NATIONAL OCEANOGRAPHY CENTRE, SOUTHAMPTON

CRUISE REPORT No. 16

RV *Ronald H. Brown* Cruise RB0602 and RRS *Discovery* Cruise D304

RAPID mooring cruise report March and May 2006

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Editor
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ABSTRACT

This report describes the mooring operations conducted during RV *Ronald H. Brown* Cruise RB0602 and RRS *Discovery* Cruise D304. Cruise RB0602 was conducted between 9 March 2006 and 28 March 2006, and Cruise D304 was conducted between 12 May 2006 and 6 June 2006.

These mooring operations were completed as part of the United Kingdom Natural Environment Research Council (NERC) funded RAPID Programme to monitor the Atlantic Meridional Overturning Circulation at 26.5ºN. The primary purpose of these cruises was to service the 26.5ºN mooring array first deployed in 2004 during RRS *Discovery* cruises D277 and D278 (SOC cruise report number 53), and serviced in 2005 during RRS *Charles Darwin* Cruise CD170 and RV *Knorr* Cruise KN182-2 (NOCS cruise report number 2), and RRS *Charles Darwin* Cruise CD177 (NOCS cruise report number 5).

Cruise RB0602 was from Barbados to Charleston, SC, and covered the Western Boundary moorings deployed on KN182-2. Cruise D304 was to and from Tenerife and covered the Eastern Boundary and Mid-Atlantic Ridge moorings deployed on cruises CD170 and CD177. These cruises are the second annual refurbishment of an array of moorings deployed across the Atlantic in order to set up a pre-operational prototype system to continuously observe the Atlantic Meridional Overturning Circulation (MOC). Cruise CD177 was an intermediate service cruise to obtain data from the two principal Eastern Boundary moorings six months after deployment. This array will be further refined and refurbished during subsequent years.

The instruments deployed on the array consists of a variety of current meters, bottom pressure recorders, CTD loggers and Inverted Echosounders, which, combined with time series measurements of the Florida Channel Current and wind stress estimates, will be used to determine the strength and structure of the MOC at 26.5ºN. (http://www.noc.soton.ac.uk/rapidmoc)

KEYWORDS

Atlantic Ocean, bottom pressure recorder, BPR, cruise RB0602 2006, cruise D304 2006, CTD, current meter, *Discovery*, Meridional Overturning Circulation, MOC, mooring array, Moorings, North Atlantic, RAPID, RAPIDMOC, *Ronald H. Brown*, THC, thermohaline circulation, Pressure Inverted Echosounder, PIES, IES

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Scientific and Technical	
Molly Baringer	AOML – NOAA
Lisa Beal	RSMAS – University of Miami
Robert Roddy	AOML – NOAA
Carols Fonseca	CIMAS – University of Miami
Rigoberto Garcia	CIMAS – University of Miami
Tania Casal	RSMAS – University of Miami
Dallas Murphy	Volunteer
Michael Beal	Volunteer
Shari Yvon-Lewis	Texas A & M (TAMU)
Julia O'Hern	Texas A & M (TAMU)
Vince Rosato	Teacher at Sea
Kim Pratt	Teacher at Sea
Jocehm Marotzke	Max Planck Institute for Meteorology
Stuart Cunningham	NOCS
Darren Rayner	NOCS
Hao Zuo	SOES – NOCS
Michelle De Voy	SOES – NOCS
Katy Fraser	SOES – NOCS
Daniel Combden	UKORS – NOCS
Colin Hutton	UKORS – NOCS
Christian Crowe	UKORS – NOCS
Stephen Whittle	UKORS – NOCS
David Childs	UKORS – NOCS
Ian Waddington	UKORS – NOCS
24 persons	
Ship's Crew	
Gary Petrae	Captain
Stacy Birk	Commander
Liz Jones	Operations LT
Jackie Almeida	Navigation ENS
James Brinkley	Junior Officer ENS
Priscilla Rodriguez	Medical LCDR
Frank Dunlop	Chief Engineer
Keegan Plaskon	1st Assistant Engineer
Gordon Gardipe	2AE
Wayne Smith	3AE
Towanda Brown	Junior Engineer
Robert Bayliss	Wiper
Ben Zileke	Wiper
Bruce Cowden	Chief Boatswain
Reginald Williams	Deck Utilityman
Phil Pokorski	AB Seaman
Jesse Byrd	AB Seaman
Mary O'Connell	Ordinary Seaman
Leo Wade	General Vessel Assistant (Deck)
Richard Whitehead	Chief Steward
Karen Baily	Chief Cook
Herb Watson	2nd Cook
Micheal Moats	GVA (Galley)
Jonathan Shannahoff	Chief Survey Tech.
Chris Churylo	Chief Electronics Tech.
25 persons	

Table 1.1: Details of personnel on cruise RB0602

Scientific and Technical	
Torsten Kanzow	NOCS
Stuart Cunningham	NOCS
Darren Rayner	NOCS
James Watson	NOCS
Laure Grignon	SOES – NOCS
Enrique Vidal	Volunteer
Robert Mclachlan	UKORS – NOCS
Stephen Whittle	UKORS – NOCS
Christian Crowe	UKORS – NOCS
Colin Hutton	UKORS – NOCS
David Childs	UKORS – NOCS
Peter Keen	UKORS – NOCS
Dougal Mountfield	UKORS – NOCS
Alan Davies	UKORS – NOCS
14 persons	
Ship's Crew	
Roger Chamberlain	Master
Richard Warner	Chief Officer
Philip Oldfield	2nd Officer
Robert Clarke	Third Officer
Stephen Moss	Chief Engineer
Stephen Bell	2nd Engineer
Chris Carey	3rd Engineer
Keith Conner	3rd Engineer
Phil Parker	ETO
Richard Bugden	Eng. Cadet
Andrew MacLean	CPO (Deck)
Simon Avery	CPO (Sci)
Mark Squibb	PO (Deck)
Charles Cooney	SG1B
Gary Crabb	SG1A
Stuart Cook	SG1B
Jonathan Roberts	SG1B
Emlyn Williams	MM1A
Stephen Nagle	SCM
Mark Preston	Chef
Wally Link	Asst. Chef
Jeffrey Osboune	Steward
22 persons	

Table 1.2: Details of personnel on cruise D304

2. Itinerary

2.1 RB0602

Depart Bridgetown, Barbados, 9th March 2006 – Arrive Charleston, South Carolina, USA, 28th March 2006.

2.2 D304

Depart Santa Cruz de Tenerife, Tenerife, 12th May 2006 – Arrive Santa Cruz de Tenerife, Tenerife, 6th June 2006.

3. Acknowledgements

The Captains and crews of both the *RV Ronald H. Brown* and the *RRS Discovery* were professional and extremely helpful throughout. Regular liaison with the officers allowed a good working relationship between the science party and the respective ships. This was important on the *RV Ronald H. Brown* when the ship had to call into the Bahamas to disembark a crew member, and also when the ship was called to a nearby distress call. Equally on the *RRS Discovery*, when mooring EBH5 was trawled during the cruise, good communication with the ship enabled the cruise to be extended by one day to allow recovery and redeployment.

The NOC moorings team once again were extremely helpful, with their hard working flexible approach allowing mooring designs to be altered when required. This mainly took place following some damage to mooring wires in transit and also to adapt the moorings for better performance using our experiences from the recovered moorings.

4. Introduction

Stuart Cunningham and Darren Rayner

RAPID-MOC is a joint UK/US programme to monitor the Atlantic Meridional Overturning Circulation at 26.5°N. There are three partners each contributing key observations. Tthe Atlantic Oceanographic and Meteorological Laboratory (AOML) – part of the USA National Oceanic and Atmospheric Administration (NOAA) – leads a programme to monitor Florida Current transport using telephone cables. Frequent cruises are used to calibrate the cable measurements.

AOML also complete an annual CTD section across the Deep Western Boundary Current (DWBC) east of the Bahamas along 26.5°N to monitor long-term property changes.

The Rosenstiel School of Marine and Atmospheric Sciences (RSMAS), University of Miami maintains three moorings in the DWBC for transport measurements. The National Oceanography Centre, Southampton manages a transatlantic array of moorings to monitor the interior Atlantic circulation.

The goal of RAPID-MOC is to develop a pre-operational array to monitor the Atlantic Meridional Overturning Circulation at 26.5°N (http://www.noc.soton.ac.uk/rapidmoc). The programme is funded to make four years of continuous observations between 2004 and 2008.

This report describes the mooring operations conducted on cruise **RB0602** onboard the US RV *Ronald H. Brown*, and all operations conducted on cruise **D304** onboard the UK RRS *Discovery*. The CTD section completed on RB0602 is not reported here.

RB0602 and D304 are the sixth and seventh cruises respectively on which staff from the NOC have completed mooring operations as part of the RAPID-MOC project. The array was first deployed in Spring 2004 with subsequent service cruises in Spring 2005 and Autumn 2005. The following cruise reports cover the deployment and service cruises prior to Spring 2006.

- RRS *Discovery* Cruise D277 and D278. Southampton Oceanography Centre Cruise Report, No 53, 2005.
- RRS *Charles Darwin* Cruise CD170 and RV *Knorr* Cruise KN182-2. National Oceanography Centre Southampton Cruise Report, No. 2, 2006
- RRS *Charles Darwin* Cruise CD177. National Oceanography Centre Southampton Cruise Report, No. 5, 2006

Cruise RB0602 was led by Chief Scientist Molly Baringer and co-chief scientist Lisa Beal. The three main objectives were to refurbish the UK western boundary moorings, complete an annual CTD section across the DWBC and two Florida Current sections for cable calibration.

Cruise D304 was led by Chief Scientist Torsten Kanzow. The two main objectives were to refurbish the eastern boundary and Mid-Atlantic ridge moorings, and to acoustically download data from previously deployed Pressure Inverted Echo Sounders (PIES).

5. Bridge Timetable of Events

There is no bridge timetable of events for RB0602.

5.1 D304

Date	Time (UT)	Event
05/05/06	0800	Mobilisation of D304 begins in Santa Cruz De Tenerife
10/05/06	1000	Scientists Join Vessel
	1400	Familiarisation of all newly joined Scientific Personnel
11/05/06	1030-1115	Emergency and Lifeboat muster and instruction given in our pre sailing activities – preparing to sail from Santa Cruz
12/05/06	0610	Pilot embarked
	0624	Vessel cleared berth
	0630	Pilot disembarked
	0636	Vessel clear of port limits and full away
		0643 PES Fish Deployed 28 26.4 N 016 14.1 W - resumed passage Course 087° T
	0842-1040	**15860#1 – CTD cast to 1500 m 28 27.6N 015 47.9W**

	1246-1636	**15860#2 – CTD cast to 3000 m 28 26.6N 015 24.4W**
	1800-2146	**15860#3 – CTD cast to 3000 m 28 25.8N 015 10.5W**
	2146	Set Course 127° T
13/05/06	0139	Altered Course to 091° T 27 57.0 N 014 30.0 W
	0700	Hove to near ADCP site **15860#4** 27 55.6 N 013 22.9 W
	0715-0840	ADCP Failed to release – Abandoned temporarily
	0855	Hove to on Station EBH5 (**STATION 15860 #5**) 27 54.5 N 013 21.8 W
	0933	mooring EBH5 released
	0938-1010	Recovering EBH5
	1050-1135	Deploying Mooring EBH5 **STATION 15860 #6**
	1135	**MOORING EBH5 DEPLOYED 27 54.24N 013 22.02W**
	1232-1325	Searching for Mooring EBH4 – NOTHING HEARD 27 52.2N 013 28.2W
	1325	Proceeding to Mooring EBH3
	1450	Hove to on Station EBH3 (**STATION 15860 #7**) 27 49.1 N
013 44.5 W		
	1453-1552	Recovering EBH3
	1622-38	Deploying Mooring EBH3 **STATION 15860 #8**
	1638	**MOORING EBH3 DEPLOYED 27 48.82N 013 44.47W**
	1805-21	Deploying Mooring EBH4 **STATION 15860 #9**
	1821	**MOORING EBH4 DEPLOYED 27 50.94N 013 32.21W**
	1845	Hove to on EBP2 Site for downloading
	1940-2355	Downloading processes underway **STATION 15860 #10** mean position 27 53.3N 013 30.5W
14/05/06	0026	Commenced search for old EBH4
	0330	Search completed awaiting daylight 27 58.8N 013 24.4W
	0500-0708	Old EBH4 Failed to release – Abandoned temporarily until later date
	0708	Set course 241° T towards Mooring EBH2
	1130	mooring EBH2 released
	1145-1215	Recovering EBH2 **STATION 15860 #11**
	1244-57	Deploying Mooring EBH2 **STATION 15860 #12**
	1257	**MOORING EBH2 DEPLOYED 27 36.20N 014 12.82W**
	1907	mooring EBH1 released
	1943-2005	Recovering EBH1 **STATION 15860 #13**
	2005-33	Deploying Mooring EBH1 **STATION 15860 #14**
	2033	**MOORING EBH1 DEPLOYED 27 16.98N 015 25.42W**
	2040-46	Deploying Mooring EBL4 **STATION 15860 #15**
	2046	**MOORING EBL4 DEPLOYED 27 17.20N 015 25.33W**
	2200-0125	**15860#16 – CTD cast to 3000 m 27 15.4N 015 37.0W**
15/05/06	0204	Set Course 248° T
	0615	mooring EBH0 released
	0717-24	Recovering EBH0 **STATION 15860 #17**
	0745-49	Deploying Mooring EBH0 **STATION 15860 #18**
	0749	**MOORING EBH0 DEPLOYED 26 59.58N 016 13.73W**
	0820	Set Course 246° T
	1200	Position Latitude 26 40.8 N Longitude 017 00.5 W
	1800	Position Latitude 26 11.8 N Longitude 018 12.3 W
16/05/06	0000	Position Latitude 25 43.9 N Longitude 019 21.4 W
	1006	Hove to on Station EBHi 24 57.2N 021 15.6W
	1100	mooring EBHi released
	1125-1214	Recovering EBHi **STATION 15860 #19**
	1252-1319	Deploying Mooring EBHi **STATION 15860 #20**
	1319	**MOORING EBHi DEPLOYED 24 57.30N 021 15.60W**

	1320	Set Course 248° T
	1720	Hove to on CTD Station 24 40.6N 021 57.9W
	1733-2022	**15860#21 – CTD cast to 3000 m 24 40.4N 021 58.2W**
	2022	Set Course 248° T
17/05/06	0000	Position Latitude 24 24.9 N Longitude 022 32.4 W
	0748	Hove to on Station EB1 23 49.6N 024 06.0W
	0800-1200	Trying to release EB1 – Failed or rising very slowly
	0813	RIB launched – Cox R. Clarke, Bowman J. Roberts
	1105	RIB Recovered
	1200	EB1 temporarily abandoned until tomorrow
	1230	Hove to on Station EB2 23 53.5N 024 03.6W
	1411-1704	Recovering EB2 **STATION 15860 #22**
	1758-2250	**15860#23 – CTD cast to 5000 m 23 47.7N 024 07.4W**
	2300	**15860#24 – ARGO Float/buoy launched 23 47.0N 024 08.0W**
	2307	**15860#25 – ARGO Float/buoy launched 23 47.0N 024 08.0W**
	2345-0340	**15860#26 – CTD cast to 5000 m 23 48.0N 024 07.0W**
18/05/06	0430-0609	Engaged in triangulation and ranging of mooring EB1
	0750	Mooring EB1 sighted
	0805	RIB launched – Cox R. Clarke Bowman J. Roberts 23 50.1N 024 07.6W
	0850	Line attached to EB1 – attention turned to recovery of RIB
	0944	J. Roberts sustains injury on RIB recovery
	0950	RIB recovered – attention turns to recovery of mooring.
	1000-1340	Recovering EB1 **STATION 15860 #27**
	1936-2325	Deploying Mooring EB1 **STATION 15860 #28**
	2325	**MOORING EB1 DEPLOYED 23 48.92N 024 07.97W**
19/05/06	0000	Set Course 274° T
	1200	Position Latitude 23 59.7 N Longitude 026 30.7 W
20/05/06	0000	Position Latitude 24 09.8 N Longitude 028 51.9 W
	1200	Position Latitude 24 19.2 N Longitude 031 14.5 W
21/05/06	0000	Position Latitude 24 29.6 N Longitude 033 46.7 W
	1100-1533	**15860#29 – CTD cast to 4800 m 24 39.1N 036 03.9W**
22/05/06	0100	Position Latitude 24 46.6 N Longitude 037 57.2 W
	1300	Position Latitude 24 56.7 N Longitude 040 24.8 W
23/05/06	0100	Position Latitude 25 06.6 N Longitude 042 49.9 W
	1200	Position Latitude 25 15.6 N Longitude 045 01.9 W
24/05/06	0100	Position Latitude 25 26.6 N Longitude 047 43.7 W
	1300	Position Latitude 25 36.7 N Longitude 050 12.7 W
	1405	Hove to on Station MAR1 25 37.9N 050 25.3W
	1410	mooring MAR1 released
	1506-1711	Recovering MAR1 **STATION 15860 #30**
	1711	Set Course 157° T
	1933	Hove to on CTD Station – CTD Cast outboard
	1933-51	Experiencing winch problems
	1933-0008	**15860#31 – CTD cast to 5200 m 25 18.8N 050 16.2W**
25/05/06	0008	Set course for MAR2 site 157° T
	0705-0820	Engaged in survey for the deployment site of MAR1
	0850	Hove to on Station MAR2 24 10.5N 049 45.1W
	0908	mooring MAR2 released
	1008-1120	Recovering MAR2 **STATION 15860 #32**
	1324-1637	Deploying Mooring MAR1 **STATION 15860 #33**

	1637	**MOORING MAR1 DEPLOYED 24 11.69N 049 43.69W**
	1815-1800	Workboat launched for mooring MAR1 to be hauled in a few metres and adjusted. – Mooring shortened to be kept submerged. Workboat crew - Cox R. Clarke and G. Crabb (bowman).
	1800	Workboat recovered – proceeding to Lander site
	2120-27	Deploying Mooring Lander MARL3 **STATION 15860 #34**
	2127	**MOORING MARL3 DEPLOYED 24 12.60N 049 43.60W**
	2130-0605	Vessel lying quietly awaiting morning shift
26/05/06	0605-0920	Deploying Mooring MAR2 **STATION 15860 #35**
	0920	**MOORING MAR2 DEPLOYED 24 10.80 049 41.60W**
	0920	Set Course 092° T
	1300	Position Latitude 24 08.9 N Longitude 048 56.9 W
	1615-35	Emergency Drills executed 24 07.0N 048 04.0W
27/05/06	0100	Position Latitude 24 04.6 N Longitude 046 23.0 W
	1300	Position Latitude 24 01.3 N Longitude 044 17.9 W
28/05/06	0100	Position Latitude 23 53.3 N Longitude 041 54.2 W
	0525	Hove to preparing for survey 23 51.8N 041 09.1W
	0545-0632	Surveying site for deployment of future MAR 3
	0703	Hove to ready to release mooring MAR4 23 52.1N 041 06.0W
	0715	mooring MAR4 released
	0900	Master decides mooring MAR4 needs workboat assistance.
	0914-35	Workboat launched for mooring MAR4 to be attached to the vessel – Cox R. Clarke and J. Roberts (bowman).
	0935	Workboat recovered and recovery continues.
	0935-1135	Recovering MAR4 **STATION 15860 #36** 23 51.9N 041 06.2W
	1215-1441	Deploying Mooring MAR3 **STATION 15860 #37**
	1441	**MOORING MAR3 DEPLOYED 23 51.60N 041 06.0W**
	1500-1511	Deploying Mooring Lander MARL4 **STATION 15860 #38**
	1511	**MOORING MARL4 DEPLOYED 23 51.60N 041 05.70W**
	1548	Old Mooring MAR3 released
	1720-1820	Recovering MAR3 **STATION 15860 #39** 23 56.4N 041 06.9W
	1820	Set Course 090° T
29/05/06	0100	Position Latitude 23 55.8 N Longitude 039 48.8 W
	1300	Position Latitude 23 55.4 N Longitude 037 32.6 W
30/05/06	0100	Position Latitude 23 55.1 N Longitude 035 11.8 W
	1300	Position Latitude 23 54.7 N Longitude 032 50.2 W
31/05/06	0100	Position Latitude 23 54.4 N Longitude 030 28.3 W
	1200	Position Latitude 23 54.1 N Longitude 028 17.9 W
01/06/06	0000	Position Latitude 23 53.7 N Longitude 025 49.3 W
	0825	Hove to on mooring station EB2 23 49.7N 024 06.7W
	0840-1208	Deploying Mooring EB2 **STATION 15860 #40**
	1208	**MOORING EB2 DEPLOYED 23 53.80N 024 02.80W**
	1300-1310	Deploying Mooring EBL3 **STATION 15860 #41**
	1310	**MOORING EBL3 DEPLOYED 23 54.00N 024 03.10W**
	1406-1640	**15860#42 – CTD cast to 3000 m 23 48.5N 024 06.4W ALSO Download of EBP1**
	1640	Set Course 071° T for displaced mooring EBH5
02/06/06	0000	Position Latitude 24 14.8 N Longitude 022 44.7 W
	1200	Position Latitude 25 00.0 N Longitude 020 23.1 W

03/06/06	0000	Position Latitude 25 43.9 N Longitude 018 07.4 W
	1300	Position Latitude 26 27.7 N Longitude 015 42.7 W
	1555	**15860#43 – ARGO Float/buoy launched 26 37.6N 015 11.3W**
	2100-2400	Vessel searching for loose Mooring EBH4 26 57.0N 014 05.0W
04/06/06	0625	Loose Mooring EBH 5 sighted
	0712-0800	Workboat launched for mooring EBH5 to be attached to the vessel – Cox R. Clarke and J. Roberts (bowman).
	0735-50	Recovering EBH5 **STATION 15860 #44a** 26 56.7N 041 05.0W
	0818	Set Course 034° T
	1430	Hove to on Station EBH5 27 53.4N 013 22.6W
	1432	mooring EBH5 released
	1513-17	Recovering EBH5 **STATION 15860 #44b**
	1615-51	Deploying Mooring EBH5 **STATION 15860 #45**
	1651	**MOORING EBH5 DEPLOYED 27 54.52N 013 21.94W**
	1744-1927	Surveying mooring EBH4
	2012-2230	**15860#46 – Download of EBP2 27 52.6N 013 30.1W**
	2230	Download complete – slow steam to mooring EBH4
05/06/06	0352	USBL spar extended 27 57.6N 013 26.2W
	0426	Commenced streaming Groundwire for Dragging operations **15860#47** 27 56.8N 013 26.9W
	0426-1142	Vessel engaged in dragging for mooring EBH4
	0945	USBL recovered and valve closed 27 59.1N 013 24.7W
	1142	All dragging equipment inboard – all clear 27 57.8N 013 24.8W
	1142-1242	Searching surface for any remains of EBH4 – no success
	1242	PES Fish Inboard – SCIENCE ENDS
	1242	Set Course for Santa Cruz de Tenerife 267° T 27 59.3N 013 25.0W
06/06/06	0600	Due to arrive at Pilot station for Santa Cruz De Tenerife

6. Mooring Operations

Mooring deployment positions and timings are given in Table 6.1, and all deployed mooring diagrams can be found in Appendix A.

6.1 RB0602

Ian Waddington

Loading was completed in Barbados with the unpacking of the commercial containers and lifting aboard of one Mooring Workshop container. On opening the workshop container we found that the mooring wires on large drums had broken loose in transit. One drum was severely damaged and also all of the top layers of 3/16 wire were damaged beyond repair (see Photograph C.1 in Appendix C). The double barrel capstan (DBC) winch had slid around in the transit container and a steel 50-inch sphere had jumped out of its pallet base. There were no lashings on any items – this will need to be better packed in future as shipping to Barbados evidently shook the containers a lot.

All equipment was taken onboard and stowed. The DBC traction unit was mounted to steel plates, supplied by the ship, and bolted to the two-foot deck matrix. The diverter sheave and metre wheel were bolted as appropriate and secured with chains. The storage reelers were bolted direct to the two-foot matrix as these were prepared for the correct spacing at NOC. (See Photograph C.2 in Appendix C for the DBC system layout).

Deck operation methods were discussed with the Chief Boatswain and a scheme was developed for using the DBC with a secondary system comprising the ships deck capstan and air-tugger, with a diverter block located on a simple gantry on the starboard side of the A frame (Photographs C.3 and C.4 in Appendix C).

All the wire section of the moorings WB1, WB2 and WB4 had been pre-wound to wooden drums at NOC ready for deployment. However the wind was so loose that complete re-winding and tensioning was necessary. This involved winding off from the wooden drums onto a steel reeler drum and then through a snatch block hanging on the crane back onto the wooden drum mounted on the second reeler. During the rewinding it was found that the drive shaft on the reeler was bending due to the load of the heavy wire on the wooden drums and the drum was fouling a previously cut off framing on the reeler. This stub was cut off using the moorings angle grinder to allow enough clearance for the drum to turn.

WB2 had to be redesigned to somehow compensate for the damaged wire. By moving the remaining useable wires up in the mooring to replace the damaged wire, a section of Parafil could be used to infill for the missing wire. There was no spare wire supplied to the ship, only Parafil. The redesign has substantially heavier wire supported by the 50 inch subsurface buoy and when run on the mooring design program it was seen to sag and create a catenary if glass buoyancy was placed at 1800 metres. Thus buoyancy was moved up in the mooring to 1000 metres. Below the heavy wire section stiffness was no problem as the Parafil inserted has very low water weight. Also the opportunity was taken to create a two-stage mooring by moving the two-stage from WB4 to WB2 and manufacturing replacement buoys onboard for WB4.

On completion of all the wire winding and re-design processes the remaining mooring hardware was assembled ready for deployment. The supplied parts for the lander buoys were not complete and fabrication and invention was required to produce a robust buoy (see photograph C.5 in Appendix C).

The 49 inch CRP syntactic ADCP was prepared for deployment. One of the through rods was bent and had to be straightened before assembly. This was probably caused when the buoy jumped out of its pallet during transit and rolled around in the container. As no zinc anodes had been provided an improvised scheme using 3/8 galvanised chain was discussed to act as sacrificial and protective anodes. It was hoped however that the recovered buoy could be turned around instead.

Recovery of WBADCP

The WBADCP mooring was relocated on the 19th March and released at first command. The ARGOS signal received on foredeck using the GONIO receiver. Recovery was made by grappling the polypropylene recovery line and hauling onboard using the ship's capstan system with assistance from the air tugger to recover the acoustic release.

On inspection the buoy system and mooring was in excellent condition (see photographs C.6 and C.7 in Appendix C). This meant that the recovered buoy could be reused for deployment of the 2006 system. Anodes were in good condition with less than ten percent erosion. The hull which had to be hand carved with hammer and chisel in 2005 was as deployed.

Some evidence of corrosion was seen at the end cap fitting clamps on both ends of the ADCP. This was stripped down and cleaned for later detailed inspection at NOC. Data was downloaded and at first glance appeared to be a full record of good quality. Tilt appears acceptable indicating that the mooring design is OK.

Deployment of WBADCP

The WBADCP design was changed in layout to allow buoy-first-anchor-last deployment by moving the acoustic release up towards the ADCP buoy allowing a longer chain section to the anchor. The acoustic release powered in 2005 was not opened up and was prepared for re-deploy as was. All rigging methods were as used in 2005. The Argos beacon PTT 11033 was checked on deck and re-greased for immediate re-use.

Deployment of the buoy was made using the DBC winch with the ships starboard crane providing over side lift for the anchor. Deployment went very smoothly and the buoy was observed to sink rapidly. Observations were not made for sink rate or confirmation of when on seabed.

Recovery of WB2

The former telemetry mooring had already been determined to have been damaged as the telemetry buoy broke loose and was recovered in June 2005. Acoustic relocation was made quickly on arrival at the site, and with the echo sounder and swath system closed down, reliable ranges were established. The mooring was released using the AR861 subsea unit. Note this was the lower of the two release systems placed in tandem in 2005. A plan was prepared for workboat intervention following mooring release, and inspection of the surfaced parts was made before recovery to the ship.

The rise rate was monitored and initially looked normal but this reduced with time. As the 49 inch syntactic should have appeared at the surface within minutes and was not seen, the suspicion was that it had been lost. Continuous acoustic monitoring was made of the ascent and eventually as the rate decreased considerably a glass sphere package was sighted at the surface. Shortly thereafter the flat top syntactic was sighted. Indications were that the flat top had significant upper mooring components attached as it was tilted over due to load on the upper attachment point.

The boat was launched with Steve Whittle onboard to carry out investigation of condition of the lines and buoyancy components. This check revealed no line on the flat top and no easy attachment point at the mid sphere package. It was decided to recover the mooring from the release support spheres and work the mooring back to the flat top. A line attached to the release spheres which was then used to haul the spheres onboard using the DBC.

During recovery the DBC failed and the mooring recovery was transferred to the ships capstan coupled to the DBC storage winch. This worked fine. There were many wire wuzzles to contend with and several stopping off methods had to be employed, ranging from fist grips to Kevlar stoppers – all provided by the Chief Bosun. The upper 100m of the mooring were not recovered – the recovered bitter end of mooring wire had evidence of contact with fishing line or similar, which had caused a failure of the jacket with subsequent corrosion failure.

It should be noted that the recovery of the flat top was very problematic in trying to stop off the wire, turn the buoy for wire detachment and removal of the swivels. Modifications are required to ensure this operation can be carried out safely for future applications. Presently this operation can only be performed in flat calm conditions and is not entirely a safe operation. Redesign must be done. The DBC failure was rectified shortly after completion of recovery operations.

Recovery of WB4

The mooring was located quickly on the 21st March 2006, and releases on the first transmission of the release code. The top subsurface glass raft and recovery float were brought alongside and recovery commenced using the DBC.

No significant problems were encountered during the recovery save the flooding of Microcat serial number 3482.

On completion of recovery the wooden recovery drum was demounted from the reeler and the replacement wire set up. Parafil was wound onto the in line reeler in preparation for re-deployment.

Deployment of WB4

Mooring WB4 was deployed buoy first, anchor last by freefall on the 22nd March 2006. As the deployment progressed it was apparent that on the course and necessary speed the drop zone would be overshot. By varying the ships course this was improved but to achieve a successful deployment an alternative position had to be determined.

During deployment all wires and Parafil were measured and marked on the way over-side. This was achieved on the inboard side of the DBC using the measuring yellow wire-measuring tool as shown in Photograph C.8 in Appendix C. Errors were apparent in this counter of the order - 6m in 1000m measured. Slow winding seems more consistent and accurate. This measuring head should be regarded as indicative and not accurate.

Deployment was comparatively straightforward with the “built onboard” top buoy assembly deploying OK. The mooring was observed at the surface after anchor freefall and the ARGOS monitored to sink. The mooring was acoustically tracked to the seabed and subsequently navigated in using acoustics on the AR861.

Deployment of WBL4

WBL4 is a single-release-single-BPR tripod assembly (see Photograph C.9 in Appendix C). Built up onboard and deployed buoy first anchor/tripod last. The package spun on deployment preventing the sea catch hook from operating. The mooring was hauled alongside and untwisted to release correctly.

Deployment of WB2

WB2 was deployed on the 23rd March 2006. It consists of a the redesigned top section using the steel spheres moved from WB4 (see Photograph C.10 in Appendix C) and remaining quantity of 6 to 8 short wires to make up the mooring.

As this mooring is comparatively high risk two ARGOS SMM 500s are incorporated into the design, although only one light was available for the upper buoy. The 50 inch sphere has a complete keel assembly inverted and fitted as a mooring mounting for the upper section.

Deployment was interesting throughout as all lines were re-measured and marked and initially some confusion crept in, causing hauling back and re-measuring of the upper section. The confusion was from the drawing put together the previous night indicating previous (pre-redesign) buoy positions.

Deployment of WB1

Deployment of WB1 was on the 23rd March 2006. The mooring consists of a modified two-stage-top design finalised in December 2005. Deployment was buoy first and commenced with no problems. The top 28 inch buoy and wire section were deployed using DBC as the sphere was too heavy for hand deployment. The anchor was released after a short tow using ships crane and Seacatch hook.

Deployment of WBL3

Deployment of WBL3 was on the evening of the 23rd March 2006 (24th March GMT). The mooring is a dual-release-dual-BPR tripod assembly (see Photograph C.11 in Appendix C). The assembly was put together onboard and tested for release action to determine the length of dual release chain required. An air-drop was made to test clearance of shackles through the round release link. A tag line attached to prevent spin was slipped as the package entered water.

6.2 D304

Rob McLachlan

Diary of Events

12th May

We sailed from Tenerife at 06:00.

Heading towards first CTD station, preparing deck for recovery of ADCP east and EBH5 whilst under way.

CTD test station at 08:53 down to 1500m. Maximum pay out speed 38m/min. due to having to use the dead man's lever.

12:46, Wire test of releases 163, 318,474 and 359. To 3000m, all fired OK.

Calibration dips for 12 seabirds. 10 second sampling rate.

s/n 3929 flooded with pressure build up in the pressure case. Due to the risk to personal the instrument was disposed of over the side.

1809, wire test of releases 497,498,162 and 319 to 3000m.

Calibration dips for 12 seabirds, 10 second sampling rate.

All OK.

Redesigned EBHi to incorporate additional instrumentation.

13th May

0700 started interrogation of ADCP east, the release was talking with good ranges, but would not release, the release was confirmed as vertical. Not recovered.

Proceeded to EBH5 site. Started recovery at 09:33, finished at 10:10, all went well.

Prepared deck and equipment for EBH5 deployment. Started deployment at 10:50 finished at 11:35, all went well.

Proceeded to EBH4 site and started interrogation at 12:32, there was no response from releases. Tried different deck units and dunking the transducer over the side as well as using the fish, still nothing. A vessel was seen trawling near this site before we got here.

Torsten suggested moving the EBH4 mooring in to deeper water and extending the mooring by around 200m. This is still in discussion, I have given an approximate guide on what lengths of spare rope I have available.

Heading towards EBH3 site.
Torsten confirmed that EBH4 will be moved to 1000m deep. This requires us to add 200m of polyester under the release.
Interrogated EBH3 release, good ranges, released at 14:50, finished recovery at 15:52.
Started deployment of EBH3 at 16:22, finished at 16:38.
Head towards EBH4 site to commence deployment of newly extended mooring.
Started deployment at 18:05, finished at 18:21, all went well.
Intention is to download pies overnight and try to establish communication with EBH4.

14th May
0600 pies downloaded OK, found EBH4 8 miles off position.
Interrogated release, good ranges and confirmed as vertical, released ok but would not rise off of sea bed, anchored to the sea bed by something. Talked about dragging and the decision was made to continue with the programme and come back for it, contacted Ian Waddington for advice on dragging operations.
Headed towards EBH2, started recovery at 11:30, finished at 12:15.
Started deployment of EBH2 at 12:44, finished at 12:57.
Headed towards EBH1 site, good ranges, released at 19:07.
Recovered and redeployed, set up EBL4 and deployed all went well finished at 22:00.

15th May
06:15 fired release of EBH0.
Recovered and redeployed EBH0 finished at 07:49.
Heading towards EBHi site ETA 0900 16th May.
Check recovered glass, some showing signs of cracking.

16th May
Arrived at EBHi site at 1000, no response from release. It took a number of attempts to establish communication and eventually it released at 11:00 and made its way to the surface.
Recovered and redeployed EBHi, during deployment it became apparent that with the additional instrumentation we should have used the double barrel for deployment; otherwise all went well, finished at 13:19.
Produced a working drawing for the re-designed EB1 telemetry mooring, showing correct lengths of parafil with stretch. Wound on all but 1000m of EB1.

17th May
Struggled to communicate with EB1 releases, eventually established communication and fired release, the mooring started to rise at around 12m/min, which slowed to 5m/min. The 50” steel did not come to the surface indicating that it has been lost.
The decision was made to steam to EB2 MMP site for recovery, then to prepare for mid water dragging operation.
Took a while to communicate with releases, got there eventually and released EB2, the ship took a long time to go and pick up the recovery line. Some good tangles to contend with. Bottom 6 glass had imploded, this could be the reason we were struggling to communicate with the releases. All done at 17:04.
Decided to look at moving the releases away from the glass in future.
Wound on 1500m of polyester, got grapnels out and prepared all ready for dragging operations in the morning.

18th May
We arrived at EB1 site ready for dragging operations at 0800. EB1 had surfaced whilst we were away; the flat top syntactic was just floating on the surface. The small boat was launched and a recovery line attached. The buoy was landed on deck where we stopped off the 3/16" wire to the deck and attached the 6-8 wire to the winch. Recovery was started but after a while, as expected, the wires became well tangled round each other, at one point we had 7 wires leading out. We eventually got it all on board, with everything recovered apart from the top 50" steel sphere, 3 Microcats, Argos beacon s/n. 257 ptt. 42749 and an acoustic release (s/n 263) that was sacrificed in order to give extra buoyancy to the rig.
Re-deployment of EB1 began at around 2000 and finished at about midnight, all went well, see drawing for the final mooring layout.
Heading off for the mid Atlantic, western most mooring first, MAR1, then heading east recovering and deploying as we go.

19th May until 23rd May
Had a clear up on deck, moved spheres above hanger, checked glass, built up glass and billings, moved anchors around. Set up instrumentation.
Re-designed landers to incorporate 2 additional glass, so that we can distribute the buoyancy in case of implosion, so we now have two sets of four glass, separated by 15m of polyprop.

24th May
Arrived at MAR1 site, released mooring at 14:10. Recovery went well, a few tangles to contend with but otherwise OK, finished at 17:11.
Deployed CTD with releases and Seabirds down to 5000m

25th May
Arrived at MAR2 site, released mooring at 09:08.
Recovered mooring OK, few tangles. Mooring diagram wasn't a true representation of what we actually recovered. S4 was the wrong serial number.
Started deployment of MAR1 at 13:24. All went well apart from running out of ocean; the two nokalons were on the surface, so we got out the small boat and attached a line to the nokalons, lifted the whole mooring and stopped off on deck under the billings, removed the billings and let it go again.
Got Lander ready, MARL3 (new design), and deployed OK, all done at 21:27.

26th May
0500, start deployment of MAR2, all was going well until we got near the end of the 1250m length, the wire got caught under a shackle on the drum and the wire parted, on the low tension side of the double barrel. So we hauled in all of the 1250m length. The quickest option available to us was to replace the 1250m with the top of MAR3. This was already wound on to another drum ready for deployment. The length was 1500m, so we left out the bottom 190m from MAR2, this made the mooring 60m longer. Deployment was then continued and all went well, reaching the anchor drop point in good time. Finished at 09:20.
Replaced 1500m length used from MAR3 with parafil, all wound on and marked ready to go.

27th May
Emptied container ready for loading, swung telemetry buoy box in to container.
Started preparing MAR3 and MARL4 ready for deployment.

28th May
0600 start, released MAR4, recovery line and buoy were wrapped around the current meter and was therefore no good for recovery. The small boat was deployed and a recovery line attached to the steel sphere. Recovery then commenced and all went well, a few tangles. Finished at 11:35.
We then started deployment of MAR3, all went well. Finished at 14:41.
MARL4 was then deployed, all went well. Finished at 15:11.
Head towards MAR3 and readied deck for recovery, recovered MAR3, all went well.
Started at 15:48, finished at 18:20.
Now heading for EB2 deployment site, ETA Thursday 1st June.

1st June
Arrived at EB2 site, decision was made to remove 50m from the top 2700m of parafil.
08:40. Deployed EB2, all went well, watched steel sphere submerge, and then talked to the releases to obtain ranges, all good.
Set up and deployed EBL3, all went well, finished at 13:10.
Headed towards the last known Argos position of the surfaced EBH5.

2nd June
Prepared a replacement mooring for EBH5, same design.

3rd June
Arrived at latest Argos position for the adrift EBH5, spent some time looking for it but with no success, nothing from the Gonio, nor could we see the light. The decision was made to wait until first light.

4th June
The top buoy of EBH5 was spotted in the morning. The small boat was launched to attach a line as the recovery float was not floating.
Recovery was started and all was recovered apart from one SBE, the bottom glass and the release. The recovery sphere had been cracked and flooded. The wire was cut to pieces and had eventually parted, absolutely no question that this mooring had been dragged off position by another vessel. Finished at 07:50.
Headed towards original EBH5 site and released the rest of the mooring at 14:32, we got everything back apart from one glass sphere from the six pack, this had been ripped off leaving the shackles behind, the wire had parted just above the bottom SBE, and the instrument was lucky to survive.
Prepared deck for EBH5 re-deployment, had to wait due to a fishing vessel fishing across the area we were about to lay the mooring. All went well with deployment once we got started. Finished at 16:51.

5th June
Arrived at the “lost” EBH4 mooring site and started to deploy the dragging gear at 04:30.
All dragging gear in board at 11:42, no sign of the lost mooring.
Head off to Tenerife.

D304 Equipment losses.

