the BPRs -see the accompanying BPR report by Peter Foden and Jeffrey Pugh-) and others, specially as regards the fate of the lost moorings, are still being investigated (see reports and recommendations by Ian Waddington above). At present, we are exploring the possibility of revisiting line B during 2007 in order to turn the moorings on sites B3 and B5 around and check the state of the BPR on B4. This work would be carried in collaboration with Canadian scientists from the Bedford Institute of Oceanography, lead by Professor John Loder.

In spite of the many misadventures, the lessons learned from the cruise and the quality of the recovered data make of D308 a very valuable contribution to WAVE-RAPID project. D308 was not an easy cruise for the officers, crew, scientists or technicians involved. However, all onboard remained professional and worked extremely hard during the cruise. Most sincere thanks to the master, officers and crew of the Discovery, and to the technical and scientific personnel that participated in D308. While all the participants in the cruise deserve congratulations for their efforts, its appropriate here to explicitly mention the excellent performance of Chris Barnard, computer technician whose support was greatly appreciated by both the UKORS and POL teams. Unfortunately, Chris did not succeed in securing a NERC appointment at NOC after the cruise. We wish him the best of lucks in his professional life and hope to meet him again at sea.

Miguel Ángel Morales Maqueda

Acknowledgements. Special thanks to Dr. Michael Meredith, principal scientist of the previous RAPID WAVE cruise, CD160, who has provided kind assistance and advice at all stages of the preparation of this cruise. Thanks as well to Julie Collins, who assisted with the installation of SeaBird software in our computers, Mark Hebden, who advised on how to prepare the cruise summary report for the BODC, and Geoff Hargreaves and David Butler, who helped with the transportation of our cruise equipment to the Vittoria Dock, Liverpool, and to Cork, respectively. Kitty Broome and Trevor Ross, from RSU, played a key role in most organisational aspects of this cruise. We are most grateful for their help. Thanks also to Mr. Philip Parker (United Kingdom Hydrographic Office) for issuing a temporary notice to mariners including the location and depths of the D308 Cruise moorings and BPRs.

APPENDIX I. MASTER'S DIARY

ROGER CHAMBERLAIN

R.R.S. DISCOVERY

CRUISE TIMETABLE OF EVENTS D308

Date	Time (UT)	Event
22/07/06	1145	Author of following report joins vessel in St. JOHN'S, NF
23/07/06	1130-1930	Preparations for cruise D308 continues
24/07/06	1030	Pilot on board
	1040-1140	Vessel shifts to Bunker Berth
	1138	Secured at bunker berth – pilot disembarks
	1200-1430	Delay due to Bunker berth not having the right connection for the ship even though this had been confirmed the week before.
	1435-1715	Loaded 190 Tonnes of Fuel
	1715-1740	Preparing to sail after bunkering
	1735	Pilot embarks
	1752	All gone and clear
	1810	Pilot disembarks the seaward end of the Narrows
	1818	Full away on passage Course 096° T 47 33.7N 052 37.8 W Cape Spear bore 170° T @ 2.20 Miles
	1842	Altered Course to 177° T 47 32.2 N 052 32.4 W
	2330-0630	Reduction of speed due to thick fog
25/07/06	1240	XBT launched 44 49.1 N 052 18.9 W
	1330-45	PES Fish Deployed 44 46.1N 052 18.6W - resumed passage
	1938	Hove to for test CTD Station
	2033-2124	**TEST CTD cast to 550 m 43 43.1N 052 14.0W**
	2150	XBT launched 43 43.1 N 052 14.6 W
26/07/06	0142	Manoeuvring in the vicinity of BPR A0 43 11.7 N 052 14.4 W
	0155	XBT launched 43 12.0 N 052 15.0 W
	1134	BPR A0 released
	1207-25	Recovering BPR A0 **STATION 16003 #1 43 15.9N 052 11.6W**
	1248	XBT launched 43 12.0 N 052 15.0 W
	1318-1417	Manoeuvring in the vicinity of mooring A1 43 11.8 N 052 14.5 W **Not responding to release commands**
	1424	Manoeuvring in the vicinity of BPR A1 43 12.1N 052 15.1W
	1519	BPR A1 released
	1557-1612	Recovering BPR A1 **STATION 16004 #1 43 12.2N 052 15.1W**
	1717	XBT launched 43 06.8 N 052 19.1 W
	1725	Manoeuvring in the vicinity of mooring A2 43 06.7 N 052 19.5 W
	1725-0142	Engaged in various search patterns for finding mooring A2 acoustically **No acoustic responses throughout**

27/07/06	0206	Returning to mooring site A1
	0254-0543	Exhaustive search is unfruitful
		No acoustic responses throughout on Mooring site A1
		Mean search position 43 11.9N 052 14.7W
	0543	Returning to Mooring A2
	0829	Commenced Search for A2 43 06.6 N 052 19.5 W
	0846-1519	Engaged in expanding square search for Mooring A2
	1106	XBT launched 43 02.4 N 052 09.7 W
	1505	XBT launched 43 11.6 N 052 13.6 W
	1519	Search for mooring A2 called off 43 09.9 N 052 15.7 W
		No acoustic responses throughout on Mooring site A2
	1552	Vessel begins searching for BPR2 43 06.7 N 052 19.4 W
	1552-1900	All acoustic avenues exhausted – so sign of BPR2 **No acoustic responses throughout on Mooring site BPR2**
	1900	Proceeding to Mooring A3
	2030	Hove to at Mooring A3 site 42 54.9 N 052 28.7 W
	2042	XBT launched 42 55.0 N 052 28.9 W
	2030-2129	Vessel searching for BPR3 and Mooring A3
	2130	Decision made to test acoustics with CTD frame.
	2203-0016	**TEST CTD cast to 3150 m 42 54.3N 052 28.8W**
28/07/06	0016	Commenced search survey for A3
	0016-0720	All acoustic avenues exhausted – so sign of A3 or BPR3
		No acoustic responses throughout from BPR3 or A3
	0720	Heading for Mooring A4 and BPR4
	0900	Hove to at Mooring A4 site 42 40.5 N 052 40.6 W
	0900-1014	All acoustic avenues exhausted – so sign of A4 or BPR4
		No acoustic responses throughout from BPR4 or A4
	1014	Heading for Mooring A5
	1038	XBT launched 42 36.8 N 052 43.2 W
	1205	Hove to at Mooring A5 site 42 29.0 N 052 49.9 W
	1205-1333	All acoustic avenues exhausted – so sign of A5
		No acoustic responses throughout from A5
	1333	Survey aborted – Heading for mooring A2 42 29.1 N 052 49.8 W
	1454	XBT launched 42 42.4 N 052 39.3 W
	1732	Decision made to deploy CTD at A2
	1808-2048	**16005#1 – CTD cast to 2785 m 43 07.9N 052 23.6W**
	2048	Proceeding to station A1
	2100	XBT launched 43 08.4 N 052 23.7 W
	2259-0131	**16006#1 – CTD cast to 2205 m 43 13.4N 052 16.5W**
29/07/06	0210	Proceeding to station A0
	0353-0551	**16007#1 – CTD cast to 1770 m 43 15.7N 052 11.2W**
	0640	Set Course 357° T for St. John's Rendezvous
	1230	Position Latitude 44 12.6 N Longitude 052 15.9 W
30/07/06	0030	Position Latitude 46 11.6 N Longitude 052 25.9 W
	0908	Altered course to 357° T 47 28.6 N 052 32.5 W
	1000	manouevring with launch 'Innovation' to begin transfer of equipment

	1037-56	lifting off reels of wire from launch (Black Head bore 090 T x 0.5 miles)
	1056	All stowed aboard
	1111	All secure commenced passage back to working area
	1118	Full away on passage co 135° T (Cape Spear bore 240 T x 0.5 Miles)
	1154	Altered course to 187° T 47 25.5 N 052 34.4 W
	1638	Altered course to 238° T 46 35.1 N 052 43.9 W
31/07/06	0030	Position Latitude 45 54.1 N Longitude 054 20.0 W
	1248	Position Latitude 44 46.0 N Longitude 057 01.6 W
01/08/06	0030	Position Latitude 43 35.5 N Longitude 059 35.3 W
	0630	Hove to on Station
	0640-0903	**16008#1 – CTD cast to 1710 m 43 00.3N 060 55.4W**
	1026	XBT launched 42 59.9 N 060 54.3 W
	1033	BPR B0 released
	1123-36	Recovering BPR B0 **STATION 16008 #2 42 59.9N 060 54.6W**
	1158-1200	Re-Deploying BPR B0 **STATION 16008 #3 42 59.9N 060 54.6W**
	1328	Mooring B1 released **STATION 16009 #1 42 55.6N 060 51.2W**
	1329	XBT launched 42 55.6 N 060 51.2 W
	1348-1419	Recovering Mooring B1
	1419	Mooring B1 inboard
	1512	BPR B1 released
	1604-15	Recovering BPR B1 **STATION 16009 #2 42 55.5N 060 51.8W**
	1646-47	Re-Deploying BPR B1 **STATION 16009 #3 42 55.6N 060 51.7W**
	1805	XBT launched 42 51.3 N 060 48.1 W
	1836	Mooring B2 released **STATION 16010 #1 42 49.1N 060 46.3W**
	1856-1951	Recovering Mooring B2
	1951	Mooring B2 inboard
	2134	BPR B2 released
	2236-47	Recovering BPR B2 **STATION 16010 #2 42 49.2N 060 46.5W**
	2309-0149	**16010#3 – CTD cast to 2680 m 42 49.4N 060 46.3W**
02/08/06	0200	Proceeding to site B3
	0830	Hove to at Mooring B3 site 42 37.6 N 060 40.7 W
	0830-1213	All acoustic avenues exhausted – so sign of B3 **No acoustic responses throughout from B3**
	1213-1424	Surveying for BPR B3
	1424	BPR B2 released
	1557-1610	Recovering BPR B3 **STATION 16011 #1 42 37.4N 060 36.4W**
	1753	XBT launched 42 27.0 N 060 28.2 W
	1803	Hove to at Mooring B4 site 42 26.5 N 060 27.7 W
	1803-1929	All acoustic avenues exhausted – so sign of B4 or BPR B4 **No acoustic responses throughout from B3 or BPR B4**
	1930	Proceeding to site B5

