National Oceanography Centre, Southampton

Cruise Report No. 34

RRS *Discovery* Cruise D324

06 OCT-09 NOV 2007

RAPID mooring cruise report

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2008

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ABSTRACT

This report describes the mooring operations and underway measurements conducted during RRS *Discovery* Cruise D324 conducted between 6th October 2007 and 9th November 2007.

This cruise was 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 this cruise was to service the Eastern Boundary and Mid-Atlantic ridge sections of the 26.5ºN mooring array. The array was 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), RRS *Charles Darwin* Cruise CD177 (NOCS cruise report number 5), in 2006 on RV *Ronald H. Brown* Cruise RB0602, RRS *Discovery* Cruise D304 (NOCS cruise report number 16) and FS *Poseidon* Cruises P343 and P345 (NOCS cruise report number 28), and in 2007 on RV *Ronald H. Brown* Cruise RB0701 (NOCS cruise report number 29).

Cruise D324 had two legs with the first a transit from Falmouth, UK to Santa Cruz de Tenerife, Tenerife and the second sailing from, and returning to, Santa Cruz de Tenerife, Tenerife. The moorings serviced on this cruise were deployed on D304, P343 and P345, along with two landers deployed on CD170.

The Rapid-MOC array of moorings was deployed across the Atlantic to set up a pre-operational prototype system to continuously observe the Atlantic Meridional Overturning Circulation (MOC). This array will be further refined and refurbished during subsequent years as part of the Rapid-WATCH programme.

The instrumentation deployed on the array consists of a variety of CTD loggers, current meters, bottom pressure recorders, and Inverted Echo-sounders, which, combined with time series measurements of the Florida Current and wind stress estimates, can 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, D324, CTD, current meter, RRS *Discovery*, Meridional Overturning Circulation, MOC, mooring array, Moorings, North Atlantic, RAPID, RAPIDMOC, Rapid-MOC, THC, thermohaline circulation

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List of Figures:

1. Scientific and Ship's Personnel

Name	Affiliation
Stuart Cunningham (PSO)	NOCS – OOC
Zoë Aston	BODC
Christopher Atkinson	NOCS – SOES
Martin Bridger	NOCS – NMFD
Maria Paz Chidichimo	MPI-Hamburg
David Childs	NOCS – NMFD
Chris Crowe	NOCS – NMFD
Andrew Cunningham	Volunteer (transit from Falmouth-Tenerife only)
Sandra Forrest	NOCS – SOES
Colin Hutton	NOCS – NMFD
Daniel Klocke	MPI-Hamburg
Robert McLachlan	NOCS – NMFD
Martin Mlecko	Photographer
Paul Provost	NOCS – NMFD
Darren Rayner	NOCS – OOC
Neil Sloan	NOCS – NMFD
Steve Whittle	NOCS – NMFD
Wing Yue Young	NOCS – SOES

Table 1.1: Details of scientific personnel (18 persons)

Name	Position
Peter Sarjeant	Master
Peter Reynolds	Chief Officer
Phil Oldfield	2nd Officer
Kieron Hailes	3rd Officer
Ian Slater	Chief Engineer
Philip Booth	Eng. Cadet
Fraser MacDonald	2nd Engineer
John Harnett	3rd Engineer
Allan Maclean	3rd Engineer
Dennis Jakobaufderstroht	Elect. Engineer E.T.O
Les Hillier	Motorman
Glen Pook	CPO Deck
Michael Minnock	CPO Scientific
Phil Allison	PO Deck
William McGeown	Seaman 1a
Robert Cumming	Seaman 1a
Gary Crabb	Seaman 1a
Joseph Cambert	Seaman 1a
Michael Ripper	Purser/Catering Officer
John Haughton	Head Chef
Darren Cavier	Chef
Graham Mingay	Steward

Table 1.2: Details of ship's personnel (22 persons)

2. Itinerary

Leg 1: Depart Falmouth, UK, 6th October 2007 – Arrive Santa Cruz de Tenerife, Tenerife, 13th October 2007
Leg 2: Depart Santa Cruz de Tenerife, Tenerife, 14th October 2007 – Arrive Santa Cruz de Tenerife, Tenerife, 9th November 2007.

3. Acknowledgments

We would particularly like to thank the Bosun, CPO (scientific) and deck crew for their work in safely recovering and deploying moorings. Peter Sarjeant and his officers offer exemplary professional support. The NMF technicians were ably led by Rob McLachlan and successfully executed a most complex set of mooring operations, working with the ship's crew to the benefit of the science programme. The whole team demonstrated a strong personal commitment to achieving the best results for the science programme.

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. The 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 a twice-yearly 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 was funded to make four years of continuous observations between 2004 and 2008, and has since had the funding extended to 2014 through Rapid-WATCH.

This report describes the mooring operations and shipboard science conducted on cruise **D324** onboard the RRS *Discovery* in Autumn 2007. D324 is the fourteenth

cruise on which staff from the NOC have completed mooring operations as part of the Rapid-MOC project (see table 4.1). The array was first deployed in Spring 2004 with subsequent service cruises in Spring and Autumn of 2005, 2006 and 2007. Details of previous cruise reports are given in Table 4.1.