ADCP East, 2005/63.

This mooring was deployed on CD177 and an attempted recovery took place on D304. Communication was established with the release and the diagnostics confirmed that it was vertical.

The mooring would not release from the sea bed for some reason.

It is worth noting that there was a large amount of biological fouling on mooring EBH5, this mooring being close to the ACDP site.

Argos beacon 21442.
Acoustic release 861 SN. 326.
150 kHz broadband ADCP.
Syntactic barrel buoy.
1 off 17" glass sphere.

EBH4, 2005/09.

This mooring was deployed on CD170 and an attempted recovery took place on D304.

This mooring was found 8 miles off position.

Communication was established with the release and it was confirmed as vertical, it would not rise from the sea bed though.

An attempt was made at dragging for the mooring but was unsuccessful.

Bowtech light.
Billings float.
10 off trymsin floats.
3 off 17" glass spheres.
6 off SBE37's, SN's 3894, 3895, 3896, 3897, 3898, 3899.
Acoustic release 861 SN. 357.

EB1, 2005/61.

This mooring was deployed on CD177 and recovery took place on D304.

The telemetry buoy came adrift shortly after deployment and was recovered. The top steel sphere came adrift two weeks before recovery. The rest of the mooring was recovered.

50" steel sphere.
Argos beacon SMM500, SN. 257.
3 off SBE37 IMP's, SN's 3240, 3241, 3242.
2 off inductive swivels.
Acoustic release 861 SN. 263.

On top of these losses there was also 9 glass spheres lost due to implosion and a further 12 written off as unusable due to severe cracking. Total: 21.

Mooring	UKORS Number	Anchor Drop Position Latitude N	Longitude W	Anchor Seabed Position Latitude N	Longitude W	Water Depth m	Deployment date	Deployment Time GMT	Argos platform ID
EBH5 (as first deployed)	2006/09	27º 54.35'	13º 22.02'			266	13/5/06	11:35	59619
EBH5 (as redeployed)	2006/10	27º 54.54'	13º 21.72'				4/6/06	16:50	59620
EBH4	2006/11	27º 50.95'	13º 32.21'				13/5/06	18:20	
EBP2	2005/65	27º 51.86'	13º 31.16'			1010	20/11/05	11:04	
EBH3	2006/12	27º 48.83'	13º 44.48'				13/5/06	16:37	
EBH2	2006/13	27º 36.20'	14º 12.83'				14/5/06	12:55	
EBH1	2006/14	27º 17.02'	15º 25.41'				14/5/06	20:33	
EBL4	2006/18	27º 17.20'	15º 25.33'				14/5/06	20:45	
EBL2	2005/13	27º 16.55'	15º 25.03'			3024	7/4/05	01:04	
EBH0	2006/15	26º 59.61'	16º 13.72'				15/5/06	07:48	
EBHi	2006/16	24º 57.29'	21º 15.60'			4495	16/5/06	13:18	
EB2	2006/20	23º 53.85'	24º 02.78'			5083	1/6/06	12:08	42749
EB1	2006/19	23º 48.92'	24º 07.96'			5097	18/5/06	23:25	46243 & 42748
EBL3	2006/17	23º 53.98'	24º 03.12'			5083	1/6/06	13:10	
EBL1	2005/17	23º 48.63'	24º 06.33'			5100	10/4/05	10:08	
EBP1	2005/64	23º 48.52'	24º 06.50'			5094	25/11/05	04:06	
MAR3	2006/23	23º 51.60'	41º 05.99'			5026	28/5/06	14:41	
MARL4	2006/25	23º 51.57'	41º 05.69'			5036	28/5/06	14:12	
MARL2	2005/21	23º 52.10'	41º 05.57'			5041	16/4/05	15:56	
MAR2	2006/22	24º 10.78'	49º 41.63'				26/5/06	09:19	
MAR1	2006/21	24º 11.69'	49º 43.69'			5219	25/5/06	16:38	42745
MARL3	2006/24	24º 12.62'	49º 43.64'			5218	25/5/06	21:27	
MARL1	2005/25	25º 37.73'	50º 24.96'			4870	23/4/05	19:22	
WB4	2006/04	26º 29.32'	76º 04.19'	26º 29.49'	76º 04.16'		22/3/06	18:41	13346
WBL4	2006/05	26º 30.02'	76º 02.95'			4810	22/3/06	22:22	
WBL2	2005/31	26º 30.01'	76º 02.86'			4794	22/5/05	03:09	
WB2	2006/06	26º 30.50'	76º 44.50'	26º 30.62'	76º 44.59'	3909	23/3/06	17:39	60202 & 42746
WBL3	2006/08	26º 30.42'	76º 44.66'				24/3/06	01:18	
WBL1	2005/29	26º 30.42'	76º 44.60'			3880	14/5/05	01:29	
WB1	2006/07	26º 29.81'	76º 49.01'	26º 29.91'	76º 49.18'	1403	23/3/06	23:08	46242 & 42747
WBADCP	2006/03	26º 31.48'	76º 52.14'			601	19/3/06	22:20	11033

Table 6.1: Mooring locations, deployment dates and Argos beacon details for year 3 moorings. (where 2 Argos IDs, 1st is upper beacon)

7. Mooring Array Design Changes

Darren Rayner

7.1 Introduction

The RAPID-MOC array is a pre-operational prototype. As such, the array design is eveolving, driven by practical demands – such as response to mooring losses, and scientifically – as each set of retrieved data suggests improvements to the measurement array to improve our estimates of the Atlantic meridional overturning circulation.

7.2 General Changes

Due to previous losses caused by insufficient backup buoyancy (see the attempted recovery of a lost EB2 on cruise CD177), and the near-loss of EB1 as recovered on D304 (barely sufficient backup buoyancy to bring remains of mooring to surface) the buoyancy deployed on the moorings was checked to ensure there is sufficient to raise the mooring if the mooring is damaged and broken – such as loss of the top buoyancy package through fishing activity.

Designs subsequent to those deployed on RB0602 and D304 will also include distributed buoyancy that will support the mooring at around 1000m or less if the top buoy is lost. This will prevent the mooring collapsing to the seabed, as was the case with EB1 recovered on D304. Luckily this collapse happened only a few weeks before recovery, otherwise density data for the whole water column would have been lost.

Previous problems with the doubling of acoustic releases were solved through using a different dropper mechanism. The more simple system comprises machined stainless links in the jaws of the releases with a bushed shackle and a short section of chain passing through a large circular link on the anchor. If either release fires the chain pulls through the ring and comes up with the releases. This solution has been used extensively in the past by many mooring institutions and should have less risk of jamming compared to the engineered dropper bar used in the first year. Parallel releases will prevent loss through release failure, as the interim solution used on CD170 and KN182-2 used releases in series meaning the bottom release would be dropped if the release above had to be fired.

A policy of deploying full depth moorings with a two-stage top has been adopted. The two-stage top consists of the main buoyancy at around 200m with a smaller buoyancy package above this bringing the mooring up to the required depth. Over-length mooring lines or small elevations on the seabed can cause problems with the top float remaining on the surface after the anchor has reached the seabed. This was particularly evident on the deployment of MAR1 the previous year where the highly irregular bathymetry meant that the mooring had to be recovered and redeployed. A two-stage top allows the upper buoyancy package to be removed without significantly affecting the mooring, therefore meaning the mooring does not need to be completely recovered. This method was used on cruise D304 when the upper buoyancy of MAR1 again remained on the surface; a short operation with the ship’s small boat was much quicker than a full recovery and redeployment.

No telemetry system was deployed from these cruises. The large surface telemetry buoy greatly endangers the mooring and affects its performance in strong currents, and the mechanical attachment of the buoy to the mooring is difficult. The decision has been made to postpone telemetry buoy usage. There will be a reassessment of the telemetry buoy requirements with a possible redesign at a later date.

The quick inclusion of bottom landers in the previous year's deployment meant that the tripod frames available could not be adapted to hold two acoustic releases. The bottom pressure data is important and deploying the landers for two years at a time should mean that they have a backup of using the dual release system. WBL3, MARL3 and EBL3 – next to WBL1, MARL1 and EBL1 respectively – are the more important of the lander pairs so these were equipped with dual releases and dual BPRs, whereas the lower importance WBL4, MARL4 and EBL4 – next to WBL2, MARL2 and EBL2 respectively – were equipped with single releases and single BPRs.

To improve the vertical resolution of the CTD measurements on the key east (EB1 and EB2) and west moorings (WB1 and WB2), the spacings were offset between the pairs of tall moorings so that if both are recovered then the merged profile does not have too many duplicate depths. This is only a minor change in instrument spacing but can greatly improve vertical resolution if both are recovered but the moorings still act as a backup to each other should one be lost.

7.3 Changes Specific to the East

The EBADCP mooring has been removed. As yet the longest record recovered from the mooring was approximately 10 days, obtained before the mooring surfaced prematurely. One EBADCP mooring was never found and that to be recovered on D304 would not surface despite being located ok. The failure to recover EBADCP on D304 meant that there was no Broadband ADCP available to deploy as a replacement, and the site is of too high a risk and too low a scientific importance to deploy a high cost instrument such as a new Longranger ADCP.

Fishing activity moved EBH4 approximately eight miles from its deployment position and made it unrecoverable. Likewise EBH5 was moved by fishing activity but as this was wire it survived and was recovered intact. As we have had (limited) success with EBH4 at the previous deployment site from the 2004 deployment, mooring EBH4 was moved back offshore but extended by 200m to bring the instruments to the required depths.

The two RCM11 current meters previously deployed on the EB2 MMP mooring were removed as they would be of more use elsewhere in the array – particularly in the West where direct current measurements are used to calculate components of the MOC.

The vertical resolution of the lower section of the EB2 MMP mooring was also increased, so that there were six Microcats below 2500m compared to three previously.

7.4 Changes Specific to the Mid Atlantic Ridge

To reduce the amount of equipment deployed in the relatively safe region, MAR4 has been removed from the array, but to still allow a degree of backup to the full-depth MAR1 mooring, MAR2 has been extended to 1000m depth. The vertical resolution of MAR1 was also improved compared to that from the previous year when it was limited by the number of available instruments at the end of the cruise.

7.5 Changes Specific to the West

There will no longer be an MMP deployed in the Western sub-array, and so when replacing the half-height WB4 mooring deployed the previous year with a full-depth mooring, a combination of Microcats and current meters were used.

The number of current meters deployed on WB1 was reduced, which allows their use on WB4. A good correlation between WB2, WB1 and mooring B currents has been found meaning that such high vertical resolution on WB1 is not needed to interpolate the currents in the wedge between WB2 and WBADCP.

8. Instruments

Darren Rayner

8.1 Summary of Instruments Recovered and Deployed

Tables 8.1 gives a summary of the instruments recovered and deployed on cruises RB0602 and D304. Appendix E gives more detailed information on which instruments were recovered from each mooring along with information on the length of record obtained. Complete setup details of deployed instruments can be found in Appendix B.

Instrument type	Manufacturer and model	Total intended for recovery *	Total recovered	Total lost	Total deployed
CTD	Seabird SBE37 SMP Microcat	63	56 (3 flooded)	7	82
	Seabird SBE37 IMP Microcat	38	26 (+8 recovered from WB1)	4	48
	RBR XR-420	1	1	0	1
	Idronaut Ocean Seven 304	0	0	0	1
Single Point Current Meter	InterOcean S4AD	11	7 (+4 recovered from WB1)	0	8
	Sontek Argonaut MD	7	6	1	5
	Aanderaa RCM11	12	7 (+5 recovered from WB1)	0	10
	Nortek Aquadopp	0	0	0	1
Current Profiler	RD Instruments 150kHz BB ADCP	1	0	1	0
	RD Instruments 75kHz Longranger ADCP	1	1	0	1
Current/CTD profiler	McLane Moore Profiler	2	2 (1 with flooded CTD)	1 from deployment cruise KN182-2	1

Table 8.1: Summary of instruments recovered and deployed on cruises RB0602 and D304. (* Intended for recovery - includes prematurely surfaced WB1 mooring and incorporates changes from CD177 service cruise in Autumn 2005.)

8.2 Instrument Problems

This section details problems encountered with instruments both recovered and deployed, and builds on previous problems detailed in SOC Cruise Report No. 53

(D277/278), NOCS Cruise Report No. 2 (CD170/KN182-2) and NOCS Cruise Report No. 5 (CD177).

8.2.1 Sontek Argonaut MDs

Of the four Sonteks that were due to be deployed on cruise RB0602 there were problems found with three. These instruments had recently been returned to Sontek for a transducer upgrade, and arrived back at the NOCS prior to shipping to Barbados.

Serial number D303 was found to be reading -10°C. This was investigated and it was found that;

1. The temperature sensor connector was not attached
2. The earthing strap was not attached
3. The end circuit board was unscrewed from the main end cap and screws were rolling around in the pressure case
4. The 8-way connector was not attached

Because of these findings the remaining Sonteks were opened and inspected: D272 had the white plastic battery stop installed in the wrong end of the pressure housing and D298 had the sensor head installed in the wrong end of the housing preventing the batteries from fitting. These faults were reported to Sontek who are addressing the repair procedure to prevent similar problems in the future.

Data quality from the recovered Sonteks was very poor, five out of the six recovered had the older green-edged Mark 2 transducers – which, Sontek have informed us, are more susceptible to ringing and noise – one had the blue-edged Mark 3 transducers. Of the units with older transducers D921 and D295 recorded no valid velocity data due excessive noise. D278 appears to have recorded good data but there may be a slight negative bias in the vertical velocity component. D290 has good data but the battery depleted very early with only 7-8 weeks of data recorded when it should have been a whole year. This unit was found to have a slightly depleted battery during setup and so it was changed for a new one. This new one became depleted rapidly during the deployment so it is suspected that the unit has an excessive current drain during normal operation. D332 has good data for 7 months and then the noise increases and the data becomes invalid. The battery on this unit became depleted 2 months later. D322 is the most interesting as it was the only one of the six recovered units that had the new 3rd generation transducer heads. From first look we are uncertain if the data is good from this unit or not. The noise is approximately 21-24 counts with the mean signal strength approximately 27-35 counts. This should provide a reasonable record but the vertical component seems too high and the whole velocity signal looks more like noise about the zero value rather than a true signal. Sontek were contacted and their response is that the data is valid but due to the low signal to noise ratio the data will need to be averaged to obtain the actual velocity.

8.2.2 SBE37 Microcats

On cruise RB0602, when setting up the new IMPs for the pre-deployment calibration cast it was noticed that the “ds” command response had a line stating “reference pressure = 0.0”. The instruments were more closely inspected and found to not have a pressure sensor installed. After contacting Seabird it was found that there had been a mix-up with the ordering process and these instruments had been incorrectly ordered without specifying the pressure sensor option. These instruments were not deployed and instead six SMPs were turned around from WB2. The instruments without pressure sensors were part of a larger order including 21 for the Eastern boundary cruise. The affected instruments were returned to Seabird for upgrade. Those allocated for cruise D304 that had not yet been delivered were corrected so that a pressure sensor was fitted.

It was found that some of the microcats had the pump uninstalled, as found with some instruments on cruise CD177. This was checked on each instrument prior to deployment. Also, several microcats were set to sample every 10 seconds during calibration casts but were actually found to sample every 20 seconds. The manuals state that the allowed "interval" range for SMPs is 5-32767 seconds and with IMPs 10-32767. The reason was not found until cruise D304 where recovered instruments had short records due to battery depletion.

The instruments both affected by the unexpected sampling rate during CTD casts and those with depleted batteries were all SMPs and found to have a new firmware version 2.6 (a or b). Further discussions with Seabird have revealed that there is a new sample-timing regime that affects the battery endurance, and coupled with a new command – the number of samples to average (NAVG=xx) – this greatly affects how the instruments should be set. The default value for NAVG should be one, but there has been a mistake that means the default value is four. Each sample was therefore taking four times more measurements than intended, which reduced the battery lifetime (hence short records from D304) and increased the time taken for each sample. Because the sampling time is increased to more than 10 seconds when NAVG=4, the instrument adjusts the set sampling rate from 10 seconds to 20 seconds. As this was not discovered till cruise D304, many of the SMPs deployed on RB0602 are likely to stop logging as their batteries deplete before intended.

As encountered on previous cruises there were still problems downloading IMPs using the Seabird software. The "IMPDownload.exe" software written by Darren Rayner to deal with this issue worked well on one laptop used for download but had to be modified to work on two others. Download of the IMPs was much more efficiently conducted using this software than the Seabird software, without the need to download a years worth of data in blocks of 250 scans at a time.

As part of the IMPDownload software the data is downloaded in Hex format and then converted to ASCII using the procedures detailed in Appendix III of the latest version of the IMP manual. This conversion was checked against data converted using Seabird's own conversion software "Cnv37IMHex.exe" and found to have converted the conductivity values differently. Both sets of converted data were then checked against data downloaded in ASCII format (Format=1) and it was found that the Seabird routines were converting the Hex data incorrectly whereas the IMPDowload software was converting it correctly. Seabird have been contacted about this and they are investigating further.

The IMPDownload software was further modified on cruise D304 to produce version 4, which allows sequential download of multiple IMPs on the same loop of inductive wire. This means up to 12 instruments can be left to download unattended, which is particularly useful if downloading overnight.

Microcats 3255, 3271 and 3480 all flooded during the deployment. All are thought to have been caused by a weld failure in the pressure sensor. All were deeper than 3500m and so susceptible to failure (despite being within the stated operating depth) as previously indicated by Seabird. Because of these failures at the base of the MAR moorings the Microact (s/n 3284) at the bottom of the replacement MAR2 mooring had the pressure sensor of the Microcat capped. This will prevent possible failure of the pressure sensor, and as the instrument depth is well known, and will vary very little, the temperature and conductivity measurements will still be useable.

SMP 3484 had suspect data from the post-deployment calibration cast. The conductivity reading didn't stabilise very quickly compared to the other instruments on the same cast. This is thought to have been caused by a faulty pump and has been returned to Seabird for repair.

SMP 3252 has a bad pressure record from approximately halfway through the deployment. This instrument is part of the batch that were susceptible to bad pressures as discovered in Spring 2006. This instrument has been returned to Seabird for pressure sensor upgrade.

SMP 3929 flooded on the pre-deployment CTD cast and started to become very hot around the batteries. The procedure for relieving pressure from Microcats was not known at the time so due to the risk of injury the instrument was disposed of. Seabird have since provided a method for the relief of pressure build up in Microcats which can be found in Appendix F.

Following the trawling and recovery of EBH5 during cruise D304, SMP s/n 3210 was found to have a very loose conductivity cell guard with a couple of missing screws. This may have been caused by the trawling, but the conductivity sensor will need careful checking prior to re-use.

8.2.3 Aanderaa RCM11s

The data recovered from RCM serial number 304 was corrupted. The download reads data for approximately 1 month and then the DSU5059 data reading program stops and asks the recording interval whilst the DSU numbers continue to count down. At first this was thought to be an error with the software stopping too early, but by attempting to download the DSU through HyperTerminal using the ctrl Q command to start the download, it was found that the data was corrupted after the point the 5059 program stops. The data just reads continuous blocks of 4 zeros instead of actual data. The DSU passed its self check test so the problem may be with the RCM11 itself. Further investigation needs to be conducted.

The reference reading in serial number 301 was seen to deviate from the set value of 284 to 283 during the year's deployment, otherwise the data seems ok. Aanderaa have since stated that this is not a major problem as the reference number is set through an analogue method, which if it drifts can cause the reference reading to oscillate between two values.

Serial numbers 300 and 306 did not work correctly on the CTD calibration cast: Both had data missing that were not recoverable. Both of these instruments were re-dipped, 306 with a new battery, and 300 using the same battery which was supposedly new. 306 worked fine with the new battery and so was redeployed. The battery was looked at following the second cast and was found to be manufactured in 2003. This would suggest that it was an old battery and may have be mistaken for a new battery at some point. The voltage under load was seen to drop from 7.17V to 6.8V and fluctuate, suggesting that the battery was depleted. The loss of data on the calibration cast may well have been caused by a depleted battery as the instrument stopped logging when in the colder deep water and then started again in the warmer shallow water, suggesting the drop in temperature reduced the battery capacity enough to stop the instrument. However to verify the correct operation of this unit it would be wise to conduct a prolonged test at NOC.

Crevice corrosion was seen on the C-clamp screws from RCM11 s/n 445 recovered from MAR4. This instrument was deployed at approximately 50m so was in relatively warm water. This corrosion needs looking at and a service conducted on all RCM11 pressure cases and fittings. The pressure case also popped open as though pressurised – this is thought to be slight battery degassing rather than any leaking during deployment.

8.2.4 InterOcean S4s

The problems encountered in previous years were thought to have been resolved. The data were downloaded easily using the S4App304 software to obtain the binary .S4B files, and the APP274 DOS based software to obtain the ASCII .S4A files. Problems were found when trying to setup the two instruments for deployment on WB4. Previously setup had always been successful using the S4App304 software, but this would not work correctly on this cruise, with the setup failing when trying to send the entered parameters to the S4. The setup had to be completed through the terminal mode and entering all commands individually. The reason for this problem was not found.

To try to resolve these problems with S4 communications, software was written by Darren Rayner during cruise D304 to allow simple download. The software (S4Download_v1) was written in Visual Basic and based on the previously written IMPDownload software. This software worked on first trials, but further testing needs to be conducted.

Serial number 35612566 recovered from mooring MAR1 was found to have a bad pressure record. Similarly serial number 35612575 recovered from MAR4 also had a bad pressure record. The whole record for s/n 35612566 was bad, however the bad pressure record from s/n 35612575 begins part way through the deployment and around the same time the currents become unusable. InterOcean have suggested that the failed pressure sensor may have caused a seawater short to the current sensors. This is being investigated further.

8.2.5 RBR XR420-CTD

A single RBR was deployed on EB2 at the same depth as Microcat to allow direct comparison of the two instruments over the duration of a deployment. This was planned to be serial number 9657, which had recently been returned from the manufacturers following repair. However this instrument now has a different firmware that required a newer version of the software to communicate with it. This newer version was not onboard and so s/n 9656 – recovered from MAR2 – was redeployed for the inter-comparison.

8.2.6 McLane Moored Profiler

There were two MMPs recovered on cruise D304; one worked reasonably well and the other collected no useable data. The instrument recovered from MAR4 did not work and had the CTD flood after the first downward profile. On recovery the CTD would not communicate through the MMP software and after using an adapted procedure for relieving pressure in a Microcat (Appendix F) the end-cap was blown across the lab as the final screw was removed. There was relatively little pressure and very little water in the pressure case so it is thought that it might have been a low-pressure leak near the surface that permitted a small amount of water to enter the pressure case. While the instrument was waiting for the next profile it is thought that this small amount of water damaged the electronics and stopped the CTD from working.

On examining the data from the second MMP recovered from EB2 we could see that the MMP appeared to drift up the mooring whilst waiting to start the upward profile. Some rudimentary tests were conducted with lengths of mooring line and we found that the smooth Parafil pulled through the breaking wheel of the MMP a lot easier than the undulating surface of the jacketed 3/16" wire. This means that at the base of the profiler where the MMP is positively buoyant it slipped up the mooring as the break wheel was insufficient to hold the instrument in place. The distance slipped was a few hundred metres and is not deemed a problem as the near-linear TS profile at this depth can be extrapolated to cover missing data.

The same instrument was also seen to occasionally stop short on the upward profiles. This was initially thought to be due to over-ballasting, but from studying the energy usage of the profiler it can be seen that the majority of energy is used travelling through the upper water column and instead of reducing the ballast, the time allowed per profile should be increased instead.

9. Current Meter Trial Mooring

Darren Rayner

Prior to purchasing equipment at the start of the Rapid-MOC project, a current meter comparison trial was conducted to assess the performance of different types and makes of current meters (SOC Current Meter Inter-Comparison Project - SOC CMIP, Southampton Oceanography Centre Internal Document, No. 94, 46pp - Unpublished manuscript). These trials were conducted in Loch Etive, Scotland, UK.

Initial concerns highlighted the poor performance of acoustic current meters in low backscatter environments. The open ocean is a region with extremely low amounts of backscatterers and is the location of the majority of the Rapid-MOC moorings. Unfortunately the Loch Etive trial was conducted in good backscattering conditions.

The need to use all instruments efficiently in the first year's array meant there was very little chance to directly compare the performance of different current meters as they were invariably deployed at different depths or locations. One attempted comparison between an InterOcean S4 and a Sontek Argonaut failed due to the Sontek working poorly in the low backscatter environment. The majority of the Rapid-MOC stock of Sontek Argonauts have now received transducer upgrades that should improve measurements in low back scatter conditions.

The reduction in use of current meters in the array and their concentration in the Western Boundary sub-array meant that there were a number available for a prolonged trial deployment starting from Spring 2006. We decided to deploy a current meter trial mooring by modifying the design of EBHi (see figure A.21 in Appendix A and Photograph C.12 in Appendix C). The location and depth of this mooring provides a suitable study area with low backscattering conditions. The mooring is to be recovered on the Autumn 2006 service cruise onboard the *RV Poseidon.*

The current meter trial will compare the electromagnetic InterOcean S4A, the acoustic Sontek Argonaut MD, the acoustic Aanderaa RCM11 and the acoustic Nortek Aquadopp. Of the acoustic instruments the RCM11 and the Nortek sample at the same frequency (2 MHz); to avoid this the sampling interval was set to 30 minutes with a 15 minute offset between the two instruments. The Sontek samples at 1.5 MHz.

10. PIES Operations

Laure Grignon, Darren Rayner and Torsten Kanzow

10.1 Introduction

Two Pressure Inverted Echo Sounders (PIES) were deployed on cruise CD177 in Autumn 2005. These instruments measure the travel time for an echo sounder pulse to travel to the surface and back to the seabed-mounted instrument. Following calibration with CTD profiles, this travel time can then be used to obtain information about the density profile of the water column.

We intend to test if, or how far, travel time measurements can be used to replace the moored CTD density measurements. It is thought that upper ocean (thermocline) density variations may be inferred from the PIES. Thus, mooring measurements may not need to cover near surface layers in future, meaning the mooring would be less susceptible to damage.

One of the instruments (EBP1, s/n #136) is located close to EB1 in about 5090m water depth and the other one (EBP2, s/n #131) in 1020 m, between EBH3 and EBH4. Because of fishery activity at site EBH4 it was decided to redeploy EBH4 during this cruise at 1000 m water depth (about 200 m deeper water than last year) in the direct vicinity of EBP2.

10.2 Data Telemetry

Data are transferred acoustically from the PIES to a transducer lowered from the vessel. Thus there is no need recovering the instrument to download the data. PIES may operate continuously in the ocean for up to 5 years.

The PIES data available via telemetry (daily mean values of bottom pressure, acoustic travel time, time) is encoded as time delays of acoustic pulses relative to a marker pulse ("pulse delay telemetry"). The estimated download time for half a year of data amounts to 90 minutes. The time delays are measured by a Benthos DS7000 deck unit connected to the transducer. The data is sent in 14 minute long blocks followed by a 1 minute pause. Each block contains 35 values (35 days worth of data). Data are transferred in reverse order, such that the most recently recored data is transmitted first.

The Matlab based script PPDTb_v3.m controls the set up of the reception channels of the deck unit and decodes and stores the incoming data. PPDTb_v3.m is based on the PPDTb.m script originally supplied by the PIES manufacturer (R. Watts / G. Chaplin). The original was found to be susceptible to data transmission problems in trials carried out during CD 177.

Based on telemetry trials carried out in the Burst Telemetry Mode during CD177 the following standard settings were chosen:

- Telemetry Mode: File Telemetry
- Gain for DS7000: Gain 6 for channels 3, 4, 5, 7 and Gain 8 for channel 2. The channels 1, 6, 8 are not used.

10.3 Practical Operation

The recommended procedure of data download goes as follows. Let the vessel go to a position upstream of the PIES. The distance should be smaller than 1.5 nm. Make sure all devices operating between 10 and 13 KHz are switched off (Echosounder, CTD pinger, ...). This is the frequency range in which the PIES transfers its data. Let the vessel drift towards the PIES site (without using the bow thruster or propeller to keep the noise level down). Send the TELEM command to the PIES using the DS7000 (PIES should confirm reception with two 12.0 KHz pings). Then switch DS7000 from command to remote mode so that it can be controlled by the software. Edit PPDTb_v3.m and enter output file name, number and path. Start programme. Channels should be set up automatically and the DS7000 should start to listen for the first marker pulse. Every received pulse is confirmed by an entry in the Matlab command window. If data reception becomes unreliable (vessel too far from site), the PIES should be sent the CLEAR command. This can be done in the one minute pause between any two of the 14 minute data blocks. Then the vessel can be repositioned to a location closer to the PIES and the session can be started again with a TELEM command. When the session is resumed within 24 hours, the download continues from the next data block. Otherwise the data pointer is reset to the most recently recorded value again.

10.3.1 EBP2 - Download

Date: 13/05/2006
Instrument: PIES #131
TELEM command: 66

- drift test indicated 1.5 kn drift speed
- vessel positioned @ 1.5 nm upwind of PIES
- problems in setting up DS7000 channels via software
- despite audible receptions (using headphones attached to DS7000), software does not pick up signals
- 21:24: only 800 m from PIES site software starts to pick up signals (year day 65)
- 22:16: download successfully completed up to year day 329
- vessel repositioned 6 cables upstream of site
- 23:10 download resumed after difficulties to set up channels again (@ year day 116)
- 23:46 transmission stopped due to internal housekeeping processes of PIES
- 24:52 send CLEAR command

10.3.2 EBP1 - Download

Date: 17/05/2006
Instrument: PIES #136
TELEM command: 65

- vessel set up 5 cables from site (for CTD cast)
- Bowthruster used throughout download process
- 19:05: consistent slant ranges received O(5150 m)
- 19:13: TELEM command sent
- channels set up manually (software control again prove to be problematic)

- after 19:20: despite audible receptions from PIES, no signals picked up by software
- session stopped (CLEAR command)
- 00:07: TELEM command (confirmed)
- channels set up manually
- 00:26 no receptions received by software
- site left due to time constraints
- download should be redone without bow thruster on way back from MAR to Tenerife

10.3.3 EBP1 - Download (2nd try)

Date: 01/06/2006
Instrument: PIES #136
TELEM command: 65

- Joint CTD / PIES operation without bowthruster
- drift test indicated 0.5 kn drift
- telemetry started 5 cables upstream (to ensure 2 hours of download time)
- 14:18 Range 5112 m
- 14:21 TELEM confirmed
- settings: all gains 6, except channel 2 (gain 8)
- 14:25 audible receptions but no software data receptions
- 14:31 set all channels to gain 8 -->> no improvement
- 14:40 TK's laptop exchanges by DR's
- right from the start software picks up good receptions (DR's Laptop uses serial port connection directly, whereas TK uses USB to Serial converter)
- software starts recording from year day 108 backwards (today's year day is 151, so most recent 43 days missing)
- 10 KHz channel gain set to 5 (to reduce noise)
- download got interrupted in between (around year day 50 with 5 days missing)
- programme restart fixed problem
- time series downloaded to end of file (year day 331)
- download restarted (TELEM), downloaded data from day 151 to 67 (40 days overlap with first downloaded)

10.3.4 EBP2 - Download (2nd try)

Date: 04/06/2006
Instrument: PIES #131
TELEM command: 66

- Method: drift without bowthruster
- Drift test indicated ~1.0 kn
- upload started 0.7 nm upwind (using DR's laptop)
- 20:48: Range 2400 m
- 20:50: TELEM confirmed
- Transfer started at year day 152

Transfer till end of file without interruptions

10.4 Processing of downloaded PIES data

TT_from_ctd.m	Matlab script to calculate travel time from CTD profiles. Currently setup for use on D279 ctd data. Travel times TT are then sorted and plotted in order of increasing TT.
TT_from_grid.m	Calculate TT from mmp/microcats profiles.
pies_plot_all.m	Plots pies data from ebp1 and ebp2. Does a basic editing, removes instrument's drift (assumed exponential, best exponential fit is calculated with exp_lin_fit2), and plots the theoretical TT obtained from eb1 and 2 for comparison.
pies_proc.m	Extracts PIES data from all Pfilei.dat corresponding to one mooring, where i is the file number, plot them.
pies_raw2procLSB.m	Extract Least Significant Bits (LSB) data from all Pfile_rawi.dat files for one mooring.
pies_raw2procMSB.m	Extract Most Significant Bits (MSB) data from all Pfile_rawi.dat files for one mooring.

Data from file i for mooring j are save in matlab format under pies_ebpj_Pfilei.mat. There are 2 files for ebp2 and 3 for ebp1.

10.5 Calculation of travel time from MMP and Microcat data

Fairly good temperature and salinity profiles were obtained with the eb1 mooring, but without any data for the top 200m. However, the MMP from eb2 gave a profile up to 80 m depth. Profiles used for travel time calculations are the mean of these two profiles when there were two values. What happens at the surface is quite critical concerning the TT, so we assumed that at every time, the surface value was equal to the maximum temperature/salinity of the profile. This introduces an additional variability in the travel time, particularly after day 100, when the MMP was not going as close to the surface; a better estimate of the surface values would give more realistic TT time series. Once this profile was obtained, sound velocity profiles were calculated, and then TT calculated.

10.6 Drift removal from Pressure data

The PIES data from ebp2 showed a jump of 0.3 dbar in pressure at about day 74. This jump was removed by adding an offset of 0.3 dbar after day 74.

The pressure data shows instrument drift and to remove this, a fit was applied to each data set (ebp1 and ebp2) using exp_lin_fit2. Then, each fitted curve was subtracted from each data set to compare them.

11. Instrument Calibration Using CTD Casts

D. Rayner

End point calibration of the Microcats and RCM11s were conducted using the ship's CTD system. Instruments that were sent from NOC and those recovered were both "dipped" to provide start-point and end-point calibrations respectively. When a recovered instrument was redeployed the post-deployment cast also acts as the pre-deployment calibration.

Instruments were set to the fastest possible sampling rate, attached to the CTD frame and lowered to depth as per a normal CTD cast – post deployment casts were only conducted once the data had been downloaded and checked. Bottle stops on the upcast were extended to 5 minutes to provide time for the instruments to stabilise relative to the more accurate ship's CTD.

For all but the final cast on D304 (cast 10), twelve sample bottles were removed from the CTD frame to allow the instruments to be attached using bespoke brackets (D304) or ratchet straps (RB0602). On D304-cast-10 there were a total of 20 Microcats lowered on the CTD frame so it was necessary to remove all but 4 sample bottles. Details of instruments deployed on calibration casts are given in Appendix D.

12. D304 Computing, Ship-borne Instrumentation & Data Archiving

Dougal Mountifield

12.1 RVS LEVEL ABC System

This is the main central data logging system aboard RRS Discovery. It was developed in-house by Research Vessel Services some 15-20 years ago and is due to be replaced by the Ifremer Techsas system. It consists of three tiers or levels:

- Level A - One programmable unit per instrument. The Level A interfaces to the source instrument via RS-232 to acquire, parse and timestamp instrument data. It subsequently transmits the parsed data to the Level B using the proprietary Ships' Message Protocol or SMP. The link between each Level A and the Level B is also by RS-232. Level As also provide a small amount of buffering, limit and rate alarms on particular fields, and can also apply a polynomial calibration to the data (not normally used).

- Level B - A single unit used to collect time-stamped data from all the Level As. The Level B then buffers all the data to mirrored hard disks before retransmitting it in SMP over Ethernet to the Level C. It also backs up the data to magnetic tapes, which are archived on the Level C. The Level B provides a user interface to control data acquisition and allows the user to view the status of each of the Level As.

- Level C – This is the Sun Solaris UNIX workstation discovery1, also known as abcgate, running the RVS suite of user software. This software provides a proprietary database system for storing acquired data and various tools for processing, converting, viewing and editing data. It also provides programs for acquiring and parsing various data sources including but not limited to the Level B. Tools are also provided for viewing the status of the data streams and files.

The clock signal source for the Level ABC system is a Radiocode GPS clock which is distributed via the RVS master/slave clock system.

Upon arrival at the ship, the Level A interface for the Ashtec ADU-2 GPS was found to have failed. No more spares are available for this ageing hardware. However as the replacement Techsas logging system currently under trial is already logging the ship's gyro but not the ADU, the gyronmea Level A interface was reconfigured as gps_ash to acquire the ADU-2 data.

The Level ABC system remains onboard as the main data logger whilst the new Techsas system is proven by running in parallel and instrument driver development for it is completed. The Level ABC was used to log the following instruments:

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 system (winch)

A "Master clock jump" Level B error occurred on day 151 which was addressed by hard-resetting all the Level A interfaces. The gps_ash (ADU-2) interface required reconfiguring with a terminal for 9600 baud on its data input port and subsequent soft reset from the terminal. 8 minutes of data was lost from 1142 to 1150.

The Level B-C link failed on day 152 at approx 0446. After checking the general status of the ABC and clock systems, the Ethernet link was reestablished using the Level B "Link – Ether" command. The data that was backed up on the Level B was subsequently pushed to the Level C. No significant time gaps are associated with this link failure.

12.2 Ifremer TECHSAS System

This is a new data logger that will replace the ageing Level A & B parts of the ABC system. The software was developed by Ifremer for use on their ships and is also used by the French Navy on hydrographic survey vessels.

Techsas runs on a Linux-based industrial PC with similar robustness and redundancy to the ABC system. It has dual hot-swap power supplies and is protected by an uninterruptible power supply. Data is logged to a local RAID 0 disk mirror and also to a network mount on the Level C via NFS. The Techsas GUI display provides similar information as the Level B for instrument status. The system will also provide future functionality for data broadcast across the ship's network.

Techsas stores data in the open standard NetCDF (binary) format and also pseudo-NMEA (ASCII). At present there are issues on some data steams with file consistency between the local and network data sets for the ASCII files. NetCDF is the preferred data type and is not affected by this problem. The Techsas data logging system was used for 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

Unfortunately some software instabilities were experienced with loss of data. There were two total system crashes that required complete reboot as follows:

- Day 134 from 1225 to 1432 – 2 hrs 7 mins lost data
- Day 151 from 0024 to 1152 – 11 hrs 28 mins lost data

There were also two GUI crashes that only resulted in small data loss whilst the TECHSAS program was restarted:

- Day 138 from 1853 to 1854 – 1 min lost data
- Day 143 from 1115 to 1117 – 2 mins lost data

As all the GPS's, the PES and the SURFMET are still logged by the old RVS level ABC system, this data loss only applies to the EM log and the Gyro. The addition of an audible alarm and automated reboot and resumption of logging using the industrial PC's watchdog timer is recommended for the future.

12.3 Techsas NetCDF to RVS Data Conversion

The EM log and Gyro data that was recorded by the Techsas system was converted to RVS data file format to allow processing of navigation data by existing pstar programs. To provide a comparison, the Trimble GPS data logged by Techsas was also converted as this is also logged by the Level AB system.

The Techsas system can record data to two different paths, the first being the host industrial PC's hotswap RAID 0 mirrored pair, and the second an NFS mount of a sub-path of the Level C /rvs/pro_data.

The new RVS style NetCDF parsing binaries (ncvars, nclistit etc) that Liz Rourke has written as def9 were used to convert the Techsas NetCDF binary data files to ASCII format. This was subsequently parsed back into RVS data files using "titsil" (reverse "listit"). The nc* binaries require two environment variables to be set:

$NCBASE – the base for the nc system, set to /rvs/def9 (equivalent of $DABASE in def7)

$NCRAWBASE – the base for the raw data files, set to /rvs/pro_data/TECHSAS/D304/NetCDF/ (equivalent to $DARAWBASE in def7)

The nc* binaries also need to be on path so the path /rvs/def9/bin was appended to the existing $PATH environment variable.

New rvs data files were created for log_chf, gyronmea and a clone of gps_4000 called gps_tech, which were then added to the streamstates database using setstr. On a daily basis the daily Techsas NetCDF files were converted using nclistit, then subsequently titsil. Because some variable names differ between Techsas and old RVS files, the output ASCII file headers from nclistit were manually edited to RVS names before titsil'ing into the RVS files. Also the timestamp of the first line in nclistit output was not written correctly, so this was also edited. It is suggested that the process of file conversion from NetCDF to RVS files be automated and run in the background in future.

Note that NetCDF filenames are of the format YYYYMMDD-HHMMSS-name-type.category, with the date/timestamp being the creation time.

- nclistit 20060527-000001-gyro-GYRO.gyr head > 20060527_gyro.asc
- vi 20060527_gyro.asc to change "head" to "heading" and correct timestamp of first line.
- cat 20060527_gyro.asc |titsil gyronmea heading

This was also done for em log:

Eg. 20060527-000001-VMVDS-log.emlog to 20060527_log.asc, editing sfa and sps to speedfa and speedps and titsil'ing to log_chf

And Trimble 4000 GPS:

Eg. 20060527-000001-position-4000.gps to 20060527_gps4000.asc, editing long to lon, gndcourse to hdg, gndspeed to hvel and titsil'ing to gps_tech.