	2051	Hove to at Mooring B5 site 42 14.0 N 060 17.7 W
	2112	XBT launched 42 13.9 N 060 17.5 W
	2147	No response from B5 – attempting to contact BPR B5
	2153	Release of BPR B5 failed
	2256-2330	CTD cast – cancelled
	2345	Science stopped for the night
03/08/06	0815	Hove to again at BPR B5 42 14.0 N 060 18.0 W
	0815-1055	Trying to release BPR B5
	1250	Proceeding to start of dragging position – **B5 DRAG**
	1327	Commence deploying dragging wire 42 12.4 N 060 20.8 W
	1604	1.5 Tonne weight attached – transferred to Trawl warp
	1730-2046	Drag line fully deployed and dragging
	2046	Commence hauling 42 13.4 N 060 18.0 W
04/08/06	0136	All draglines inboard - All clear 42 13.8 N 060 18.2 W
	0223-0607	**16012#1 – CTD cast to 4100 m 42 13.1N 060 16.6W**
	0624	Proceeding to start of dragging position – **B3 DRAG**
	1051	Commence deploying dragging wire 42 36.6 N 060 43.9 W
	1337	1.5 Tonne weight attached – transferred to Trawl warp
	1547-1830	Drag line fully deployed and dragging
	1830	Commence hauling 42 37.14 N 060 38.5 W
	2214	All draglines inboard - All clear 42 37.7 N 060 41.3 W
	2242-0152	**16013#1 – CTD cast to 3310 m 42 38.4N 060 41.0W**
05/08/06	0923	Hove to in vicinity of B4 42 25.0 N 060 31.3 W
	1049	Proceeding to start of dragging position – **B4 DRAG**
	1049	Commence deploying dragging wire 42 24.8 N 060 31.3 W
	1243	1.5 Tonne weight attached – transferred to Trawl warp
	1438-1912	Drag line fully deployed and dragging
	1912	Commence hauling 42 37.14 N 060 38.5 W
	2114	**LOST ALL DRAGGING GEAR** – see report 42 27.6 N 060 27.3 W
	2131	Trawl warp inboard.
	2210-30	Deploying temporary mooring B4
	2230	**Temporary Mooring B4 deployed 42 27.0 N 060 25.8 W**
	2314-0012	Triangulating mooring
06/08/06	0012	Commenced transit to site B2 – course 328° T
	0850	Hove to at site B2
	1040-44	**Deployed BPR B2 42 49.177 N 060 46.482 W**
	1147-1345	**16014#1 – CTD cast to 2660 m 42 50.0N 060 46.7W**
	1438-1730	**16015#1 (B1) – CTD cast to 2180 m 42 55.4N 060 51.9W**
	1739	Commenced transit to site B4 – course 150° T
	2149-0223	**16016#1 (B4) – CTD cast to 3660 m 42 25.7N 060 26.2W**
07/08/06	0953	Temporary Mooring B4 released from seabed
	1025-1109	Recovering Temporary mooring B4 42 27.2 N 060 25.3 W
	1109	Mooring inboard
	1155	Commenced transit to site B5 – course 150° T
	1400	Hove to on BPR site B5 42 13.9 N 060 18.4 W
	1405-1542	Triangulating the position of BPR B5
	1614-0017	Vessel engaged in dragging the site to try and dislodge BPR B5

		No success
08/08/06	0017	All secure – preparing for CTD
	0036-0442	**16017#1 (B5) – CTD cast to 4020 m 42 15.1N 060 18.0W**
	0442-1100	Hove to in vicinity of Mooring B5 preparing to lay mooring
	1222-1435	Deploying Mooring B5
	1435	**Mooring B5 deployed 42 12.59 N 060 18.85 W**
	1535-1635	Triangulating mooring
	1643	Proceeding to site B4 333° T
	1915	Hove to at site B4
	1915-19	**Deployed BPR B4 42 26.50 N 060 28.20 W**
	2006	Proceeding to site B3 329° T
	2212-1216	Hove to in vicinity of Mooring B3 preparing to lay mooring
09/08/06	1216-1306	Deploying Mooring B3
	1306	**Mooring B3 deployed 42 36.026 N 060 37.514 W**
	1342-1536	Triangulating mooring
	1549	Proceeding to CTD site C1 145° T
	1812-14	XBT launched 42 13.0 N 060 18.4 W
	2046	Hove to at CTD Station C1 41 48.6 N 059 58.7 W
	2046-2140	Down time with technical Problem related to GPS
	2152-0143	**16018#1 (C1) – CTD cast to 4560 m 41 48.0N 060 00.0W**
10/08/06	0148	Set Course 087° T for CTD station C2
	0200	XBT launched 41 48.3 N 059 59.3 W
	1001	XBT launched 41 53.2 N 058 07.9 W
	1216	Core Cable streamed for spooling correction 41 54.4 N 057 36.7 W
	1430	cable streamed to 4790 metres - hauling 41 55.4 N 057 14.1 W
	1554	Core cable inboard and clear 41 55.9 N 057 00.5 W
	1624	XBT launched 41 56.1 N 056 55.0 W
	1800	Hove to at CTD Station C2 41 57.0 N 056 34.0 W
	1808-2202	**16019#1 (C2) – CTD cast to 4760 m 41 57.3N 056 34.0W**
	2202	Set Course 087° T for CTD station C3
	2213	XBT launched 41 58.1 N 056 32.7 W
11/08/06	0205	XBT launched 41 59.8 N 055 30.7 W
	1039	XBT launched 42 05.6N 053 20.0 W
	1134	Hove to at CTD Station C3 42 06.0 N 053 09.3 W
	1137-1532	**16020#1 (C3) – CTD cast to 4910 m 42 06.0N 053 09.3W**
	1545	Set Course 031° T for Site A3
	2103-24	Deploying temporary mooring A3
	2124	**Temporary Mooring A3 deployed 42 55.30 N 052 29.70 W**
	2152-0059	**16021#1 (A3) – CTD cast to 3150 m 42 55.7N 052 28.5W**
12/08/06	0059	Set Course 251° T for Site A5
	0844	Hove to at CTD Station A5 42 29.1 N 052 50.6 W
	0935-1308	**16022#1 (A5) – CTD cast to 4080 m 42 29.1N 052 50.2W**
	1445	Hove to at CTD Station A4 42 40.0 N 052 39.4 W
	1457-1803	**16023#1 (A4) – CTD cast to 3630 m 42 39.9N 052 38.7W**
	1812	Set Course 025° T for Site A3 (Temporary mooring).
	2015	Hove to at temporary mooring A3 42 55.6 N 052 29.6 W

	2033	Temporary Mooring A3 released from seabed
	2101-51	Recovering Temporary mooring A3
	2151	Mooring inboard 42 55.9 N 052 29.5 W
	2158	PES Fish inboard
	2205	Commenced echo sounder survey – Course 025° T
	2245	Altered Course to 090° T 43 03.0 N 052 29.1 W
	2318	Altered Course to 000° T 43 03.2 N 052 19.5 W
	2348	Altered Course to 090° T 43 09.0 N 052 19.3 W
13/08/06	0003	Altered Course to 000° T 43 09.0 N 052 15.1 W
	0030	Altered Course to 090° T 43 14.0 N 052 14.7 W
	0042	Altered Course to 000° T 43 14.2 N 052 11.4 W
	0053	Completed echo sounder Survey Set Course for St. Johns 43 16.2 N 052 11.3 W Course 357° T – full away
14/08/06	0900	ETA St Johns – alongside bunker berth.

END OF REPORT

APPENDIX II. Incident report on the loss of 3000 m of dragging on 5th August

RRS DISCOVERY INCIDENT & INVESTIGATION FORM

(underwater) Incident Report No: 050

Type: Presumed failure of a GUNNEBO MASTER Link and loss of 3000 metres of drag cable and a 1.5 tonne weight.	**Date:** 05 August 2006	**Time:** 2114 UT 1844 LT

Geographical Position: 42 28N 060 27W	**Geographical Location:** Western North Atlantic Ocean – approx 200 Miles South of Halifax, Nova Scotia, Canada

Location on Ship: After Deck – After Gantry – Centre hanging block

Weather: Daylight operations. Wind 330˚ x 15 knots – Sea slight – swell low – little movement	**Course:** 330 T	**Speed:** 0.5 knots

Activity:
Recovering theTrawl warp which was attached to a 1.5 tonne weight and 3000 metres of drag line. The trawl warp and weight were about to be recovered, and the rest of the 3000 metres of drag wire would then subsequently be recovered by deck winches.

NATURE OF INCIDENT

At 100 metres read-out the recovery was switched from ‘deployment mode’ to ‘handling (dead man) control’ in the winch cab. The hauling process was then resumed and at 93 metres wire out (at 1845 LT), there was a noticeable bang and a coinciding loss of tension. Proceedings were stopped to gather information and assimilate the circumstances and eventually the recovery of the trawl warp resumed. The trawl warp and a GUNNEBO swivel were recovered intact and there was no sign of the linkage to the 1.5 Tonne weight and the rest of the 3000 metres of drag wire.

Investigative Interview : Conducted by R.Chamberlain (Master) in the Master's cabin at 1045 LT 07/08/06, assisted by G.G. Parkinson (Ch/Eng)

Those Present represented those people involved in the above incident – They were:

After Deck Party: Steve Whittle, Ian Waddington, Iain Thomson CPOD and John mitchell Ch Off

1) UNDERLYING REASONS FOR OCCURRENCE

Presumed failure of a certificated 8 Tonne SWL rated GUNNEBO oval link 93 metres underwater.

2) WHO INSPECTED THE GUNNEBO LINK, SHACKLES AND SWIVEL (BEFORE THE OPERATION COMMENCED) AND WHAT WERE THEIR FINDINGS - ANY ACTIONS TAKEN ?

GUNNEBO link and Swivel: Ian Waddington & Steve Whittle, NMF SS Technicians

FINDINGS: All fit for purpose with no damage.

3) ANY SPECIFIC ACTION TAKEN BECAUSE OF THE INSPECTION

No, as the inspection passed the gear for operational duties.
There was no gear to inspect after the incident, as it failed 93 metres **underwater.**

4) WHAT TRAINING HAS BEEN PROVIDED? IS THERE A NEED FOR FURTHER TRAINING?
None. All personnel performed professionally as expected.

5) ARE THERE PLANS TO MONITOR FUTURE SIMILAR OPERATIONS?

None – see 6 and 'RECOMMENDATIONS'

6) ARE THE GUNNEBO LINKS ABOARD ALLOWED TO STAY READY FOR SERVICE? ARE THEY BATCH RELATED?
Yes, they are allowed to stay in (selected) service as they are certificated.

7) ANY ADDITIONAL INFORMATION

All personnel were off the after deck wearing the appropriate PPE at stanby to take their positions
The tension at incident was 4.05 Tonnes (1.5 Tonne weight plus the weight of 3000 metres of dragline). The highest tension throughout the whole cast and whilst on the bottom dragging was 6.25 Tonnes. It never rose above this tension throughout the operation.
The water depth was 3575 metres. The cable out was 93 metres plus 3000 metres of drag wire. This means that the whole rig was off the bottom and clear when the incident occurred.
The loss was considered to be due to a failure of a GUNNEBO Master link which was rated at 8 tonnes SWL (certification available from Ian Waddington). Bearing in

mind that the breaking strain should have been 4 times that rating, it should have eaily withstood a tension of 4 Tonnes.
The surviving GUNNEBO swivel was rated at 7 Tonnes SWL.

RECOMMENDATIONS to prevent a repetition:
It is recommended that this design of link is not used again in high loads. Ian Waddington is now sourcing 'SLING' Links, a different design which is not subject to 'cocking', i.e. a self aligning pear shaped Link.

Completed By: Roger Chamberlain - Master	

APPENDIX III. CTD DATA PROCESSING ON CD160

MIKE MEREDITH
Proudman Oceanographic Laboratory

The following is a transcription of the "CTD Data Processing" section from the cruise report for CD160 (Dr. Mike Meredith). No substantial changes were made to the routines described below during D308 save that, in the Matlab files, all references to CD160 files were replaced by references to D308 files.

"CTD data were processed on CD160 using a combination of SeaBird software (SBEDataProcessing-Win32) and Matlab. Some of the Matlab routines used were based on ones written on JR80 (ShagEx), but were modified and adapted for purposes specific to CD160. The steps were as follows:-

(SeaBird routines:-)

`datcnv` *To read the "CD160_XX.dat" file and "CD160_XX.con" file appropriate to the cast, and write output to "CD160_XX.cnv". The variables written were:-*

1. *scan count*
2. *pressure, digiquartz, (dbar)*
3. *temperature, ITS90, degC*
4. *temperature2, ITS90, degC*
5. *conductivity, mS/cm*
6. *conductivity2, mS/cm*
7. *altimeter, m*
8. *beam transmission, Chelsea/Seatech/Wetlabs*
9. *fluorescence, Chelsea Aqua 3, ug/l*
10. *oxygen saturation, ml/l*
11. *oxygen voltage, SBE43*
12. *oxygen, SBE43, ml/l*
13. *pump status*

`filter` *Low-pass filter the conductivity (0.03 seconds) and pressure (0.15 seconds) to increase pressure resolution prior to* `loopedit`*. (Loop Edit operates on three successive scans to determine velocity - this is such a fine scale that noise in the pressure channel from counting jitter or other unknown sources can cause* `loopedit` *to mark scans as bad in error). Output file called "CD160_XX_filt.cnv".*

`align` *Oxygen variables were advanced by 7 seconds relative scan, to account for time constants of sensors and water transit time delay in the pumped plumbing line. This value was derived by P.Duncan by comparison of*

upcast and downcast profiles. More insight into the best value to use might have been obtainable had bottle samples been measured for oxygen concentration, but on CD160 they were not. No alignment was made for conductivity, since the deck unit was programmed to advance both primary and secondary conductivity with respect to pressure by +1.75 scans (at 24 Hz, this is 1.75/24 = 0.073 seconds, the typical value suggested by SeaBird). Previous versions of the deck unit firmware only advanced primary conductivity, hence this alignment was then required, but this was not the case for CD160. Output was "CD160_XX_align.cnv".

`celltm` *Applies a recursive filter to remove conductivity cell thermal mass effects from measured conductivity. Thermal anomaly amplitude (alpha) was set to 0.03; thermal anomaly time constant (1/beta) was set to 7. Output was "CD160_XX_celltm.cnv".*

`loopedit` *This routine marks scans where the CTD package is moving less than minimum velocity or traveling backwards due to ship roll. For CD160, the minimum velocity was fixed, and set to 0.25 m/s. SBE911+ CTDs have been observed previously to show significant wake effects when working on large packages; routines such as* `loopedit` *have been shown to be effective at minimising the effects of these processes. Output was "CD160_XX_loop.cnv".*

`(wildedit` *In addition to the above routines, cast 1 (a rather noisy profile) was* `wildedit`*ed using to remove large fliers).*

(Matlab routines:-)

`ctdread.m` *This program reads data stored in the "CD160_XX_loop.cnv" file into Matlab matrices by invoking the* `cnv2mat.m` *routine, and names them accordingly. Output is "ctdXX.cal".*

`editctd.m` *Reads "ctdXX.cal", and launches an interactive editor to enable manual despiking. Pairs of values (temperature1/conductivity1; temperature2/conductivity2) are set to missing if either are manually excluded, so as to avoid errors in calculation of salinity that would arise from original temperature and interpolated conductivity, or vice versa. Other variables were also edited. Output was "ctdXX.edt".*

`offpress.m` *This was a substantially cut-down version of the code of the same name used on JR80, which did far more than was necessary. This version enabled the inputting of an offset pressure (default 0), and*

set variables to missing if the pumps were not operational (judged by pump status). Output was "ctdXX.wat"

`makebot.m` *Reads the SeaBird "CD160_XX.ros" file and the "ctdXX.wat" file to create a bottle file ("botXX.1st"). CTD data corresponding to the bottle firings were derived as the median values obtained between the start and stop scans given in the .ros file. Temperature on the IPTS-68 scale was derived (used for input to Matlab seawater routines), and salinity and potential temperature calculated using* `ds_salt.m` *and* `ds_ptmp.m`*. Warnings were written if large standard deviations in the CTD data corresponding to the bottle firings were obtained. The "CD160_XX.bl" file was read to determine which bottle was fired where.*

`readsal.m` *This loads the text file of bottle salinities, "CD160_XX_sam.txt", sets a flag according to presence/quality of salinity measurement, and outputs "salXX.mat".*

`addsal.m` *This reads the "botXX.1st" file, and adds the sample salinity. Output is "botXX.sal".*

`setsalflag.m` *Sets flag to zero for instances where the standard deviation of any of conductivity1, conductivity2, temperature1 or temperature2 at the bottle firing levels is greater than 0.002 in the "botXX.sal" file.*

`salplot.m` *Produces plots of CTD and bottle salinity with depth, and CTD-bottle salinity difference with depth. Enables determination of which bottles should be used to determine offsets to be applied to the CTD data to reconcile them with the bottle data. Flags were changed in the "botXX.sal" file for this by loading the file, manually changing the salflag variable, and re-saving it.*

`salcal.m` *Calculated the adjustment to nominally calibrated CTD salinity required to get the best fit to bottle data. Calls the* `sw_cndr.m` *routine to calculate conductivity from the bottle salinities at the temperature and pressure of the corresponding CTD salinities. The derived offsets are placed in the "botXX.sal" file.*

`salcalapp.m` *Applies the derived offsets to the CTD conductivities, calculates salinity, potential temperature, potential densities (sigma0, sigma2, sigma4). Works on CTD data stored in both CTD file and bottle file. Outputs to "ctd01.var" and "bot01.cal".*

`splitcast.m` *Divides the CTD cast into an upcast and a downcast, with the dividing point being determined via the maximum value of pressure. Output is "ctdXX.var.dn" and "ctdXX.var.up".*

`gridctd.m` *Reads the downcast profile and derives 2 dbar averages of all properties. Writes to "ctdXX.2db".*

`fill_to_surf.m` *Used in instances where very surface layers contained missing values, due to CTD not being brought sufficiently close to surface before commencing downcast. Extends shallowest measured level to levels above. Output again to "ctdXX.2db".*

Miscellaneous points:

1) Best values for salinity, temperature etc were stored as variables "salin", "temp" etc, alongside the primary and secondary values ("salin1", "temp1" etc.), to indicate the preferred sensor to use.

2) On cast 1 (site 0A), the secondary salinity was set to missing since it was extremely noisy.

3) Cast 5 (at site 4A) had no bottle samples, since the CTD package was lost during recovery. No conductivity offsets were applied to the data from this cast.

Table of deployments lat/long/depths/times

Table of offsets

Theta-S plots, one for line A and one for line B.

Contour plots of sections?"

APPENDIX IV. UNDERWAY PROCESSING ON CD160

MIKE MEREDITH
Proudman Oceanographic Laboratory

The following is a transcription of the "Underway Processing" section from the cruise report for CD160 (Dr. Mike Meredith). No substantial changes were made to the routines described below during D308 save that, in the Matlab files, all references to CD160 files were replaced by references to D308 files.

"For CD160, all processing of underway data was done in the Matlab environment. It had been intended for some time to port the existing Pstar code to Matlab, to make the processing more independent of platform, and to enable use of structured arrays available in Matlab. This was done now, since time was available at the start of CD160 for this coding to take place. Some of the code was developed from programs written on JR80 by D. Stevens et al., but with developments and modifications as appropriate.

Navigation

Gyrocompass

`get_gyro`	*Invokes the RVS* `listit` *command to retrieve 24 hours of gyrocompass data, corresponding to JDAY XXX, and write to an ascii file "gyro.XXX"*
`loadgyro.m`	*Matlab code to read "gyro.XXX", arrange into matrices and name accordingly. Saves output as "gyroXXX.mat". Produces a rough plot of heading against time, for quick check of data completeness and integrity.*
`gyroall.m`	*Matlab code to append "gyroXXX.mat" to the master file "gyro_all_cd160.mat"*

Bestnav

`get_bestnav`	*Invokes the RVS* `listit` *command to retrieve 24 hours of bestnav data, corresponding to JDAY XXX, and write to an ascii file "bestnav.XXX"*
`loadbestnav.m`	*Matlab code to read "bestnav.XXX", arrange into matrices and name accordingly. Saves output as "bestnavXXX.mat". Produces*

a rough plot of ship's position over the 24 hour period, for quick check of data completeness and integrity.

`bestnavall.m` *Matlab code to append "bestnavXXX.mat" to the master file "bestnav_all_cd160.mat"*

Ashtech

`get_gpsash` *Invokes the RVS* `listit` *command to retrieve 24 hours of Ashtech data, corresponding to JDAY XXX, and write to an ascii file "gpsash.XXX"*

`loadgpsash.m` *Matlab code to read "gpsash.XXX", arrange into matrices and name accordingly. Saves output as "gpsashXXX.mat". Produces a rough plot of ship's position over the 24 hour period, for quick check of data completeness and integrity.*

`gpsashall.m` *Matlab code to append "gpsashXXX.mat" to the (raw data) master file "gpsash_all_cd160.mat"*

`gpsgyrmerge.m` *Matlab code to read "gpsashXXX.mat", and merge in gyrocompass data from gyro master file "gyro_all_cd160.mat". Uses Ashtech time stamps for interpolation, and calculates heading difference (Ashtech minus gyro). Ensures that heading difference lies in the range -180 to +180º. Produces a quick plot of Ashtech heading, gyro heading and the heading difference. Saves as "gpsashgyrXXXmerge.mat".*

`gpsgyrclean.m` *Cleans up merged Ashtech and gyro. Rejects heading difference (Ashtech minus gyro) for which the following criteria apply:-*
Ashtech heading > 360 or < 0
Ashtech minus gyro heading difference < -5 or > 5
Ashtech pitch < -5 or > 5
Ashtech roll < -7 or > 7
Ashtech attf < -0.5 or > 0.5
Ashtech mrms < 0.00001 or > 0.01
Ashtech brms < 0.00001 or > 0.1
Runs a 9 point median filter over the heading difference, and creates 2 minute averages (ensuring that time stamps of 2 minute averages are even integers, to enable future concatenation)
Produces a quick plot of heading difference (raw) and heading difference (2 minute averages), and interpolates across missing data in the output file "gpsashgyrXXXclean.mat"