The Techsas system is configured to switch to new data files at 0000hrs each day. However due to system restarts and GUI crashes that were experienced some days have more than one file per day. During conversion from NetCDF via ASCII to RVS data files, the ascii file names for the extra files can be identified by the suffix '2', '3' etc prior to the file extension.

The nclistit command marked negative values of speedfa in the log_chf file from the EM log with status values of 30 (SUSPECT). This will cause some RVS programs and other scripts to ignore this data. Conversion of the status values to 50 (GOOD) is suggested.

12.4 Timebase comparison between AB system and Techsas.

Stuart Cunningham used the gps_4000 and gps_tech files to compare time base accuracy between the old Level AB system and the new Techsas system. It should be noted that the ABC system Level A for the GPS4000 logs the Trimble's ASCII 'Printer' message, whereas the Techsas system records the Trimble's NMEA $GPGLL message. Initial analysis has showed that the new Techsas system has a remarkably stable timebase. This system is time synchronized to a new GPS clock using NTP across the ship's Ethernet network and should provide a maximum time-base error of approximately 30μs. However it has also highlighted that the Level AB system has some significant instabilities in its time-stamping. The exact nature of this issue needs further investigation. The Radiocode and RVS Master/Slave clock system was checked and was found to be operating correctly with satellite lock, clock accuracy and Master/Slave synchronization functions as expected. All Level A's were reset repeatedly at the start of the cruise, and also after the previously mentioned Master Clock Jump situation.

12.5 Fugro Seastar DGPS Receiver

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

Fugro were contacted via the NOC for advice on regional Virtual Base Station DGPS service subscription for the area we were entering for the MAR moorings. Their advice was that our current subscription was suitable, but coverage in this 'overlap' area between EASAT and AMSAT may be patchy with either service. To minimize this, Fugro remotely reconfigured the Seastar unit to increase its range.

When the EASAT signal reduced, the receiver automatically switched to AMSAT and service continued with no problems. However whilst steaming east again the receiver continued to select the AMSAT service when it should have switched to EASAT and DGPS service was temporarily lost. The receiver was subsequently manually switched back to the EASAT service and DGPS correction resumed.

12.6 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).

When at the western extreme of the RAPID MAR moorings, the position updates on the SSDS from the GPS4000 often stalled for seconds to 10's of seconds at a time. On further investigation this was traced to a reduced frequency of RTCM (DGPS correction) messages from the Seastar DGPS unit. The Trimble had been set with a 20 second timeout from reception of the last RTCM message. After this timeout period had elapsed it was configured to stop calculating fixes, hence causing the observed behaviour on the ship's display system.

The prime source of error in GPS fixes is caused by atmospheric conditions which are homogeneous at the regional scale. Hence a single differential correction can be applied over a regional area with significant improvement in accuracy compared to an uncorrected fix. The RTCM timeout was increased to the unit's maximum allowable value of 100 seconds. This was preferable to reverting to non-corrected fixes (order of magnitude decrease in accuracy) as DGPS fixes using old DGPS corrections are estimated to only introduce a position error of only 1 mm for every kilometer from the last differential fix (source: Ashtec GG24 manual).

As time-stamps for GPS streams are taken from the GPS's themselves, and no new fixes occur during the DGPS dropouts, duplicate times in the data files are thought to be associated with these dropouts.

12.7 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.

Upon arrival at the ship this unit was outputting data at 2 Hz. This was causing the Level A interface to suffer from buffer overruns. This was resolved by using the older version of the Ashtec Evaluate terminal program to turn off all outputs, and change the output rate to 1 Hz before re-enabling data outputs.

A quality check on the ADU-2 data on day 133 revealed non-sensible values for roll and pitch, with the unit producing a series of zero values, then suddenly large values of the order of 20 degrees. The antenna calibration and location parameters were re-entered several times before the unit finally started producing sensible values. Diagnostics on each of the antennae showed no other problems. Prior to the final entry of antenna parameters at 0906 on day 133, the attitude data should not be used. Position fixes and their derivatives ie. CMG, SMG etc, are ok as they are taken from one antenna only. After further examination of the ADU-2 data in conjunction with consultation of the manual, it is now thought that the non-sensible values of heading, pitch and roll are associated with saturation of the low-pass kalman value and rate filters. Periodically bad fixes from one or more antennas can cause spikes which produce instabilities in the filters. The filters usually recover in the order of minutes, but sometimes a manual filter reset may be necessary using the Ashtec 'Evaluate' software.

The NMFD Ashtec "head, pitch roll" interface box that formats the correct RS-232 message format for the RDI OS75 VMADCP required resetting at the start of the cruise.

12.8 Ashtec GG24 GPS/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 GPS receiver stopped outputting data at 0537 on day 132. The unit was removed from the rack in the Comms Room and bench tested. The unit had a failed 5V 1A power supply unit (PSU) probably due to its age. A similar but 5A PSU was found in a spare Ship's Display System (SSDS) unit and used to replace the failed one. A further bench test confirmed correct operation before the Glonass unit was returned to the rack. Data acquisition re-commenced at 1006 on the same day. 4.5 hrs data was lost.

Regular but infrequent Level B alarms were noted "CMG has not changed from 0 for 60 secs". It is suspected that this was caused by occasional GPS dropouts as the Glonass receiver is historically the first unit to suffer from poor reception of satellites.

12.9 RDI Ocean Surveyor 75kHz Vessel Mounted ADCP (VMADCP)

The VMADCP was configured by the science party. Initially the maximum file size was set to several hundred Mb which resulted in the creation of some large difficult to manage files. This was then reduced to 60Mb (daily files), and then further to 10Mb to produce new files after approximately 4hrs of data acquisition.

Prior to the cruise the 9-way RS-232 input from the NMFD head/pitch roll ADU-2 interface was not connected to the OS75 PC. The D-socket was found to be incorrectly assembled with one pin and one socket crimp pin, thus preventing insertion of the connector. The serial line was re-crimped correctly with 2 socket crimps and connected to the OS75 machine. Subsequently the attitude input functioned correctly.

Several unsuccessful attempts were made to transfer OS75 data to the data32 disk via the network. The Ethernet cable was replaced but the problem persisted. The PC's ethernet driver is thought to have caused the transfer problems and occasional crashes. Transfer was attempted using both ftp and Samba. Transfer of VMADCP data was eventually done using an external USB hard drive on a daily basis. Due to the crashes during network data transfer attempts, some small gaps are present in the data (minutes to 10's of minutes). Major file numbers were incremented after restart.

This PC was acquired during a previous port-call in Portugal to replace the old failed system. Due to additional RS-232 problems with the Portuguese PC, it is recommended that it be replaced with a new system.

12.10 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 speed.

The EM log was not calibrated at the start of the cruise due to insufficient time in the science programme for the 4hrs of calibration runs required whilst at sea. The science party intends to cross calibrate the EM log data with the VMADCP post-cruise. The log was reading approximately 1.3 knots astern (-1.3 knots) when alongside.

Early in the cruise it was noticed that the Techsas system was logging the Chernikeef EM log transverse speed as zero. Further investigation revealed that the SSDS system was also displaying zero for speed port-starboard. It was confirmed that no device sits between the Chernikeef and the SSDS/data loggers that could re-write the format of the NMEA messages, i.e. the message received by the SSDS and loggers originated solely from the Chernikeef. The transverse speed was confirmed to be measured correctly when using the display on the EM log itself.

The Chernikeef manual was consulted but was found to be out of date. The manual states that 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. Referring 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.

12.11 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 the following operations often required turning the EA500 off:

- Pinger work with the CTD frame.

- Moorings release work including release tests at the bottom of a CTD cast.
- PIES telemetry.

The PES was restarted as soon as possible after there was no further requirement for acoustic quietness.

The PES started producing bad depth values on day 150. The sounder was reconfigured to display a reasonable echogram and bottom detection resumed.

The EA500 is configured for a constant velocity of sound profile of 1500ms^{-1}. Hence the data produced is uncorrected for velocity of sound in situ. Regionally corrected data is produced by using Carter's Tables and is stored in the RVS file 'prodep'.

12.12 Surfmet System

12.12.1 Description

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 the instruments is degassed using a debubbler with 40 l/min inflow and 10 l/min waste flow. Discrete salinity samples were drawn from the TSG housing and the sample tube was left continuously flowing at approx 2 l/min.

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).

12.12.2 Deployment Comments

Prior to the cruise the surface water system had been flushed with fresh water. There was a couple of hours delay in establishing flow through the surface water instruments due to a sealing gasket failing in the pumped system when the pumps were initially switched on. Subsequently, no problems were encountered.

In the early part of the cruise, the Surfmet system was temporarily stopped twice for calibration checks. Hence there are small gaps in the data on day 131 from 0853 – 0916 and from 1240-1249. Also during the early part of the cruise, the Surfmet program crashed and was restarted. However it appears that the crash was confined to the GUI and no loss of data occurred.

As there was no requirement for fluorometer, and transmissometer data from this system, no air & blank values were recorded, though the instruments were cleaned and checked prior to sailing. The mast instrument serial numbers were checked prior to the cruise, the PAR and TIR gimbals checked for free movement and the optical sensor faces polished.

The general principal of Surfmet data recording is to store raw data unless the sensor itself produces calibrated data. Calibration sheets for the Surfmet instruments were supplied to the science party in electronic format (pdf).

12.12.3 Surface Water calibrations and units

The surface temperature sensors in the pump pickup (remote) and the TSG (housing) have calibrations stored internally and produce calibrated data. Units for both are degrees C. The conductivity cell also has calibration stored internally, and produces calibrated data, but this calibration is the manufacturer's original as this instrument is calibrated against discrete underway salinity samples. Units are Siemens per metre. The fluorometer and transmissometer have regular calibrations, but do not have calibrations applied. The data is displayed in Volts but recorded in mV.

12.12.4 Met package calibrations and units

The wind vane and anemometer produce calibrated data. Units for the vane are degrees relative to 0 deg aft. Units for the anemometer are ms^{-1}. The air temperature & humidity sensors have regular calibrations and have calibrations applied for display purposes only. Raw data is uncalibrated. Units are degrees C for temperature and % relative humidity for humidity. The atmospheric pressure sensor is regularly calibrated but has calibration applied for display purposes only, raw data is uncalibrated. Units are milli-bars (mb). The TIR and PAR sensors have regular calibrations but these are applied for display purposes only (Wm^{-2}). Data is recorded as raw voltage with units of Volts.

12.13 Systems Shutdown during 240VAC Clean Supply Earth Leakage Problem

During the CTD cast on day 152 the ship's ETO reported an earth leakage on the 240VAC clean supply. He requested that once the cast was completed everything in the Main Lab, Plot and Computing Room be shutdown to isolate the problem. All data acquisition was stopped, and all computers and science instruments were powered down at approximately 1710. The earth leakage was then identified by the Chief Engineer as being in the Comms Room. Data logging was re-commenced at 1743 before restoring other non-essential services. Approx 30 minutes of data was lost. The cause was a further power supply problem with the Glonass GPS unit which was resolved later. Had the location of the earth fault been correctly identified by the ships engineers at the outset, the power down of these systems would not have been required and data would not have been lost.

12.14 Sohydro 6 and other Science Party Workstations

The Sohydro6 system was setup for Discovery's network including integration into the NIS and DNS name services. The D304 subfolder of data32 was exported from Discovery3 and mounted on sohydro6. The issue of different pstar UID and GID's between the ship's systems and sohydro6 was resolved by chown'ing the D304 part of data32 to the sohydro6 UID and GID for pstar.

The sohydro6 Uniras license had expired and the first license sent from NOC by ITG failed to work. This prevented the use of the pstar plots on sohydro6, but Matlab was used in the interim. After several days waiting for a replacement license from ITG, this was installed and after restarting all the license manager daemons pstar plotting functionality returned.

Configuring sohydro6 for printing caused some confusion, but after restarting the print daemons on all machines, printers hosted by discovery2ng became functional. Use was made of the new svcs and svcadm commands in Solaris 10 were used for service management.

Some problems were encountered with printing from a second Matlab session on sohydro6 running in an X-terminal session on a Mac. The cause of this was not determined, though may be associated with how Matlab handles print settings amongst multiple sessions rather than workstation configuration itself.

Assistance was provided for the network configuration of various Mac, PC and Linux desktops and laptops for the science party, and other members of NMFD.

12.15 Network

Several times during the early part of the cruise, loss of network access was experienced in the main lab. This was traced to the 3COM Gigabit Ethernet Switch in the EL4 cabinet in the lab. Network service was temporarily restored by power-cycling the switch. However the intermittent network service persisted. The cabinet door was left open to aid cooling and though the problem improved, network service was still lost occasionally. Referring to previous cruise notes, this had happened before and a replacement switch had been sent to the ship. The suspect 3COM switch was replaced with the new unit and no further problems were encountered.

The automatic issue of IP address and other network settings using DHCP continues to work well. However the address pool still required occasional administration to release timed out leases and re-enable addresses that had been locked out of service.

12.16 802.11 b/g Wireless Network

Numerous members of the ships' complement made use of the wireless network service including scientists, technicians, officers and crew. The system performed adequately but the existing problem of the "radio1" access point on the Forecastle Deck crashing is still unresolved. I suspect it is the wired Ethernet side of the Access Point that has the problem, as it is still possible to talk to it wirelessly, but not possible to obtain an IP address via DHCP.

12.17 Email

Some problems with the email system during the early part of the cruise were traced to several hundred Argos beacon messages that were queued at base for transmission to the ship. Eventually after several days of long link times all these messages were downloaded. Three email transfers per day were done nominally, with occasional extra transfers as requested. During the tracking of the drifting EBH5 mooring, hourly or three-hourly transfers were done to obtain an accurate Argos data set for position and drift determination.

12.18 Data Storage

Two USB external hard drives are being used as a RAID 0 mirror hosted by Discovery3 as the /data32 export. This 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 this disk set is minimal and the performance more than adequate.

Data32 was used as the main storage for science data during the cruise. Level C and Techsas data was hosted by the internal SCSI disk in discovery1. There was no requirement for the provision of Samba shares of UNIX disks for Windows hosts.

12.19 Data Backups

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

Daily backup 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 (fssnap) to LTO2 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.

12.20 Data Archiving

Data32 has a large amount of historical data on it, and further existing RAPID data was transferred to the drive at the start of the cruise for operational use. The proposed data archive consists of the following components:

1) Reduced subset of data32, including only new data from D304 (DVD)
2) RVS & Techsas data files for the cruise up to the dragging operation (CD)
3) RVS data files for navigation and PES only during dragging operation (CD)
4) OS75 VMADCP data set (DVD)
5) SBE CTD data set (CD)

This set of DVDs and CDs was issued to the PSO. Two additional copies were made, one being left aboard RRS Discovery, and the other returned to the NOC. The final backup tapes were also left aboard the vessel with instructions to keep them and the D304 data on the UNIX disks until the ship departs after its upcoming port-call in Falmouth, UK.

12.21 Miscellaneous

Further work was done to resolve clock inaccuracy with the CTD logging PCs. These computers run Windows XP and although the master PC was already configured to synchronise its clock with the NTP GPS clock, the default windows “Internet Time” update period is one week. During this interval, the clock drifted several minutes per week when powered up, and apparently more when powered down. The windows registry on the machine was searched and an entry was found for the update period (entered in seconds). This was changed from one week to one day and after the system was rebooted the new update period was confirmed. There were still further problems with clock drift and this is thought to be associated with increased clock drift rate when the machine is powered down and also that Windows does not synchronise its clock on power up like UNIX systems do. To ensure that the CTD PCs had accurate clocks, they were subsequently manually synchronized to the NTP clock prior to each cast.

Problems were encountered during winch Cable Logging and Monitoring (CLAM) software modifications resulting in logging failure to the Level B. After attempted resolution based on the assumption that the Level B port was ‘blocked’, the problem was eventually resolved by disabling the FIFO on the CLAM system COM 2 port. No operational data was lost due to this problem.

Assistance was provided to establish an ASCII CTD Depth Readout to the Winch Cab to alleviate the Caley winch cable meter reset problem. This was the only real-time means of providing the winch driver with information as to the CTD package depth.

13. D304 Ashtech and GPS navigation

Laure Grignon & James Watson

High quality navigation data is crucial for obtaining accurate measurements of ocean currents using both vessel-mounted and lowered ADCPs. The following sections describe the operation and data processing paths for both ADCPs as well as the navigation data, crucial for obtaining accurate ADCP current measurements.

13.1 Navigation Summary

There are four GPS receivers on the *RRS Discovery*: the Trimble 4000 (gps_4000) which is a differential GPS; the Glonas (gps_glos) which uses a combination of Russian and American satellite networks; the Ashtech (gps_ash); and the GPS G12 (gps_g12). Data from all instruments were logged to the RVS level A system before being transferred to the RVS Level C system.

13.2 GPS

GPS data is extracted from the Trimble 4000 using the PEXEC gps4exec0. It uses correction from a SeaStar differential. At the beginning of the cruise, the GPS was set to wait for the correction from the differential every 20 sec. When the correction was not received, the GPS would record the same data line that the last one recorded. On day 148 around 7am, this time was changed to 2 minutes, so we found less short gaps after that.

gps4exec0 has been modified to calculate as well distrun, which was previously in the bestnav file. This distance has to be recalculated at the end of *gps4exec0* every time the file is updated, which means it takes longer to execute.

13.3 Ship’s Gyrocompass

The ship’s gyrocompass provides a reliable (i.e. not dependent on transmissions external to the ship) estimate of the ship’s heading. However, the instrument is subject to a latitudinal dependent error, heading dependent error and has an inherent oscillation following a change in heading.

Ship's heading from the gyro was logged every second to the RVS level C system. Processing consisted of regular acquisition of the gyro heading using PEXEC script *gyroexec0*. This exec requires the input of the times you want data extracted (e.g. 06134000000 – 06134235959, YYDDDHHMMSS, this is day 134). Data were edited for headings outside the 0-360 degree range, saved and then appended to a separate master file.

13.4 Ashtech 3DF GPS Attitude Detection unit

The Ashtech GPS is a system comprising four satellites receiving antennae mounted on the bridge top. Every second, the Ashtech calculates ship attitude (heading, pitch and roll) by comparing phase differences between the four incoming signals. These data are used in post-processing to correct the ADCP current measurements for 'heading error'. This post processing is necessary because in real-time the ADCP uses the less accurate but more continuous ship's gyro heading to resolve east and north components of current. In processing, small drifts and biases in the gyro headings are corrected using the Ashtech heading measurements.

Process outline

ashexec0 acquisition of raw data

ashexec1 merge Ashtech and gyro data. The difference between the Ashtech and gyro headings are calculated (a-ghdg) and set in the range between -180 and 180.

ashexec2 quality control data. This exec removes data outside the limits for the following variables.

hdg	0	360
pitch	-5	5
roll	-7	7
attf	-0.5	0.5
a-ghdg	-7	7
mrms	0.00001	0.01
brms	0.00001	0.1

- Manually edit any remaining outliers in a-ghdg using plxyed with ash.pdf
- Interpolate a-ghdg using pintrp

ashmaster.exec append to a master file - ash304i1.master. This master file is then copied as ash304i1.int for use in meteorological data processing.

14. D304 CTD Calibration

Stuart Cunningham

Calibration of the CTD data follows three steps. In the first raw engineering frequency data from the instrument are converted to engineering then physical units using routines from the instrument manufacturer. In the second step the calibrated data are reduced in frequency from 24hz to 1hz and then gridded to 2db data. Salinity sample data are then merged with the CTD data to produce a calibration of the CTD conductivity sensor. Thirdly the salinity sample data and CTD data are joined in a sample file for calibration of the CTD conductivity sensor against salinity samples.

14.1 SeaBird Processing

Raw CTD data are logged directly to a PC from the SeaBird deck unit using SeaBird software (Seasave Win32 version 5.35). The following routines then applied instrument calibrations to convert from frequency data to physical units.

1. DatCnv: File in D304*nnn*.dat, D304*nnn*.BL, Instrument calibration file D304*nnn*.CON. File out D304*nnn*.cnv, D304*nnn*.ros (scan offset zero, scan range duration 0.001s).
2. WildEdit: File in/out : D304*nnn*.cnv. The mean and standard deviations are computed on blocks of 500 points. Points lying outside two standard deviations are excluded. Points then lying outside ten standard deviations of a new mean are then replaced by absent data.
3. CellTM: File in/out: D304*nnn*.cnv. Removes conductivity cell thermal mass effects with a recursive filter, alpha=0.03, tau=7.0.
4. Trans: File in/out: D304*nnn*.cnv. Convert file from binary to ascii.

14.2 PSTAR Processing

ctd0: File in D304*nnn*.cnv (ascii format). File out ctd304*nnn*.24hz. Read ascii file to PSTAR format.

ctd1: File in ctd304*nnn*.24hz. File out ctd304*nnn*.1hz, .10s. Average 24hz file to 1hz and 10s.

ctd2: File in ctd304*nnn*.1hz. File out: ctd304*nnn*.ctu. Create 1hz up/down file with bad datacycles at beginning and end of cast excluded. File out: ctd304*nnn*.2db. Sort on pressure and average downcast 1hz file to 2db pressure grid.

ctd3_matlab.m: For each cast plot a set of diagnostic T/S and profile plots.

fir0: File in: D304*nnn*.ros, D304*nnn*.cnv, ctd304*nnn*.10s. File out: fir304*nnn*. Read SeaBird .ros file into PSTAR using header data extracted from .cnv file. The pstar file is then merged with the .10s file to create a firing file with one record per bottle fire. Each record is a 10s average of the ctd upcast data at the time of the bottle fire (5s before and after).

sam0: File in fir304*nnn*, sam.masterD304, ctd304*nnn*.24hz. File out: sam304*nnn*. Create a blank sample file, paste in firing data and header data from the .24hz file.

sal.exec: File in: sal304*nnn*.txt. File out: sal304*nnn*. Read salinity sample text file into PSTAR format.

passal: File in: sal304*nnn*, sam304*nnn*. File out: sam304*nnn*. Paste salinity sample data from sal into the sample file sam.

botcond.exec: File in: sam304*nnn*. File out: sam304*nnn*, sam.append.cal. Compute botcond=fn(temp,press,botsal) and botcond2=fn(temp2, press, botsal) in sam file. Create a file of all sample files appended.

ctd_cal_noc.m: File in: ctd_cal_append.mat (created from PSTAR file sam.append.cal). Create CTD conductivity calibration coefficients.

pheadr.exec: File in: ctd304*nnn*.1hz, File out: ctd304*nnn*.1hz. Swap primary and secondary variables: cond<->cond2, temp<->temp2, potemp<->potemp2, salin<->saliln2. Primary Seabird Conductivity sensor s/n 04c-2165 (casts 2 to 10) was much noisier and had a larger displacement between down and up casts compared to Seabird Conductivity sensor s/n 04c-3160. For this reason the primary and secondary designations were swapped. Therefore the final data set labelled primary comes from conductivity sensor s/n 04c-2165 and temperature sensor s/n 03p-4593.

ctd_calib_D304.exec: File in: ctd304*nnn*.1hz, File out: ctd304*nnn*.1hz. Apply conductivity calibration coefficients to 1hz data.

ctd1_10s.exec: File in: ctd304*nnn*.1hz, File out: ctd304*nnn*.10s. Recreate 10s data from calibrated data.

ctd2.exec running subroutine *ctd2_noc*: File in: ctd304*nnn*.1hz, File out: ctd304*nnn*.ctu, .2db. New ctu and 2db files with calibrated data.

fir0_noc: Create new firing file with calibrated ctd data.

pasfir_noc: Paste calibrated firing data into sample file.

botcond_noc.exec: File in: sam304*nnn*. File out: sam304*nnn*, sam.append.cal. Compute botcond=fn(temp,press,botsal) and botcond2=fn(temp2, press, botsal) in sam file. Create a file of all sample files appended.

position_d304.exec: File in: ctd304*nnn*.1hz, File out: *nnn*.position. Extract time using data cycles at time of cast beginning, end of down cast in 1hz file and merge with a 30 second navigation file.

add position_d304.exec: Adds positions to all CTD and sample files.

14.3 CTD Conductivity Calibration Coefficients

Calibrations of CTD conductivity against bottle samples were obtained using *ctd_cal_noc.m*. This programme reads file *sam_append_cal.mat* (created from PSTAR file *sam.append.cal*). A variety of plots are used to identify bottle samples with incorrect conductivities. Data were first rejected where the ratio $K=\langle C_{bot}/C_{CTD}\rangle$ was outside the limits 0.999 to 1.001 where $\langle\ \rangle$ denotes station average and then outside ±3 standard deviations of the new station mean (Table 14.1).

Station Number	Bottle Number
4	12
5	5
5	6
7	11
7	12
8	11
8	12

Table 14.1: CTD Conductivity bottle samples not used for CTD calibration

A second order polynomial was then fitted to K versus C_{bot}, giving $K=1.007+4.0652e\text{-}07xC_{bot}$ $+4.0652e\text{-}07x$ C_{bot}^2 and CTD corrected=C_{CTD}*K.

After this correction was applied a final station-by-station correction was obtained by fitting a second order polynomial to K versus station number giving K2=1.0001-3.8463e-05xC_{bot} +3.1638e-06x C_{bot}^2 and CTD corrected=C_{CTD}*K2 (Table 14.2).

Station Number	K2
002	1.00003243895210
003	1.00000979475631
004	0.99999347825173
005	0.99998348943836
006	0.99997982831620
007	0.99998249488525
008	0.99999148914551
009	1.00000681109697
010	1.00002846073965

Table 14.2: Station-by-station conductivity correction coefficients K2.

The final standard deviation of conductivity residuals C_{bot}-C_{CTD} for 91 out out of 98 bottle samples is 0.000867 mS/cm (Figure 14.1). NB: mmho/cm ≡ mS/cm. Station times and positions are summarised in Table 14.3.

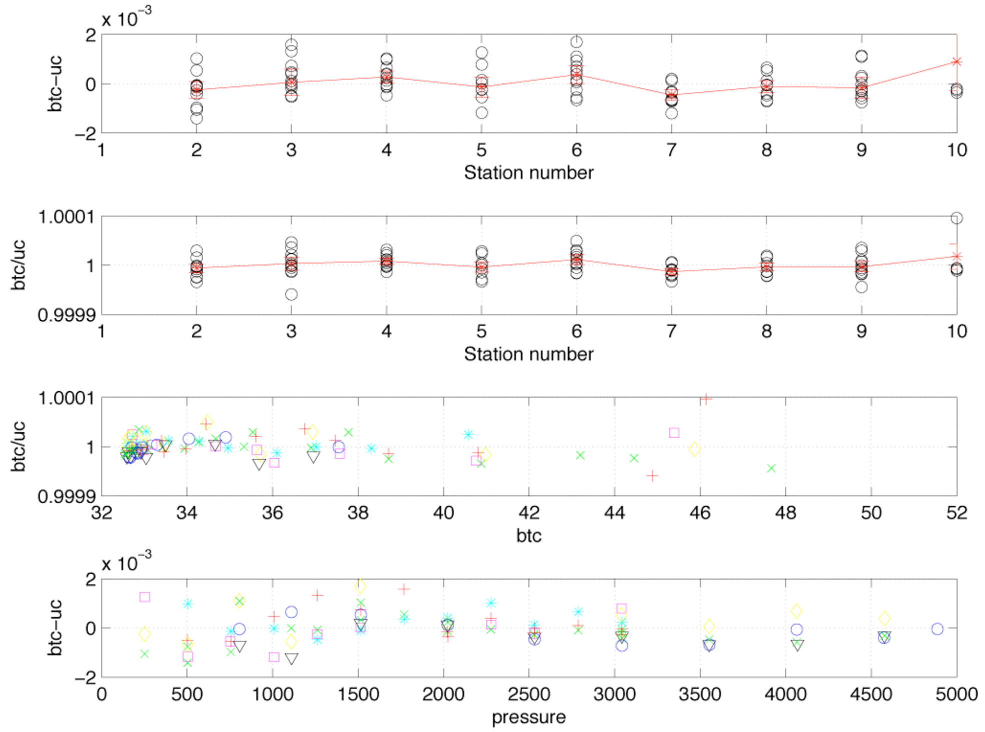


Figure 14.1: Conductivity ratio and differences plotted against station number, bottle conductivity (mS/cm) and pressure (dbar) for the calibrated CTD conductivity data.

In the lower two panels the colours and symbols change for each station they are (station number/symbol/colour): 001/o/blue, 002/x/green, 003/+/red, 004/*/cyan, 005/s/magenta, 006/d/yellow, 007/v/black, 008/o/blue, 009/x/green, 010/+/red.

Station number	year	month	day	hhmmss	Lat deg	Lat min	Lon deg	Lon min	Pmin dbar	Pmax dbar	Depth m
001	2006	05	12	104052	028	27.59	-015	48.04	3.0	1517.0	1501.1
002	2006	05	12	152240	028	26.89	-015	24.64	1.0	3045.0	3002.9
003	2006	05	12	204418	028	25.76	-015	10.54	3.0	3043.0	3000.9
004	2006	05	14	233216	027	13.15	-015	36.99	1.0	3043.0	3001.2
005	2006	05	16	183830	024	40.39	-021	58.21	1.0	3041.0	2999.8
006	2006	05	17	195102	023	48.16	-024	7.08	1.0	5093.0	5001.2
007	2006	05	18	011646	023	47.97	-024	7.02	3.0	5093.0	5001.2
008	2006	05	21	124219	024	39.13	-036	3.89	3.0	4889.0	4802.8
009	2006	05	24	214521	025	18.91	-050	16.21	1.0	5301.0	5202.4
010	2006	06	01	151330	023	48.50	-024	6.37	1.0	3043.0	3001.9

Table 14.3: Summary of CTD station times and positions.

15. D304 WATER SAMPLE SALINITY ANALYSIS

Enrique Vidal

15.1 Equipment

All salinity sample analysis was performed on the UKORS Guildline 8400B Salinometer in the Constant Temperature (CT) laboratory. The water bath temperature was set to 24°C and the laboratory temperature maintained between 22°C and 23°C.

15.2 Sample Collection and Analysis

On each CTD cast, one water sample was drawn per Niskin bottle for salinity analysis (except station 1 where two Niskin bottles were fired at each depth and two samples taken from each Niskin bottle). Samples were taken in 200ml glass sample bottles, rinsed 3 times, and sealed with disposable plastic stoppers and screw on caps after drying the neck. Samples were stored in the CT laboratory for a minimum of 24 hours before analysis to allow equilibration to the laboratory temperature.

A sample of IAPSO Standard Seawater was run every 24 samples for salinometer calibration. One Standard Seawater batch was used: P144. One bad standard in batch P144 was identified and rejected. Laure Grignon, James Watson and Enrique Vidal carried out the sample collection, and Enrique Vidal carried out the water sample analysis.

Stability of the salinometer during the cruise is indicated in Figure 15.1. Corrections for the samples from the underway salinities are included for this purpose. The correction is applied to the conductivity ratio measured by the salinometer (equal to the expected standard value minus the measured value). The base value for this correction was taken from the first good SSW sample measured (in this case, the second SSW bottle, with a value of 1.99979). Correction has a range of +0.00003 to -0.00005.

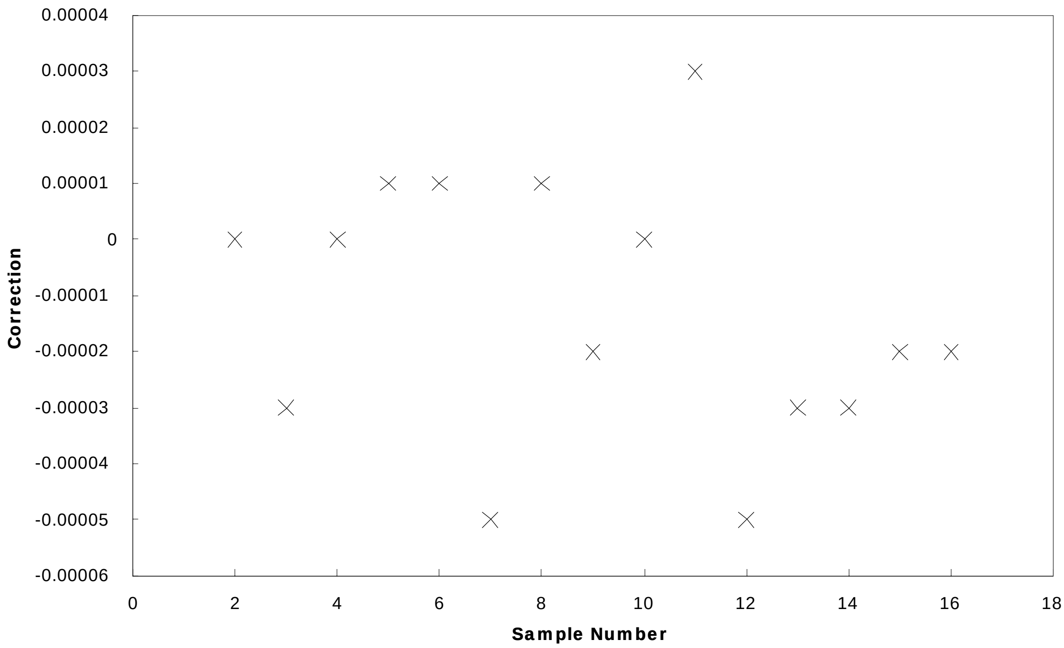


Figure 15.1: Correction applied to salinometer conductivity reading. A correction of +0.00001 equals +0.0002 psu.

15.2 Data Processing

Raw conductivities from the salinometer were converted to salinities using an Excel spreadsheet, accounting for salinometer calibration. Results were saved to a comma delimited text file with name tsg304*nn*.csv.

16. D304 Salinity Calibration of Underway Data

Enrique Vidal

For calibration of underway thermosalinograph salinity data, samples were collected from the uncontaminated water supply at roughly four hour intervals. Sampling frequency varied considerably during and between mooring operations. No samples were taken while the ship was stationary or at very slow ship speeds.

The collected bottle salinities were analysed using the procedure detailed in section 15 and the results were entered into Excel CSV files, ftp'd onto the UNIX system and converted into PSTAR format.

Processing of the TSG data is summarised in table 16.1. Finally calibrated underway salinity data was not worked up on the cruise.

Process	**File(s) In**	**File(s) Out**
tsg.exec: reads .csv file to text to pstar	tsg304nn.csv	Tsg304nn
tsg2.exec: calculates time in seconds from jday,hh,mm,ss and appends to master data file: 304tsg.samples	tsg304nn	304tsg.samples
tsg3.exec: merges smt master (10 minute averaged) file into tsg samples master file	304tsg.samples	304tsg_samples.mrg

Table 16.1: Underway salinity processing sequence

17. D304 Ocean Surveyor 75kHz Shipboard Acoustic Doppler Current Profiler

James Watson and Laure Grignon

17.1 Configuration and Performance

The 75kHz ADCP is a narrow band phased array with a 30-degree beam angle. Data was logged on a PC, using RDI data acquisition software (version 1.3). The instrument was configured to sample over 120 second intervals, with 60 bins of 16m thickness, and a blank beyond transmit of 8 m. Data were then averaged into 2 minute averaged files (Short Term Averaging, file extension STA) and 10 minute averaged files (Long Term Averaging, file extension LTA). The former were used for all data processing. The software logs the PC clock time and its offset from GPS time. This offset was applied to the data during processing, before merging with navigation. Gyro heading and GPS Ashtech heading, location and time were fed as NMEA messages into the software, which was configured to use the gyro heading for coordinate transformation.

Calibration of the OS75 ADP was not performed due to the unavailability of a bottom track record before day 155. Instead calibration values of phi and A were used from a previous cruise, D279. On day 155, at 15h55 GMT, the configuration file was changed to bottom track mode: os75NBD304bt with command BP=00.1. The BX maximum tracking depth was set to 1200 m. The logging was stopped on day 155, before 19:39 GMT. A final calibration using these bottom track data has not been worked up.

17.2 Process Outline

Data were logged on the OS75 PC and transferred by ftp to a UNIX workstation for processing.

surexec0:	read data into PSTAR format from RDI binary file; write water track data into files of the form sur304nn.raw and equivalent, where nn is a two character code; scale velocities to cm/s and amplitude by 0.45 to dB; correct time variable by combining GPS and the PC times; set the depth of each bin.
surexec0b:	extract data corresponding to one day to create a raw file for this day only, using other raw files.
surexec1:	edit data (status flag equal to 1 is bad data); edit on percent good variable; move ensemble time to the end of its interval.
surexec2:	merge data with Ashtech-gyro difference file (created by ashexec2) and correct heading.
surexec3:	calibrate velocities by scaling by factor A and rotating by angle phi.
surexec4.5:	calculate absolute velocities by merging with navigation data (gp4) and removing the ship's velocity over the ground from the ADCP data.
pedita:	edit the .abs file to keep only the ship's velocities (ve and vn) and the absolute velocities (absve and absvn) that are between -1000 and 1000 cm/s. This step was added due to the huge and unrealistic

	velocities obtained when the gps did not receive the correction term to apply to the data from the differential.
plot_os75.m	Matlab script to load and plot OS75 data, to interpolate over longitude and to calculate and plot the longitudinally averaged velocities.

18. D304 Surface Met Data

Enrique Vidal

The meteorological data was processed by the following execs:

Smtexec0	transfers the underway surfmet data from RVS to PSTAR format.
Smtexec1a	changes surfmet absent data values of 99999 to –999, computes the surface salinity and merges in bestnav positions.
Smtexec1b	merges the underway data with the heading files, gyro and ash-gyro.
Smtexec2	computes vessel speed and subtracts this from relative winds to get true wind speed and direction.
Smtexec3	calculates JDAY from time in seconds
Smt_plot.m	produces 5 day plots of the data in Matlab

This processing was done on a daily basis. The Ashtech data were bad up until 06133094900. This made the wind data for the first two days erroneous. Plots were produced of the Surfmet data every 5 days. Table 18.1 and table 18.2 show the SMT calibrations for mean meteorology parameters measured during D304.

Variable	Sensor s/n	sensitivity	m	c
PAR (port) W/m^2	28558	1.000 mV/100W/m^2	100000	0
PAR (stbd) W/m^2	28557	1.000 mV/100W/m^2	100000	0
TIR (port) W/m^2	47463	10.63 µV/W/m^2	94073.4	0
TIR (stbd) W/m^2	47462	11.84 µV/W/m^2	84459.5	0

Table 18.1: Calibrations for radiation sensors.

To convert from mV/100W/m2 or µV/W/m2 to W/m2 = (1/cal value)x106 × raw mvolts. A good sanity check is to plot the difference of port and starboard radiation sensors. Calibrated data (W/m2) = m × raw + c.

Variable	Sensor s/n	m	c
Temperature °C	UI850012	1.0160	-0.05
Humidity %	UI850012	1.0891	1.78
Pressure mbar	U1420016	1.00039	-0.71

Table 18.2: Air temperature, humidity and pressure sensor serial numbers and calibration coefficients. Calibrated data = m × raw + c.