`gpsgyredit.m` *Launches a basic interactive editor to enable manual cleaning of the 2 minute averaged Ashtech-gyro heading. Interpolates across removed points, and produces a quick plot of original data and final data. Saves output to "gpsashgyrXXXedit.mat"*

`gpsgyrashaveall.m` *Reads output of* `gpsgyredit.m` *and appends to master file of cleaned, edited data, "gpsgyrave_all_cd160,mat". Produces a quick plot of heading difference in master file.*

GPS NMEA

`get_gpsnmea` *Invokes the RVS* `listit` *command to retrieve 24 hours of nmea data, corresponding to JDAY XXX, and write to an ascii file "gpsnmea.XXX".*

`loadgpsnmea.m` *Matlab code to read "gpsnmea.XXX", arrange into matrices and name accordingly. Saves output as "gpsnmeaXXX.mat". Produces a rough plot of ship's position over the 24 hour period, for quick check of data completeness and integrity.*

`gpsnmea_all.m` *Matlab code to append "gpsnmeaXXX.mat" to the master file "gpsnmea_all_cd160.mat"*

GPS4000

`get_gps4000` *Invokes the RVS* `listit` *command to retrieve 24 hours of gps4000 data, corresponding to JDAY XXX, and write to an ascii file "gps4000.XXX".*

`loadgps4000.m` *Matlab code to read "gps4000.XXX", arrange into matrices and name accordingly. Saves output as "gps4000XXX.mat". Produces a rough plot of ship's position over the 24 hour period, for quick check of data completeness and integrity.*

`gps4000all.m` *Matlab code to append "gps4000_XXX.mat" to the master file "gps4000_all_cd160.mat"*

Acoustic Doppler Current Profiler (ADCP)

`get_adcp` *Invokes the RVS* `listit` *command to retrieve 24 hours of adcp data, corresponding to JDAY XXX, and write to an ascii file "adcp.XXX".*

`loadadcp.m` *Matlab code to read "adcp.XXX", arrange into matrices and name accordingly. Subtracts 45° from heading variable, to account for orientation of transducers in hull – this would not be needed on certain other ships. Velocities converted to cm/s, automatic gain control (agc) converted to db, and time moved to centre of 2 minute ensemble. Absent values replaced with NaN (Matlab missing data code). Water velocity data saved as a matrix into "adcpXXXwater.mat", bottom velocity data saved as an array into "adcpXXXbottom.mat".*

`adcpashcorr.m` *Reads "adcpXXXwater.mat" and the master Ashtech/gyro merged file "gpsgyrave_all_cd160.mat". Interpolates Ashtech/gyro heading correction to times of adcp data. Uses imaginary numbers to calculate speed and direction from adcp east and north velocities, then adds Ashtech/gyro heading correction to adcp direction. Converts speed and direction back to east and north velocities, then saves output as "adcpXXXwater_true.mat". Repeats above for bottom velocities, saving output to "adcpXXXbottom_true.mat".*

`adcpcal.m` *Loads "adcpXXXwater_true.mat" and "adcpXXXbottom_true.mat". Asks if a dummy or real calibration is being applied (if dummy, offset correction phi is set to 0 and scaling factor A is set to 1. These values are derived more accurately toward the end of the cruise, and data reprocessed from this stage with correct values of phi and A). Working on bottom velocity data: calculates speed and direction from adcp east and north velocity, applies cals for A and phi, and convert back. Saves output as "adcpXXXbottom_cal.mat". Repeats above for water velocity data, but in addition removes velocities for which percentage good is less than 25. Saves output as "adcpXXXwater_cal.mat".*

`adcpvelabs.m` *Reads "adcpXXXwater_cal.mat", "adcpXXXbottom_cal.mat", and "bestnav_all_cd160.mat" (bestnav master file). Moves timebase (temporarily) to end of 2 minute ensemble, interpolates bestnav latitude and longitude to times of adcp time stamps, and calls* `sw_dist.m` *to calculate distance and angle (of ship's course) from navigation data. Distance converted to cm, and speed (in cm/s) calculated from this and the time interval. Speed and angle then used to calculate ship's east and north velocities. Timebase moved back, and work saved to "adcpXXXbottom_abs.mat". Ship's east and north velocities*

interpolated to times of adcp time stamps, and absolute water velocities calculated by adding water velocities (east and north) to ship's velocities. Output saved as "adcpXXXwater_abs.mat". A quick plot of vectors at a randomly-chosen bindepth is produced.

Echosounding

Simrad EA500

`get_ea500` *Invokes the RVS* `listit` *command to retrieve 24 hours of ea500 data, corresponding to JDAY XXX, and write to an ascii file "ea500.XXX".*

`loadea500.m` *Matlab code to read "ea500.XXX", arrange into matrices and name accordingly. Saves output as "ea500_XXX.mat". Produces a rough plot of uncorrected depth over the 24 hour period.*

`cleanea500.m` *Loads "ea500_XXX.mat", removes large spikes with* `dspike.m`*, and launches basic interactive editor for further cleaning. A second run of* `dspike.m` *is enabled, followed by a 101-point median filter. Discarded depths are interpolated across, and output saved to "ea500_XXXclean.mat".*

`ea500nav.m` *Loads file "ea500_XXXclean.mat", interpolates across missing values and puts data on a regular 5 second interval, from which 2 minute averages are derived. The bestnav master file "bestnav_all_cd160.mat" is loaded, and latitudes and longitudes interpolated to the times of the ea500 timestamps. A quick plot of depth along the ship's track is produced, and data are saved to a file "ea500_XXXnav.mat".*

`ea500all.m` *Load "ea500_XXXnav.mat", and appends to master file "ea500_all_cd160.mat"*

Prodep

`get_prodep` *Invokes the RVS* `listit` *command to retrieve 24 hours of prodep data, corresponding to JDAY XXX, and write to an ascii file "prodep.XXX".*

`loadprodep.m` *Matlab code to read "prodep.XXX", arrange into matrices and name accordingly. Saves output as "prodepXXX.mat". Produces a rough plot of corrected depth over the 24 hour period.*

`cleanprodep.m` *Loads "prodepXXX.mat", removes large spikes with* `dspike.m`*, and launches basic interactive editor for further cleaning. A second run of* `dspike.m` *is enabled, followed by a 101-point median filter. Discarded depths are interpolated across, and output saved to "prodepXXXclean.mat".*

`prodepnav` *Loads file "prodepXXXclean.mat", interpolates across missing values and puts data on a regular 5 second interval, from which 2 minute averages are derived. The bestnav master file "bestnav_all_cd160.mat" is loaded, and latitudes and longitudes interpolated to the times of the prodep timestamps. A quick plot of depth along the ship's track is produced, and data are saved to a file "prodepXXXnav.mat".*

`prodepall.m` *Load "prodepXXXnav.mat", and appends to master file "prodep_all_cd160.mat"*

Surface meteorology and thermosalinograph

`get_surfmet` *Invokes the RVS* `listit` *command to retrieve 24 hours of surfmet data, corresponding to JDAY XXX, and write to an ascii file "surfmet.XXX".*

`loadsurfmet.m` *Matlab code to read "surfmet.XXX", arrange into matrices and name accordingly. Saves output as "surfmet_XXX.mat". Produces rough plots of sea surface temperature, sea surface conductivity, air temperature, barometric pressure and surface fluorescence over the 24 hour period.*

`cleansurfmet.m` *Loads "surfmetXXX.mat", and runs dspike.m to remove large spikes in conductivity, housing (CTD) temperature and remote (hull) temperature. Interpolates across removed points, then launches basic interactive editor for further cleaning of conductivity, housing temperature and remote temperature. Calls* `ds_salt.m` *to calculate surface (uncalibrated) salinity from conductivity and housing temperature. Output saved to "surfmetXXXclean.mat".*

`truewind.m` *Loads file "surfmetXXXclean.mat" and master file "gyro_all_cd60.mat". Interpolates gyro heading onto same time stamps as surfmet, and ensures that they lie in the range 0 to 360. Note that, on the Darwin, the convention is that the surfmet wind direction is the direction the wind is blowing TO, not FROM (this*

is because, when the ship is on station, i.e. head-to-wind, the direction would otherwise be flicking around 0/360, which would cause problems with averaging. Hence it is made that when ship is head-to-wind, direction is ~180). Read wind direction is obtained by adding surfmet direction to gyrocompass heading. Surfmet wind speeds and (real) directions are broken into east and north velocity components. Ship's velocity is derived from position fixes, and this speed and angle are converted to ship's east and north velocities. These are interpolated to the same timestamps as the surfmet data. East and north components of real wind and derived by adding the east and north components of ship's velocity and wind velocity. These are converted back to true wind speed and direction, with direction forced to lie in range 0 to 360. Two direction variables are defined, one being the direction the wind is blowing to and the other being the direction the wind is blowing from (this to avoid any possible confusion!). Output is file "surfmetXXXwinds.mat".

`surfmetnav.m` *Loads file "surfmetXXXwinds.mat", interpolates data onto 5 second interval and derives 2 minute averages (uses proper vector averaging for wind direction, to avoid problems with cyclicity giving incorrect averages). Loads master file "bestnav_all_cd160.mat", and interpolates latitude and longitude to timestamps of surfmet data. Produces quick plots of sea surface temperature, sea surface salinity, and wind vectors along ship's track. Saves output to master file "surfmetXXXnav.mat". Ensure, that* `truewind.m` *was run immediately before* `surfmetnav.m`*.*

`surfmetall.m` *Loads "surfmetXXXnav.mat" and appends to master file "surfmet_all_cd160.mat". Produces quick plots of sea surface temperature, sea surface salinity and wind vectors along ship's track for the duration of the cruise to date."*

APPENDIX V. CTD SPREADSHEETS FOR D308

RRS Discovery D308

Station: ..CTD TEST.. **Date:** 200620.....

Start Position: Lat 43°43'N **Lon** 052°13'W **Water depth:** ..573.....
PC filename: ...CTD000...dat..... **Pressure on deck:** ..0.6 db
Time in water: 2033. **Time start down (after soak & surface):** ..2038.....
Time at bottom: 2052. **Wire out:** 550. **Pressure:** 554 db **Water depth:** .550...m
Time start up: ..2055..
Time inboard: 2127
End Position: Lat 43°43'N **Lon** 052°14'W

Time bottle fired

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Weather and other comments
1	1	550	554	500				2054
2	2	550	554	501				"
3	3	550	554	502				"
4	4	550	554	503				"
5	5	400	406	504				2100
6	6	400	406	505				"
7	7	400	406	506				"
8	8	400	406	507				"
9	9	300	305	508				2105
10	10	300	305	509				2105
11	11	300	305	510				2105
12	12	300	305	511				2105
13	13	200	203	512				2110
14	14	200	203	513				"
15	15	200	203	514				"
16	16	200	203	515				"
17	17	100	103	516				2115
misfired! ← 18	18	100	103	517 Empty				2115
19	19	100	103	518				2115
20	20	100	103	519				2115
21	21	~~100~~ 10	11.4	520				2120
22	22	~~100~~ 10	11.4	521				2120
23	23	10	11.4	522				2120
24	24	10	11.4	523				2120

Sample Crate number .....20..... **colour** ..ORANGE bottles 500 - 523

ACOUSTIC TX TESTS WITH SINGLE ELEMENT OK.

~~2 1700~~
→ 1700

RRS Discovery D308

Station: ....0A..... **Date:** 2006 210.....

Start Position: Lat 43°15.77'N **Lon** 052°11.12'W **Water depth:** 1790
PC filename: ...CTD004.dat..... **Pressure on deck:** 0.8 dbar
Time in water: 0353. **Time start down (after soak & surface):** ..0356.....
Time at bottom: 0433.. **Wire out:** ~~1770~~ **Pressure:** ~~1796~~ 1794... **Water depth:** ~~1800~~ 1796
Time start up: ...0434.....
Time inboard: ...0551.....
End Position: Lat ~~43°15.6'N~~ **Lon** 052°11.1'W

Alt = 4m @ bottom

Rosette number	Bottle number	Wire out	Pressure dbar	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1770 1750	1	~~1750~~ 1770	1794	572				0433	wind up again + sea spray
	2	~~1750~~ 1750	1773	573				0435	
	3	1700	1722	574				0438	
	4	1650	1670	575				0441	
	5	1600	1620	576				0443	
	6	1550	1569	577				0446	
	7	1500	1517	578				0449	
	8	1450	1467	579				0452	
	9	1400	1413	580				0455	
	10	1350	1363	581				0457	
	11	1300	1314	582				0500	
	12	1250	1264	583				0502	
	13	1200	1213	584				0504	
	14	1100	1111	585				0508	* salty sampling error
	15	1000	1009	586				0511	
	16	900	910	~~587~~				0515	588 (2nd sample)
	17	800	808	588				0518	589
	18	700	707	589				0521	590
	19	600	605	590				0525	591
	20	500	504	591				0528	592
	21	400	403	592				0531	593
	22	300	302	593				0534	594
	23	200	201	594				0538	595
	24	100	100	595				0542	— no sample!

Sample Crate number ...23..... **colour** ORANGE... **bottle numbers** ...572-595

→ 2100
→ 2195
→ 2205

RRS Discovery D308

Station: 1A **Date:** 2006 209

Start Position: Lat 43° 12.88' N **Lon** 052° 16.27' W **Water depth:** 2247
PC filename: CTD003.dat **Pressure on deck:** 0.8 dbar
Time in water: 2302 **Time start down (after soak & surface):** 2304
Time at bottom: 2348 **Wire out:** 2205 **Pressure:** 2235 **Water depth:** 2241
Time start up: 2350
Time inboard: 0131
End Position: Lat 43° 14.09' N **Lon** 052° 16.68' W

AH = 27 m @ 60 Hom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	2205	2235	548				2349	wind easing / drizzle + SEA SPRAY
2	2	2150	2180	549				2353	
3	3	2100	2130	550				2356	
4	4	2000	2028	551			A2-1	0000	
5	5	1900	1924	552				0005	
6	6	1800	1825	553			A2-2/11	0010	
7	7	1700	1724	554				0014	
8	8	1600	1622	555			A2-3	0019	
9	9	1500	1521	556				0023	
10	10	1400	1419	557			A2-4	0027	
11	11	1300	1317	558				0032	
12	12	1200	1216	559			A2-5	0036	
13	13	1100	1114	560				0040	
14	14	1000	1013	561			A2-6	0045	
15	15	900	910	562				0049	
16	16	800	809	563				0053	
17	17	700	709	564				0057	
18	18	600	608	565				0102	
19	19	500	507	566			A2-7	0106	
20	20	400	406	567				0110	
21	21	300	305	568				0114	
22	22	200	204	569			A2-8	0119	
23	23	100	104	570			A2-9	0124	
24	24	10	12	571			A2-10	0128	

Sample Crate number 22 **colour** Orange **bottle numbers** 548-571

2315 downcast stopped @ 502 m to resolve wire load order ship.
2318 downcast recommenced.

→2700
→2785

RRS Discovery D308

Station: 2A **Date:** 2006 209

Start Position: Lat 43°07.91'W **Lon** 052°23.2'W **Water depth:** 2813
PC filename: CTD002 **Pressure on deck:** 0.8 dBar
Time in water: 1810 **Time start down (after soak & surface):** 1813
Time at bottom: 1900 **Wire out:** 2785 **Pressure:** 2830 **Water depth:** 2821
Time start up: 1903
Time inboard: 2048
End Position: Lat 43°08.65'W **Lon** 052°24.57'W

Alt 27m @ bottom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	2785	2830	524	1		A2-1/13	1902	CTWIND + SWELL 1202
2	2	2650	2693	525			*	~~1907~~ 1907	BUT FRESHEN
3	3	2600	2641	526	2		A2-2	1911	~~1911~~ 1911
4	4	2550	2590	527				1915	~~1915~~ 1915
5	5	2500	2538	528				1919	
6	6	2400	2435	529			A2-3	1923	
7	7	2300	2332	530				1928	
8	8	2200	2229	531			A2-4	1933	
9	9	2100	2126	532				1937	
10	10	2000	2024	533	3		A2-5	1941	
11	11	1900	1922	534				~~1944~~	
12	12	1800	1819	535			A2-6	1948	
13	13	1700	1717	536	5			1951	
14	14	1600	1614	537				1955	
15	15	1500	1510	538			A2-7	1959	
16	16	1400	1408	539				2003	
17	17	1300	1309	540				2006	
18	18	1200	1210	541				2010	
19	19	1000	1011	542			A2-8	2016	
20	20	800	809	543	6			2022	
21	21	500	507	544			A2-9	2029	
22	22	200	205	545			A2-10	2036	
23	23	100	105	546			A2-11	2040	
24	24	10	10.2	547	7		A2-12	2045	SURF

Sample Crate number 21 **colour** Orange **bottle numbers** 524-547

→ 3100
then 3150

RRS Discovery D308

Station: 3A (ACOUSTIC RELEASE TEST) **Date:** 2006 208

Start Position: Lat 42°54.3'N **Lon** 052°28.8'W **Water depth:** 3226
PC filename: CTD001.dat **Pressure on deck:** 0.8 dbar
Time in water: 2204 **Time start down (after soak & surface):** 2208
Time at bottom: 2303 **Wire out:** 3150 **Pressure:** 3205 **Water depth:** 3214
Time start up: 2315
Time inboard: 0017
End Position: Lat 42°56.8'N **Lon** 052°29.02'W

Alt at bottom = 52 m

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									

NO BOTTLES REQUESTED

Sample Crate number ..... **colour** ..... **bottle numbers** .....

LADCPS NOT RUN
corr bottom depth ≃ 3200m

→3100
→3150

RRS Discovery D308

Station: 3A **Date:** 2006 223

Start Position: Lat 42°55.34'N **Lon** 052°28.74'W **Water depth:** 3200
PC filename: CTD017.dat **Pressure on deck:** 0.9 dbar
Time in water: 2153 **Time start down (after soak & surface):** 2157
Time at bottom: 2254 **Wire out:** 3158 **Pressure:** 3200 **Water depth:** 3175
Time start up: 2301
Time inboard: 0005.9
End Position: Lat 42°56.28'N **Lon** 052°28.35'W

A4 = 23m @ 60 bar

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	3150	3200	932			A3-1	2300	
2	2	3100	3149	933				2303	
3	3	3000	3048	934			A3-2	2308	
4	4	2900	2945	935				2312	
5	5	2800	2844	936			A3-3	2316	
6	6	2700	2741	937				2321	
7	7	2600	2639	938			A3-4	2325	
8	8	2500	2536	939				2330	
9	9	2400	2432	940			A3-5	2334	
10	10	2300	2330	941				2338	
11	11	2200	2230	942			A3-6	2342	
12	12	2100	2130	943				2347	
13	13	2000	2029	944			A3-7	2350	
14	14	1900	1928	945				2354	
15	15	1800	1826	946				2359	
16	16	1700	1724	947				0003	
17	17	1500	1521	948			A3-8	0009	
18	18	1200	1217	949				0017	
19	19	1000	1014	950			A3-9	0023	
20	20	800	811	951				0029	
21	21	500	508	952			A3-10/11	0037	
22	22	200	205	953			A3-11	0044	
23	23	100	105	954			A3-12	0049	
24	24	10	13	955			A3-13	0054	

Sample Crate number 38 **colour** ORANGE **bottle numbers** 932-955

→ 3600
→ 3630

RRS Discovery D308

Station: 4A **Date:** 2006.224

Start Position: Lat 42°10.00'N **Lon** 052°39.27'W **Water depth:** 3670
PC filename: CTD019.dat **Pressure on deck:** 0.8 dbar
Time in water: 1458 **Time start down (after soak & surface):** 15.00
Time at bottom: 1607 **Wire out:** 3630 **Pressure:** 3695 **Water depth:** 3670
Time start up: 1609
Time inboard: 1805
End Position: Lat 42°39.8'N **Lon** 052°38.4'W

Alt = 33 m @ bottom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	3630	3695	1004			A4-1	1608	
2	2	3550	3614	1005				1612	
3	3	3400	3460	1006			A4-2	1616	
4	4	3350	3409	1007				1619	
5	5	3200	3255	1008			A4-3	1623	
6	6	3150	3205	1009				1626	
7	7	3000	3051	1010			A4-4	1630	
8	8	2800	2846	1011			A4-5	1635	
9	9	2700	2744	1012				1638	
10	10	2600	2642	1013			A4-6	1642	
11	11	2300	2335	1014			A4-7	1649	
12	12	2200	2233	1015				1653	
13	13	2000	2030	1016			A4-8	1658	
14	14	1900	1928	1017				1703	
15	15	1800	1827	1018				1707	
16	16	1700	1725	1019				1711	
17	17	1500	1521	1020			A4-9	1716	
18	18	1200	1217	1021				1724	
19	19	1000	1015	1022			A4-10	1730	
20	20	800	812	1023				1735	
21	21	500	508	1024			A4-11	1743	
22	22	200	205	1025			A4-12	1750	
23	23	100	105	1026			A4-13	1754	
24	24	10	11	1027			A4-14	1800	

Sample Crate number 41 **colour** ORANGE **bottle numbers** 1004-1027

→ 3600
→ 3630

RRS Discovery D308

Station: 4A **Date:** 2006 224

Start Position: Lat 42° 40.00'N **Lon** 052° 39.27'W **Water depth:** 3670
PC filename: CTD019.dat **Pressure on deck:** 0.8 dbar
Time in water: 1458 **Time start down (after soak & surface):** 1500
Time at bottom: 1607 **Wire out:** 3630 **Pressure:** 3695 **Water depth:** 3670
Time start up: 1609
Time inboard: 1845
End Position: Lat 42° 39.8'N **Lon** 052° 38.4'W

Alt = 33 m @ bottom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	3630	3695	1004			A4-1	1608	
2	2	3550	3614	1005				1612	
3	3	3400	3460	1006			A4-2	1616	
4	4	3350	3409	1007				1619	
5	5	3200	3255	1008			A4-3	1623	
6	6	3150	3205	1009				1626	
7	7	3000	3051	1010			A4-4	1630	
8	8	2800	2846	1011			A4-5	1635	
9	9	2700	2744	1012				1638	
10	10	2600	2642	1013			A4-6	1642	
11	11	2300	2335	1014			A4-7	1649	
12	12	2200	2233	1015				1653	
13	13	2000	2030	1016			A4-8	1658	
14	14	1900	1928	1017				1703	
15	15	1800	1827	1018				1707	
16	16	1700	1725	1019				1711	
17	17	1500	1521	1020			A4-9	1716	
18	18	1200	1217	1021				1724	
19	19	1000	1015	1022			A4-10	1730	
20	20	800	812	1023				1735	
21	21	500	508	1024			A4-11	1743	
22	22	200	205	1025			A4-12	1750	
23	23	100	105	1026			A4-13	1754	
24	24	10	11	1027			A4-14	1800	

Sample Crate number 41 **colour** ORANGE **bottle numbers** 1004 - 1027

→4050.