Appendix A: Additional Figures

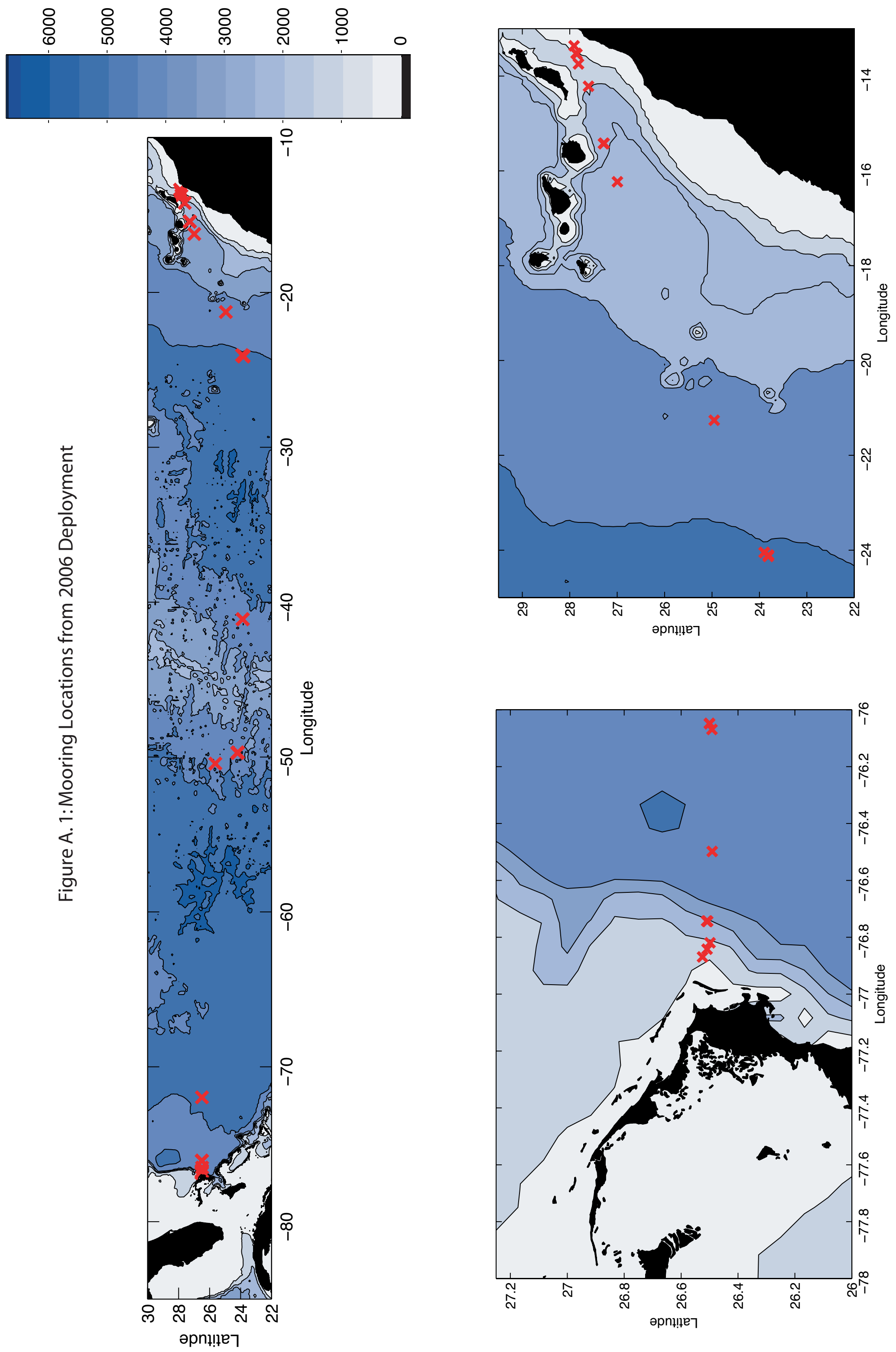


Figure A. 1: Mooring Locations from 2006 Deployment

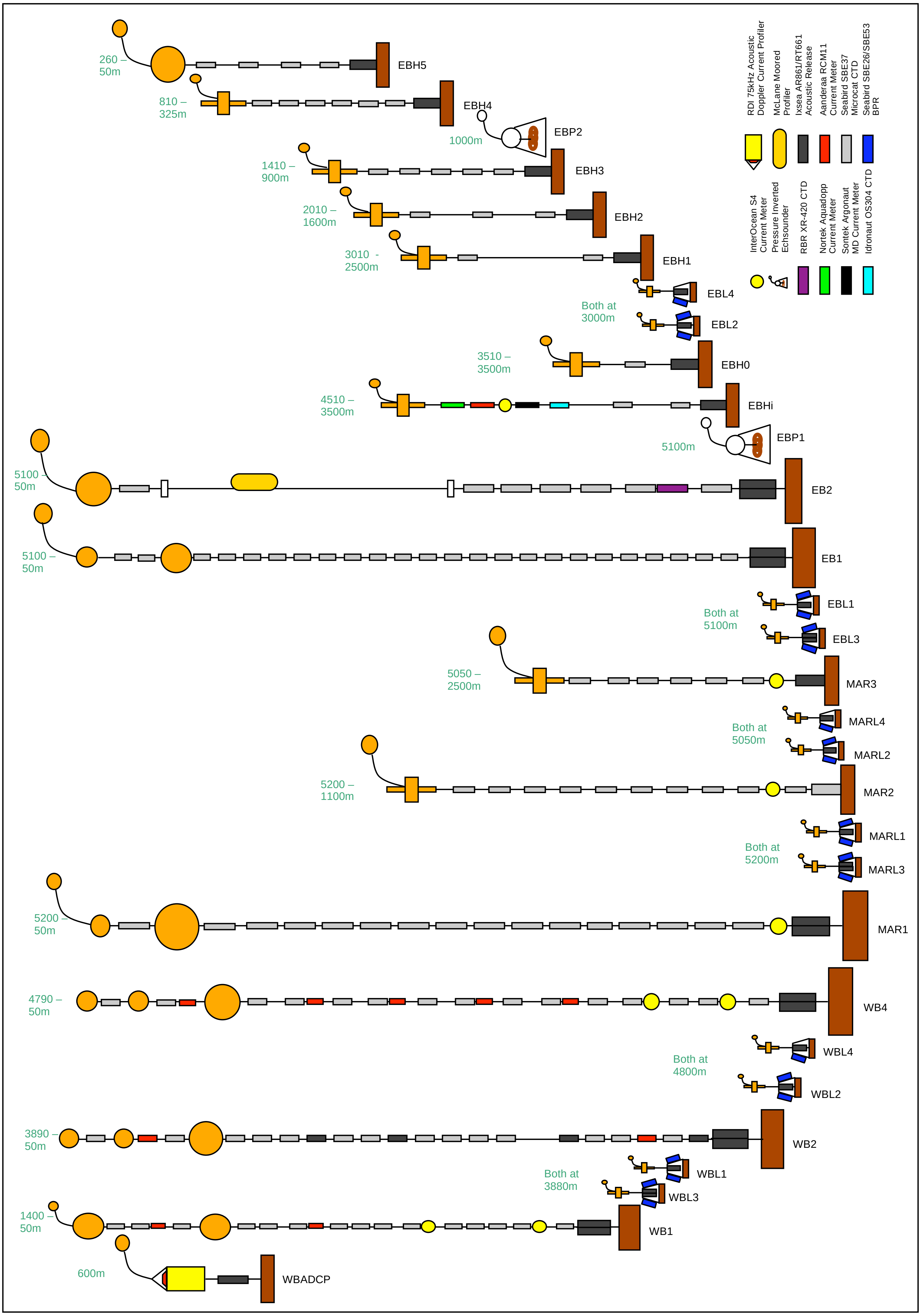


Figure A.2: Mooring Array Schematic – Spring 2006 Deployment (not including University of Miami Moorings)

Figure A.3: Whole Mooring Array as Deployed 2006

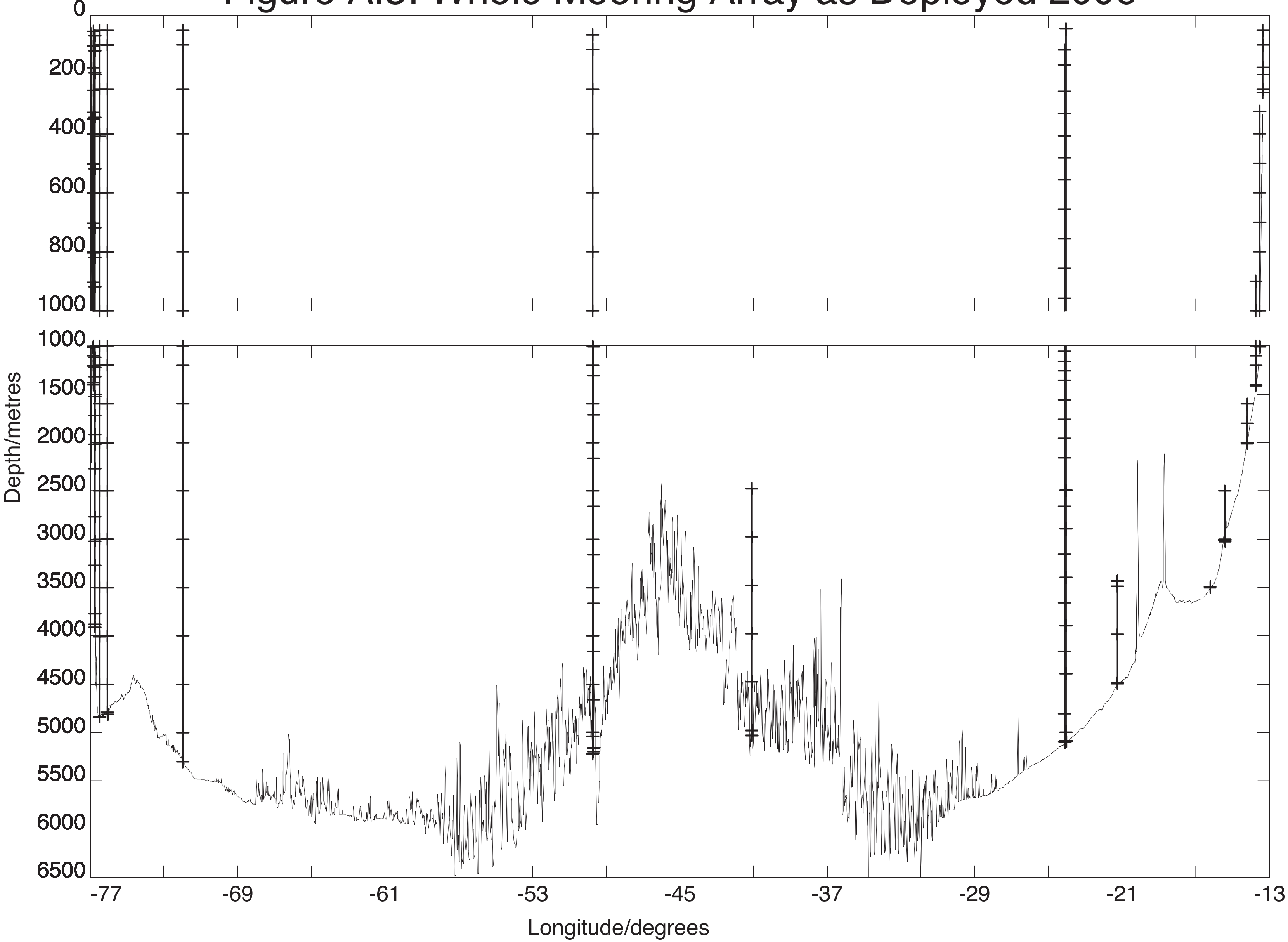


Figure A.4: Eastern Boundary Mooring Array as Deployed 2006

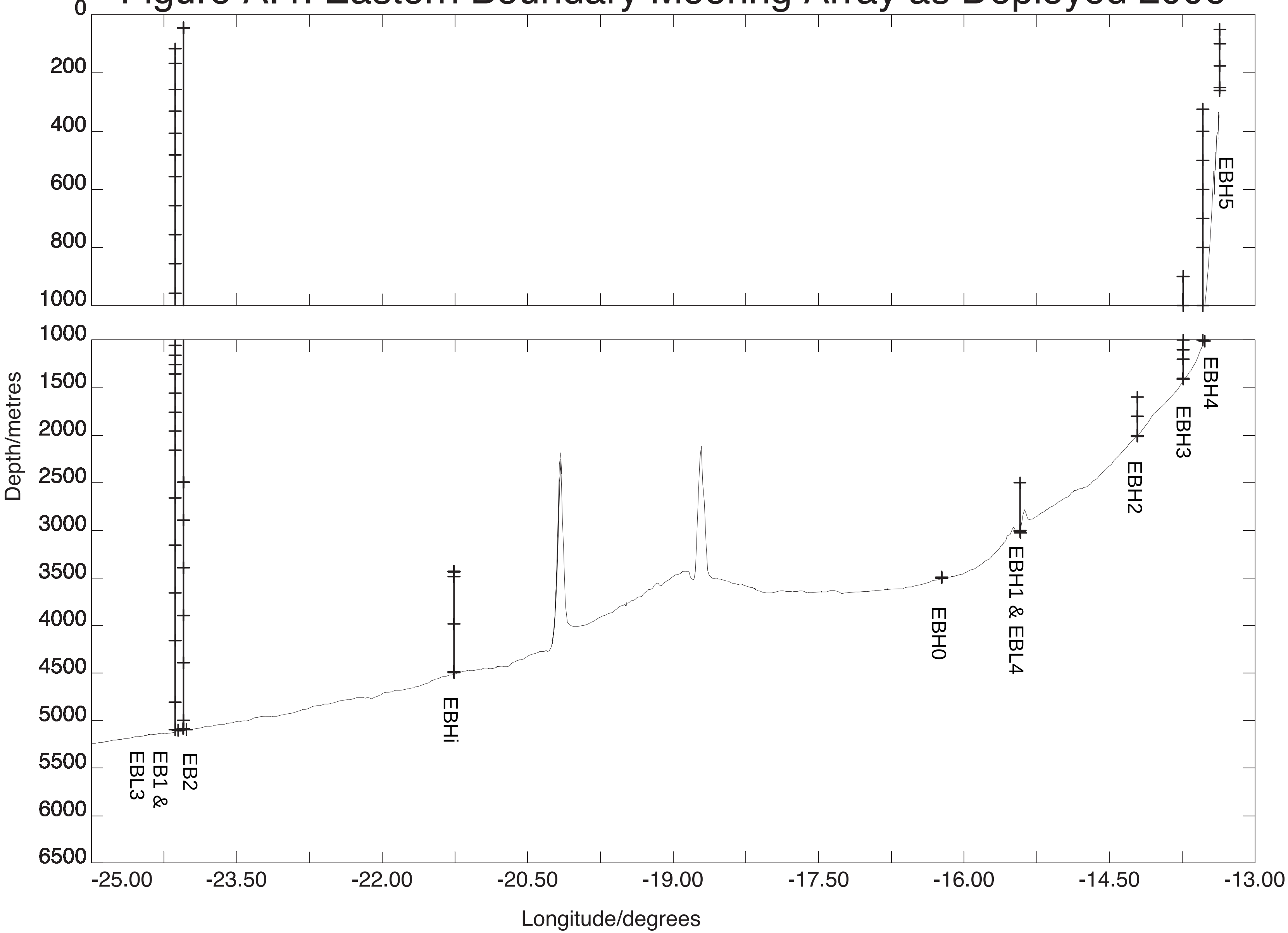


Figure A.5: Mid Atlantic Ridge Mooring Array as Deployed 2006

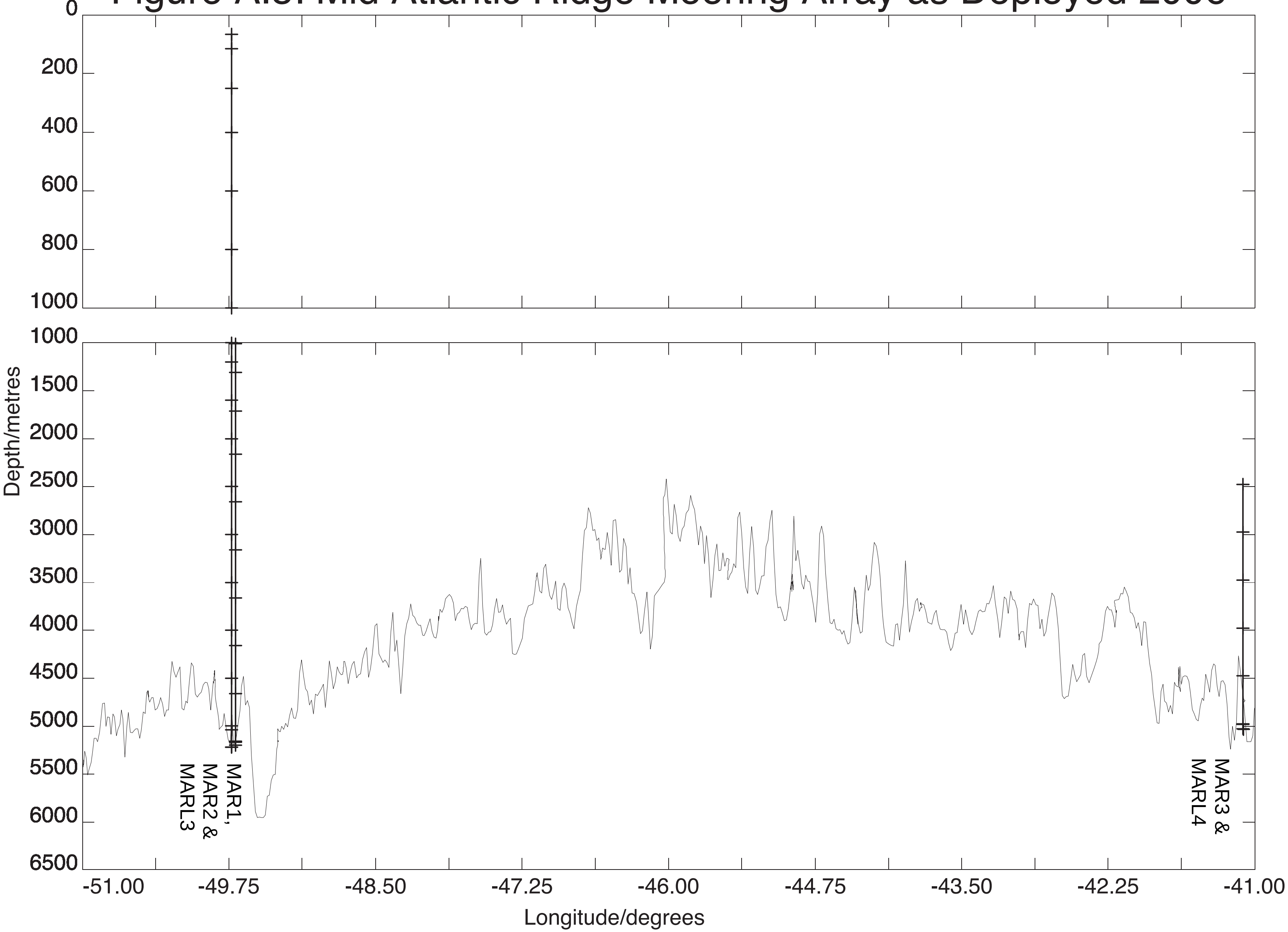


Figure A.6: Western Boundary Mooring Array as Deployed 2006

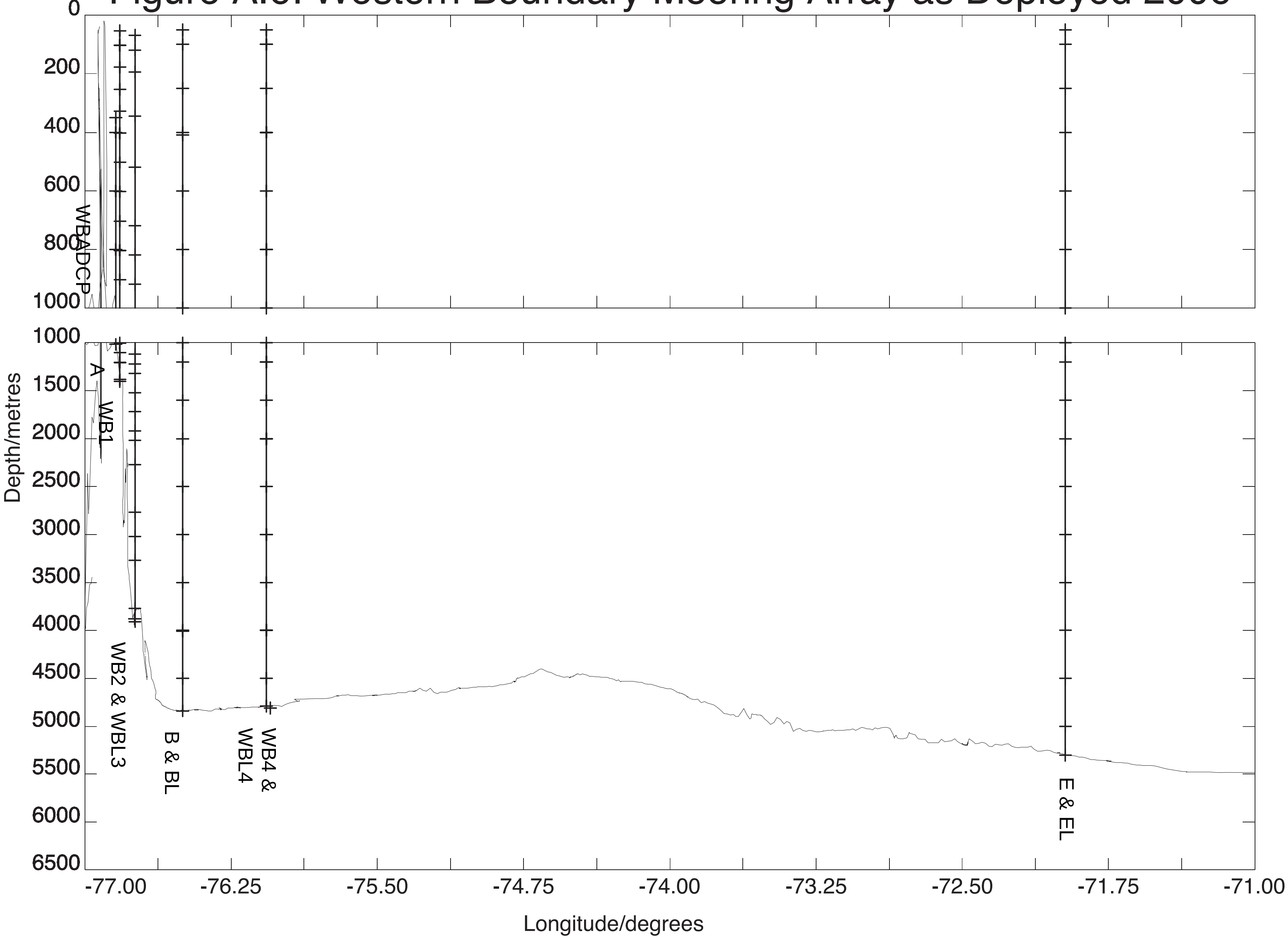


Figure A.7: Mooring diagram of WBADCP as deployed on RB0602

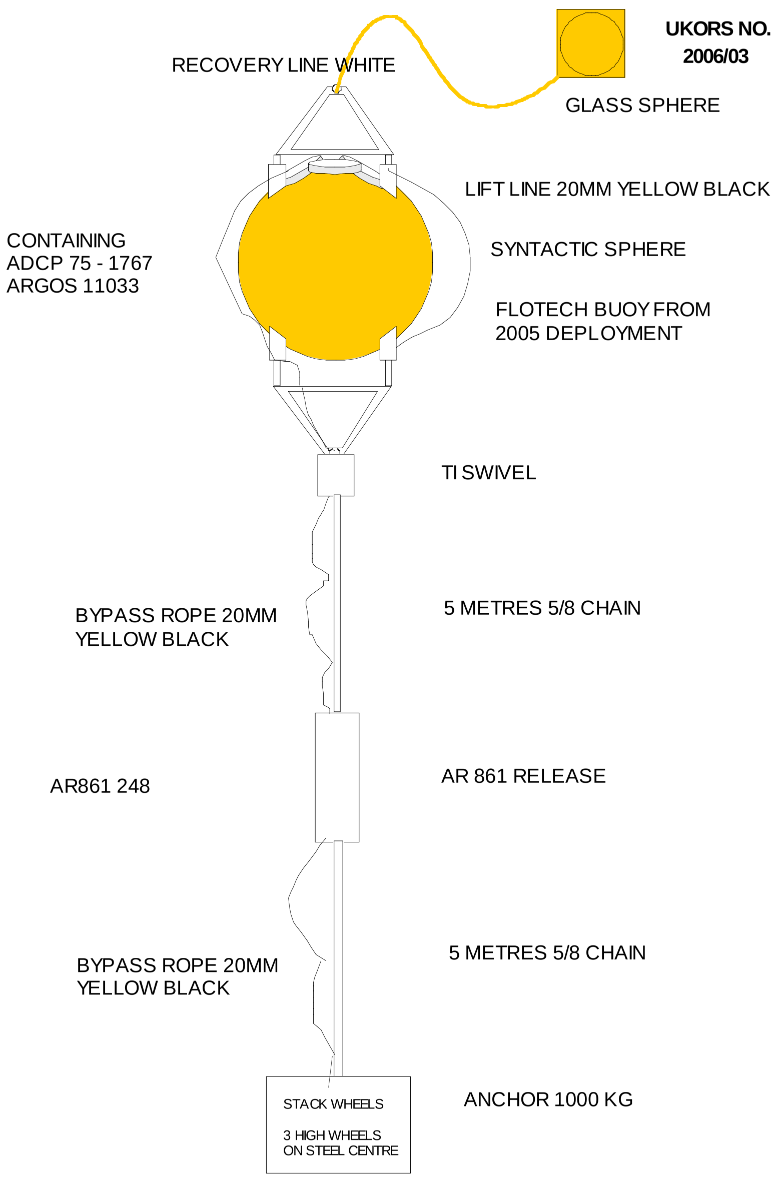


Figure A.8: Mooring diagram of WB1 as deployed on RB0602

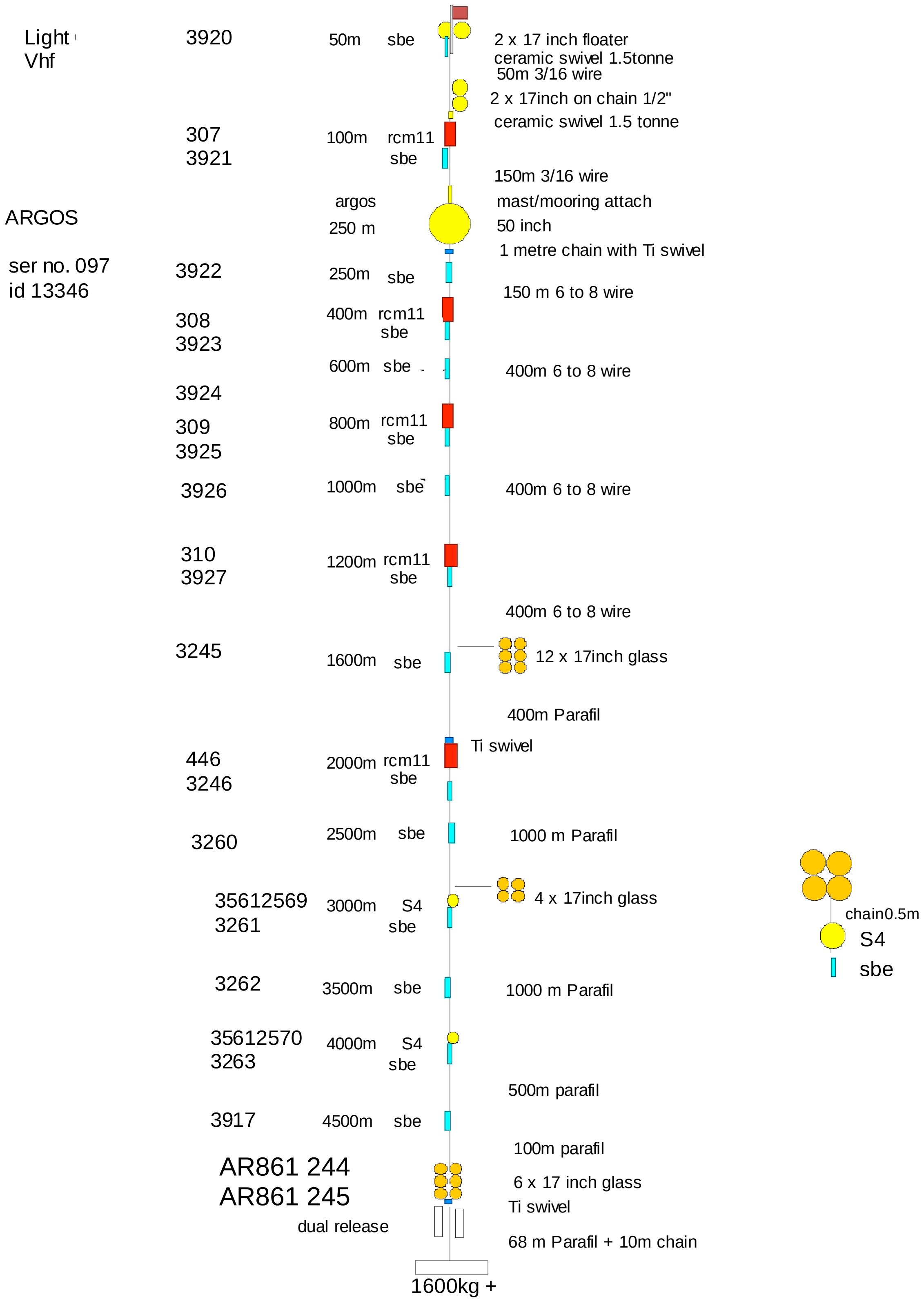


Figure A.9: Mooring diagram of WBL3 as deployed on RB0602

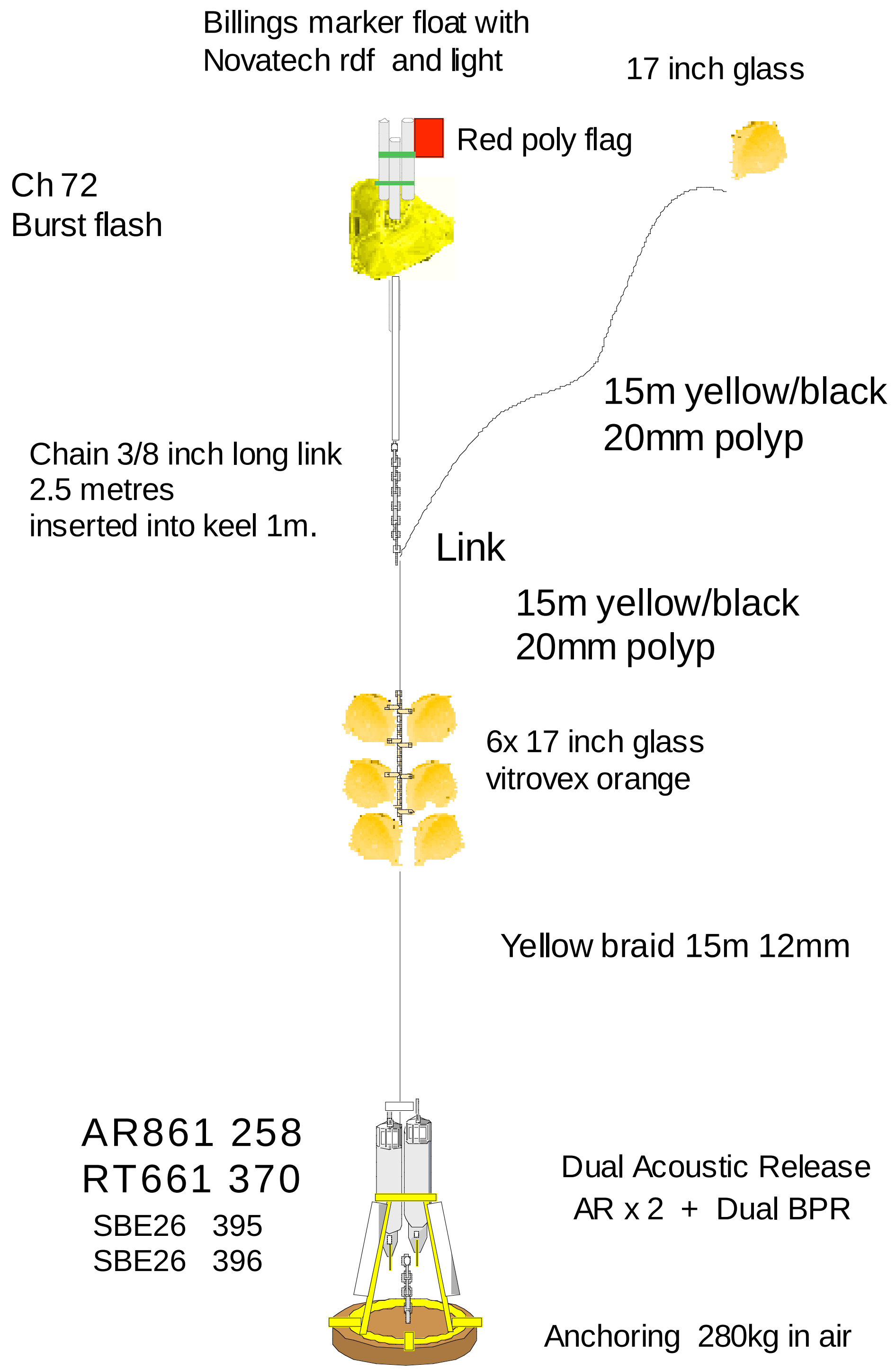


Figure A.10: Mooring diagram of WB2 as deployed on RB0602

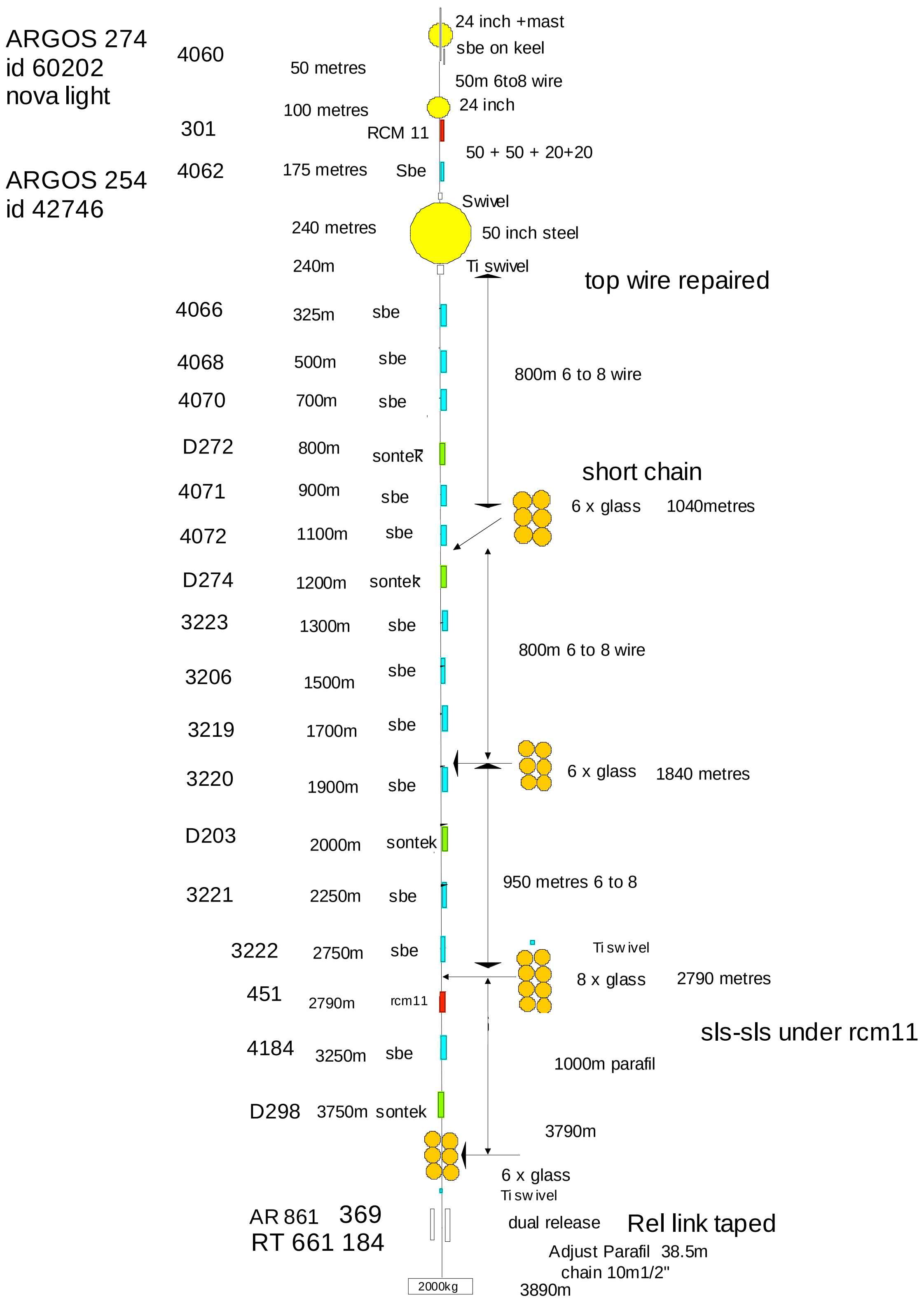


Figure A.11: Mooring diagram of WB4 as deployed on RB0602

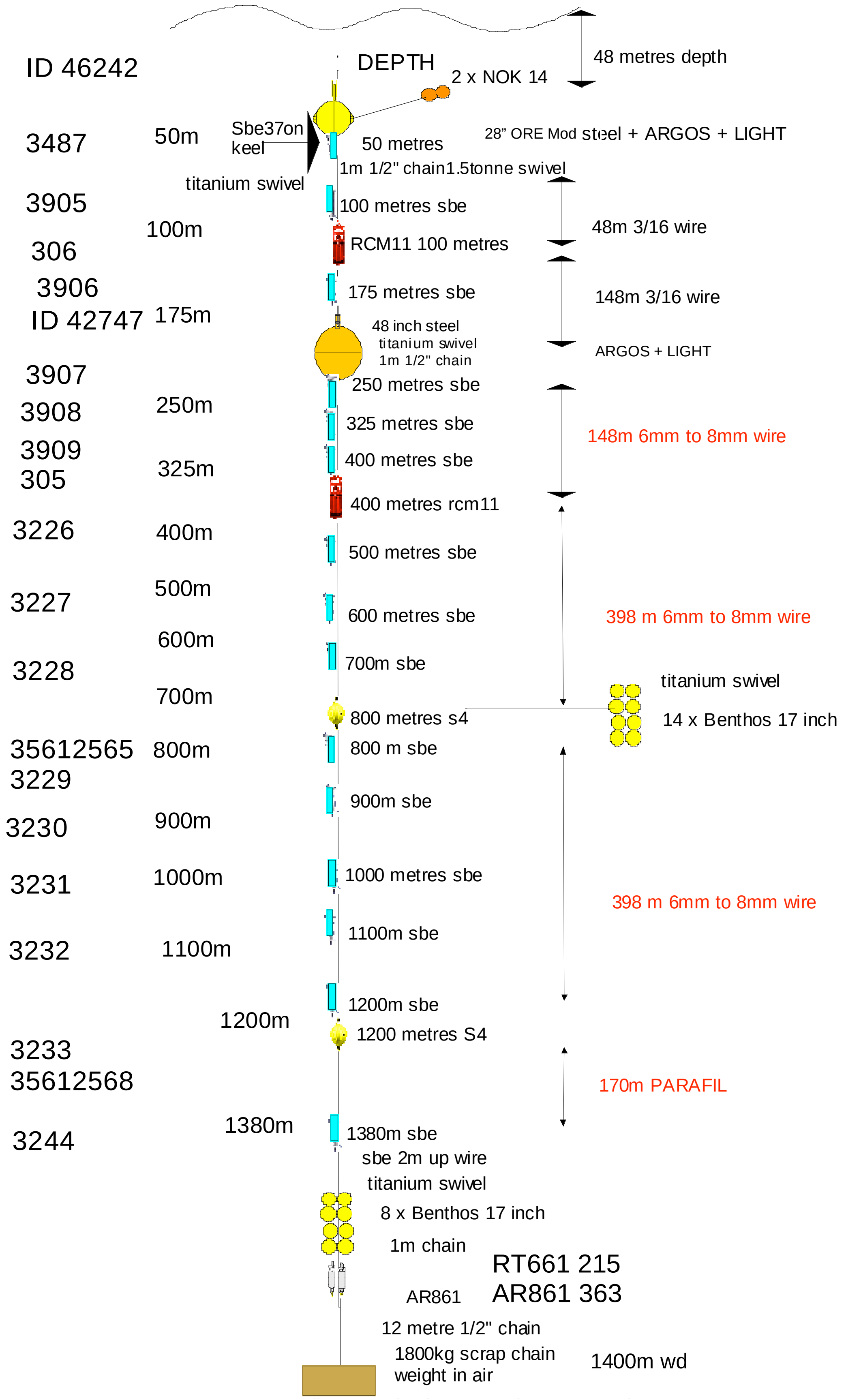


Figure A.12: Mooring diagram of WBL4 as deployed on RB0602

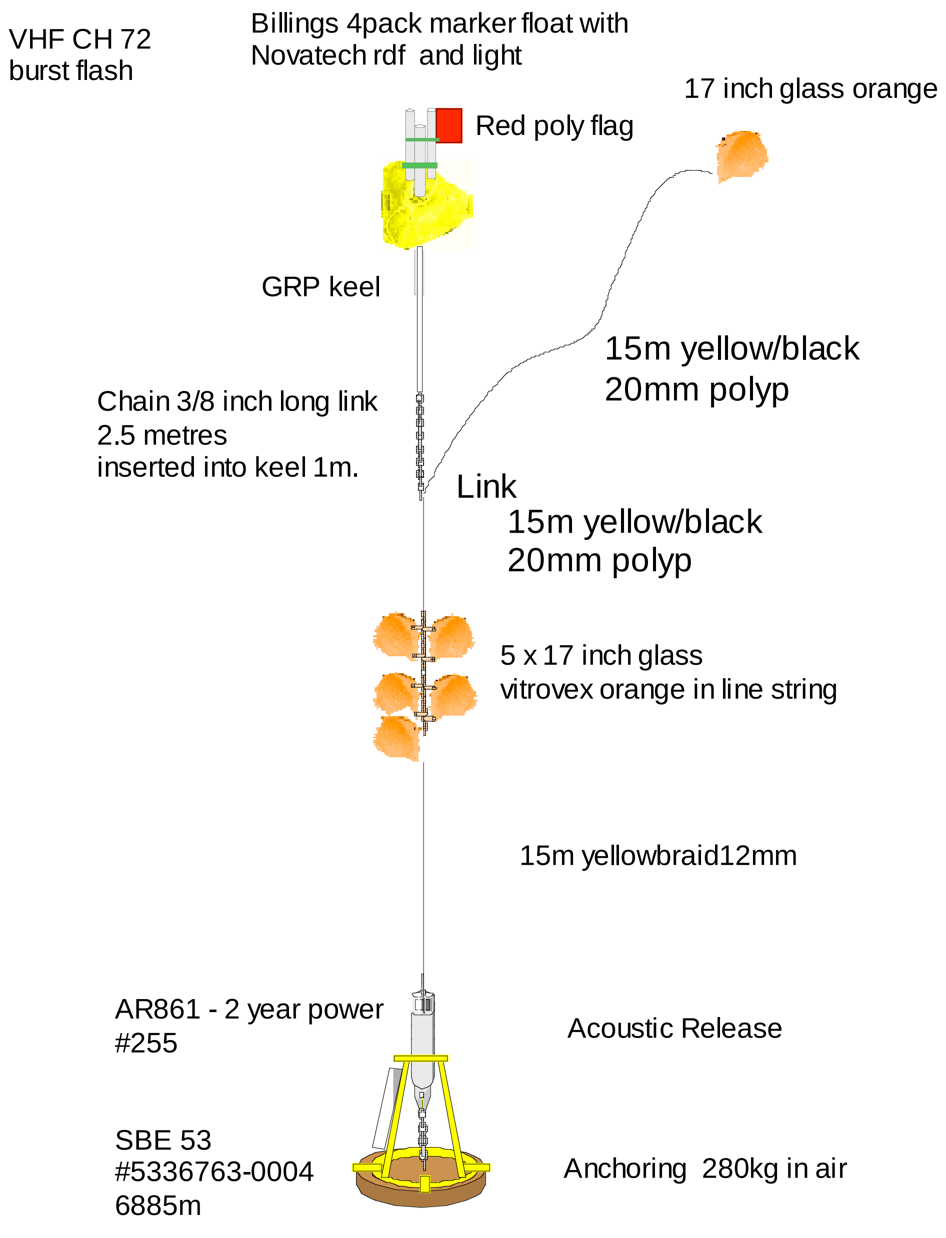


Figure A.13: Mooring diagram of EBH5 as deployed and subsequently recovered on D304