RRS Discovery D308

Station: 5A **Date:** 2006 224

Start Position: Lat 47° 29.14' N **Lon** 052° 50.17' W **Water depth:** 4118

PC filename: CTD018.dat **Pressure on deck:** 0.9 abs.

Time in water: 0931 **Time start down (after soak & surface):** 0938

Time at bottom: 1051 **Wire out:** 4080 **Pressure:** 4153 **Water depth:** 4104

Time start up: 1053

Time inboard: 1308

End Position: Lat 47° 28.45' N **Lon** 052° 48.78' W

alt = 34 @ bottom 30 m

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	4080	4153	956			AS-1	1052	
2	2	4000	4071	957			AS-2	1056	
3	3	3900	3968	958				1102	
4	4	3800	3864	959			AS-3	1107	
5	5	3700	3759	960				1112	
6	6	3600	3655	961			AS-4	1116	
7	7	3500	3552	962				1120	
8	8	3300	3342	963			AS-5	1127	
9	9	3200	3237	964				1130	
10	10	3100	3133	965			AS-6	1134	
11	11	2800	2820	966				1142	
12	12	2700	2715	967				1145	
13	13	2500	2505	968			AS-7	1151	
14	14	2200	2191	969				1158	
15	15	2000	1986	970			AS-8	1204	wire leaning away from ship
16	16	1800	1783	971				1209	" "
17	17	1500	1487	972			AS-9/16	1218	" "
18	18	1200	1206	973				1226	wire lead good again.
19	19	1000	1013	974			AS-10	1232	
20	20	800	812	975				1238	
21	21	500	510	976			AS-11	1246	
22	22	200	207	977			AS-12	1254	
23	23	100	107	978			AS-13	1258	
24	24	10	11	979			AS-14	1303	

Sample Crate number 39 **colour** ORANGE **bottle numbers** 956-979

→1600
→1650
→1700
→1710

RRS Discovery D308

Station: OB **Date:** 2006 213

Start Position: Lat 43°0.00'N **Lon** 060°55.1'W **Water depth:** 1771

PC filename: CTD005.dat **Pressure on deck:** 0.8 dbar

Time in water: 0617 **Time start down (after soak & surface):** 0646

Time at bottom: 0723 **Wire out:** 1710 **Pressure:** 1723 **Water depth:** 1741

Time start up: 0724

Time inboard: 0903

End Position: Lat 43.00.13'N **Lon** 060°56.16'W

Alt = 33m @ bottom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	~~1700~~ 1690	1723	620				~~0724~~ 0727	clear + calm
2	2	~~1750~~ 1670	1703	621				0727	strong current.
3	3	~~1700~~	1682	622				0729	affecting CTD wire angle.
4	4	1650	1661	623				0731	
5	5	1600	1611	624				0735	
6	6	1550	1561	625				0739	
7	7	1500	1510	626				0743	
8	8	1450	1460	627				0746	
9	9	1400	1409	628				0749	
10	10	1350	1359	629				0753	
11	11	1300	1311	630				0757	
12	12	1250	1262	631				0800	
13	13	1200	1212	632				0803	
14	14	1100	1109	633				0808	
15	15	1000	1008	634				0812	
16	16	900	907	635				0817	
17	17	800	808	636				0822	
18	18	700	707	637				0827	
19	19	600	603	638				0832	
20	20	500	503	639				0837	
21	21	400	404	640				0841	
22	22	300	303	641				0846	
23	23	200	203	642				0851	
24	24	100	102	643				0855	

Sample Crate number 25 **colour** orange **bottle numbers** 620-643

→2100
→2170

RRS Discovery D308

Station: 1B **Date:** 2006 218

Start Position: Lat 42° 55.5' N **Lon** 060° 51.78' W **Water depth:** 2212
PC filename: CTD011.dat **Pressure on deck:** 0.8 dbar
Time in water: 1508 **Time start down (after soak & surface):** 1512
Time at bottom: 1554 **Wire out:** 2180 **Pressure:** 2211 **Water depth:** 2219
Time start up: 1556
Time inboard: 1732
End Position: Lat 42° 55.21' N **Lon** 060° 52.28' W

Alt = 27m @ bottom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	2180	2211	Z40			B1-1	1555	Sunny, dry, calm
2	2	2150	2181	Z41				1558	
3	3	2100	2130	Z42				1601	
4	4	2000	2029	Z43			B1-2	1605	
5	5	1900	1927	Z44				1609	
6	6	1800	1825	Z45			B1-3	1613	
7	7	1700	1723	Z46				1616	
8	8	1600	1622	Z47			B1-4	1620	
9	9	1500	1520	Z48				1624	
10	10	1400	1418	Z49			B1-5	1627	
11	11	1300	1317	Z50				1631	
12	12	1200	1216	Z51				1635	
13	13	1100	1114	Z52				1640	
14	14	1000	1012	Z53			B1-6	1643	
15	15	900	910	Z54				1647	
16	16	800	810	Z55				1651	
17	17	700	709	Z56				1657	
18	18	600	608	Z57				1701	
19	19	500	507	Z58			B1-7	1705	
20	20	400	406	Z59				1709	
21	21	300	305	Z60				1713	
22	22	200	204	Z61			B1-8	1717	
23	23	100	103	Z62			B1-9	1722	
24	24	10	12	Z63			B1-10	1726	

Sample Crate number 30 **colour** ORANGE **bottle numbers** Z40–Z63

→2600
→2650
→2680

RRS Discovery D308

Station: [redacted]2B **Date:** 2006 213

Start Position: Lat 42°49.35'W **Lon** 060°46.52W **Water depth:** 2699
PC filename: CTD006.dat **Pressure on deck:** 0.8.05w
Time in water: 2307 **Time start down (after soak & surface):** 2310
Time at bottom: 2357 **Wire out:** 2680 **Pressure:** 2720 **Water depth:** 2722
Time start up: 2359
Time inboard: 0150
End Position: Lat 42°49.44'W **Lon** 060°46.06'W

Alt = 26m @ bottom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	2680	2720	596				2358	Calm, dry
2	2	2650	2690	597				0001	
3	3	2600	2639	598			B2-0	0005	
4	4	2550	2587	599				0009	
5	5	2500	2536	600				0012	
6	6	2400	2434	601			B2-1	0016	
7	7	2300	2332	602				0021	
8	8	2200	2230	603			B2-2	0025	
9	9	2100	2130	604				0029	
10	10	2000	2028	605			B2-3 R72	0034	
11	11	1900	1927	606				0038	
12	12	1800	1825	607			B2-4	0043	
13	13	1700	1724	608				0047	
14	14	1600	1622	609			B2-5	0052	
15	15	1500	1521	610				0058	
16	16	1400	1419	611			B2-6	0102	
17	17	1300	1318	612				0106	
18	18	1200	1216	613				0109	
19	19	1000	1014	614			B2-7	0114	
20	20	800	811	615				0120	
21	21	500	508	616			B2-8	0126	
22	22	200	205	617			B2-9	0134	
23	23	100	105	618			B2-10	0138	
24	24	7[redacted]	10	619			B2-11	0143	

Sample Crate number 24 **colour** orange **bottle numbers** 596..619

Release tests 310 / 311 / 252 ok at bottom

We missed a deep bottle in the previous cast, hence the cast was repeated but no samples were taken save the missing He-3H one

→ 2600
→ 2640
→ 2660

RRS Discovery D308

Station: 28 **Date:** 20/6/18

Start Position: Lat 42°69.75'N **Lon** 066°46.22'W **Water depth:** 2727
PC filename: CTD010.dat **Pressure on deck:** 9.8 dbar
Time in water: 1148 **Time start down (after soak & surface):** 1152
Time at bottom: 1242 **Wire out** 2660 **Pressure:** 2696 **Water depth:** 2695
Time start up: 1244
Time inboard: 1346
End Position: Lat 42°5.19'N **Lon** 066°47.08'W

Alt = 34mtrs bottom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	2660	2696					1243	
2	2	2600	2696					1243	
3	3	2600	2634					1247	
4	4	2600	2634					1247	
5	5	2400	2431					1253	
6	6	2400	2431					1253	
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									

2660

NO FURTHER BOTTLES REQUESTED.

Sample Crate number ..... **colour** ..... **bottle numbers** .....

Repeat cast for bottom and 2600 m bottles
no further bottles requested.

NOTE: CARGO's run as normal.

→ 3200

RRS Discovery D308

Station: 3B **Date:** 2006 216

Start Position: Lat 47° 37.85' N **Lon** 06° 41.23' W **Water depth:** 3378
PC filename: CTD009.dat **Pressure on deck:** 0.8 dbar
Time in water: 2247 **Time start down (after soak & surface):** 2250
Time at bottom: 2354 **Wire out:** 3318 **Pressure:** 3351 **Water depth:** 3330
Time start up: 2355
Time inboard: 0153
End Position: Lat 47° 39.27' N **Lon** 06° 41.11' W

Mt = 47m @ bottom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	3310	3351	692			B1	2354	
2	2	3100	3137	693			B2	0001	
3	3	3000	3036	694			B3-3	0005	
4	4	2900	2933	691				0009	
5	5	2800	2830	696			B4	0013	
6	6	2700	2729	697				0016	
7	7	2600	2629	698			B5-5	0020	
8	8	2500	2528	699				0024	
9	9	2400	2428	700			B6-6	0028	
10	10	2300	2328	701				0032	
11	11	2200	2229	702			B7-7	0036	
12	12	2100	2127	703				0040	
13	13	2000	2023	704			B8-8	0044	
14	14	1900	1919	705				0048	
15	15	1800	1822	706				0052	
16	16	1700	1723	707				0056	
17	17	1500	1521	708			B9-9/15	0102	
18	18	1200	1215	709				0109	
19	19	1000	1012	711			B10-10	0115	
20	20	800	811	710				0121	
21	21	500	508	712			B11-11	0128	
22	22	200	206	713			B12-12	0136	
23	23	100	105	714			B13-13	0142	
24	24	10	10	715			B14-14	0148	

Sample Crate number 8 **colour** ORANGE **bottle numbers** 692-715

possible strong bottom current ?