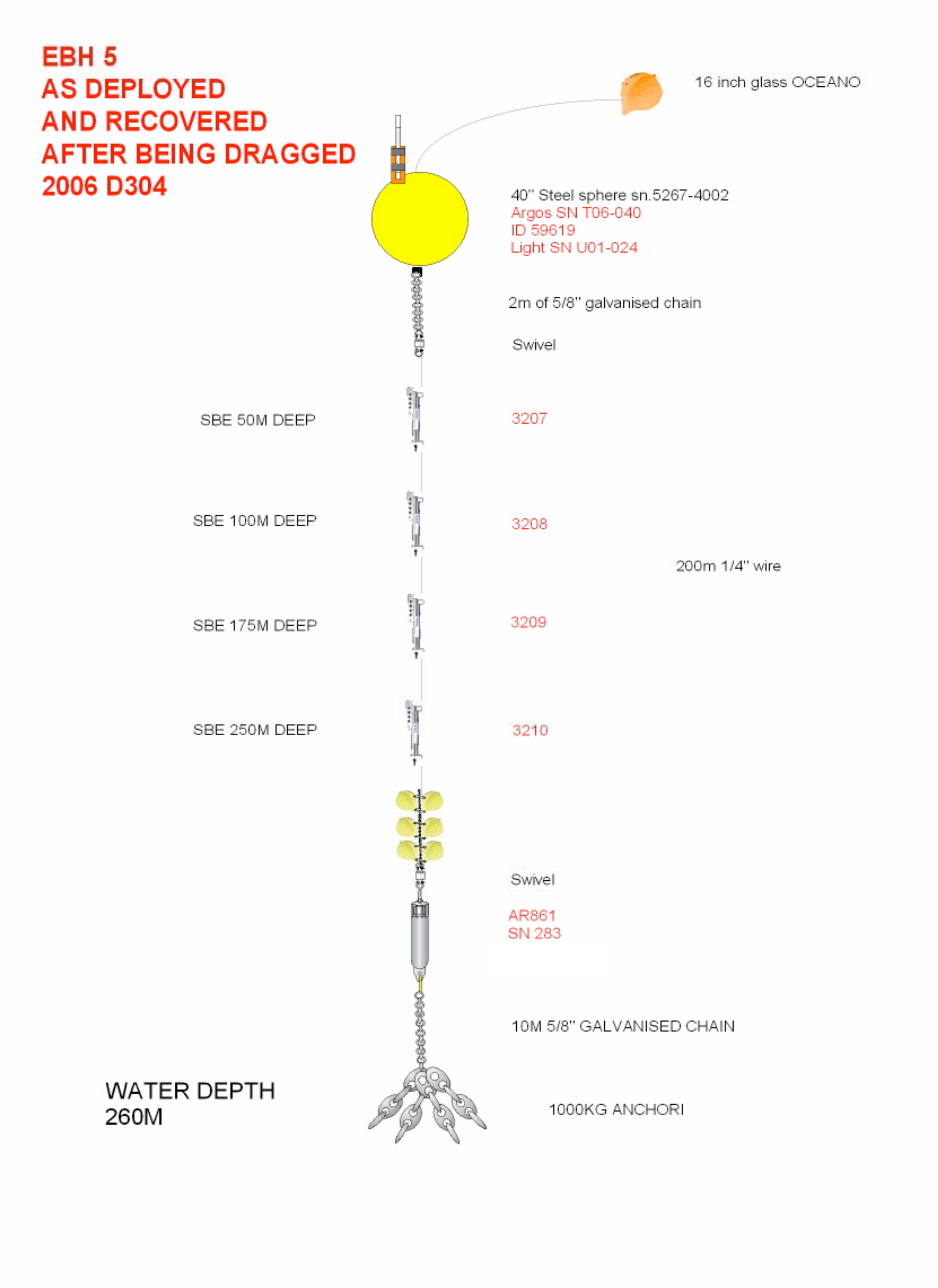


Figure A.14: Mooring diagram of EBH5 as re-deployed on D304

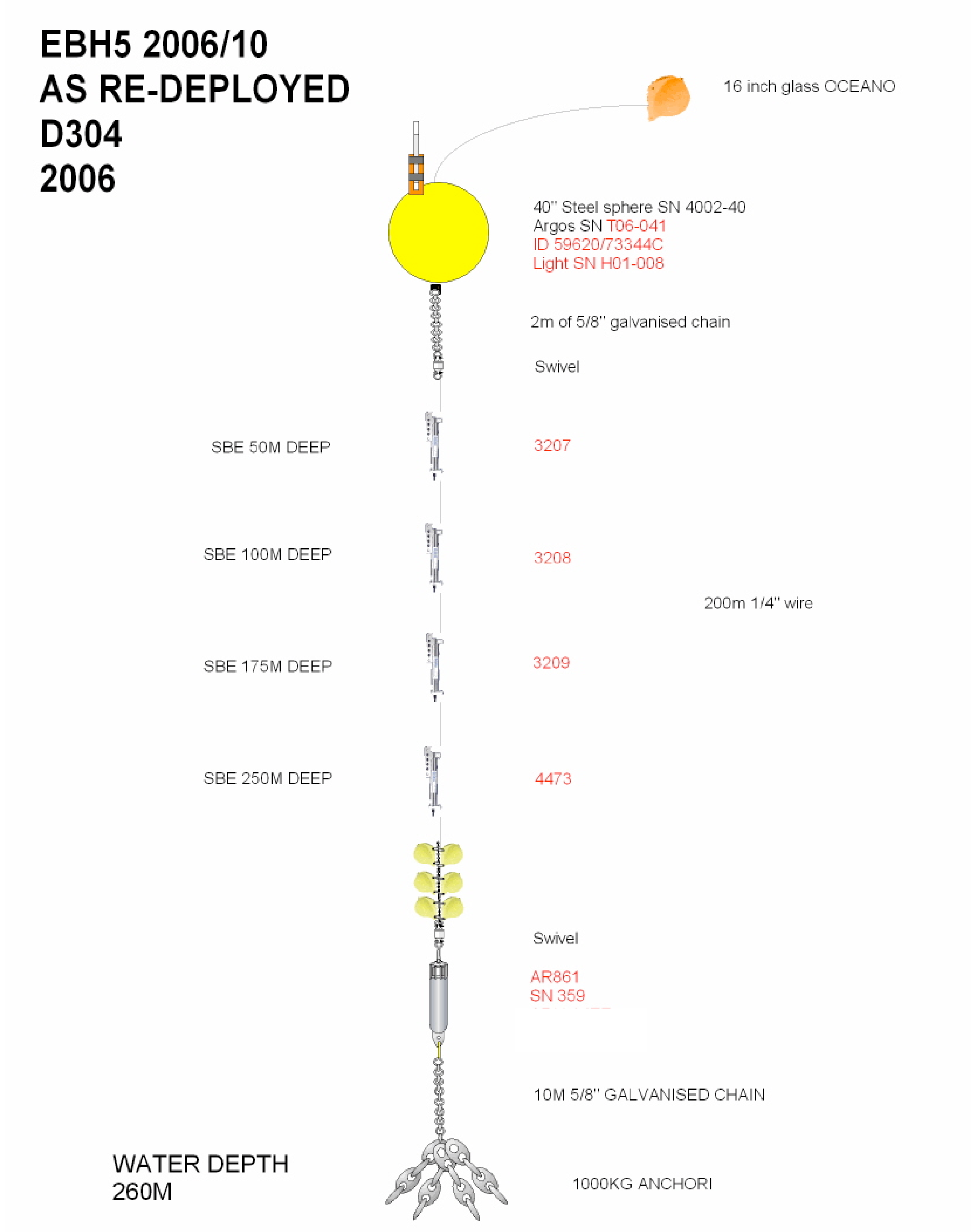


Figure A.15: Mooring diagram of EBH4 as deployed on D304

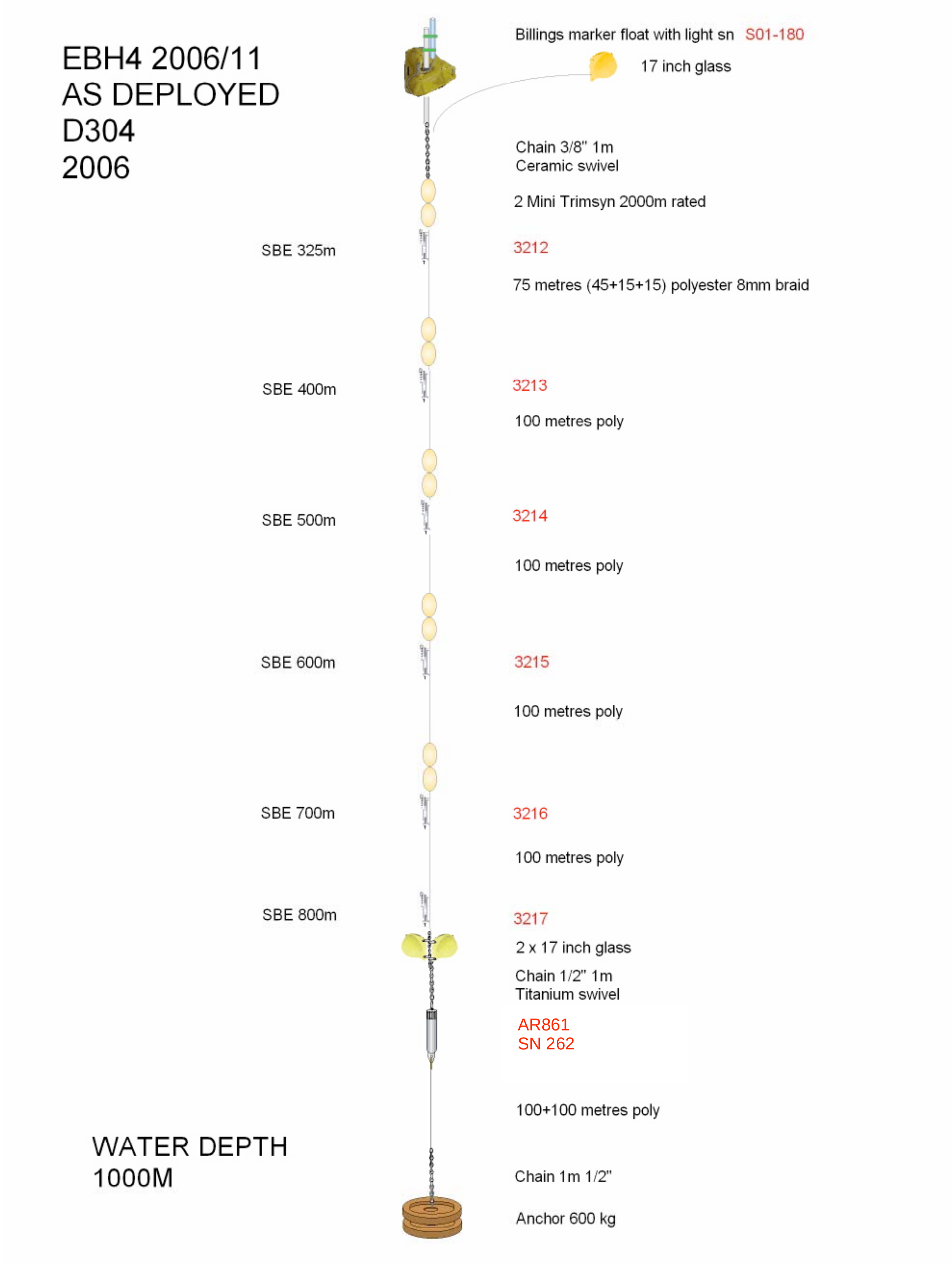


Figure A.16: Mooring diagram of EBH3 as deployed on D304

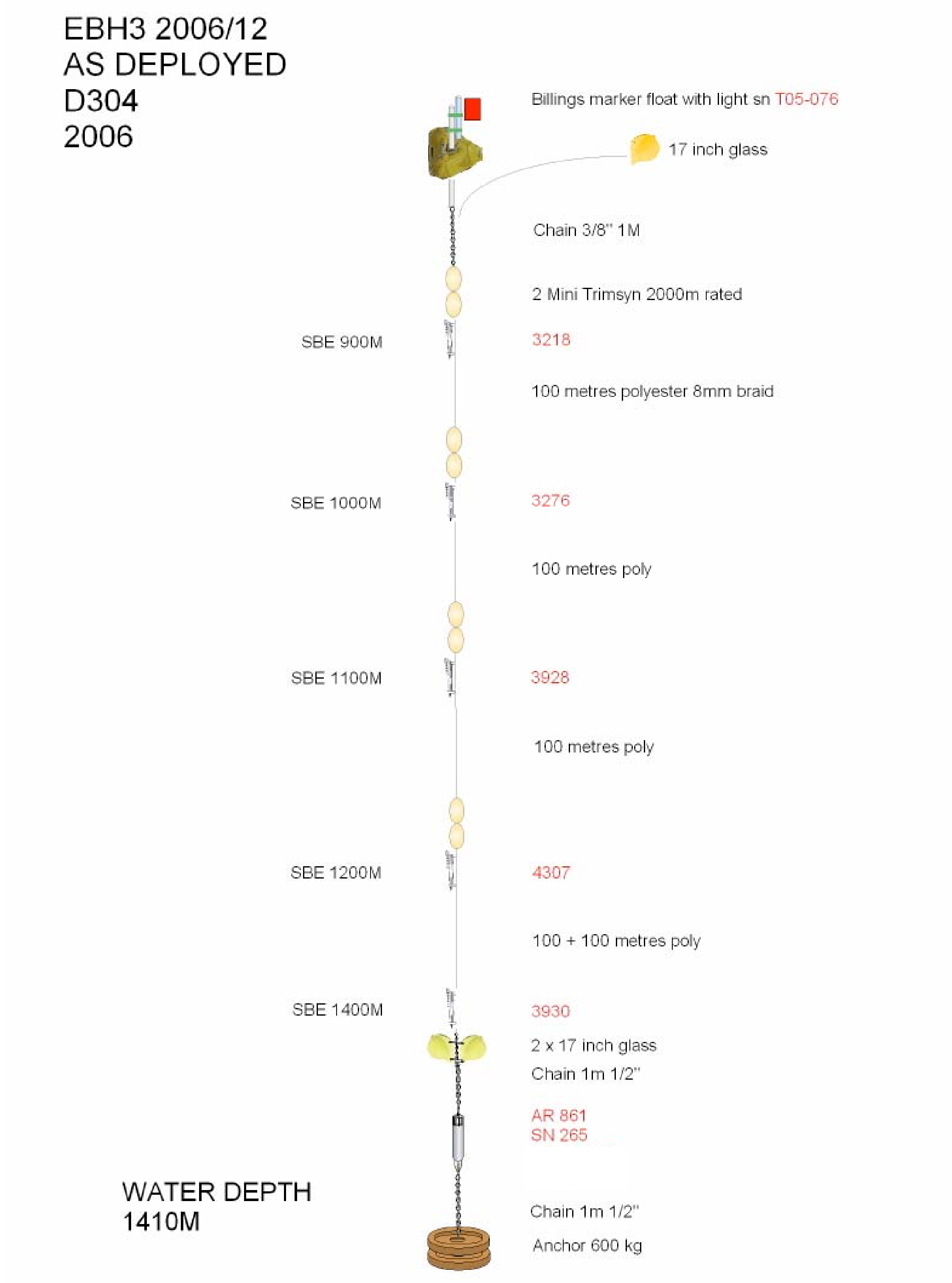


Figure A.17: Mooring diagram of EBH2 as deployed on D304

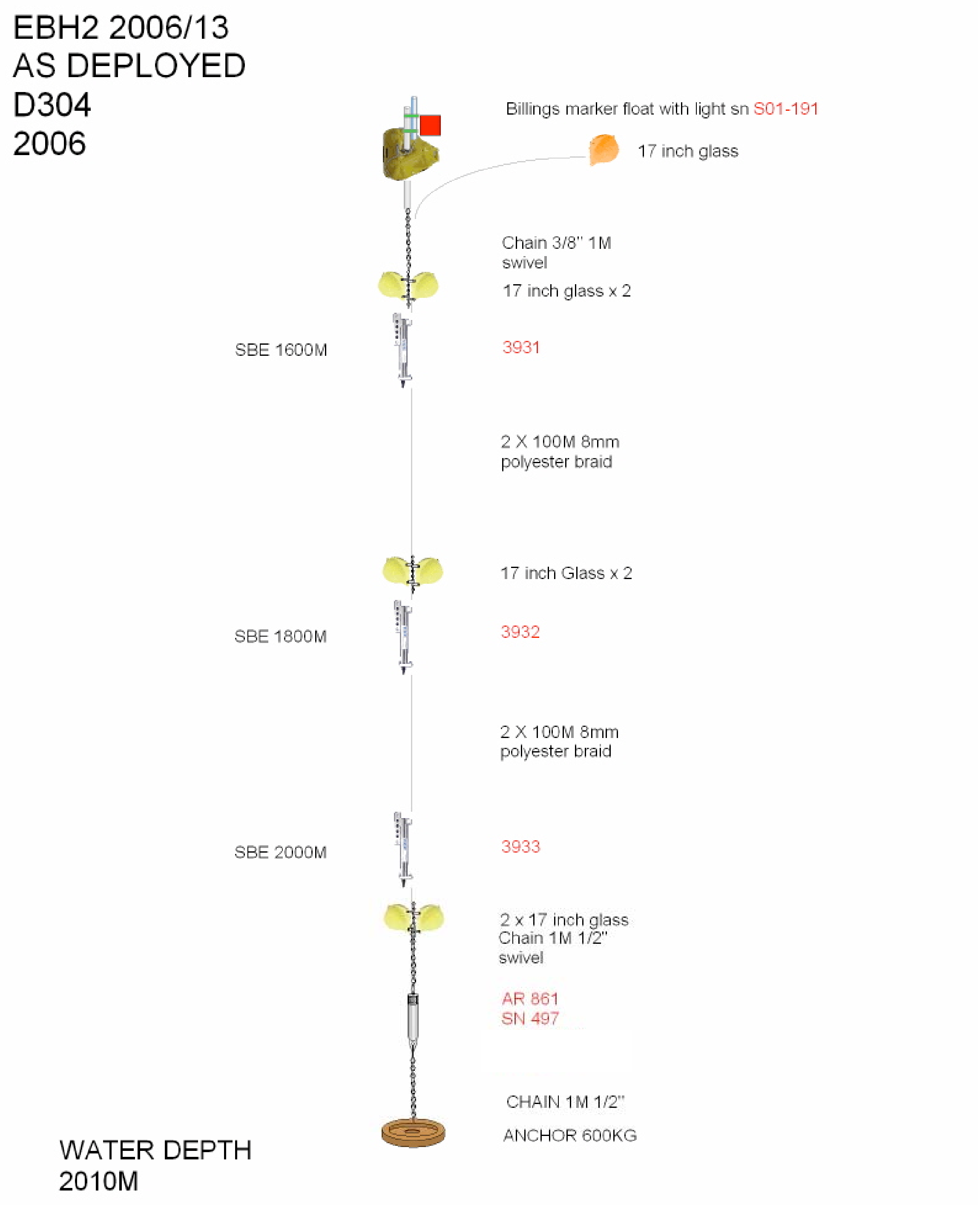


Figure A.18: Mooring diagram of EBH1 as deployed on D304

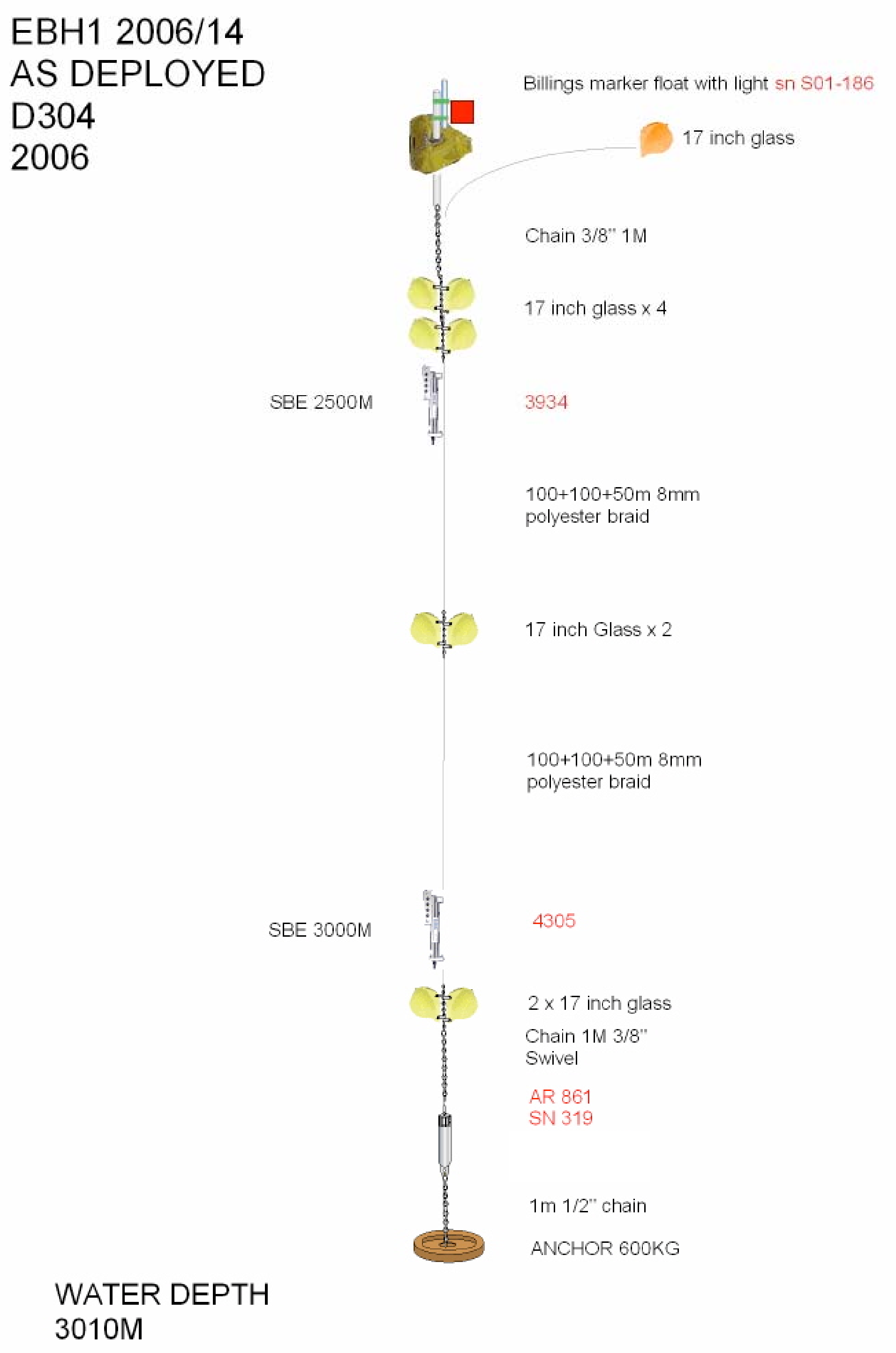


Figure A.19: Mooring diagram of EBL4 as deployed on D304

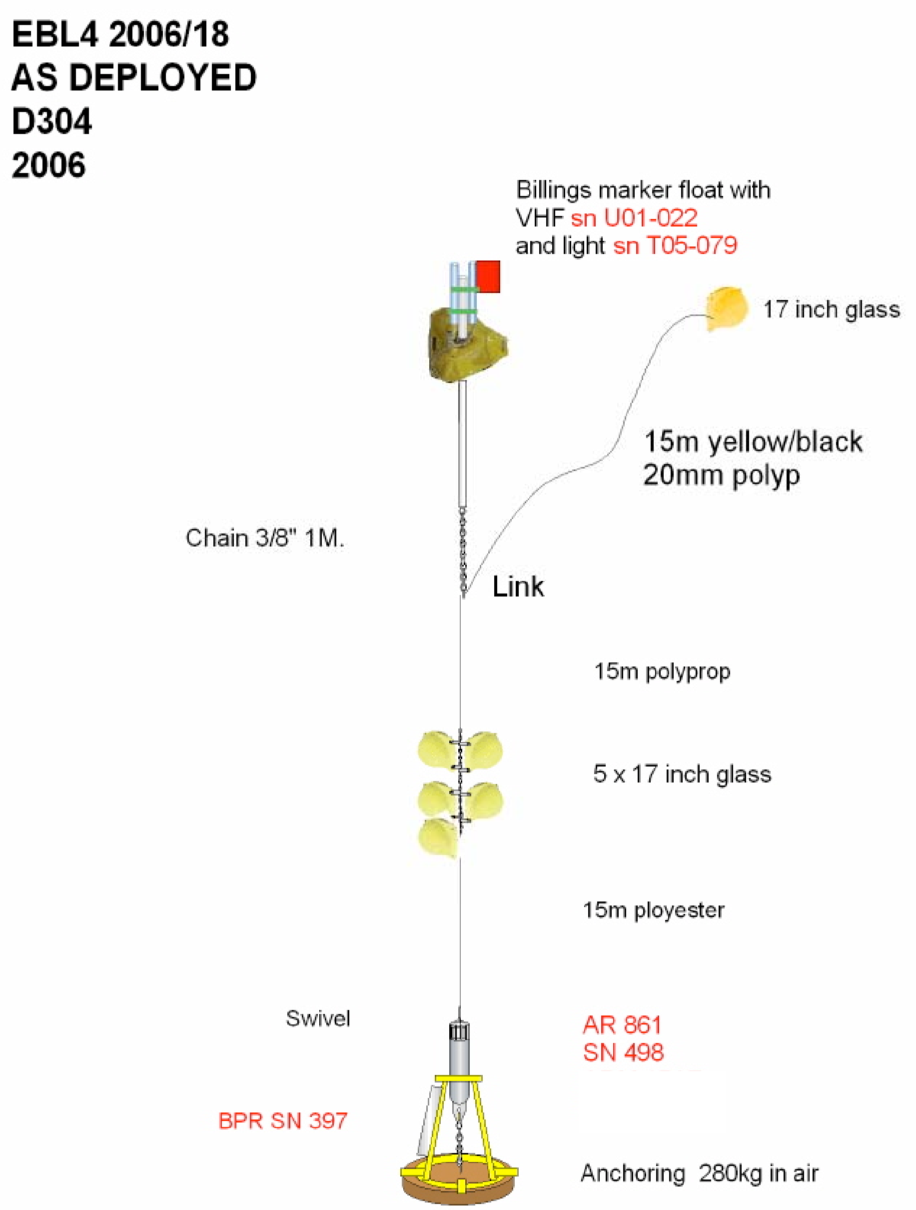


Figure A.20: Mooring diagram of EBH0 as deployed on D304

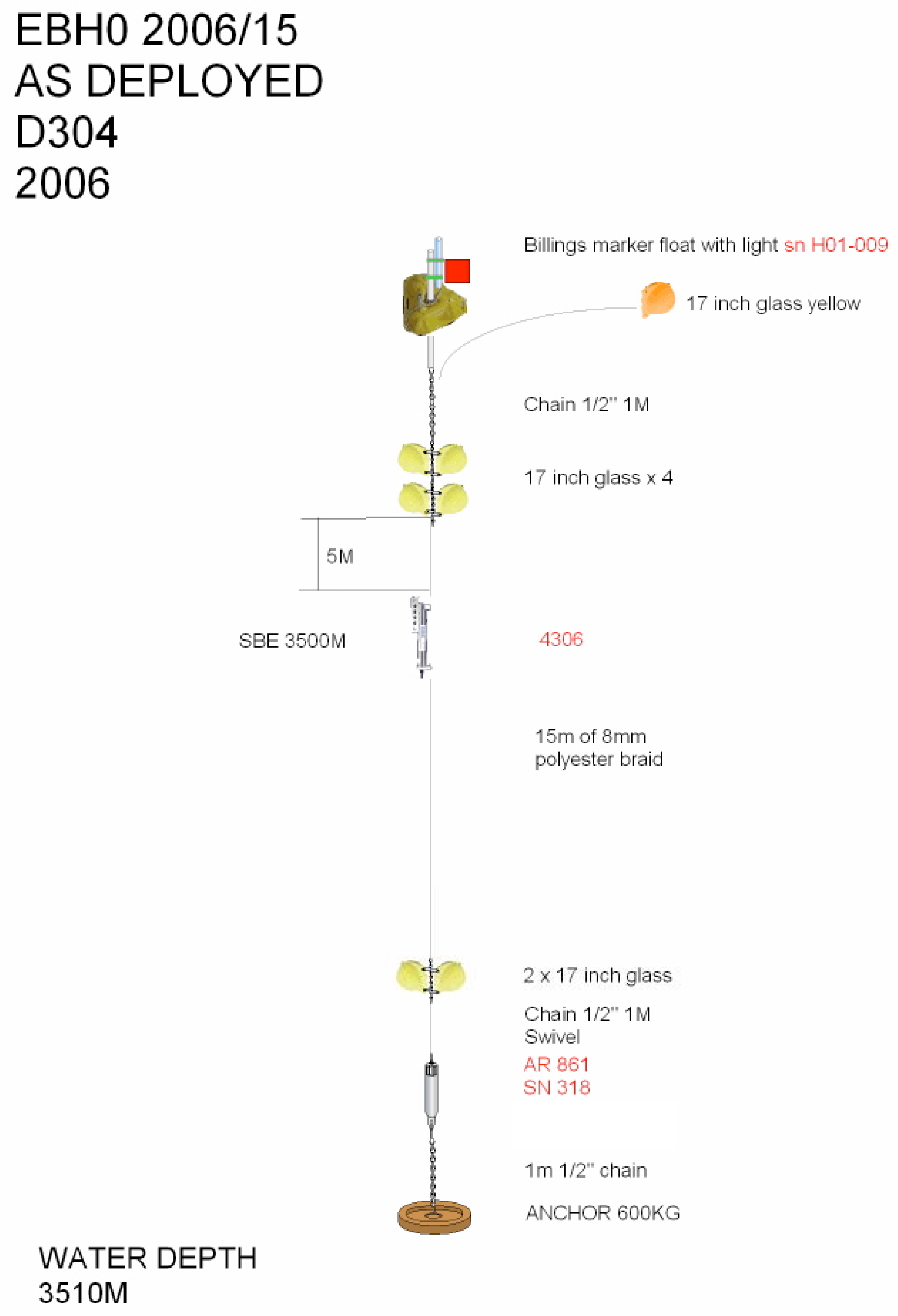


Figure A.21: Mooring diagram of EBHi as deployed on D304

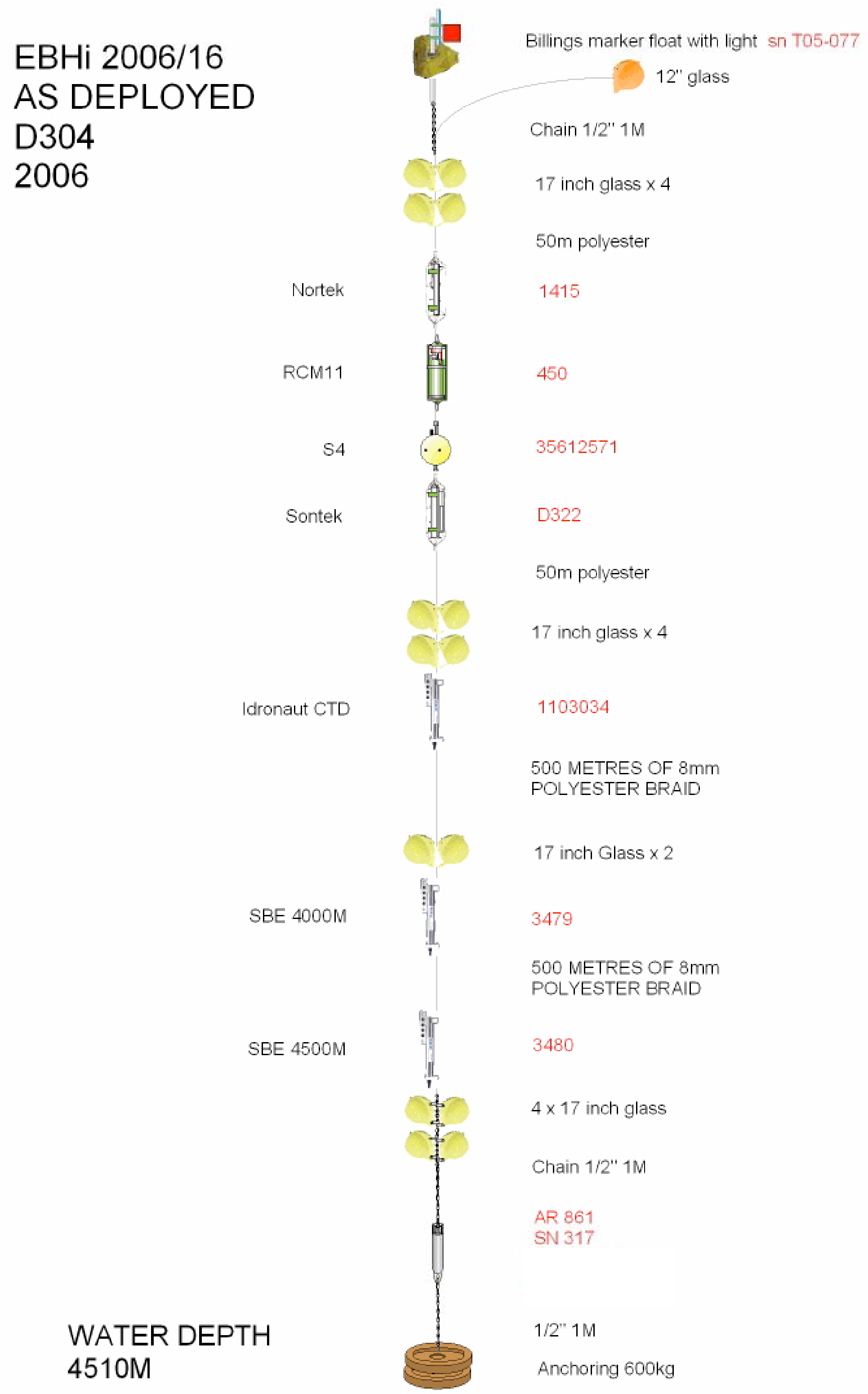


Figure A.22: Mooring diagram of EB2 as deployed on D304

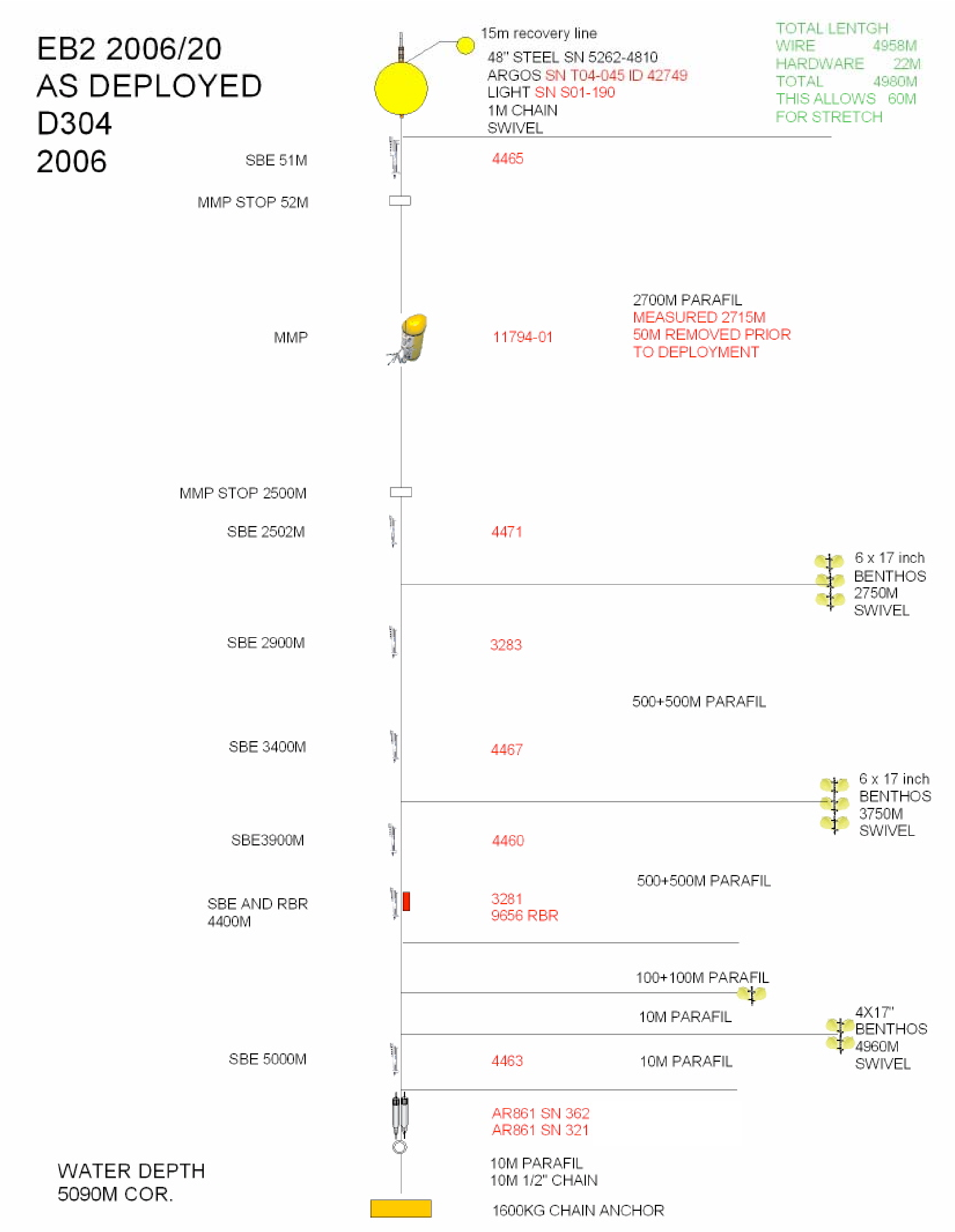


Figure A.23: Mooring diagram of EB1 as deployed on D304

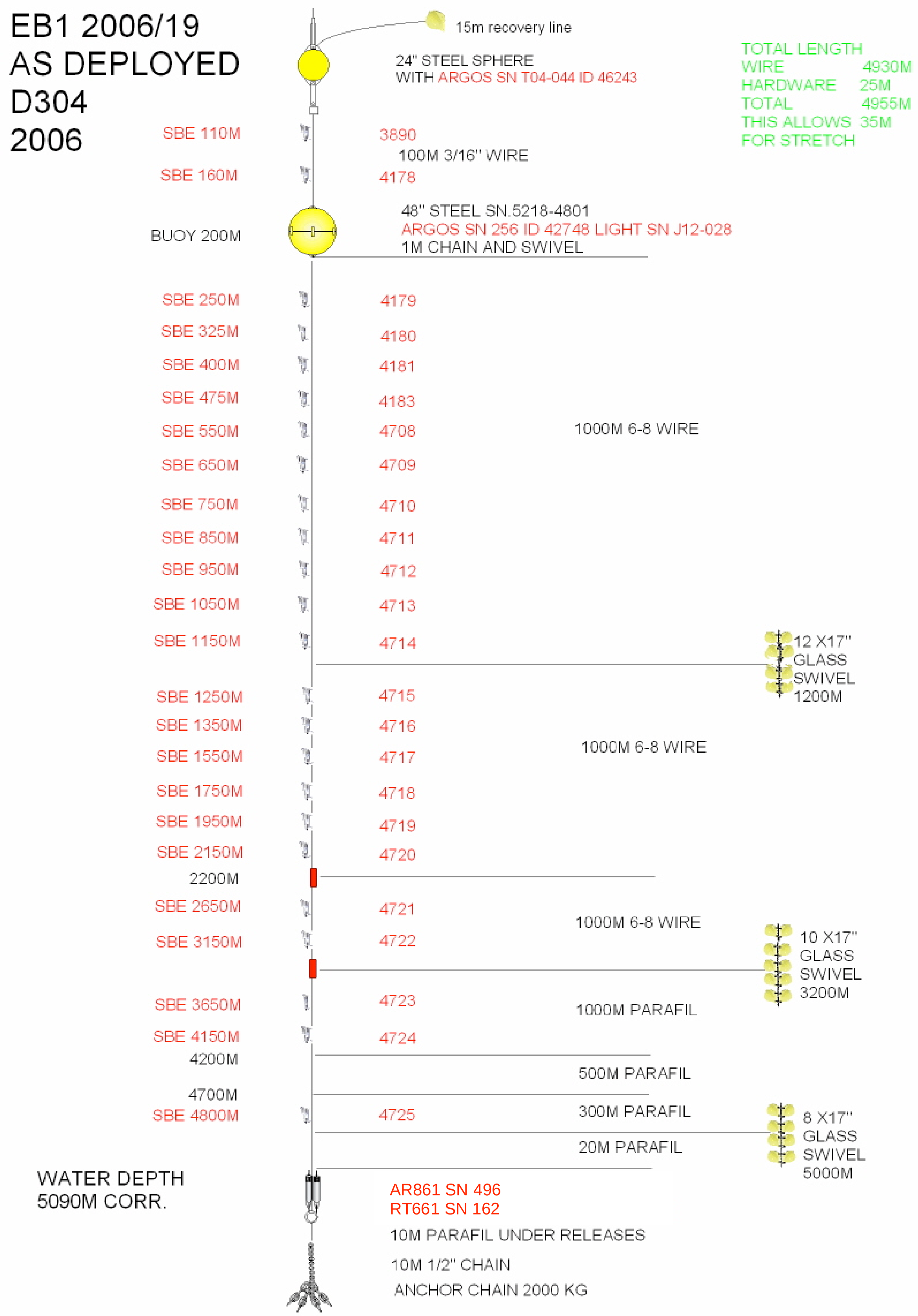


Figure A.24: Mooring diagram of EBL3 as deployed on D304

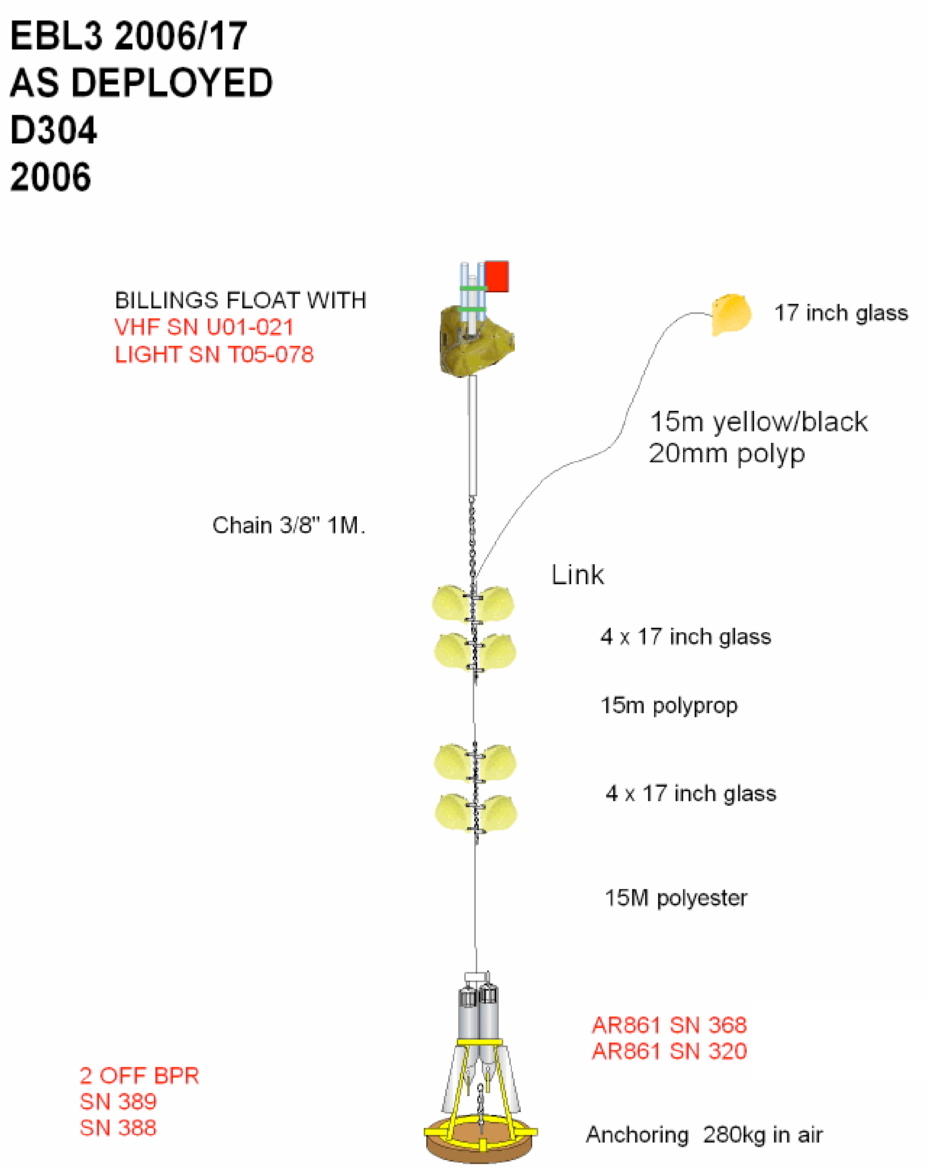


Figure A.25: Mooring diagram of MAR3 as deployed on D304

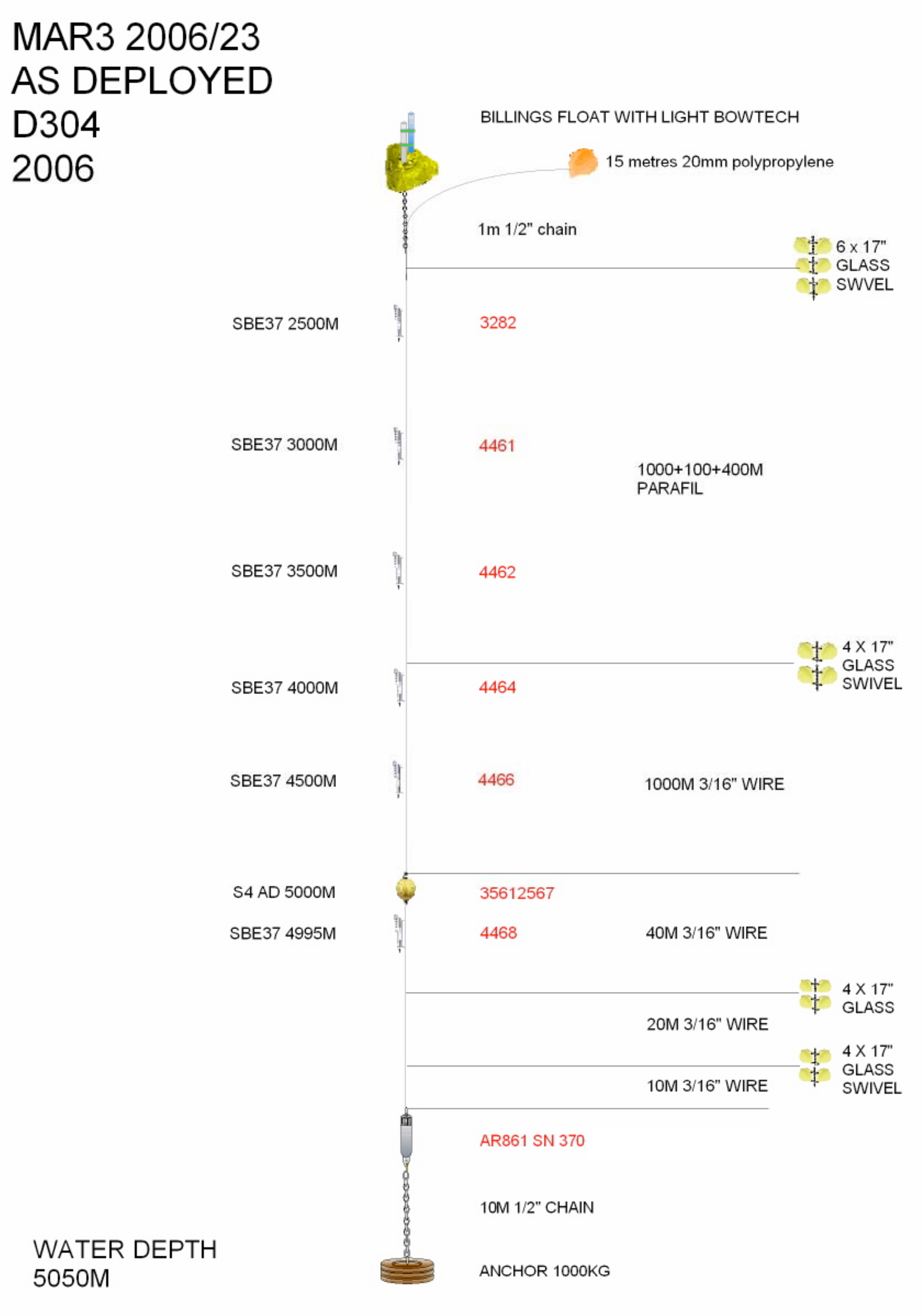


Figure A.26: Mooring diagram of MARL4 as deployed on D304

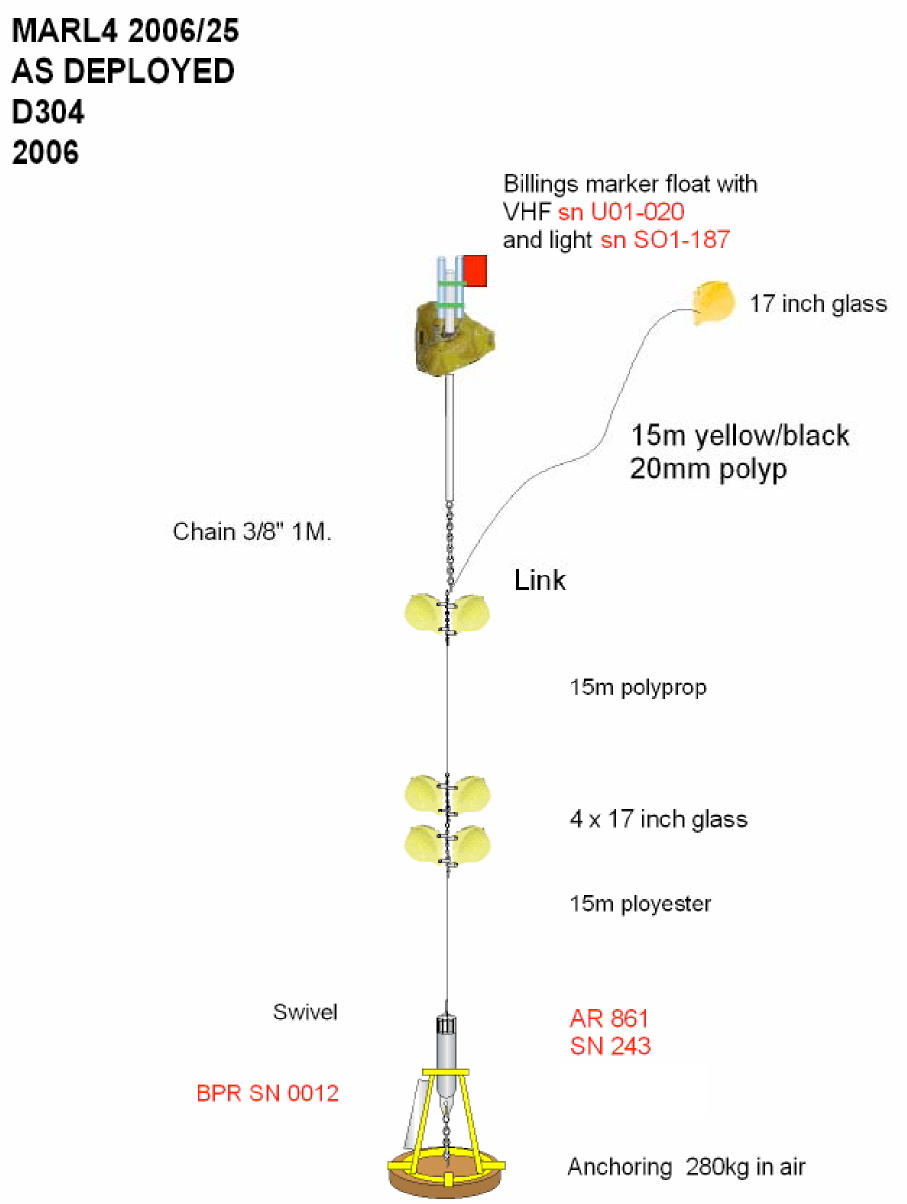


Figure A.27: Mooring diagram of MAR1 as deployed on D304

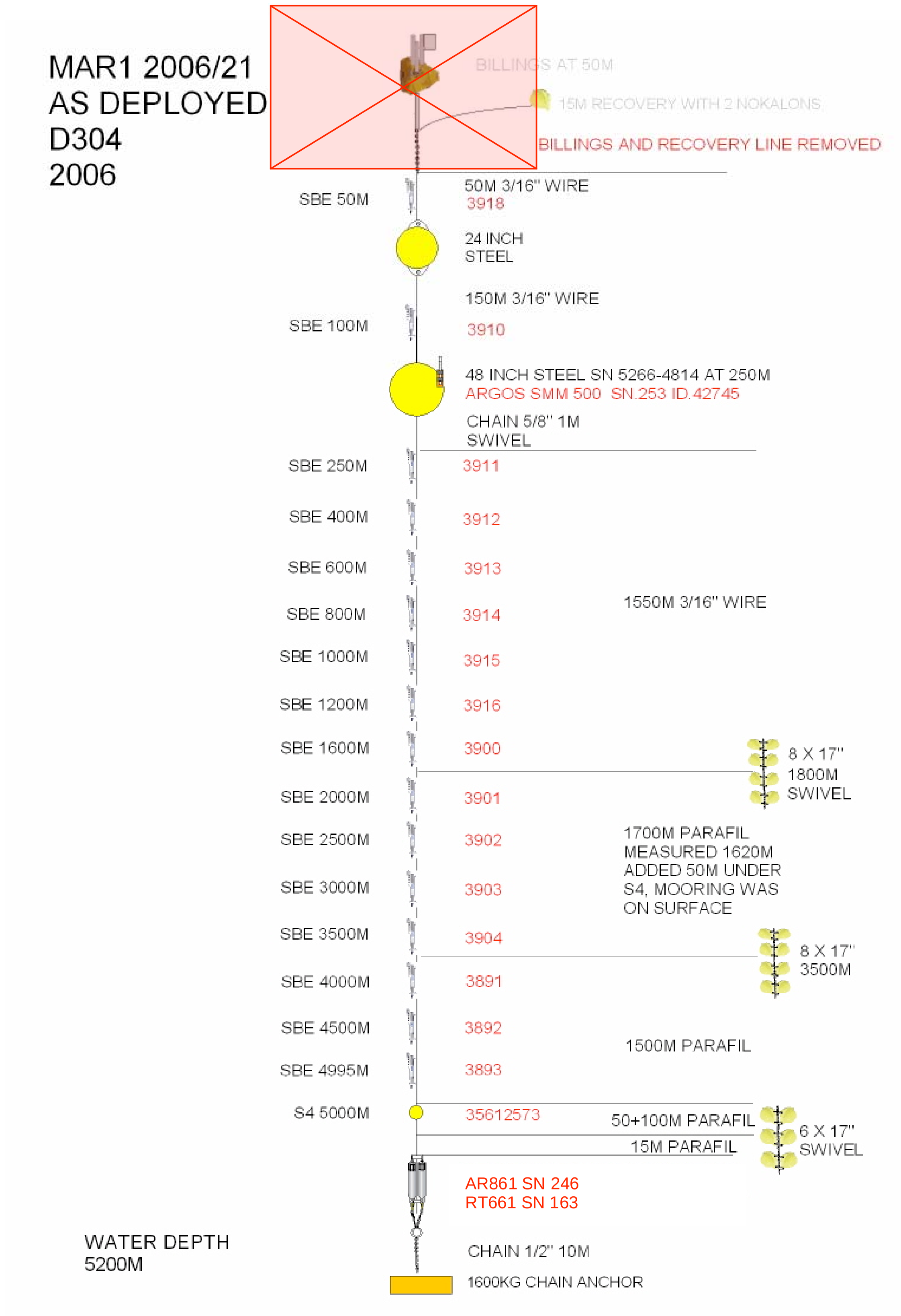


Figure A.28: Mooring diagram of MAR2 as deployed on D304

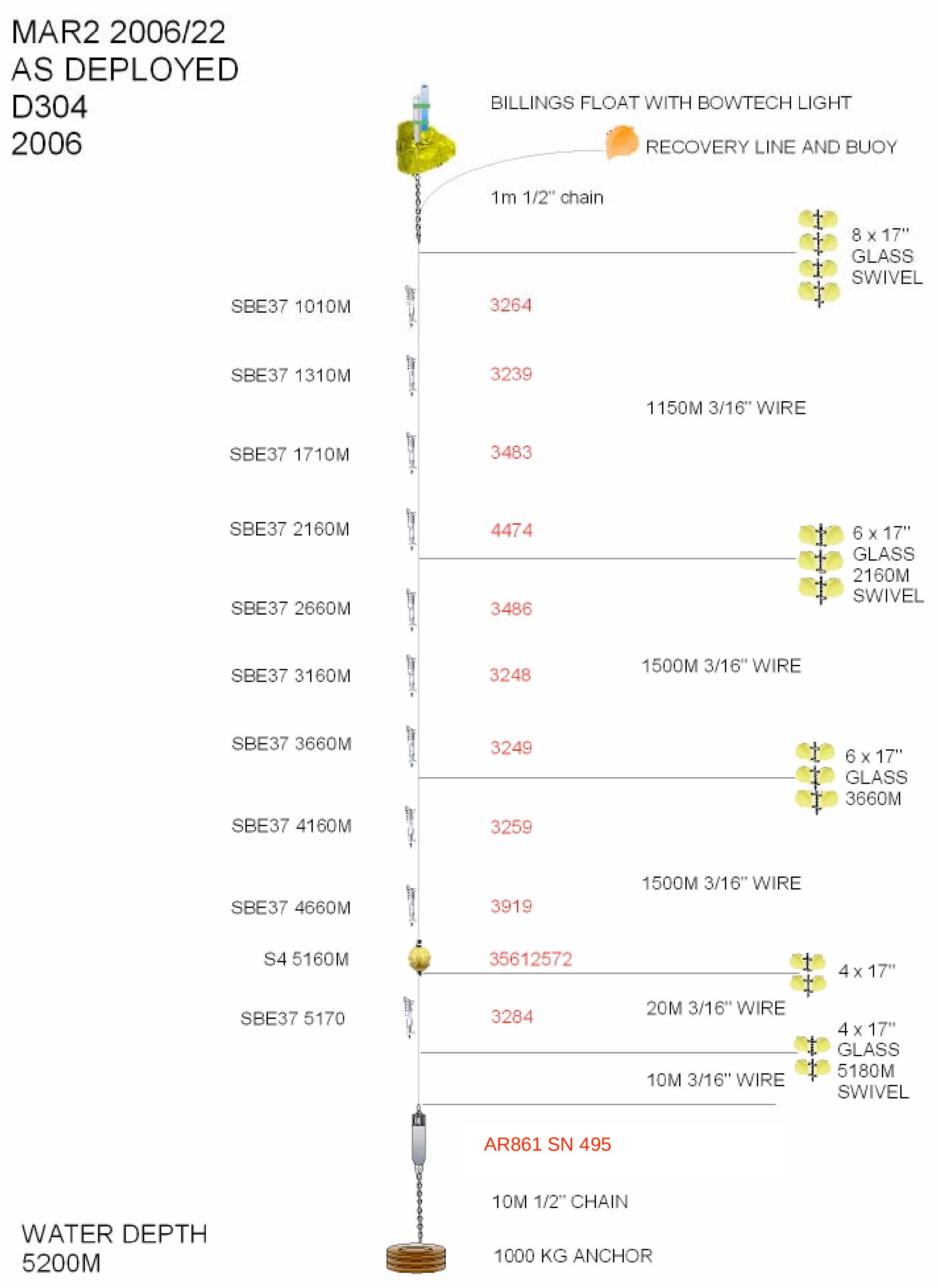
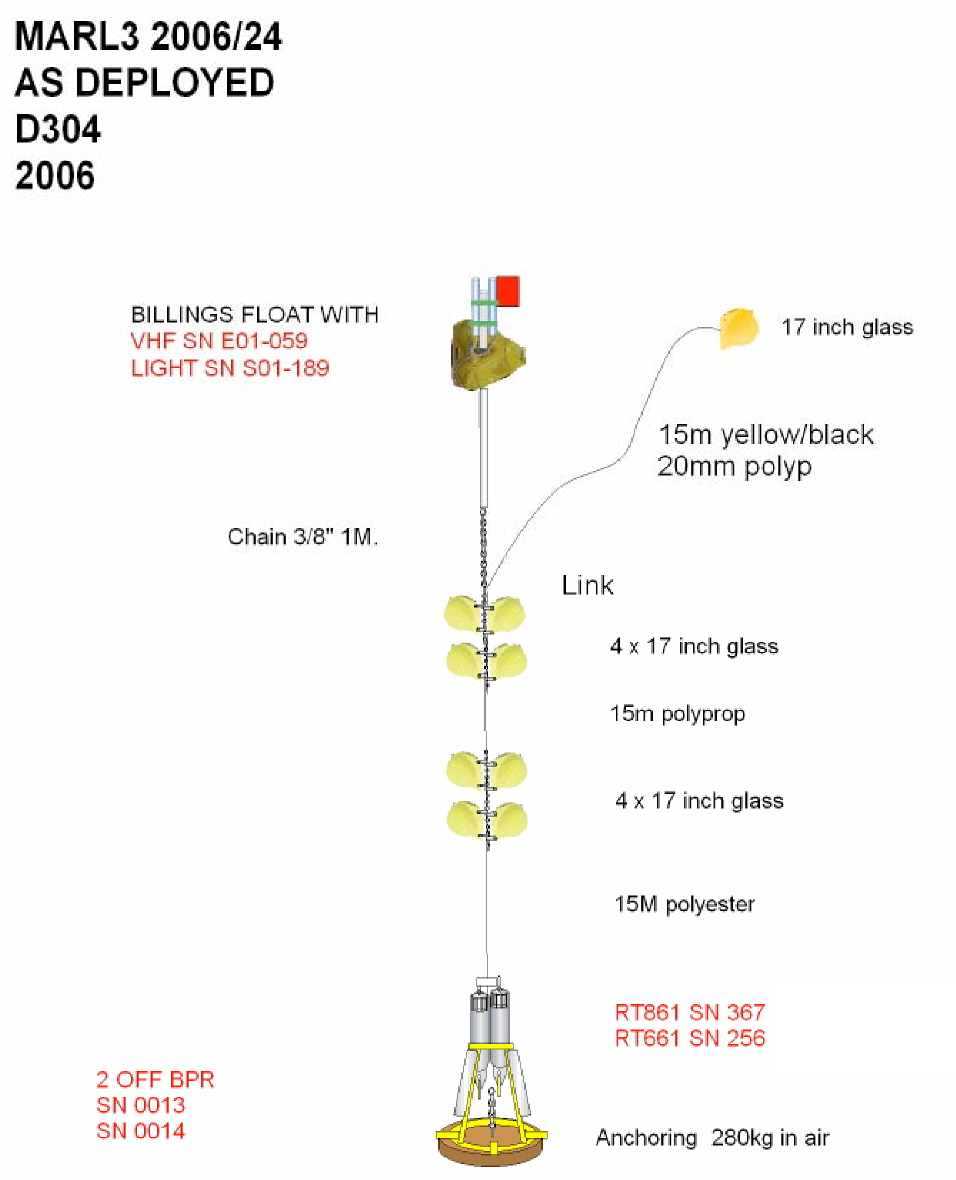


Figure A.29: Mooring diagram of MARL3 as deployed on D304



Appendix B: Instrument Setup Details

EBH5 (as 1st Deployed)

Seabird SBE37 SMP CTD – serial number **3207**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	10:00:00

Seabird SBE37 SMP CTD – serial number **3208**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	10:00:00

Seabird SBE37 SMP CTD – serial number **3209**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	10:00:00

Seabird SBE37 SMP CTD – serial number **3210**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	10:00:00

EBH5 (as redeployed)

NB: data not erased between 1st and second deployments

Seabird SBE37 SMP CTD – serial number **3207**

Sample interval	1200 seconds
Start date	04/06/2006
Start time	15:30:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3208**

Sample interval	1200 seconds
Start date	04/06/2006
Start time	15:30:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3209**

Sample interval	1200 seconds
Start date	04/06/2006
Start time	15:30:00
Number of samples to average	1

Seabird SBE37 IMP CTD – serial number **4473**

ID number	41
Sample interval	1200 seconds
Start date	04/06/2006
Start time	16:00:00

<u>EBH4</u>

Seabird SBE37 SMP CTD – serial number **3212**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	13:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3213**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	13:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3214**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	13:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3215**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	13:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3216**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	13:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3217**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	13:00:00
Number of samples to average	1

<u>EBH3</u>

Seabird SBE37 SMP CTD – serial number **3218**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	14:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3276**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	14:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3928**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	14:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **4307**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	14:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3930**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	14:00:00
Number of samples to average	1

EBH2

Seabird SBE37 SMP CTD – serial number **3931**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	15:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3932**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	15:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3933**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	15:00:00
Number of samples to average	1

EBH1

Seabird SBE37 SMP CTD – serial number **3934**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	15:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **4305**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	15:00:00
Number of samples to average	1

EBL4

Seabird SBE26 BPR – serial number **0397**

Tide sample interval	30 minutes
Tide measurements per wave burst	9999
Wave samples/burst	68
No. of 0.25s periods to integrate waves	33
Start date	14/05/2006
Start time	13:30:00

EBH0

Seabird SBE37 SMP CTD – serial number **4306**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	15:00:00
Number of samples to average	1

EBHi

Seabird SBE37 SMP CTD – serial number **3479**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	15:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3480**

Sample interval	1200 seconds
Start date	13/05/2006
Start time	15:00:00
Number of samples to average	1

Idronaut OS304 CTD – serial number **113034**

Sample interval	15 minutes
Number of records per sample	1
Number of acquisition cycles	9999
Start date	16/05/2006
Start time	09:30:00

Aanderaa RCM11 – serial number **450**

Pings per ensemble	600
Temperature range	Arctic
Conductivity range	31-34mS (rollover on)
Recording interval	30 mins
No of channels	8
Mode	Burst
DSU serial number	14722
Instrument started	15/05/2006 19:30:00

Sontek Argonaut MD – serial number **D322**

Averaging interval	120 seconds
Sampling interval	1800 seconds
Salinity	34.9 ppt
Blanking distance	1.5m
Cell size	1.5m
Deployment name	EBHi
Start date	15/05/2006
Start time	21:00:00
Baud rate	9600.

InterOcean S4AD – serial number **35612571**

Header	EBHi CM TRIAL
On time	2 mins
Cycle time	30 mins
Average count	240
Channels at average	Hx, Hy, Cond., Temp., Depth
Special Record Block Count	48

Channels at SRB	Hx, Hy, Cond., Temp., Depth
Start date	15/05/2006
Start time	19:30:00

Nortek Aquadopp – serial number **1415**

Measurement interval	1800 seconds
Average interval	120 seconds
Measurement load	4 (auto)
Blanking distance	1.5m
Compass update	2 seconds
Speed of sound	Measure from Temp and fixed Salin.
Salinity	35 ppt
Diagnostics interval	720 minutes
Number of samples for diagnostics	20
Coordinate system	ENU
Power level	High

<u>EB2</u>

Seabird SBE37 IMP CTD – serial number **4465**

ID number	49
Sample interval	1800 seconds
Start date	01/06/2006
Start time	09:00:00

McLane Moore Profiler – serial number **11794-01**

Comprising MMP electronics – serial number **317**
Seabird SBE41 CP – McLane V1.0 – serial number **1008**
FSI ACM – serial number **1766D**

Start date	01/06/2006
Start time	13:00:00
Profile start interval	2 days 5 hours
Reference date	01/06/2006
Reference time	21:00:00
Burst interval	Disabled
Paired profiles	Enabled
Profiles per file set	1
Shallow pressure limit	52 dbar
Deep pressure limit	2500 dbar
Shallow pressure error	100 dbar
Deep pressure error	100 dbar
Profile time limit	6 hours
Stop check interval	30 seconds

Seabird SBE37 IMP CTD – serial number **4471**

ID number	43
Sample interval	1800 seconds
Start date	01/06/2006
Start time	09:00:00

Seabird SBE37 IMP CTD – serial number **3283**

ID number	36
Sample interval	1800 seconds
Start date	01/06/2006
Start time	09:00:00

Seabird SBE37 IMP CTD – serial number **4467**

ID number	47
Sample interval	1800 seconds
Start date	01/06/2006
Start time	09:00:00

Seabird SBE37 IMP CTD – serial number **4460**

ID number	54
Sample interval	1800 seconds
Start date	01/06/2006
Start time	09:00:00

Seabird SBE37 IMP CTD – serial number **3281**

ID number	38
Sample interval	1800 seconds
Start date	01/06/2006
Start time	09:00:00

RBR XR-420 CTD – serial number **9656**

Sampling interval	10 minutes
Start date	01/06/2006
Start time	09:00:00
End date	06/05/2008
End time	09:00:00
Averaging enables	Yes

Seabird SBE37 IMP CTD – serial number **4463**

ID number	51
Sample interval	1800 seconds
Start date	01/06/2006
Start time	09:00:00

EB1

Seabird SBE37 SMP CTD – serial number **3890**

Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:20:00
Number of samples to average	1

Seabird SBE37 IMP CTD – serial number **4178**

ID Number	22
Sample interval	1800 seconds
Start date	18/05/2006
Start time	15:00:00

Seabird SBE37 IMP CTD – serial number **4179**

ID Number	23
Sample interval	1800 seconds
Start date	18/05/2006
Start time	15:00:00

Seabird SBE37 IMP CTD – serial number **4180**

ID Number	24
Sample interval	1800 seconds

Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4181**

ID Number	25
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4183**

ID Number	27
Sample interval	1800 seconds
Start date	18/05/2006
Start time	15:00:00

Seabird SBE37 IMP CTD – serial number **4708**

ID Number	01
Sample interval	1800 seconds
Start date	18/05/2006
Start time	15:00:00

Seabird SBE37 IMP CTD – serial number **4709**

ID Number	02
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4710**

ID Number	03
Sample interval	1800 seconds
Start date	18/05/2006
Start time	15:00:00

Seabird SBE37 IMP CTD – serial number **4711**

ID Number	04
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4712**

ID Number	05
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4713**

ID Number	06
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4714**

ID Number	07
Sample interval	1800 seconds
Start date	18/05/2006

Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4715**

ID Number	08
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4716**

ID Number	09
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4717**

ID Number	10
Sample interval	1800 seconds
Start date	18/05/2006
Start time	15:00:00

Seabird SBE37 IMP CTD – serial number **4718**

ID Number	11
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4719**

ID Number	12
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4720**

ID Number	13
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4721**

ID Number	14
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4722**

ID Number	15
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4723**

ID Number	16
Sample interval	1800 seconds
Start date	18/05/2006
Start time	15:00:00

Seabird SBE37 IMP CTD – serial number **4724**

ID Number	17
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

Seabird SBE37 IMP CTD – serial number **4725**

ID Number	18
Sample interval	1800 seconds
Start date	18/05/2006
Start time	16:00:00

EBL3

Seabird SBE26 BPR – serial number **0388**

Tide sample interval	30 minutes
Tide measurements per wave burst	9999
Wave samples/burst	68
No. of 0.25s periods to integrate waves	33
Start date	31/05/2006
Start time	14:03:05

Seabird SBE26 BPR – serial number **0389**

Tide sample interval	30 minutes
Tide measurements per wave burst	9999
Wave samples/burst	68
No. of 0.25s periods to integrate waves	33
Start date	31/05/2006
Start time	14:13:30

MAR3

Seabird SBE37 IMP CTD – serial number **3282**

ID Number	37
Sample interval	1800 seconds
Start date	28/05/2006
Start time	11:00:00

Seabird SBE37 IMP CTD – serial number **4461**

ID Number	53
Sample interval	1800 seconds
Start date	28/05/2006
Start time	11:00:00

Seabird SBE37 IMP CTD – serial number **4462**

ID Number	46
Sample interval	1800 seconds
Start date	28/05/2006
Start time	11:00:00

Seabird SBE37 IMP CTD – serial number **4464**

ID Number	48
Sample interval	1800 seconds
Start date	28/05/2006
Start time	11:00:00

Seabird SBE37 IMP CTD – serial number **4466**

ID Number	50
Sample interval	1800 seconds
Start date	28/05/2006
Start time	11:00:00

Seabird SBE37 IMP CTD – serial number **4468**

ID Number	52
Sample interval	1800 seconds
Start date	28/05/2006
Start time	11:00:00

InterOcean S4AD – serial number **35612567**

Header	MAR3_DEPLOY
On time	1 mins
Cycle time	30 mins
Average count	120
Channels at average	Hx, Hy, Cond., Temp., Depth
Special Record Block Count	48
Channels at SRB	Hx, Hy, Cond., Temp., Depth
Start date	28/05/2006
Start time	11:00:00

MARL4

Seabird SBE53 BPR – serial number **0012**

Header	MARL4 Deployed 2006 on D304
Tide interval	15 minutes
Tide measurement duration	15 minutes
Frequency of reference measurements	96 tide samples
Start date	27/05/2006
Start time	18:00:00

MAR2

Seabird SBE37 SMP CTD – serial number **3264**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	17:00:00
Number of samples to average	1

Seabird SBE37 IMP CTD – serial number **3239**

ID number	34
Sample interval	1800 seconds
Start date	25/05/2006
Start time	17:00:00

Seabird SBE37 SMP CTD – serial number **3483**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	17:00:00
Number of samples to average	1

Seabird SBE37 IMP CTD – serial number **4474**

ID number	40
Sample interval	1800 seconds
Start date	25/05/2006

Start time	17:00:00

Seabird SBE37 SMP CTD – serial number **3486**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	17:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3248**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	17:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3249**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	17:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3259**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	17:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3919**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	17:00:00
Number of samples to average	1

InterOcean S4AD – serial number **35612572**

Header	MAR2_2006_DP
On time	1 min
Cycle time	30 mins
Average count	120
Channels at average	Hx, Hy, Cond., Temp., Depth
Special Record Block Count	48
Channels at SRB	Hx, Hy, Cond., Temp., Depth
Start date	25/05/2006
Start time	18:00:00

Seabird SBE37 IMP CTD – serial number **3284**

ID number	35
Sample interval	1800 seconds
Start date	25/05/2006
Start time	17:00:00

MARL3

Seabird SBE53 BPR – serial number **0013**

Header	MARL3 Deployed 2006 on D304
Tide interval	15 minutes
Tide measurement duration	15 minutes
Frequency of reference measurements	96 tide samples

Start date	25/05/2006
Start time	18:30:00

Seabird SBE53 BPR – serial number **0014**

Header	MARL3 Deployed 2006 on D304
Tide interval	15 minutes
Tide measurement duration	15 minutes
Frequency of reference measurements	96 tide samples
Start date	25/05/2006
Start time	18:30:00

MAR1

Seabird SBE37 SMP CTD – serial number **3918**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	11:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3910**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	11:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3911**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	11:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3912**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	12:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3913**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	12:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3914**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	12:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3915**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	12:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3916**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	12:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3900**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	12:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3901**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	12:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3902**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	12:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3903**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	12:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3904**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	12:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3891**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	12:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3892**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	12:00:00
Number of samples to average	1

Seabird SBE37 SMP CTD – serial number **3893**

Sample interval	1800 seconds
Start date	25/05/2006
Start time	12:00:00
Number of samples to average	1

InterOcean S4AD – serial number **35612573**

Header	MAR1_2006_deplo

On time	1 min
Cycle time	30 mins
Average count	120
Channels at average	Hx, Hy, Cond., Temp., Depth
Special Record Block Count	48
Channels at SRB	Hx, Hy, Cond., Temp., Depth
Start date	25/05/2006
Start time	12:30:00

WB4

Seabird SBE37 SMP CTD – serial number **3920**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3921**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Aanderaa RCM11 – serial number **307**

Pings per ensemble	600
Temperature range	Highc
Conductivity range	51-55mS (rollover on)
Recording interval	30 mins
No of channels	8
Mode	Burst
DSU serial number	13997
Instrument started	22/03/2006 04:30:00

Seabird SBE37 SMP CTD – serial number **3922**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3923**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Aanderaa RCM11 – serial number **308**

Pings per ensemble	600
Temperature range	Low
Conductivity range	46-55mS (rollover on)
Recording interval	30 mins
No of channels	8
Mode	Burst

DSU serial number	13998
Instrument started	22/03/2006 04:30:00

Seabird SBE37 SMP CTD – serial number **3924**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3925**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Aanderaa RCM11 – serial number **309**

Pings per ensemble	600
Temperature range	Low
Conductivity range	37-41mS (rollover on)
Recording interval	30 mins
No of channels	8
Mode	Burst
DSU serial number	13999
Instrument started	22/03/2006 04:30:00

Seabird SBE37 SMP CTD – serial number **3926**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3927**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Aanderaa RCM11 – serial number **310**

Pings per ensemble	600
Temperature range	Low
Conductivity range	33-35mS (rollover on)
Recording interval	30 mins
No of channels	8
Mode	Burst
DSU serial number	14000
Instrument started	22/03/2006 04:30:00

Seabird SBE37 SMP CTD – serial number **3245**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00

Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3246**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Aanderaa RCM11 – serial number **446**

Pings per ensemble	600
Temperature range	Arctic
Conductivity range	32-34mS (rollover on)
Recording interval	30 mins
No of channels	8
Mode	Burst
DSU serial number	14569
Instrument started	22/05/2006 04:30:00

Seabird SBE37 SMP CTD – serial number **3260**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3261**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

InterOcean S4AD – serial number **35612569**

Header	WB4_2006
On time	1 min
Cycle time	30 mins
Average count	120
Channels at average	Hx, Hy, Cond., Temp., Depth
Special Record Block Count	48
Channels at SRB	Hx, Hy, Cond., Temp., Depth
Start date	22/03/2006
Start time	10:00:00

Seabird SBE37 SMP CTD – serial number **3262**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3263**

Sample interval	900 seconds
Start date	22/03/2006

Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

InterOcean S4AD – serial number **35612570**

Header	WB4_2006
On time	1 min
Cycle time	30 mins
Average count	120
Channels at average	Hx, Hy, Cond., Temp., Depth
Special Record Block Count	48
Channels at SRB	Hx, Hy, Cond., Temp., Depth
Start date	22/03/2006
Start time	10:00:00

Seabird SBE37 SMP CTD – serial number **3917**

Sample interval	900 seconds
Start date	22/03/2006
Start time	10:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

WBL4

Seabird SBE53 BPR – serial number **0004**

Header	WBL2_2006_deploy
Tide interval	15 minutes
Tide measurement duration	15 minutes
Frequency of reference measurements	96 tide samples
Start date	17/03/2006
Start time	15:50:00

WB2

Seabird SBE37 IMP CTD – serial number **4060**

ID number	01
Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00

Aanderaa RCM11 – serial number **301**

Pings per ensemble	600
Temperature range	High
Conductivity range	44-55mS (rollover on)
Recording interval	30 mins
No of channels	8
Mode	Burst
DSU serial number	13883
Instrument started	23/03/2006 03:00:00

Seabird SBE37 IMP CTD – serial number **4062**

ID number	22
Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00

Seabird SBE37 IMP CTD – serial number **4066**

ID number	07
Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00

Seabird SBE37 IMP CTD – serial number **4068**

ID number	09
Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00

Seabird SBE37 IMP CTD – serial number **4070**

ID number	11
Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00

Sontek Argonaut MD – serial number **D272**

Averaging interval	120 seconds
Sampling interval	1800 seconds
Salinity	37.85 ppt
Blanking distance	1.5m
Cell size	1.5m
Deployment name	D272
Start date	23/03/2006
Start time	06:00:00
Baud rate	9600.