→ 3580
→ 3630
→ 3660

RRS Discovery D308

Station: 4B **Date:** 2006 218

Start Position: Lat 42° 25.83'N **Lon** 060° 27.19'W **Water depth:** 3680
PC filename: CTD012.dat **Pressure on deck:** 0.8 dbar
Time in water: 2149 **Time start down (after soak & surface):** 2153
Time at bottom: 2310 **Wire out:** 3660 **Pressure:** ~~3655~~ 3726 **Water depth:** 3688
Time start up: 2315
Time inboard: 0223
End Position: Lat 42° 25.78'N **Lon** 060° 26.73'W

Alt = 26 m @ bottom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	3660	3726	817			B14	2311	clear bright warm lovely!
2	2	3550	3615	813				2319	sunny
3	3	3400	3461	814			B4-2	2328	
4	4	3350	3409	815				2336	
5	5	3200	3256	816			B4-3	2345	
6	6	3150	3204	812				2352	
7	7	3000	3050	818			B4-4	0001	
8	8	2800	2847	819			B4-5	0011	
9	9	2700	2744	820			B4-7/8	0019	
10	10	2600	2641	821			B4-6	0027	
11	11	2300	2335	827			B4-7	0039	
12	12	2200	2233	823				0048	
13	13	2000	2030	824			B4-8	0058	
14	14	1900	1928	825				0107	5 min stops
15	15	1800	1826	826				0116	
16	16	1700	1725	827				0124	
17	17	1500	1521	828			B4-9	0134	
18	18	1200	1218	829				0146	normal ~1 min stops
19	19	1000	1014	830			B4-10	0152	
20	20	800	810	831				0157	
21	21	500	508	832			B4-11	0204	
22	22	200	205	833			B4-12	0210	
23	23	100	105	834			B4-13	0214	
24	24	10	10	835			B4-14	0218	

Sample Crate number 33 **colour** ~~orange~~ **bottle numbers** 817-835

wire angle lead under ship – surface current?
5 min bottle stops for 1500 m and deeper.
2209 downcast stopped to resolve wire angle.
2218 user continues mine leading astern.

→4000

RRS Discovery D308

Station: 5B **Date:** 2006 214

Start Position: Lat 42°13.04'N **Lon** 060°16.71'W **Water depth:** 4127

PC filename: CTD007.dat **Pressure on deck:** 0.8dbar

Time in water: 22.58 **Time start down (after soak & surface):** 23.04

Time at bottom: ..... **Wire out:** ..... **Pressure:** ..... **Water depth:** .....

Time start up: .....

Time inboard: 2331

Alt = m @ bottom

End Position: Lat ..... **Lon** .....

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1								
2	2	4000							
3	3	3900							
4	4	3800							
5	5	3700							
6	6	3600							
7	7	3500							
8	8	3300							
9	9	3200							
10	10	3100							
11	11	2800							
12	12	2700							
13	13	2500							
14	14	2200							
15	15	2000							
16	16	1800							
17	17	1500							
18	18	1200							
19	19	1000							
20	20	800							
21	21	500							
22	22	200							
23	23	100							
24	24	10							

CANCELLED PLEASE TO 450m

Sample Crate number ..... **colour** ..... **bottle numbers** .....

2314 cst aborted at request of PSO. recover to 10m from approx 450m then inboard.

→ 4000
→ ~~3~~900

RRS Discovery D308

Station: 58 **Date:** 2006 21 6

Start Position: Lat 42° 13.26' N **Lon** 060° 17.15' W **Water depth:** 4118
PC filename: ....CTD008.dat **Pressure on deck:** 0.8 dBar
Time in water: 0222 **Time start down (after soak & surface):** 0227
Time at bottom: 0340 **Wire out:** 4100 **Pressure:** 4169 **Water depth:** 4126
Time start up: 0341
Time inboard: 0609
End Position: Lat 42° 13.05' N **Lon** 060° 15.42' W

Alt = 35 m @ bottom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	4100	4169	644			~~BS~~-1	0341	Calm, dry, ship moving at ~ 10 knots
2	2	4000	4067	645				0345	
3	3	3900	3966	646			BS-2	0350	
4	4	3800	3863	647				0355	
5	5	3700	3760	648			BS-3	0400	
6	6	3600	3658	649				0404	
7	7	3500	3556	650			BS-4	0409	
8	8	3300	3351	651			BS-5	0416	
9	9	3200	3249	652				0420	
10	10	3100	3147	653			BS-6	0425	
11	11	2900	2943	654			BS-7	0433	
12	12	2700	2740	655				0437	
13	13	2500	2535	656			BS-8/16	0444	
14	14	2200	2231	657			BS-9	0452	
15	15	2000	2029	658				0459	
16	16	1800	1824	659				0505	
17	17	1500	1519	660			BS-10	0514	
misfired empty ← 18	18	1200	1214	661				0523	
19	19	1000	1012	662			BS-11	0530	
20	20	800	808	663				0536	
21	21	500	509	664			BS-12	0544	
22	22	200	208	665			BS-13	0551	
23	23	100	108	666			BS-14	0556	
24	24	10	9	667			BS-15	0603	

Sample Crate number 26 **colour** ORANGE **bottle numbers** 644–667

wire angle issues again!

→ 3950
→ 4020

RRS Discovery D308

Station: 5B **Date:** 2006 220

Start Position: Lat 62° 14.79'N **Lon** 060° 19.35'W **Water depth:** 4066

PC filename: CTD013.dat **Pressure on deck:** 0.5 dbar

Time in water: 0123 **Time start down (after soak & surface):** 0132

Time at bottom: 0241 **Wire out:** 4020 **Pressure:** 4020 **Water depth:** 4086

Time start up: 0253

Time inboard: 0445

End Position: Lat 62° 15.41'N **Lon** 060° 16.62'W

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									

NO BOTTLES FIRED - CAL DIP FOR MICROCATS ONLY.

LADCPs run as normal.

pressure.

wire out

Sample Crate number ..... **colour** ..... **bottle numbers** .....

wire out					pressure
4020	STOP 1	≈ 100 m.a.b. =	3950 m	0248 — 0253	4020 db
3570	STOP 2		3500 m	0303 — 0308	3555 db
3060	STOP 3		3000 m	0321 — 0326	3063 db
2530	STOP 4		2500 m	0340 — 0345	2548 db
2011	STOP 5		2000 m	0356 — 0401	2031 db
			(deep salt water)		

→ 4500
→ 4566

RRS Discovery D308

Station: 1C **Date:** 2006 221

Start Position: Lat 41° 48·36'N **Lon** 059° 59·55'W **Water depth:** 4578
PC filename: CTD014.dat **Pressure on deck:** 0·8 dbar
Time in water: 2153 **Time start down (after soak & surface):** 2155
Time at bottom: 2316 **Wire out:** 4560 **Pressure:** 4653 **Water depth:** 4580
Time start up: 2318
Time inboard: 0144
End Position: Lat 41° 48·26'N **Lon** 060° 01·28'W

Alt = 28m @ bottom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	4560	4653	860				2317	Calm, dry
2	2	4500	4590	861			C1-1	2321	
3	3	4300	4381	862			C1-2	2327	
4	4	4160	4179	863			C1-3	2334	
5	5	3900	3975	864			C1-4	2340	→ & C1-16
6	6	3700	3771	865			C1-5	2346	
7	7	3500	3566	866			C1-6	2353	
8	8	3250	3310	867				2359	
9	9	3100	3156	868				0003	
10	10	3000	3054	869			C1-7	0008	
11	11	2900	2952	870				0012	
12	12	2700	2747	871				0017	
13	13	2500	2543	872			C1-8	0024	
14	14	2200	2236	873				0032	
15	15	2000	2034	874			C1-9	0038	
16	16	1800	1828	875				0044	
17	17	1500	1522	876			C1-10	0051	
18	18	1200	1221	877				0058	
19	19	1000	1017	878			C1-11	0104	
20	20	800	813	879				0110	
21	21	500	511	880			C1-12	0118	
22	22	200	209	881			C1-13	0126	
23	23	100	110	882				0132	
24	24	10	11	883				0136	

Sample Crate number 35 **colour** ORANGE **bottle numbers** 860 - 883

→ 4700
→ 4760

RRS Discovery D308

Station: 26 **Date:** 2006 222

Start Position: Lat 41°57.03'N **Lon** 056°36.00'W **Water depth:** 4783
PC filename: CTD015.dat **Pressure on deck:** 0.8 dbar
Time in water: 1803 **Time start down (after soak & surface):** 1811
Time at bottom: 1937 **Wire out:** ~~4760~~ **Pressure:** ~~4861~~ **Water depth:** ~~4784.0~~
Time start up: 1939
Time inboard: 2205
End Position: Lat ~~44°57.9'N~~ **Lon** 056°34.11'W

Alt = 28 m @ bottom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	4760	4861	884				1938	
2	2	4500	4594	885			C2-1	1945	
3	3	4300	4387	886			C2-2	1952	
4	4	4100	4182	887			C2-3	1958	
5	5	3900	3977	888			C2-4	2005	→ C2-16 (duplicate)
6	6	3700	3771	889			C2-5	2011	
7	7	3500	3567	890			C2-6	2017	
8	8	3250	3310	891				2024	
9	9	3100	3156	892				2029	
10	10	3000	3053	893			C2-7	2033	
11	11	2900	2949	894				2037	
12	12	2700	2747	895				2042	
13	13	2500	2542	896			C2-8	2047	
14	14	2200	2238	897				2055	
15	15	2000	2033	898			C2-9	2101	
16	16	1800	1827	899				2108	
17	17	1500	1520	900			C2-10	2115	
18	18	1200	1219	901				2122	
19	19	1000	1018	902			C2-11	2127	
20	20	800	816	903				2132	
21	21	500	503	904			C2-12	2139	
22	22	200	210	905			C2-13	2146	
23	23	100	110	906			C2-14	2151	
24	24	10	10	907			C2-15	2157	

Sample Crate number 36 **colour** ORANGE **bottle numbers** 884 - 907

→4850

RRS Discovery D308

Station: 36 **Date:** 2006 223

Start Position: Lat 42°06.03'N **Lon** 053°09.35'W **Water depth:** 4930
PC filename: CTD016.dat **Pressure on deck:** 0.8 dbar
Time in water: 1137 **Time start down (after soak & surface):** 1141
Time at bottom: 1307 **Wire out:** 4910 **Pressure:** 5014 **Water depth:** 4929
Time start up: 1309
Time inboard: 1533
End Position: Lat 42°06.36'N **Lon** 053°08.8'W