Seabird SBE37 IMP CTD – serial number **4071**

ID number	12
Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00

Seabird SBE37 IMP CTD – serial number **4072**

ID number	13
Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00

Sontek Argonaut MD – serial number **D274**

Averaging interval	120 seconds
Sampling interval	1800 seconds
Salinity	33.75 ppt
Blanking distance	1.5m
Cell size	1.5m
Deployment name	D274
Start date	23/03/2006
Start time	06:00:00
Baud rate	9600.

Seabird SBE37 SMP CTD – serial number **3223**

Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00

Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3206**

Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3219**

Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3220**

Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Sontek Argonaut MD – serial number **D303**

Averaging interval	120 seconds
Sampling interval	1800 seconds
Salinity	33.13 ppt
Blanking distance	1.5m
Cell size	1.5m
Deployment name	D303
Start date	23/03/2006
Start time	06:00:00
Baud rate	9600.

Seabird SBE37 SMP CTD – serial number **3221**

Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3222**

Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Aanderaa RCM11 – serial number **451**

Pings per ensemble	600
Temperature range	Arctic
Conductivity range	32-34mS (rollover on)
Recording interval	30 mins
No of channels	8

Mode	Burst
DSU serial number	14570
Instrument started	23/03/2006 03:00:00

Seabird SBE37 IMP CTD – serial number **4184**

ID number	24
Sample interval	900 seconds
Start date	23/03/2006
Start time	06:00:00

Sontek Argonaut MD – serial number **D298**

Averaging interval	120 seconds
Sampling interval	1800 seconds
Salinity	32.46 ppt
Blanking distance	1.5m
Cell size	1.5m
Deployment name	D298
Start date	23/03/2006
Start time	06:00:00
Baud rate	9600.

WBL3

Seabird SBE26 BPR – serial number **0395**

Tide sample interval	15 minutes
Tide measurements per wave burst	9999
Wave samples/burst	68
No. of 0.25s periods to integrate waves	33
Start date	17/03/2006
Start time	18:15

Seabird SBE26 BPR – serial number **0396**

Tide sample interval	15 minutes
Tide measurements per wave burst	9999
Wave samples/burst	68
No. of 0.25s periods to integrate waves	33
Start date	17/03/2006
Start time	15:17

WB1

Seabird SBE37 SMP CTD – serial number **3487**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3905**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Aanderaa RCM11 – serial number **306**

Pings per ensemble	600

Temperature range	High
Conductivity range	47-58mS (rollover on)
Recording interval	30 mins
No of channels	8
Mode	Burst
DSU serial number	14573
Instrument started	23/03/2006 18:00:00

Seabird SBE37 SMP CTD – serial number **3906**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3907**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3908**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3909**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Aanderaa RCM11 – serial number **305**

Pings per ensemble	600
Temperature range	High
Conductivity range	43-52mS (rollover on)
Recording interval	30 mins
No of channels	8
Mode	Burst
DSU serial number	13887
Instrument started	23/03/2006 18:00:00

Seabird SBE37 SMP CTD – serial number **3226**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3227**

Sample interval	900 seconds

Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3228**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3229**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	1

InterOcean S4AD – serial number **35612565**

Header	WB1_2006
On time	1 min
Cycle time	30 mins
Average count	120
Channels at average	Hx, Hy, Cond., Temp., Depth
Special Record Block Count	48
Channels at SRB	Hx, Hy, Cond., Temp., Depth
Start date	23/03/2006
Start time	19:30:00

Seabird SBE37 SMP CTD – serial number **3230**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3231**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3232**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

Seabird SBE37 SMP CTD – serial number **3233**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

InterOcean S4AD – serial number **35612568**

Header	WB1_2006
On time	1 min
Cycle time	30 mins
Average count	120
Channels at average	Hx, Hy, Cond., Temp., Depth
Special Record Block Count	48
Channels at SRB	Hx, Hy, Cond., Temp., Depth
Start date	23/03/2006
Start time	19:30:00

Seabird SBE37 SMP CTD – serial number **3244**

Sample interval	900 seconds
Start date	23/03/2006
Start time	18:00:00
Number of samples to average	4

NB: Likely to deplete battery due to incorrect setting of number of samples to average.

<u>WBADCP</u>

RD Instruments 75kHz Workhorse Longranger ADCP – Serial Number **1767**

System frequency	76.8kHz
Beam angle	20 degrees
Transmit power	High
Water temperature	14 deg C
Water salinity	36ppt
Depth of transducer	600m
Heading alignment	0
Heading bias	0
Mode 1 bandwith	Narrow
WT Pings per ensemble	10
Depth cell size	16.00m
Number of depth cells	40
False target threshold maximum	50
Blank after transmit	7.04m
Pings per ensemble	10
Ambiguity velocity	175cm/s
Time between ping groups	3 mins
Time per ensemble	00:30:00
Start date	19/03/06
Start time	20:00:00

Appendix C: Photographs

Photograph C.1: Damaged drum containing pre-wound wire for WB2

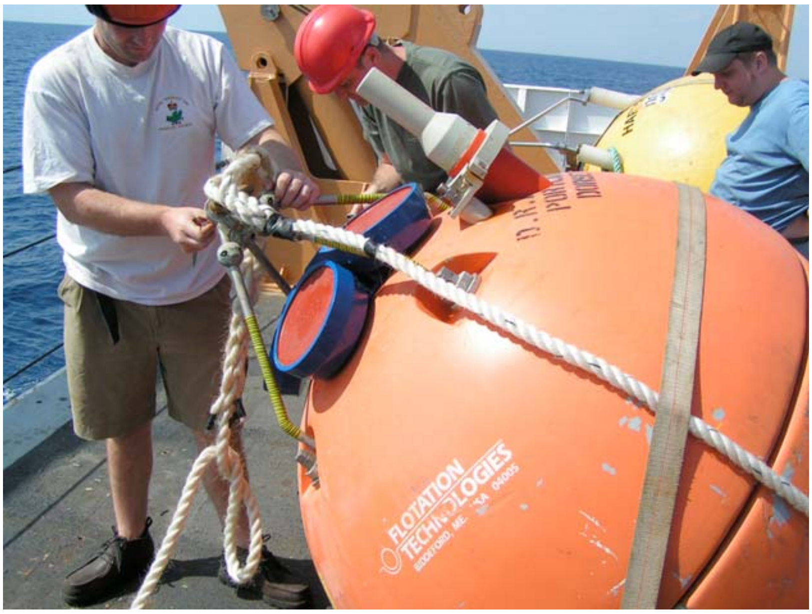
Photograph C.2: Double Barrel Capstan winch in place with diverter sheave leading to storage reeler. (RB0602)

Photograph C.3: Ships Deck capstan with air-tugger behind (yellow). (RB0602)

Photograph C.4: Diverter sheave on simple gantry. (RB0602)

Photograph C.5: Lander buoys showing inserted 3/8 chain into keel and protective side rigging lines.

Photograph C.6: Lower framework and swivel of buoy recovered from WBADCP.

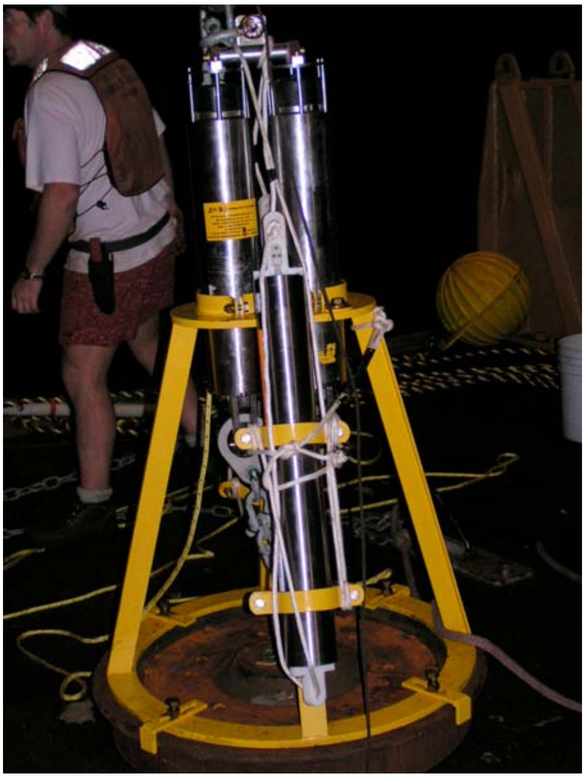


Photograph C.7: Upper framework and ADCP transducers as recovered from WBADCP. Note little marine growth and clean transducer faces.

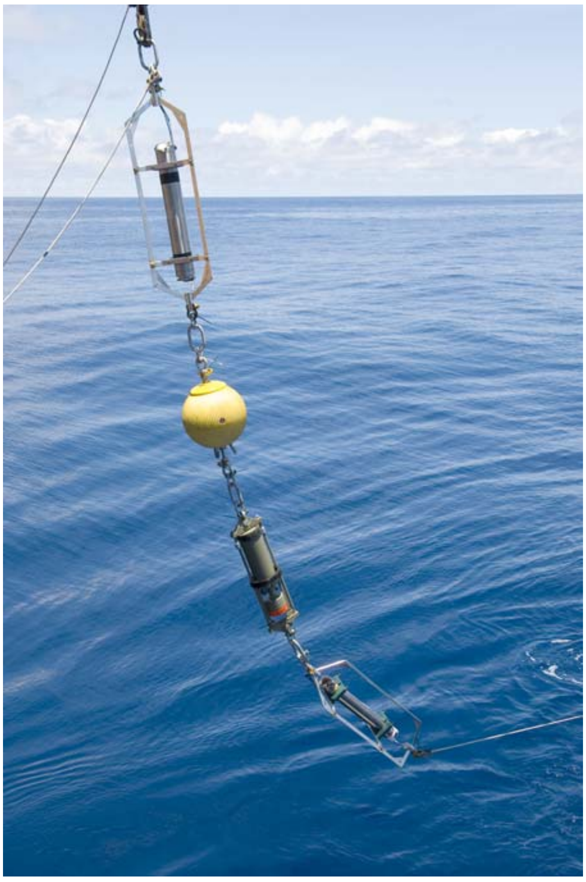
Photograph C.8: Wire-measuring on inboard side of DBC during deployment.

Photograph C.9: WBL4 tripod and buoy assembly

Photograph C.10: WB2 steel spheres – showing top buoy and 100m buoy.



Photograph C.11: WBL3 immediately prior to deployment. Note the increased height of releases in tripod to permit dual release to function



Photograph C.12: Deployment of current meters on modified-EBHi current meter trial mooring. (D304)

Appendix D: Details of Instruments Lowered on CTD Calibration Casts.

Table D.1: Details of Instruments Lowered on CTD Calibration Casts

Cruise	Cast	Instrument details			
		Type	Serial numbers	Comment	Calibration type
RB0602	1	Microcat	3920		Pre-deployment
		Microcat	3921		Pre-deployment
		Microcat	3922		Pre-deployment
		Microcat	3923		Pre-deployment
		Microcat	3924		Pre-deployment
		Microcat	3925		Pre-deployment
		Microcat	3926		Pre-deployment
		Microcat	3927		Pre-deployment
		Microcat	3245		Pre-deployment
		Microcat	3246		Pre-deployment
		Microcat	3260		Pre-deployment
		Microcat	3261		Pre-deployment
RB0602	2	Microcat	3262		Pre-deployment
		Microcat	3263		Pre-deployment
		Microcat	3917		Pre-deployment
		Microcat	4184		Pre-deployment
		Microcat	4068		Pre-deployment
		Microcat	4070		Pre-deployment
		Microcat	4066		Pre-deployment
		RCM11	307		Pre-deployment
		RCM11	308		Pre-deployment
		RCM11	309		Pre-deployment
		RCM11	310		Pre-deployment
		RCM11	446		Pre-deployment
RB0602	3	Microcat	4060		Pre-deployment
		Microcat	4062		Pre-deployment
		Microcat	4071		Pre-deployment
		Microcat	4072		Pre-deployment
		Microcat	3206		Pre-deployment
		Microcat	3219		Pre-deployment
		Microcat	3220		Pre-deployment
		Microcat	3221		Pre-deployment
		Microcat	3222		Pre-deployment
		Microcat	3223		Pre-deployment
		Microcat	3226		Pre-deployment
		Microcat	3227		Pre-deployment
RB0602	4	Microcat	3228		Pre-deployment
		Microcat	3229		Pre-deployment
		Microcat	3230		Pre-deployment
		Microcat	3231		Pre-deployment
		Microcat	3232		Pre-deployment
		Microcat	3233		Pre-deployment

		Microcat	3487		Post-deployment
		Microcat	3905		Post-deployment
		Microcat	3906		Post-deployment
		Microcat	3907		Post-deployment
		Microcat	3908		Post-deployment
		Microcat	3909		Post-deployment
RB0602	5	Microcat	3480		Post-deployment
		Microcat	3479		Post-deployment
		Microcat	3244		Pre-deployment
		RCM11	300	Bad Record	Pre-deployment (but not deployed)
		RCM11	305		Pre-deployment
		RCM11	301		Pre-deployment
		RCM11	306	Bad Record	Pre-deployment (but re-dipped)
		RCM11	451		Pre-deployment
RB0602	6	Microcat	4178		Post-deployment
		Microcat	4179		Post-deployment
		Microcat	4180		Post-deployment
		Microcat	4181		Post-deployment
		Microcat	4183		Post-deployment
		RCM11	300	Re-dipped – still bad record	Pre-deployment (but not deployed)
		RCM11	306	Changed battery and re-dipped - OK	Pre-deployment
		S4	35612578		Post-deployment
		S4	35612571		Post-deployment
D304	002	Microcat	3933		Pre-deployment
		Microcat	3932		Pre-deployment
		Microcat	3931		Pre-deployment
		Microcat	3934		Pre-deployment
		Microcat	4305		Pre-deployment
		Microcat	4306		Pre-deployment
		Microcat	4307		Pre-deployment
		Microcat	3479		Pre-deployment
		Microcat	3480		Pre-deployment
		Microcat	3930		Pre-deployment
		Microcat	3929	Flooded on cast	Pre-deployment
		Microcat	3928		Pre-deployment
D304	003	Microcat	3207		Pre-deployment
		Microcat	3208		Pre-deployment
		Microcat	3209		Pre-deployment
		Microcat	3210		Pre-deployment
		Microcat	3212		Pre-deployment
		Microcat	3213		Pre-deployment
		Microcat	3214		Pre-deployment
		Microcat	3215		Pre-deployment
		Microcat	3216		Pre-deployment
		Microcat	3217		Pre-deployment
		Microcat	3218		Pre-deployment
		Microcat	3276		Pre-deployment
D304	004	Microcat	4714		Pre-deployment

		Microcat	4715		Pre-deployment
		Microcat	4716		Pre-deployment
		Microcat	4717		Pre-deployment
		Microcat	4725		Pre-deployment
		Microcat	4719		Pre-deployment
		Microcat	4720		Pre-deployment
		Microcat	4721		Pre-deployment
		Microcat	4722		Pre-deployment
		Microcat	4723		Pre-deployment
		Microcat	4724	No data logged – incorrectly setup	Pre-deployment
		Microcat	4718		Pre-deployment
		Idronaut	1103034		Pre-deployment
D304	005	Microcat	4724		Pre-deployment
		Microcat	4712		Pre-deployment
		Microcat	4711		Pre-deployment
		Microcat	4179		Pre-deployment
		Microcat	4713		Pre-deployment
		Microcat	4180	No data logged – incorrectly setup	Pre-deployment
		Microcat	4183		Pre-deployment
		Microcat	4181		Pre-deployment
		Microcat	4178		Pre-deployment
		Microcat	4709		Pre-deployment
		Microcat	4708		Pre-deployment
		Microcat	4710		Pre-deployment
		RCM11	448	C-range 45-55	Pre-deployment
		RCM11	449	C-range 32-34	Pre-deployment
D304	006	Microcat	3890		Post-deployment
		Microcat	3891		Post-deployment
		Microcat	3892		Post-deployment
		Microcat	3893		Post-deployment
		Microcat	3900		Post-deployment
		Microcat	3901		Post-deployment
		Microcat	3902		Post-deployment
		Microcat	3903		Post-deployment
		Microcat	3904		Post-deployment
		Microcat	3910		Post-deployment
		Microcat	3911		Post-deployment
		Microcat	4180		Pre-deployment
D304	007	Microcat	3912		Post-deployment
		Microcat	3913		Post-deployment
		Microcat	3914		Post-deployment
		Microcat	3915		Post-deployment
		Microcat	3916		Post-deployment
		Microcat	3918		Post-deployment
		Microcat	3919		Post-deployment
		Microcat	3248		Post-deployment
		Microcat	3249		Post-deployment
		Microcat	3259		Post-deployment
		Microcat	3264		Post-deployment
D304	008	Microcat	4462		Post and Pre-

					deployment
		Microcat	4472		Post-deployment
		Microcat	4470		Post-deployment
		Microcat	4461		Post and pre-deployment
		Microcat	4469		Post-deployment
		Microcat	3282		Post and pre-deployment
		Microcat	3239		Post and pre-deployment
		Microcat	3284		Post and pre-deployment
		Microcat	4475		Post-deployment
		Microcat	4468		Post and pre-deployment
		Microcat	4464		Post and pre-deployment
		Microcat	4466		Post and pre-deployment
D304	009	Microcat	3483		Post and pre-deployment
		Microcat	3484		Post and pre-deployment
		Microcat	3486		Post and pre-deployment
		Microcat	4465		Post and pre-deployment
		Microcat	4460		Post and pre-deployment
		Microcat	4467		Post and pre-deployment
		Microcat	3283		Post and pre-deployment
		Microcat	4471		Post and pre-deployment
		Microcat	4474		Post and pre-deployment
		Microcat	4463		Post and pre-deployment
		Microcat	3281		Post and pre-deployment
		Microcat	4473		Post and pre-deployment
D304	010	Microcat	3274		Post-deployment
		Microcat	3277		Post-deployment
		Microcat	3481		Post-deployment
		Microcat	3224		Post-deployment
		Microcat	3234		Post-deployment
		Microcat	3225		Post-deployment
		Microcat	3266		Post-deployment
		Microcat	3265		Post-deployment
		Microcat	3268		Post-deployment
		Microcat	3272		Post-deployment
		Microcat	3269		Post-deployment
		Microcat	3256		Post-deployment
		Microcat	3257		Post-deployment

		Microcat	3258		Post-deployment
		Microcat	3270		Post-deployment
		Microcat	3203		
		Microcat	3247		
		Microcat	3251		
		Microcat	3252		
		Microcat	3254		

Appendix E: Instrument Record Lengths

Table E.1: Instrument record lengths

Mooring	Instrument	Serial Number	Approx depth (m)	Recovered?	Date of first useable record	Date of last useable record
EBADCP	RDI Broadband ADCP	1184	430	No	n/a	n/a
EBH5	Seabird SBE37 SMP CTD	3890	50	Yes	3/4/05	27/2/06
	Seabird SBE37 SMP CTD	3891	100	Yes	3/4/05	17/2/06
	Seabird SBE37 SMP CTD	3892	175	Yes	3/4/05	19/2/06
	Seabird SBE37 SMP CTD	3893	250	Yes	3/4/05	23/2/06
EBH4	Seabird SBE37 SMP CTD	3894	325	No	n/a	n/a
	Seabird SBE37 SMP CTD	3895	400	No	n/a	n/a
	Seabird SBE37 SMP CTD	3896	500	No	n/a	n/a
	Seabird SBE37 SMP CTD	3897	600	No	n/a	n/a
	Seabird SBE37 SMP CTD	3898	700	No	n/a	n/a
	Seabird SBE37 SMP CTD	3899	800	No	n/a	n/a
EBH3	Seabird SBE37 SMP CTD	3900	900	Yes	4/4/05	16/2/06
	Seabird SBE37 SMP CTD	3901	1000	Yes	4/4/05	12/2/06
	Seabird SBE37 SMP CTD	3902	1100	Yes	4/4/05	18/2/06
	Seabird SBE37 SMP CTD	3903	1200	Yes	4/4/05	17/2/06
	Seabird SBE37 SMP CTD	3904	1400	Yes	4/4/05	18/2/06
EBH2	Seabird SBE37 SMP CTD	3910	1600	Yes	4/4/05	6/9/05
	Seabird SBE37 SMP CTD	3911	1800	Yes	4/4/05	15/2/06
	Seabird SBE37 SMP CTD	3912	2000	Yes	4/4/05	14/2/06
EBH1	Seabird SBE37 SMP CTD	3913	2500	Yes	4/4/05	16/2/06
	Seabird SBE37 SMP CTD	3914	3000	Yes	4/4/05	11/2/06
EBH0	Seabird SBE37 SMP CTD	3915	3500	Yes	7/4/05	19/2/06
EBHi	Seabird SBE37 SMP CTD	3916	3500	Yes	8/4/05	29/1/06
	Seabird SBE37 SMP CTD	3918	4000	Yes	8/4/05	31/1/06
	Seabird SBE37 SMP CTD	3919	4500	Yes	8/4/05	4/2/06
EB2	Aanderaa RCM11	302	50	Yes	26/11/05	17/5/06
	Seabird SBE37 SMP CTD	3264	50	Yes	26/11/05	17/5/06
	McLane Moored Profiler	11672-01	50-2500	Yes	26/11/05	17/5/06
	Aanderaa RCM11	303	2500	Yes	26/11/05	17/5/06
	Seabird SBE37 SMP CTD	3248	2500	Yes	26/11/05	17/5/06
	Seabird SBE37 SMP CTD	3249	3500	Yes	26/11/05	17/5/06
	Seabird SBE37 SMP CTD	3259	4850	Yes	26/11/05	17/5/06
EB1	Seabird SBE37 IMP CTD	3242	50	No	n/a	n/a
	Seabird SBE37 IMP CTD	3241	100	No	n/a	n/a
	Seabird SBE37 IMP CTD	3240	175	No	n/a	n/a
	Seabird SBE37 IMP CTD	3239	250	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	3284	325	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	3283	400	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	3282	500	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	3281	600	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4475	700	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4474	800	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4473	900	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4472	1000	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4471	1100	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4470	1200	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4469	1400	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4468	1600	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4467	1800	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4466	2000	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4465	2500	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4464	3000	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4463	3500	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4462	4000	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4461	4500	Yes	25/11/05	5/5/06*
	Seabird SBE37 IMP CTD	4460	4850	Yes	25/11/05	5/5/06*
MAR3	Seabird SBE37 SMP CTD	3203	2700	Yes	15/4/05	28/5/06
	Seabird SBE37 SMP CTD	3247	3200	Yes	15/4/05	28/5/06
	Seabird SBE37 SMP CTD	3251	3700	Yes	15/4/05	28/5/06
	Seabird SBE37 SMP CTD	3252	4200	Yes	15/4/05	28/5/06[◊]
	Seabird SBE37 SMP CTD	3254	4700	Yes	15/4/05	28/5/06
	Seabird SBE37 SMP CTD	3255	5150	Yes – Flooded	n/a	n/a
	Interocean S4AD	35612574	5200	Yes	15/4/05	27/5/06
MAR4	Aanderaa RCM11	445	50	Yes	16/4/05	28/5/06

	McLane Moored Profiler	11794-02	50-2500	Yes	none[‡]	none[‡]
	Seabird SBE37 SMP CTD	3256	2500	Yes	16/4/05	28/5/06
	Seabird SBE37 SMP CTD	3257	3000	Yes	16/4/05	28/5/06
	Seabird SBE37 SMP CTD	3258	3500	Yes	16/4/05	28/5/06
	Seabird SBE37 SMP CTD	3270	4000	Yes	16/4/05	28/5/06
	Seabird SBE37 SMP CTD	3271	4500	Yes - Flooded	n/a	n/a
	Interocean S4AD	35612575	4700	Yes	16/4/05	28/5/06[⊗]
MAR2	Seabird SBE37 SMP CTD	3274	2550	Yes	22/4/05	25/5/06
	Seabird SBE37 SMP CTD	3277	3180	Yes	22/4/05	25/5/06
	RBR XR420 CTD	9656	3800	Yes	22/4/05	25/5/06
	Seabird SBE37 SMP CTD	3481	4430	Yes	22/4/05	25/5/06
	Interocean S4AD	35612577	5050	Yes	22/4/05	25/5/06
MAR1	Seabird SBE37 SMP CTD	3224	50	Yes	23/4/05	24/5/06
	Seabird SBE37 SMP CTD	3234	100	Yes	23/4/05	24/5/06
	Seabird SBE37 SMP CTD	3225	250	Yes	23/4/05	24/5/06
	Seabird SBE37 SMP CTD	3266	600	Yes	23/4/05	24/5/06
	Seabird SBE37 SMP CTD	3265	1000	Yes	23/4/05	24/5/06
	Seabird SBE37 SMP CTD	3268	1600	Yes	23/4/05	24/5/06
	Seabird SBE37 SMP CTD	3272	2000	Yes	23/4/05	24/5/06
	Seabird SBE37 SMP CTD	3269	2500	Yes	23/4/05	24/5/06
	Seabird SBE37 SMP CTD	3483	3000	Yes	23/4/05	24/5/06
	Seabird SBE37 SMP CTD	3484	3500	Yes	23/4/05	24/5/06
	Seabird SBE37 SMP CTD	3486	4000	Yes	23/4/05	24/5/06
	Interocean S4AD	35612566	4500	Yes	23/4/05	24/5/06[∆◊]
	Interocean S4AD	35612576	5200	Yes	23/4/05	24/5/06
WB4	Aanderaa RCM11	304	1000	Yes	25/5/05	6/6/05
	Aanderaa RCM11	306	1200	Yes	25/5/05	21/3/06
	Aanderaa RCM11	451	1600	Yes	25/5/05	21/3/06
	Aanderaa RCM11	301	2000	Yes	25/5/05	21/3/06
	Seabird SBE37 SMP CTD	3482	2500	Yes	25/5/05	21/3/06
	Interocean S4AD	35612578	3000	Yes	25/5/05	21/3/06
	Seabird SBE37 SMP CTD	3479	3500	Yes	25/5/05	21/3/06
	Interocean S4AD	35612571	4000	Yes	25/5/05	21/3/06
	Seabird SBE37 SMP CTD	3480	4500	Yes - Flooded	n/a	n/a
WB2	Seabird SBE37 IMP CTD	4177	50	No	n/a	n/a
	Sontek Argonaut MD	D265	100	No	n/a	n/a
	Seabird SBE37 SMP CTD	3485	10	No	n/a	n/a
	Seabird SBE37 IMP CTD	4178	250	Yes	14/5/05	9/3/06
	Sontek Argonaut MD	D291	400	Yes	none	none[Ω]
	Seabird SBE37 SMP CTD	3487	400	Yes	14/5/05	9/3/06
	Seabird SBE37 IMP CTD	4179	600	Yes	14/5/05	9/3/06
	Sontek Argonaut MD	D295	800	Yes	none	none[Ω]
	Seabird SBE37 SMP CTD	3905	800	Yes	14/5/05	9/3/06
	Seabird SBE37 IMP CTD	4180	1000	Yes	14/5/05	9/3/06
	Sontek Argonaut MD	D278	1600	Yes	14/5/05	9/3/06
	Seabird SBE37 SMP CTD	3906	1600	Yes	14/5/05	9/3/06
	Seabird SBE37 IMP CTD	4181	2000	Yes	14/5/05	9/3/06
	Sontek Argonaut MD	D290	2500	Yes	14/5/05	5/7/05
	Seabird SBE37 SMP CTD	3907	2500	Yes	14/5/05	5/7/05
	Sontek Argonaut MD	D332	3000	Yes	14/5/05	22/12/05
	Seabird SBE37 SMP CTD	3908	3000	Yes	14/5/05	10/2/06
	Seabird SBE37 IMP CTD	4183	3500	Yes	14/5/05	9/3/06
	Sontek Argonaut MD	D322	3850	Yes	14/5/05	9/3/06
	Seabird SBE37 SMP CTD	3909	3850	Yes	14/5/05	9/3/06
WB1	Aanderaa RCM11	307	50	Yes – Nov '05	10/5/05	10/11/05
	Aanderaa RCM11	309	100	Yes – Nov '05	10/5/05	24/5/05
	Seabird SBE37 IMP CTD	4060	175	Yes – Nov '05	10/5/05	10/11/05
	Aanderaa RCM11	310	250	Yes – Nov '05	10/5/05	20/5/05
	Seabird SBE37 IMP CTD	4062	325	Yes – Nov '05	10/5/05	10/11/05
	Aanderaa RCM11	446	400	Yes – Nov '05	10/5/05	10/11/05
	Seabird SBE37 IMP CTD	4066	500	Yes – Nov '05	10/5/05	10/11/05
	Aanderaa RCM11	450	600	Yes – Nov '05	10/5/05	10/11/05
	Seabird SBE37 IMP CTD	4068	700	Yes – Nov '05	10/5/05	10/11/05
	Interocean S4AD	35612565	800	Yes – Nov '05	10/5/05	10/11/05
	Seabird SBE37 IMP CTD	4070	900	Yes – Nov '05	10/5/05	10/11/05
	Interocean S4AD	35612568	1000	Yes – Nov '05	10/5/05	10/11/05
	Seabird SBE37 IMP CTD	4071	1100	Yes – Nov '05	10/5/05	10/11/05
	Interocean S4AD	35612569	1200	Yes – Nov '05	10/5/05	10/11/05
	Seabird SBE37 IMP CTD	4072	1200	Yes – Nov '05	10/5/05	10/11/05
	Interocean S4AD	35612570	1375	Yes – Nov '05	10/5/05	10/11/05
	Seabird SBE37 IMP CTD	4184	1375	Yes – Nov '05	10/5/05	10/11/05
WBADCP	RDI Longranger ADCP	5817	600	Yes	10/5/05	19/3/06

* Mooring collapsed on 5/5/06 but not recovered until 18/5/06

‡ MMP CTD flooded after first profile so subsequent data of no use.

⊗ Bad currents and pressure record from mid-August.
Δ Suspect heading record may have affected current measurements so caution required when handling these data.
Ω No valid current measurements
◊ Bad pressure record

Appendix F: Pressure relief procedure for flooded Microcats

The procedures below were received by email from Seabird following a problem we experienced with a flooded but pressurised Microcat on cruise D304.

SBE 37-IM or 37-IMP MicroCAT

There are 4 socket head cap screws securing the conductivity cell tray to the end cap. There is an o-ring face seal between the cell tray and end cap. Using a **9/64 inch Allen hex key**, loosen each screw 1/2-turn while looking for signs of internal pressure (hissing or water leakage). If no sign of pressure is detected, continue to loosen the screws in 1/2-turn increments until the cell tray is loose and the o-ring seal is broken. If internal pressure is detected, let it bleed off slowly. Then, you can safely remove the end cap. The seals and surrounding surfaces must be properly cleaned before remounting the cell tray; we recommend that this work be performed at Sea-Bird. Remount the tray (to secure the conductivity cell for transport) and send the MicroCAT to Sea-Bird for servicing, with a note that the cell tray o-ring seals have been broken.

SBE 37-SM or 37-SMP - loosen (unscrew anti-clockwise) the bulkhead connector on the battery end cap very slowly, at least 1 turn. This opens an o-ring seal under the connector. Look for signs of internal pressure (hissing or water leak). If internal pressure is detected, let it bleed off slowly past the connector o-ring. Then, you can safely remove the end cap. If the connector is broken or otherwise not readily removable, loosen the cell tray as described for 37-IM's above.

Appendix G: Mooring Recovery and Deployment Log Sheets

RAPID MOORINGS **CRUISE D304** **MRG ID:** EBH5

Eastern Atlantic 26N RECOVERY **UKORS ID**

LATITUDE 27 55.59 **DATE** 13/05/06

LONGITUDE -13 22.97 **DAY** 133

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

COMPLETION TIME

ITEM	SER NO	COMMENT	TIME
16" ORANGE PICKUP FLOAT		FOULED	0947
40" STEEL SPHERE			0950
ARGOS BEACON	256	ID 42748	0950
LIGHT		WORKING	0950
SBE 37	3890	TEMP SENSOR FOULED	0955
SBE 37	3891	TEMP SENSOR FOULED	1003
SBE 37	3892	TEMP SENSOR FOULED	1008
SBE 37	3893	TEMP SENSOR FOULED	1111
ACOUSTIC RELEASE	368	FOULED WITH ORANGE MOLLUSC - SEE PIC	1111

Comments : JAMES WATSON

RAPID MOORINGS CRUISE D304

MRG ID: EBH5

Eastern Atlantic 26N

RECOVERY OF BROKEN MOORING

UKORS ID

LATITUDE

DATE 04/06/06

LONGITUDE

DAY 155

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 7:31

COMPLETION TIME 15:10

ITEM	SER NO	COMMENT	TIME	
RECOVERY FLOAT	n/a	17" GLASS SPHERE scratch marks on Benthos pickup buoy sphere damaged	7:31	
RECOVERY LINE	n/a	15M POLYPROP ROPE		
MAIN BUOYANCY	n/a	40" STEEL	7:30	Recovered 75 nm south of deployment position
ARGOS BEACON	T06-040	PTT 59619: antenna bent	7:30	
LIGHT	U01-024	Swivel in horizonal position	7:30	
CHAIN	n/a	2m 5/8" Galvanised		
SWIVEL	n/a			
SBE 37	3207		7:38	
SBE 37	3208		7:43	
SBE 37	3209	Superficial marks on instrument and clamps	7:46	
SBE 37	3210		~15:10	Recovered at Deployment position
6 OFF GLASS SPHERES	n/a	One sphere missing	15:10	
SWIVEL	n/a		15:10	
ACOUSTIC RELEASE	283	AR861	15:10	
10M CHAIN	n/a			
1000KG ANCHOR	n/a			

MOORING METHOD

COMMENTS

Mooring went adrift just 4 days after being deployed
Small boat operation required to recover: pickup line not accessible from vessel
7:49: wire torn apart between SBE 3209 and 3210
Superficial marks on SBE 3209 and intense signs of damage of wire jacket starting at least 10m before break point of wire
15:10: wire snapped just a few centimetres above SBE 3210

RAPID MOORINGS **CRUISE D304** **MRG ID:** EBH3

Eastern Atlantic 26N RECOVERY **UKORS ID**

LATITUDE

LONGITUDE

DATE 13/05

DAY 133

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

COMPLETION TIME

ITEM	SER NO	COMMENT	TIME
17" YELLOW PICKUP FLOAT			1530
BILLINGS FLOAT (4)			1533
LIGHT ON BILLINGS			
2 FLOATS		MINI TRIMSYNS	1533
SBE MICROCAT	3900		1533
2 FLOATS			1538
SBE MICROCAT	3901	MINI TRIMSYNS, TANGLE	1538
2 FLOATS		MINI TRIMSYNS, TANGLE	1543
SBE MICROCAT	3902	TANGLE, ROPE AROUND SBE	1543
2 FLOATS		MINI TRIMSYNS, TANGLED WITH SBE 3903	1547
SBE MICROCAT	3903		1547
SBE MICROCAT	3904	FOULED	1552
2 FLOATS			1552
ACOUSTIC RELEASE		AR861, FOULED	1553

Comments :

RAPID MOORINGS **CRUISE D304** **MRG ID:** EBH2

Eastern Atlantic 26N RECOVERY **UKORS ID** 2005/11

LATITUDE 27° 36.72 N **DATE** 14/05/06

LONGITUDE 14° 13.15 W **DAY** 134

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 11:55

COMPLETION TIME 12:13

ITEM	SER NO	COMMENT	TIME
17" yellow pickup float	n/a		11:59
Billings Float (4 pack)	n/a		11:59
Light on Billings		on	11:59
2 floats	n/a	17" Glass	11:59
SBE37 Microcat	3910		11:59
2 floats	n/a	17" Glass	12:04
SBE37 Microcat	3911	Tangled with previous floats; no damage	12:04
SBE37 Microcat	3912		12:11
2 floats	n/a	17" glass	12:13
Acoustic Release (AR861)	367		12:13

RECOVERY METHOD Double barrel capstan, crane mooring table

COMMENTS

Release time: 11h28
Surface time: 11h46

RAPID MOORINGS   CRUISE D304   MRG ID: EBH1

Eastern Atlantic 26N   RECOVERY   **UKORS ID** 2005/12

LATITUDE	27° 16.58 N	**DATE**	14/05
LONGITUDE	15° 25.50 W	**DAY**	134

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME	19:40
COMPLETION TIME	20:06

ITEM	SER NO	COMMENT	TIME
17” yellow pickup float	n/a		19:47
Billings Float (4 pack)	n/a		19:47
Light on Billings		working	19:47
2 floats	n/a	17” Glass	19:47
SBE37 Microcat	3913		19:51
2 floats	n/a	17” Glass	19:56
SBE37 Microcat	3914		20:03
2 floats	n/a	17” glass	20:05
Acoustic Release (AR861)	???		20:05

RECOVERY METHOD Double barrel capstan, crane mooring table

COMMENTS

RAPID MOORINGS CRUISE D304

MRG ID: EBH0

Eastern Atlantic 26N | RECOVERY | **UKORS ID** 2005/14

LATITUDE 26° 59.48 N

LONGITUDE 16° 13.63W

DATE 15/05/06

DAY 135

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 7:15

COMPLETION TIME 7:24

ITEM	SER NO	COMMENT	TIME
17” yellow pickup float	n/a		7:15
Billings Float (4 pack)	n/a		7:18
Light on Billings			7:18
2 floats	n/a	17” Glass	7:18
SBE37 Microcat	3915		7:21
2 floats	n/a	17” glass 1 glass sphere flooded	7:24
Acoustic Release (AR861)	???		7:24

RECOVERY METHOD Double barrel capstan, crane mooring table

COMMENTS

Fired: 06h14
Sighted: 06h56

RAPID MOORINGS CRUISE D304

MRG ID: EBHi

Eastern Atlantic 26N RECOVERY

UKORS ID 2005/15

LATITUDE 24° 57.67 N When picked up

LONGITUDE 21° 15.14 W Depth: 4466m

DATE 16/05/06

DAY 136

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 11:47

COMPLETION TIME 12:13

ITEM	SER NO	COMMENT	TIME
17” yellow pickup float	n/a		11:47
Billings Float (4 pack)	n/a		11:49
Light on Billings		Not working	11:49
2 floats	n/a	17” Glass	11:49
SBE37 Microcat	3916		11:53
2 floats	n/a	17” glass	12:02
SBE37 Microcat	3918		12:04
SBE37 Microcat	3919		12:12
4 floats	n/a	17” glass 2 floats destroyed	12:13
Acoustic Release (AR861)	260		12:13

RECOVERY METHOD Double barrel capstan, crane mooring table

COMMENTS

Release: ~10h33: no initial response from mooring, then found to be released.
Sighting: 11h20

RAPID MOORINGS CRUISE D304

MRG ID: EB1

UKORS ID

Eastern Atlantic 26N

RECOVERY

LATITUDE 23 48.92N

DATE 18/05

LONGITUDE 24 07.96W

DAY

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 0830

COMPLETION TIME 1345

ITEM	SER NO	COMMENT	TIME
TELEMETRY BUOY		No longer attached to mooring	X
ARGOS BEACON	257	Missing	X
49" STEEL SPHERE		Missing	X
SBE	3242	Missing	X
SBE	3241	Missing	X
SBE	3240	Missing	X
SBE	3239		1259
SBE	3284	Top instrument recovered at 250m	1304
SBE	3283		1311
SBE	3282		1325
SBE	3281		1324
SBE	4475		1309
SBE	4474		1327
SBE	4473		1327
4 GLASS SPHERES			1340
SBE	4472		1339
SBE	4471		1222
SBE	4470		1255
SBE	4469		1248
SBE	4468		1135
SBE	4467		1120
SBE	4466		1105
SBE	4465		1043
SBE	4464		1023
SYNTACTIC BUOY		0854 attached line to pickup using small boat	0854
SBE	4463		1040
SBE	4462		1110
SBE	4461		1159
SBE	4460		1208
8 GLASS SPHERES			1225
ACOUSTIC RELEASE	UPPER	Serial no: 370 ARM CODE: 14FA	1225
ACOUSTIC RELEASE	LOWER	Serial no: 263 ARM CODE: 14B4, Released to increase mooring buoyancy	x

MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS Small boat attached light line to syntactic. Heavy recovery line floated out to small boat then attached to light line

0907: Syntactic stopping off to bottom
0913: Grip used on 6-8 below FT on 1m chain stopper, 10m join & difficult to undo. Used threadlock on deployment
0939: Could not undo lower buoy shackle. Blue wire cut, temporary loop made using bulldog grips. Attached to OB, start taking weight
0956: Weight off, wire jammed on stopper.
095830: Wire grip removed, crane o/b to reduce angle wire is pulled over block
1011: top 3/16 wire removed from FT and stopped off
1145: section of 3/16 wire separated from tangle and severed. Separating it from main lines being pulled in.
1142: 6-8 & 3/16 wire cut & rejoined to cut out tangle
1154: 3/16 looped on 6-8, end of tangle. From now on, pulling in 6-8 wire only.

RAPID MOORINGS   CRUISE D304   MRG ID: EB2

Eastern Atlantic 26N   RECOVERY   UKORS ID

LATITUDE 25 53.60 (position: just before recovery buoy pickup)   **DATE** 17/05

LONGITUDE 24 03.87   **DAY** 137

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1410

COMPLETION TIME 1704

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			1410
ARGOS BEACON	253	ID: 42745	1415
48" STEEL FLOAT			1415
RCM 11	302		1419
SBE	3264	Fouled	1419
MMP STOP		Fouled	1419
MMP	11672-01		1504
MMP STOP			1513
SBE	3248		1514
8X17" GLASS SPHERES			1515
RCM 11	303		1515
SBE	3249		1556
8X17" GLASS SPHERES			1600
SBE	3259		1658
6X17" GLASS SPHERES		Whole pack imploded	1704
ACOUSTIC RELEASE	243		1704
ACOUSTIC RELEASE	439	ARM14A0	1704

COMMENTS

Water depth at recovery buoy pickup : 5040 uncorrected

1504: MMP wire tangled with lower MMP stop with occasional knots. Wire tangled around MMP itself
After MMP stop wire still tangled with part of the wire where RCM11 was; RCM11 came before the 8 glass spheres: wire had to be cut

1608: Wire caught on clamp desk and damaged, possibility of snap (right after cable link)
1618: Wire cut & linked again for safety

Laure Grignon & Enrique Vidal

RAPID MOORINGS **CRUISE D304** **MRG ID:** MAR4

Eastern Atlantic 26N RECOVERY **UKORS ID**

LATITUDE ???

LONGITUDE ???

DATE 28/5/06

DAY 148

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

COMPLETION TIME

ITEM	SER NO	COMMENT	TIME
RECOVERY BUOY		Tangles with wire below surface	0944
LIGHT		Not working when first sighted (dark ~ 0630)	0944
48” STEEL SPHERE		Picked up by RIB	0944
RCM11	445		0944
MMP STOP			0944
MMP		Slight tangle, one piece, Brake on	1023
MMP STOP			1029
12x17” GLASS SPHERES		Wire cut due to tangle	1033
SBE	3256		1029
SBE	3257		1046
SBE	3258	Damage to wire	1056
SBE	3270		1117
SBE	3271	Damged microcat – top unscrewed	1125
8x17” GLASS SPHERES			1132
S4	2575223		1132
ACOUSTIC RELEASE	UPPER	AR861 SN=223	1132
ACOUSTIC RELEASE	LOWER	AR861 SN=252	1132
ANCHOR			1132

COMMENTS

Enrique Vidal-Vijande Recovery aided by small RIB

James Watson Fouling –top 70 -100m

RAPID MOORINGS | CRUISE D304

MRG ID: MAR3
UKORS ID

Eastern Atlantic 26N

RECOVERY

LATITUDE 23 55.74N
LONGITUDE 41 06.29W

DATE 28/5/06
DAY 148

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1718
COMPLETION TIME 1821

ITEM	SER NO	COMMENT	TIME
RECOVERY BUOY			1718
LIGHT			1720
BILLINGS marker float			1720
6x17" GLASS SPHERES			1720
SBE	3203		1724
SBE	3247		1734
SBE	3251		1743
2x17" GLASS SPHERES		Tangle, several lines, lines cut	1750
SBE	3252		1752
SBE	3254		1801
2x17" GLASS SPHERES		Small Tangle	1806
SBE	3255	Microcat lid open, flooded	1818
4x17" GLASS SPHERES			1821
S4	35612574	With Swivel	1821
ACOUSTIC RELEASE		AR861 SN=253	1821
ANCHOR			

COMMENTS
Enrique Vidal-Vijande

Released 1600
Surfaced 1620
Depth 5026m (uncorr, just before rec-buoy pickup)

RAPID MOORINGS | CRUISE D304

MRG ID: MAR2

UKORS ID

Eastern Atlantic 26N

RECOVERY

LATITUDE 24 10.78N

Depth (uncorr) : 5147m

DATE 25/5/06

LONGITUDE 49 41.63W

DAY 145

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1010

Sighted : 0933

COMPLETION TIME 1120

ITEM	SER NO	COMMENT	TIME
RECOVERY BUOY			1012
Novatech Light			1012
BILLINGS 4 + SWIVEL			1012
6X17" GLASS SPHERES			1012
SBE	3274		1017
SBE	3277	Fishing net attached, no damage	1026
2X17" GLASS SPHERES		NOT PRESENT	
RBR	9656		1036
2X17" GLASS SPHERES		Tangle	1044
SBE	3481		1054
4X17" GLASS SPHERES		Tangle	1120
S4	35612577		1120
ACOUSTIC RELEASE	257	RT861 ARM CODE:	1120

MOORING METHOD

COMMENTS

James Watson

10:54 Wire cut due to tangle

RAPID MOORINGS CRUISE D304

MRG ID: MAR1

UKORS ID

Eastern Atlantic 26N

RECOVERY

LATITUDE 25 37.80N

LONGITUDE 56 25.43W

DATE 24/5/06

DAY 144

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

COMPLETION TIME

ITEM	SER NO	COMMENT	TIME
RECOVERY BUOY		Fouled	1407
NOVATECH LIGHT		Fouled	1410
BILLINGS 4 + SWIVEL		Fouled	1410
SBE	3224	Fouled, sensor block fouled lightly	1410
1X17" GLASS SPHERES			1416
SBE	3234		1416
48" STEEL SPHERE		Paint removed, swivel ok	1421
SBE	3225		1430
SBE	3266		1532
8X17" GLASS SPHERES			1550
SBE	3265	Tangles, came up before x8 glass, wire cut	1547
6X17" GLASS SPHERES			1608
SBE	3268	Tangle, order mixed up	1622
SBE	3272	Tangle, order mixed up	1616
SBE	3269	Tangle, order mixed up	1550
SBE	3483	Tangle, order mixed up	1614
SBE	3484	Tangle, order mixed up	1645
SBE	3486		1655
S4	35612566		1706
4X17" GLASS SPHERES			1712
S4	35612576		1712
ACOUSTIC RELEASE	UPPER	RT661 SN:216 Rusty	1712
ACOUSTIC RELEASE	LOWER	AR861 SN:250 Rusty	1712
ANCHOR		Chain corroded	

COMMENTS
Laure Grignon
James Watson

Depth 4857 (uncorr) as rec. bouy on ship

Ship crossed mooring line before all buoys surfaced.

Various parts of mooring were tangled, wires were cut and some came up damaged (black cover removed)

RAPID MOORINGS CRUISE RB-06-02

MRG ID: WB4

Western Atlantic 26N

RECOVERY

UKORS ID 2005/32

LATITUDE 26 29.95N

LONGITUDE 76 02.43W

DATE 21/3/06

DAY 080

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 13:00

COMPLETION TIME 15:52

ITEM	SER NO	COMMENT	TIME
17" glass recovery float	n/a		14:07
1st Raft of 6 x 17" glass	n/a		14:11
2nd Raft of 6 x 17" glass	n/a		14:11
RCM11	304		14:18
RCM11	306		14:25
RCM11	451	Caught fishing net	14:36
3rd Raft of 6 x 17" glass	n/a		14:48
RCM11	301	Wire tangled around hard hats	14:45
SBE37 Microcat	3479		15:01
Raft of 4 x 17" glass	n/a	Wire tangled around glass hard hats	15:10
S4 current meter	35612571		15:10
SBE37 Microcat	3480	Wire twisted	15:23
S4 current meter	35612578		15:23
SBE37 Microcat	3482	FLOODED	15:48
Raft of 6 x 17" glass	n/a		15:51
Acoustic Release (AR 861)	359		15:51
Acoustic Release (RT661)	244		15:51

RECOVERY METHOD Double barrel capstan and A-Frame

COMMENTS

On site pinging at 12:59 – ranges of 4850m
Fire release at 13:00
Spotted 13:19
All on surface 13:57

RAPID MOORINGS CRUISE RB-06-02

MRG ID: WB2

Western Atlantic 26N

RECOVERY

UKORS ID 2005/28

LATITUDE 26 30.605N

LONGITUDE 76 44.633W

DATE 20/3/06

DAY 079

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 13:00

COMPLETION TIME

ITEM	SER NO	COMMENT	TIME
Telemetry Buoy	n/a	Broke loose weeks after deployment.	n/a
1st tether support float	n/a		
2nd tether support float	n/a		
3rd tether support float	n/a		
4th tether support float	n/a		
49" yellow syntactic	n/a	Did not surface – assumed LOST	
SBE37 microcat	4177	LOST	
Sontek Argonaut with SBE37 microcat	D265/3485	LOST	
SBE37 microcat	4178		20:12
Sontek Argonaut with SBE37 microcat	D291/3487		19:55
SBE37 microcat	4179		19:28
Sontek Argonaut with SBE37 microcat	D295/3905	Bad tangle	19:07
SBE37 microcat	4180	Bad tangle	18:35
Sontek Argonaut with SBE37 microcat	D278/3906	Bad tangle	18:35
SBE37 microcat	4181	Wire tangled	18:10
Orange flat top syntactic buoyancy	n/a		17:24
Sontek Argonaut with SBE37 microcat	D290/3907	Rusty connection	17:01
2 x 17" clamp on glass	n/a		16:45
Sontek Argonaut with SBE37 microcat	D332/3908		16:41
4 x 17" clamp on glass	n/a		
SBE37 microcat	4183		16:19
Sontek Argonaut with SBE37 microcat	D322/3909		16:05
Raft of 6 x 17" glass	n/a		15;54
Acoustic release (RT661)	162		15:52
Acoustic release (AR861)	245	Bolt very rusty	15:52

RECOVERY METHOD Double barrel capstan and A-Frame

COMMENTS

Released 13:13
Spotted 14:27 range 1224m (6 hard hats)
Recovered from release end and in tangles so not in simple order from top to bottom.
17:45 Winch stopped pulling. Switched to ship's capstan.
Wire damaged and then corroded – caused loss of top section.

RAPID MOORINGS **CRUISE RB-06-02** **MRG ID:** WBADCP

Western Atlantic 26N RECOVERY **UKORS ID** 2005/26

LATITUDE 26 32.246N **DATE** 19/3/06

LONGITUDE 76 53.090W **DAY** 078

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 14:00

COMPLETION TIME 15:08

ITEM	SER NO	COMMENT	TIME
17" yellow pickup float	n/a		14:55
ADCP buoy with ADCP And Argos beacon		Argos ID 11033	15:02
Acoustic release (AR861)	248		15:02

RECOVERY METHOD Double barrel capstan and A-Frame

COMMENTS

Release 14:12
Surface 14:17

Visually all in excellent condition.

RAPID MOORINGS   CRUISE D304

MRG ID: EBH5

Eastern Atlantic 26N   DEPLOYMENT

UKORS ID

LATITUDE 27 54.35

LONGITUDE -13 22.02

DATE 13/05

DAY 133

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

COMPLETION TIME

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT		17" GLASS SPHERE	1058
RECOVERY LINE		15M POLYPROP WARP	1100
MAIN BUOYANCY		40" STEEL SPHERE	1102
ARGOS BEACON	T06-040		
LIGHT	U01-024		
CHAIN			
SWIVEL			
SBE 37	3207		1102
SBE 37	3208		1106
SBE 37	3209		1109
SBE 37	3210		1120
6 GLASS SPHERES			1120
SWIVEL			1120
ACOUSTIC RELEASE	283	AR861	1120
10M CHAIN			1135
1000KG ANCHOR			1135

Comments : Depth 266m (Corr). Laure Grignon.

RAPID MOORINGS CRUISE D304

MRG ID: EBH5

Eastern Atlantic 26N

RE-DEPLOYMENT

UKORS ID

LATITUDE	27° 54.54	**DATE**	04/06/06
LONGITUDE	13° 21.72	**DAY**	155

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME	16:17
COMPLETION TIME	16:50

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	n/a	17" GLASS SPHERE	16:17
RECOVERY LINE	n/a	15M POLYPROP ROPE	16:17
MAIN BUOYANCY	n/a	40" STEEL	16:18
ARGOS BEACON	T06-041	PTT 59620	16:18
LIGHT	H01 024		16:18
CHAIN	n/a	2m 5/8" Galvanised	16:18
SWIVEL	n/a		16:18
SBE 37	3207		16:19
SBE 37	3208		16:23
SBE 37	3209		16:29
SBE 37	4473		16:36
6 OFF GLASS SPHERES	n/a		16:41
SWIVEL	n/a		16:41
ACOUSTIC RELEASE	359	AR861	16:41
10M CHAIN	n/a		16:50
1000KG ANCHOR	n/a		16:50

MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS

RAPID MOORINGS **CRUISE D304** **MRG ID:** EBH4

Eastern Atlantic 26N DEPLOYMENT **UKORS ID**

LATITUDE 27° 50.95 **DATE** 13/05/06

LONGITUDE 13° 32.21 **DAY** 133

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 18:03

COMPLETION TIME 18:20

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	n/a	17" GLASS SPHERE	18:03
RECOVERY LINE	n/a	15M POLYPROP ROPE	18:03
BILLINGS FLOAT	n/a	4 PACK	18:03
LIGHT BEACON		With Flag	18:03
CHAIN	n/a	1m of 3/8"	18:03
SWIVEL (ceramic)	n/a		18:03
2 OFF FLOATS	n/a	TRIMSYN	18:03
SBE 37	3212		18:04
2 OFF FLOATS	n/a	TRIMSYN	18:06
SBE 37	3213		18:06
2 OFF FLOATS	n/a	TRIMSYN	18:08
SBE 37	3214		18:08
2 OFF FLOATS	n/a	TRIMSYN	18:10
SBE 37	3215		18:10
2 OFF FLOATS	n/a	TRIMSYN	18:12
SBE 37	3216		18:12
SBE 37	3217		18:14
2 OFF FLOATS	n/a	17" GLASS	18:14
SWIVEL(Titanium)	n/a		18:14
CHAIN	n/a	1m of 1/2"	18:14
ACOUSTIC RELEASE	262	AR861	18:14
CHAIN	n/a	1m of 1/2"	
600KG ANCHOR	n/a		18:20

MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS

200m of rope added below acoustic release

RAPID MOORINGS

CRUISE D304

MRG ID: EBH3

Eastern Atlantic 26N

DEPLOYMENT

UKORS ID

LATITUDE 27° 48.831 N

DATE 13/05/06

LONGITUDE 13° 44.48

DAY 133

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 16:22

COMPLETION TIME 16:37

ITEM	SER NO	COMMENT	TIME	
RECOVERY FLOAT	n/a	17" GLASS SPHERE	16:22	
RECOVERY LINE	n/a	15M POLYPROP ROPE	16:22	
BILLINGS FLOAT	n/a	4 PACK	16:22	
LIGHT BEACON		With Flag	16:22	
CHAIN	n/a	1m of 3/8"	16:22	
SWIVEL	n/a		16:22	
2 OFF FLOATS	n/a	TRIMSYN	16:22	
SBE 37	3218		16:22	
2 OFF FLOATS	n/a	TRIMSYN	16:25	Boat change of speed: 1 knots to 1.5 knots
SBE 37	3276		16:25	
2 OFF FLOATS	n/a	TRIMSYN	16:27	
SBE 37	3928		16:27	
2 OFF FLOATS	n/a	TRIMSYN	16:29	
SBE 37	4307		16:30	
SBE 37	3930		16:34	
2 OFF FLOATS	n/a	17" GLASS	16:35	
SWIVEL	n/a		16:35	
CHAIN	n/a	1m of 1/2"	16:35	
ACOUSTIC RELEASE		AR861 Dropped, banged against deck	16:37	
CHAIN	n/a	1m of 1/2"	16:37	
600KG ANCHOR	n/a		16:37	

MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS

Acoustic release dropped onto deck from 1m height, banged on its side: no apparent damage

RAPID MOORINGS **CRUISE D304** **MRG ID:** EBH2

Eastern Atlantic 26N

DEPLOYMENT

UKORS ID

LATITUDE	27° 36.20	**DATE**	14/05
LONGITUDE	14° 12.83	**DAY**	134

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME	12:33
COMPLETION TIME	12:55

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	n/a	17" GLASS SPHERE	
RECOVERY LINE	n/a	15M POLYPROP ROPE	
BILLINGS FLOAT	n/a	4 PACK	
LIGHT BEACON		With Flag	
CHAIN	n/a	1m of 3/8"	
SWIVEL	n/a		
2 OFF FLOATS	n/a	17" GLASS	
SBE 37	3931		
2 OFF FLOATS	n/a	17" GLASS	12:48
SBE 37	3932		12:48
SBE 37	3933		12:52
2 OFF FLOATS	n/a	17" GLASS	12:52
SWIVEL	n/a		12:55
CHAIN	n/a	1m of 1/2"	12:55
ACOUSTIC RELEASE	497	AR861	12:55
CHAIN	n/a	1m of 1/2"	12:55
600KG ANCHOR	n/a		12:55

MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS

RAPID MOORINGS　　CRUISE D304　　MRG ID: EBH1

Eastern Atlantic 26N　　DEPLOYMENT　　**UKORS ID**

LATITUDE 27° 17.02 N　　**DATE** 14/05/06

LONGITUDE 15° 25.41 W　　**DAY** 134

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 20:18

COMPLETION TIME 20:33

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	n/a	17" GLASS SPHERE	20:18
RECOVERY LINE	n/a	15M POLYPROP ROPE	20:18
BILLINGS FLOAT	n/a	4 PACK H01-009	20:18
LIGHT BEACON	S01-186	With Flag - working	20:19
CHAIN	n/a	1m of 3/8"	20:19
SWIVEL	n/a		20:20
4 OFF FLOATS	n/a	17" GLASS	20:20
SBE 37	3934		20:21
2 OFF FLOATS	n/a	17" GLASS	20:26
SBE 37	4305		20:30
2 OFF FLOATS	n/a	17" GLASS	20:33
SWIVEL	n/a		20:33
CHAIN	n/a	1m of 1/2"	20:33
ACOUSTIC RELEASE	319	AR861	20:33
CHAIN	n/a	1m of 1/2"	20:33
600KG ANCHOR	n/a		20:33

MOORING METHOD Anchor last, freefall deployment

COMMENTS

Between SBE 3934 and next 2 floats: link
Between SBE 4305 and previous 2 floats: 2 links

RAPID MOORINGS CRUISE D304

MRG ID: EBH0

Eastern Atlantic 26N

DEPLOYMENT

UKORS ID

DATE 15/05

DAY 135

LATITUDE 26° 59.61 N

LONGITUDE 16° 13.72 W

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 7:45

COMPLETION TIME 7:48

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	n/a	17" GLASS SPHERE	07:45
RECOVERY LINE	n/a	15M POLYPROP ROPE	07:45
BILLINGS FLOAT	n/a	4 PACK	07:45
LIGHT BEACON		With Flag	07:45
CHAIN	n/a	1m of 3/8"	07:45
SWIVEL	n/a		07:45
4 OFF FLOATS	n/a	17" GLASS	07:45
SBE 37	4306		07:46
2 OFF FLOATS	n/a	17" GLASS	07:46
SWIVEL	n/a		07:46
CHAIN	n/a	1m of 1/2"	07:46
ACOUSTIC RELEASE	318	AR861	07:46
CHAIN	n/a	1m of 1/2"	07:46
600KG ANCHOR	n/a		07:48

MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS

Oval link to releases not taped

RAPID MOORINGS CRUISE D304

MRG ID: EBHi

Eastern Atlantic 26N — DEPLOYMENT — **UKORS ID**

LATITUDE	24° 57.29 N	Just after anchor's deployment	**DATE**	16/05/06
LONGITUDE	21° 15.60 W	Water depth: 4464 (uncorrected)	**DAY**	136

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 12:50

COMPLETION TIME 13:18

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	n/a	17" GLASS SPHERE	12:50
RECOVERY LINE	n/a	15M POLYPROP ROPE	12:50
BILLINGS FLOAT	n/a	4 PACK	12:50
LIGHT BEACON		With Flag	12:50
CHAIN	n/a	1m of 3/8"	12:50
SWIVEL	n/a	NO SWIVEL	
4 OFF FLOATS		17" GLASS	12:51
Nortek Current Meter	1415	In frame: pointed up	12:54
RCM11 Current meter	450		12:54
S4 current meter	35612571		12:54
Sontek current meter	D322	In frame (potted connector as no plug) Pointed down	12:54
4 OFF FLOATS	n/a	17" GLASS	12:55
Idronaut CTD	1103034		12:55
2 OFF FLOATS	n/a	17" GLASS	13:03
SBE 37	3479		13:03
SBE 37	3480		13:10
4 OFF FLOATS	n/a	17" GLASS	13:11
SWIVEL	n/a	NO SWIVEL	
CHAIN	n/a	1m of 1/2"	13:15
ACOUSTIC RELEASE	317	AR861	13:15
CHAIN	n/a	1m of 1/2"	13:15
600KG ANCHOR	n/a		13:18

MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS

12h55: weight of glass spheres led to a uncontrolled deployment of the Idronaut.
Note: put a longer distance between floats and instruments

RAPID MOORINGS CRUISE D304

MRG ID: EB1

UKORS ID

Eastern Atlantic 26N DEPLOYMENT

LATITUDE	23 48.92N
LONGITUDE	24 07.96W
DATE	15/5/06
DAY	138

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

COMPLETION TIME

ITEM	SER NO	COMMENT	TIME
Pickup float			19:38
23" STEEL SPHERE			1939
ARGOS BEACON		ID number 46243	1939
SBE	3890		1942
SBE	4178		1944
49" STEEL SPHERE	+ Argos	SN:256 – light on. ID 42748	1953
SBE	4179		2000
SBE	4180		2004
SBE	4181		2008
SBE	4183		2011
SBE	4708		2016
SBE	4709		2020
SBE	4710		2024
SBE	4711		2029
SBE	4712		2032
SBE	4713		2036
SBE	4714		2039
12 GLASS SPHERES		Swivel - lower part	2047
SBE	4715		2053
SBE	4716		2055
SBE	4717		2101
SBE	4718		2106
SBE	4719		2111
SBE	4720		2120
LINK			2120
SBE	4721		2129
SBE	4722		2142
10 GLASS SPHERES		Swivel – lower part	2146
SBE	4723		2157
SBE	4724		2208
SBE	4725		2225
8 GLASS SPHERES		Swivel – lower part	2247
ACOUSTIC RELEASE	496		2308
ACOUSTIC RELEASE	162		2308
ANCHOR			2325

MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS

RAPID MOORINGS **CRUISE D304** **MRG ID:** EB2

Eastern Atlantic 26N DEPLOYMENT **UKORS ID**

LATITUDE 23° 53.85N **DATE** 01/06

LONGITUDE 24° 02.78W **DAY** 152

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 8:40 Water depth: 5037m uncorrected

COMPLETION TIME 12:08

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	n/a		8:40
48” STEEL FLOAT	n/a	With swivel	8:40
ARGOS BEACON	Nt04-045		8:40
LIGHT BEACON	SO1-190		8:40
SBE	4465		8:40
MMP STOP			8:40
MMP	11794-01		9:25
MMP STOP			10:02
SBE	4471		10:02
6X17” GLASS SPHERES		With swivel	10:13
SBE	3283		10:20
SBE	4467		10:40
6X17” GLASS SPHERES			10:53
SBE	4460		10:59
SBE + RBR	3281	RBR 9656	11:20
2X GLASS SPHERES			11:49
4X17” GLASS SPHERES		With swivel	11:54
SBE	4463		11:57
ACOUSTIC RELEASE	362	AR861 ARM14F2 REL1455	12:00
ACOUSTIC RELEASE	321	AR861 ARM14D1 REL1455	12:00
10M CHAIN			12:05
ANCHOR			12:08

MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS

Link between seabirds 3283 and 4467

RAPID MOORINGS **CRUISE D304** **MRG ID:** EBL3

Eastern Atlantic 26N DEPLOYMENT **UKORS ID**

LATITUDE 23° 53.98 **DATE** 01/06/06

LONGITUDE 24° 03.12 **DAY** 152

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 13:06 Water depth: 5037m (uncorrected) Just after anchor's deployment

COMPLETION TIME 13:10

ITEM	SER NO	COMMENT	TIME
Pickup float	n/a	17" Glass	13:06
Pickup line	n/a	15m yellow/black 20mm polyprop	13:06
Billings float	n/a	4 pack	13:07
Radio beacon on float			13:07
Light on float			13:07
4 OFF 17" Glass	n/a		13:08
4 OFF 17" Glass	n/a		13:10
SBE26 BPR	389		13:10
SBE26 BPR	388		13:10
Acoustic release	368		13:10
Acoustic release	320		13:10
Anchor	n/a		13:10

DEPLOYMENT METHOD Freefall anchor last.

COMMENTS

RAPID MOORINGS CRUISE D304

MRG ID: EBL4

Eastern Atlantic 26N

DEPLOYMENT

UKORS ID

LATITUDE	27° 17.20
LONGITUDE	15° 25.33

DATE	14/05/06
DAY	134

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME	20:41
COMPLETION TIME	20:45

ITEM	SER NO	COMMENT	TIME
Pickup float	n/a	17” Glass	20:42
Pickup line	n/a	15m yellow/black 20mm polyprop	20:42
Billings float	n/a	4 pack	20:42
Radio beacon on float	U01-022	On	20:42
Light on float	T05-099	on	20:42
Raft of glass	n/a	5 OFF 17” Glass	20:42
SBE26 BPR	397		20:45
Acoustic release	498		20:45
Anchor	n/a		20:45

DEPLOYMENT METHOD Freefall anchor last.

COMMENTS

RAPID MOORINGS	**CRUISE D304**	**MRG ID:** MAR3
Eastern Atlantic 26N	DEPLOYMENT	**UKORS ID**
LATITUDE 23 51.60N		**DATE** 28/5/06
LONGITUDE 41 05.99W		**DAY** 148

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

COMPLETION TIME

ITEM	SER NO	COMMENT	TIME
RECOVERY BUOY			1216
LIGHT			1216
BILLINGS			1216
6x17" GLASS SPHERES			1220
SBE	3282		1223
SBE	4461		1238
SBE	4462		1255
SBE	4464		1308
4x17" GLASS SPHERES		Swivel	1311
SBE	4466		1322
S4	35612567		1346
SBE	4468		1348
4x17" GLASS SPHERES		No swivel	1455
4x17" GLASS SPHERES		Swivel	1400
ACOUSTIC RELEASE	LOWER	AR861 SN=370 ARM 14FA REL 1455	1406
ANCHOR			1441

COMMENTS

Laure Grignon
James Watson

Depth: 4981m (uncorr)

Billings tangled with top glass spheres, recovered then redeployed.

Between SBE 4466 and 4468 wire slightly damaged, taped up.

Before SBE 4468 jam in drum, speed slowed.

RAPID MOORINGS   CRUISE D304

MRG ID: MAR2
UKORS ID

Eastern Atlantic 26N   DEPLOYMENT

LATITUDE 24 10.78N   **DATE** 26/5/06
LONGITUDE 49 41.63W   **DAY** 146

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

COMPLETION TIME

ITEM	SER NO	COMMENT	TIME
RECOVERY BUOY			0606
BILLINGS + LIGHT		Working	0607
8X17" GLASS SPHERES		Swivel below glass	0609
SBE	3264		0612
SBE	3239		0619
SBE	3483		0627
SBE	4474		0637
6X17" GLASS SPHERES			0645
SBE	3486		0655
SBE	3248		0704
SBE	3249		0713
6X17" GLASS SPHERES			0828
SBE	3259		0839
SBE	3919	Wire snapped, recovered/redeployed	0849
S4	35612572		0902
4X17" GLASS SPHERES			0902
SBE	3284		0909
4X17" GLASS SPHERES		Swivel below	0909
ACOUSTIC RELEASE	495	RT861 ARM: 15A4 REL 1555	0915
ANCHOR			0919

MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS

Enrique Vidal-Vijande

0738 – wire snapped on winch, recovered and redeployed mooring – OK

Snapped wire (1200m) replaced by 1500m length wire
190m were taken off.

Release rigged with stainless double link

RAPID MOORINGS CRUISE D304

MRG ID: MAR1
UKORS ID

Eastern Atlantic 26N

DEPLOYMENT

LATITUDE 24 11.69N

LONGITUDE 49 43.69W

DATE 25/5/06

DAY 145

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

COMPLETION TIME

ITEM	SER NO	COMMENT	TIME
RECOVERY BUOY		REMOVED AFTER DEPLOYMENT	1324
ARGOS BEACON	T04-045	REMOVED AFTER DEPLOYMENT	1325
LIGHT		REMOVED AFTER DEPLOYMENT	1325
BILLIGS		REMOVED AFTER DEPLOYMENT	1325
SBE	3918		1326
24" STEEL SPHERE		With swivel	1329
SBE	3910		1332
ARGOS BEACON			1343
48" STEEL SPHERE		With swivel	1343
SBE	3911		1343
SBE	3912		1350
SBE	3913		1358
SBE	3914		1403
SBE	3915		1408
SBE	3916		1414
SBE	3900		1419
8X17" GLASS SPHERES		With swivel	1430
SBE	3901		1438
SBE	3902		1448
SBE	3903		1500
SBE	3904		1514
8X17" GLASS SPHERES		With swivel	1515
SBE	3891	Some old fouling	1532
SBE	3892		1543
SBE	3893		1606
S4	35612573		1606
6X17" GLASS SPHERES		With swivel	1620
ACOUSTIC RELEASE		SN = 246	1635
ACOUSTIC RELEASE		SN = 163	1635
ANCHOR			1638

COMMENTS
Laure Grignon
James Watson

Microcats in direct sunlight, very hot.

50m of wire was added after S4

After deployment top floats surfaced (mooring too long). ALL INSTRUMENTS UP TO BILLINGS WERE REMOVED

DEPTH: 5168 (uncorr)

RAPID MOORINGS **CRUISE D304** **MRG ID:** MARL3

Mid Atlantic 26N DEPLOYMENT **UKORS ID**

LATITUDE 24 12.62 **DATE** 25/5/06

LONGITUDE 49 43.64 **DAY** 145

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

COMPLETION TIME

ITEM	SER NO	COMMENT	TIME
17” glass pickup float	n/a		2123
Billings float	n/a		‘2123
Radio beacon on float			2123
Light on float			2123
4 x 17” glass	n/a		2123
4 x 17” glass	n/a		2123
1st SBE53	0013		2124
2nd SBE53	0014		2124
1st Acoustic release		367 AR861	2125
2nd Acoustic release		256 AR861	2126
Anchor	n/a		2127

DEPLOYMENT METHOD Freefall anchor last.
COMMENTS Depth 5167 (uncorr)
James Watson

RAPID MOORINGS | **CRUISE D304** | **MRG ID:** MARL4

Eastern Atlantic 26N | DEPLOYMENT | **UKORS ID**

LATITUDE 23 51.57N | **DATE** 28/5/06

LONGITUDE 41 05.69W | **DAY** 148

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1408

COMPLETION TIME 1412

ITEM	SER NO	COMMENT	TIME
RECOVERY BUOY			1408
LIGHT	SO1-187		1409
VHF	U01-020		1409
BILLINGS			1409
2x17" GLASS SPHERES		Yellow cover slightly open	1409
4x17" GLASS SPHERES			1410
BPR	0012		1412
ACOUSTIC RELEASE		AR861 SN=243 ARM 14A0 REL 1455	1412
ANCHOR			1412

COMMENTS Depth: 4991m (uncorr)

Laure Grignon

RAPID MOORINGS	**CRUISE RB-06-02**	**MRG ID:** WB4
Western Atlantic 26N	DEPLOYMENT	**UKORS ID**
LATITUDE 26 29.316N		**DATE** 22/3/06
LONGITUDE 76 04.192W		**DAY** 081

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 13:45

COMPLETION TIME 18:41

ITEM	SER NO	COMMENT	TIME
2 x 17” glass and swivel	n/a		14:33
Light and flag	n/a		14:33
SBE37 microcat on keel	3920		14:40
2 x 17” glass and swivel			14:43
RCM11	307		14:43
SBE37 microcat	3921		14:43
50” yellow sphere	n/a		15:00
Argos beacon on buoy		ID 13346	15:00
Swivel	n/a		15:00
SBE37 Microcat	3922		15:00
RCM11	308		15:14
SBE37 Microcat	3923		15:14
SBE37 Microcat	3924		15:22
RCM11	309		15:32
SBE37 Microcat	3925		15:32
SBE37 Microcat	3926		15:40
SBE37 Microcat	3927		15:53
RCM11	310		15:53
Raft of 12 x 17” glass	n/a	Orange hard hats	16:25
SBE37 Microcat	3245		16:25
Swivel	n/a		16:43
RCM11	446		16:43
SBE37 Microcat	3246		16:43
SBE37 Microcat	3260		16:56
Raft of 4 x glass	n/a		17:15
S4	35612569		17:15
SBE37 Microcat	3261		17:15
SBE37 Microcat	3262		17:45
S4	35612570		17:59
SBE37 Microcat	3263		17:59
SBE37 Microcat	3917		18:10
Raft of 6 x glass	n/a		18:30
Swivel	n/a		18:30
Dualled acoustic release	215	RT661	18:30
Dualled acoustic release	363	AR861	18:30
Adjustment parafil	n/a		
Anchor	n/a		18:41

DEPLOYMENT METHOD Freefall anchor last. Double barrel capstan

COMMENTS

Main float disappeared 19:07
Pickup float disappeared 19:11

RAPID MOORINGS CRUISE RB-06-02 MRG ID: WB2

Western Atlantic 26N DEPLOYMENT UKORS ID

LATITUDE 26 30.5N 3890m u/c. 3909m corr. **DATE** 23/3/06

LONGITUDE 76 44.5W **DAY** 082

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 13:00

COMPLETION TIME 17:40

ITEM	SER NO	COMMENT	TIME
17” glass pickup float	n/a		13:48
24” yellow steel sphere	n/a		13:49
Argos beacon on sphere	254	ID 42746	13:49
SBE37 Microcat	4060	On keel	13:49
Light on sphere	n/a		13:49
24” steel sphere and Swivel			13:54
RCM11	301	Chain to 24” steel	13:54
SBE37 Microcat	4062		13:58
50” steel sphere with swivel	n/a	Deployed upside down at first but then recovered and righted	14:30
Argos Beacon	274	ID 60202	14:30
SBE37 Microcat	4066		14:50
SBE37 Microcat	4068		14:53
SBE37 Microcat	4070		14:58
Sontek	D272		15:02
SBE37 Microcat	4071		15:06
SBE37 Microcat	4072		15:13
Raft of 6 x 17” glass	n/a		15:21
Sontek	D274		15:24
SBE37 Microcat	3223		15:27
SBE37 Microcat	3206		15:31
SBE37 Microcat	3219		15:35
SBE37 Microcat	3220		15:41
Raft of 6 x 17” glass	n/a		15:50
Sontek	D303		15:52
SBE37 Microcat	3221		15:58
SBE37 Microcat	3222	At end of 6-8 wire so only 2m above RCM11 not 250m	16:16
Raft of 8 x 17” glass	n/a		16:26
RCM11	451		16:26
SBE37 Microcat	4184		16:35
Sontek	D298		16:49
Raft of 8 x 17” glass	n/a		17:12
Swivel	n/a		17:12
Dualled acoustic release	369	AR861	17:12
Dualled acoustic release	184	RT661	17:12
Adjusting parafil	n/a	35m	
Anchor	n/a		17:39

DEPLOYMENT METHOD

COMMENTS 50” sphere vanished 17:57. Top float vanished 18:00

RAPID MOORINGS CRUISE RB-06-02 MRG ID: WB1

Western Atlantic 26N DEPLOYMENT UKORS ID

LATITUDE 26 29.81N **DATE** 23/3/06

LONGITUDE 76 49.01W Depth 1395m u/c, 1403 corrected **DAY** 082

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 20:55

COMPLETION TIME 23:08

ITEM	SER NO	COMMENT	TIME
1 x 17" pickup floats	n/a	Orange hard hat	20:58
28" steel sphere	n/a		20:58
Argos beacon	264	PTT 46242 no light	20:58
SBE37 microcat	3487	On keel	20:58
Swivel	n/a		20:58
SBE37 microcat	3905		21:05
RCM11	306		21:05
SBE37 microcat	3906		21:09
48" steel sphere	n/a		21:18
Argos beacon	255	PTT 42747	21:18
Swivel	n/a		21:18
SBE37 microcat	3907		21:18
SBE37 microcat	3908		21:21
SBE37 microcat	3909		21:26
RCM11	305		21:26
SBE37 microcat	3226		21:30
SBE37 microcat	3227		21:40
SBE37 microcat	3228		21:45
Swivel	n/a		21:58
Raft of 14 17" glass	n/a		21:58
S4	35612565		22:00
SBE37 microcat	3229		22:00
SBE37 microcat	3230		22:04
SBE37 microcat	3231		22:07
SBE37 microcat	3232		22:11
SBE37 microcat	3233		22:48
S4	35612568		22:48
SBE37 microcat	3244		23:05
Swivel	n/a		23:05
Raft of 6 x 17" glass	n/a		23:05
Dual release (AR661)	244		23:05
(AR861)	245		
Anchor	n/a		23:08

DEPLOYMENT METHOD Freefall anchor last.

COMMENTS

Wound 170m Parafil on drum after SBE3244/S4. Wire cut being pulled through block. Top float vanished 23:14

RAPID MOORINGS **CRUISE RB-06-02** **MRG ID:** WBADCP

Western Atlantic 26N DEPLOYMENT **UKORS ID**

LATITUDE 26 31.483N 592m u/c. 601m corr. **DATE** 19/3/06

LONGITUDE 76 52.142W **DAY** 078

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 22:00

COMPLETION TIME 22:20

ITEM	SER NO	COMMENT	TIME
17” glass pickup float	n/a		22:15
ADCP buoy with ADCP	1767		22:17
Argos Beacon on ADCP buoy		ID 11033	
Swivel	n/a	Elkins 2T	22:18
Acoustic release (AR861)	248		22:18
Anchor	n/a	350kgs (3 railway wheels)	22:20

DEPLOYMENT METHOD Freefall anchor last.

COMMENTS

RAPID MOORINGS **CRUISE RB-06-02** **MRG ID:** WBL3

Western Atlantic 26N DEPLOYMENT **UKORS ID**

LATITUDE 26 30.42N **DATE** 24/3/06

LONGITUDE 76 44.66W **DAY** 083

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 01:10

COMPLETION TIME 01:18

ITEM	SER NO	COMMENT	TIME
17" glass pickup float	n/a		01:15
Billings float	n/a		01:16
Radio beacon on float	U01-019		01:16
Light on float			01:16
6 x 17" glass	n/a		01:17
1st SBE26	395		01:18
2nd SBE26	396		01:18
1st Acoustic release	370	RT661	01:18
2nd Acoustic release	258	AR861	01:18
Anchor	n/a		01:18

DEPLOYMENT METHOD Freefall anchor last.

COMMENTS

Vanished 01:19

RAPID MOORINGS CRUISE RB-06-02

MRG ID: WBL4

Western Atlantic 26N DEPLOYMENT **UKORS ID**

LATITUDE 26 30.02 Water depth 4810m corr

DATE 22/3/06

LONGITUDE 76 02.95

DAY 081

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 22:10

COMPLETION TIME 22:22

ITEM	SER NO	COMMENT	TIME
17” glass pickup float	n/a		22:12
Billings float	n/a		22:13
Radio beacon on float		VHF channel 72	22:13
Light on float			22:13
5 x 17” glass	n/a		22:14
SBE53	0004		22:17
Acoustic release	255	AR861	22:17
Anchor	n/a		22:22

DEPLOYMENT METHOD Freefall anchor last.

COMMENTS