Alt 35m @ bottom

Rosette number	Bottle number	Wire out	Pressure	Salt bottle	Oxygen bottle	He bottle	3H bottle	Time bottle fired	Weather and other comments
1	1	4910	5014	908				1308	Calm, no breeze
2	2	4500	4593	909			C3-1	1317	
3	3	4300	4387	910			C3-2	1324	
4	4	4100	4181	911			C3-3	1329	
5	5	3900	3975	912			C3-4	1335	
6	6	3700	3770	913			C3-5	1340	
7	7	3500	3566	914			C3-6	1346	
8	8	3250	3309	915				1352	
9	9	3100	3154	916				1358	
10	10	3000	3051	917			C3-7	1403	
11	11	2900	2948	918				1406	
12	12	2700	2743	919				1412	
13	13	2500	2539	920			C3-8	1417	
14	14	2200	2231	921				1424	
15	15	2000	2027	922			C3-9	1430	
16	16	1800	1823	923				1436	
17	17	1500	1516	924			C3-10	1444	
18	18	1200	1212	925				1451	
19	19	1000	1011	926			C3-11	1457	
20	20	800	811	927				1503	
21	21	500	512	928			C3-12	1511	
22	22	200	210	929			C3-13	1518	
23	23	100	110	930			C3-14	1523	
24	24	10	11	931			C3-15	1528	

Sample Crate number 37 **colour** ORANGE **bottle numbers** 908 - 931

APPENDIX VI. Oxygen spreadsheets for D308

Blank Determination				
Date	Volume of Sodium Thiosulphate			D - Avg(E,F)
~~2~~	~~0.0876~~			#DIV/0!
				#DIV/0!
				#DIV/0!
29/07/06	0.0941	0.0852	0.0755	#DIV/0!
0.1097	~~0.1055~~	0.0796	0.0926	#DIV/0!
	0.1118	0.0819	0.0851	#DIV/0!
31/07/06	0.1322	0.1085	0.1053	#DIV/0!
"	0.0674	0.1577	0.1009	#DIV/0!
"	0.0512	0.1784	0.0889	#DIV/0!
04/08/06	0.1314	0.0588	0.0934	#DIV/0!
"	0.1331	0.1082	0.1059	#DIV/0!
"	0.1328	0.0773	X	#DIV/0!
"	0.1329	0.0629	0.0667	#DIV/0!
				#DIV/0!
				#DIV/0!
06/08/06	0.1331	0.0898	0.1069	#DIV/0!
"	0.1251	0.1072	0.0919	#DIV/0!
"	0.1282	0.0964	0.1194	#DIV/0!
09/08/06	0.1335	0.0897	0.0667	#DIV/0! ?
	0.1202	0.1066	0.0656	#DIV/0!
	0.1138	0.1111	FAIL	#DIV/0!
	0.1285	0.0990	0.0254	#DIV/0! ?
	0.1337		FAIL	#DIV/0!
	0.0666	0.1403	0.0683	#DIV/0!
				#DIV/0!
				#DIV/0!
				#DIV/0!
				#DIV/0!
				#DIV/0!
				#DIV/0!
				#DIV/0!
				#DIV/0!
				#DIV/0!
				#DIV/0!
				#DIV/0!

Date	Volume of Sodium Thiosulphate ml				
29/07/06	0.6085ml	0.4982	0.4892	0.4960	0.4913
31/07/06	0.6353	0.4719	0.4610	0.4954	0.6289
03/08/06	0.6289	0.6303	0.6269	0.6246	0.5870
06/08/06	0.6211	0.6242	0.6221	0.6117	0.6230
09/08/06	0.6154	0.6149	0.6213	0.6071	0.6236

D308 Oxygen Logsheet

Cast	A0	Analysis date	30/07/06
Date	30/07/06	Analysis time	05:00
Time	03:45	Analyst	RJBI
Sampler	RJBI		

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)	
1					
2					
3					
5					
6					
7					
18					
20					
28					
29					
31					
32					
34					
48					
51	3		5.6	1.2651	
57	5		5.6	1.2394	
(2) 111	9		5.7	1.2356	
(2) 147	11		6.3	1.1948	
(2) 154	15		6.5	1.9133	← Suspect quality! Didn't fill bottle properly.
165	17		6.8	1.1681	
166	20		8.5	0.9412	
168	22		10.4	0.7078	
173 176	24		13.4	1.0110	
187					
188					
213					
243					
245					
247					
250					

D306 Oxygen Logsheet

Cast	A2	Analysis date	30/07/06
Date	29/07/06	Analysis time	01:40
Time		Analyst	RJB1
Sampler	RJB1		

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)
1	1	2800	Forgot	1.1320
2	3	2600	to	1.3175
3	10		rec	1.1200
5			temps!	
6				
7				
18				
20				
28				
29				
31				
32				
34				
48				
51				
57				
111				
147				
154				
165				
166				
168				
176				
187				
188				
213				
243				
245				
247				
250				

D306 Oxygen Logsheet

Cast	A3	Analysis date	11/08/06
Date	10/08/06	Analysis time	3.50
Time	21:30Z	Analyst	M.A.M.M.
Sampler	M.A.M.M.		

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)
254				
255	2		9.3	1.1608
257	8		9.5	1.1348
258	12		10.1	1.1125
262	16		10.1	1.1205
266-2	18		10.8	1.0846
267-2	20		11.1	1.0328
268				
269				
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D306 Oxygen Logsheet

Cast	A4	Analysis date	10/08/06
Date	10/08/06	Analysis time	16:30
Time	16:30	Analyst	M.A.M.M.
Sampler	M.A.M.M.		

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)
254				
255	3		12.8	1.1453
257	7		13.1	1.1305
258	11		13.7	1.1088
262	15		13.2	1.1198
266	19		14.1	1.0932
267	23		16.9	0.9111
268				
269				
270				
271				
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D308 Oxygen Logsheet

Cast	A5	Analysis date	11/08/2006
Date	13:30	Analysis time	17:00
Time	11/08/2006	Analyst	M.M.M.M.
Sampler	M.A.M.M.		

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)
254				
255	2		13.1	1.1113
257	5		12.7	1.1410
258	9		13.6	1.1121
262	13		14.0	1.1054
266-2	19		15.0	1.0866
267-7	21		15.5	0.8964
268				
269				
270				
271				
272				
274				
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D308 Oxygen Logsheet

Cast	150	Analysis date	01/08/06
Date	01/08/06	Analysis time	0820
Time	0600	Analyst	RJBI
Sampler	rjbi		

0930 z

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)
1				
2				
3				
5				
6				
7				
18				
20				
28				
29				
31				
32				
34				
48				
51				
57				
111				
147				
154				
165				
166				
168				
176				
187				
188	1		5.5	1.1880
213(2)	3		5.6	1.1627
243	12		6.2	1.0899
245	15		6.5	1.0562
247	20		7.6	0.8954
250			~~9.5~~	
258	22		9.5	0.6621

D308 Oxygen Logsheet

Cast	[illegible]	Analysis date	02/08/06
Date	02/08/06	Analysis time	04:45
Time	03002	Analyst	RJBI
Sampler	RJBE		

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)	
1					
2					
3					
5					
6					
7					
18					
20					
28					
29					
31					
32					
34					
48					
51					
57					
111					
147					
154					
165					
166					
168					
176					
187					
188	1		9.6	1.1822	
213(2)	5		9.8	1.2032	* Approx Salts!
243	10		11.0	1.2311	*
245	13		10.4	1.1106	
247	17		11.3	1.0703	
~~250~~					
258	23		14.8	0.8841	

D306 Oxygen Logsheet

Cast	B1	Analysis date	07/08/06
Date	06/08/06	Analysis time	00:25 z
Time	19:30 z	Analyst	RJB1
Sampler	RJB1		

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)
254				
255	1		10.6	1.0782
257	4		10.7	1.1262
258	10		12.6	1.1136
262				
266				
267(2)	14		11.5	1.0745
268(2)	22		15.7	0.6147
269	24		22.0	0.8798 ← error on this reading
270				
271				
272				
274				
275				
276				
277				
279				
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283				
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300				

D308 Oxygen Logsheet

Cast	B3	Analysis date	05/08/06
Date	05/08/06	Analysis time	1700 Z
Time	02:00 Z	Analyst	RJBI
Sampler	RJBI		

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)
254				
255	1		12.5	1.1107
257	5		11.1	1.1329
258	12		11.0	1.1281
262	#			
266				
267(2)	14		11.1	1.1231
268(68)	18		11.5	1.1098
269(8)	20		11.9	1.#0227
270				
271				
272				
274				
275				
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D306 Oxygen Logsheet

Cast	B4	Analysis date	07/08/06
Date	07/08/06	Analysis time	05 30 z
Time	~~00~~ 04:00z	Analyst	RJBJ
Sampler	RJBJ		

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)	
254					
255	2		8.7	1.1477	* Approx failed.
257	4		8.4	1.1457	
258	9		9.9	1.1293	
262			~~8.7~~		
266			~~9.2~~		
267 (2)	12		8.7	Fail	
268 (2)	15		9.2	1.1231	
269 (2)	20		9.9	1.0355	* Approx failed
270					
271					
272					
274					
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D306 B5 Oxygen Logsheet

Cast	B5	Analysis date	04/08/06
Date	04/08/06	Analysis time	07:30
Time	05:30	Analyst	RAI
Sampler	RJBI		

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)
254				
255	2		11.3	1.1322
257	4		11.4	1.1349
258	11		13.2	1.1146
262				
266				
267(2)	22		17.0	0.7554
268(68)	20		12.8	1.0102
269(2)	13		13.5	1.1154
270				
271				
272				
274				
275				
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D306 Oxygen Logsheet

Cast	C1	Analysis date	10/08/06
Date	08/08/06	Analysis time	0200
Time	~~23:00~~ 01:00 (hour)	Analyst	KJ01
Sampler	KJ&I		

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)
254				
255	1		10.7	1.0932
257	3		11.6	1.1002
258	5		11.8	1.0887
262	9		11.2	1.1199
266	14		11.8	1.1076
267	20		12.3	0.9905
268				
269				
270				
271				
272				
274				
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0308

~~D306~~ Oxygen Logsheet (local time)

Cast	C2	Analysis date	09/08/06
Date	09/08/06	Analysis time	22:40
Time	~~07~~ 21:00	Analyst	
Sampler	RJBi		

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)
254				
255	1		9.6	1.1068
257	6		10.7	1.1319
258	8		9.6	1.1246
262	12		10.1	1.1250
266-2	16		10.3	1.1376
267-2	20		10.5	1.1606
268				
269				
270				
271				
272				
274				
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D306 Oxygen Logsheet

Cast	C3	Analysis date	09/08/06
Date	09/08/06	Analysis time	19:35 Z
Time	17:35 Z	Analyst	M.A.M.M
Sampler	M.A.M.M.		

O2 bottle	Niskin	Depth (m)	Temp at Fixing (oC)	Titre (ml)
254				
255	1		11.7	1.1196
257	3		12.8	1.1117
258	8		13	1.1167
262	9		13.3	1.1101
266-2	16		13.1	1.1034
267-2	20		13.4	1.0242
268				
269				
270				
271				
272				
274				
275				
276				
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