Cruise D324 was led by Stuart Cunningham. The main objectives were to refurbish the eastern boundary and mid-Atlantic ridge mooring sub-arrays, with CTD casts conducted to provide end-point calibrations of the timeseries collected by the self-logging instruments on the moorings. Underway data was also collected and processed with details given in this report.

Cruise	Vessel	Date	Objectives	Cruise Report
D277	RRS Discovery	Feb - Mar 2004	Initial Deployment of Eastern Boundary and Mid-Atlantic Ridge moorings	RRS *Discovery* Cruise D277 and D278. Southampton Oceanography Centre Cruise Report, No 53, 2005
D278	RRS Discovery	Mar 2004	Initial Deployment of UK and US Western Boundary Moorings	RRS *Discovery* Cruise D277 and D278. Southampton Oceanography Centre Cruise Report, No 53, 2005
P319	RV Poseidon	Dec 2004	Emergency deployment of replacement EB2 following loss	Appendix in RRS *Charles Darwin* Cruise CD170 and RV *Knorr* Cruise KN182-2. National Oceanography Centre Southampton Cruise Report, No. 2, 2006
CD170	RRS Charles Darwin	Apr 2005	Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings	RRS *Charles Darwin* Cruise CD170 and RV *Knorr* Cruise KN182-2. National Oceanography Centre Southampton Cruise Report, No. 2, 2006
KN182-2	RV Knorr	May 2005	Service and redeployment of UK and US Western Boundary Moorings and Western Boundary Time Series (WBTS) hydrography section	RRS *Charles Darwin* Cruise CD170 and RV *Knorr* Cruise KN182-2. National Oceanography Centre Southampton Cruise Report, No. 2, 2006
CD177	RRS Charles Darwin	Nov 2005	Service and redeployment of key Eastern Boundary moorings	RRS *Charles Darwin* Cruise CD177. National Oceanography Centre Southampton Cruise Report, No. 5, 2006
WS05018	RV F.G. Walton Smith	Nov 2005	Emergency recovery of drifting WB1 mooring	No report published
RB0602	RV Ronald H. Brown	Mar 2006	Service and redeployment of UK Western Boundary moorings and WBTS hydrography section	RV *Ronald H. Brown* Cruise RB0602 and RRS *Discovery* Cruise D304. National Oceanography Centre Southampton Cruise Report, No. 16, 2007
D304	RRS Discovery	May - Jun 2006	Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings	RV *Ronald H. Brown* Cruise RB0602 and RRS *Discovery* Cruise D304. National Oceanography Centre Southampton Cruise Report, No. 16, 2007
P343	RV Poseidon	Oct 2006	Service and redeployment of key Eastern Boundary moorings	RS Poseidon Cruises P343 and P345. National Oceanography Centre Southampton Cruise Report No. 28, 2008.
P345	RV Poseidon	Dec 2006	Emergency redeployment of EB1 and EB2 following problems on P343	RS Poseidon Cruises P343 and P345. National Oceanography Centre Southampton Cruise Report No. 28, 2008.
SJ06	RV Seward Johnson	Sep – Oct 2006	Recovery and redeployment of WB2 and US Western Boundary moorings, and WBTS hydrography section	Appendix G in RV *Ronald H. Brown* Cruise RB0701. National Oceanography Centre, Southampton Cruise Report, No 29
RB0701	RV Ronald H. Brown	Mar - Apr 2007	Service and redeployment of UK Western Boundary moorings and WBTS hydrography section	RV *Ronald H. Brown* Cruise RB0701. National Oceanography Centre, Southampton Cruise Report, No 29
D324	RRS Discovery	Oct – Nov 2007	Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings	This report

Table 4.1: Summary of previous Rapid-MOC cruises

5. Bridge Diary of Events

Peter Sarjeant

NB: Times in text are not GMT. see inclusive comments for changing time zones

2007-10-05

0900	2 x Sci. & Technical party embarked; Mobilisation continues	
1400-1600	Sign-on & Safety Briefing + Tour for Sci/Tech contingent	

2007-10-06

0915	ME, BT & Strng gear tested & satis; Bridge control & critical instr. all correct.	
1500	Decision to sail given stbd aft crane repair could not commence before 10th.	
1800	ERSB; commence singling up	
1808	PoB Mr Bush	
1817	All gone & clear	
1834	Pilot away; Castle buoy abm to port	
1848	FAOP; St Anthony's Hd brng 003deg x 1.6nm; Strng 175degs	
2000	49 54.2N 04 59.1W	Wind ExS 10 knots
2400	49 21.7N 05 42.8W	V/l on passage towards Santa Cruz de Tenerife
		Wind N'ly 13 knots

2007-10-07

0400	48 48.7N 06 19.4W	Wind Var 10 knots
0800	48 09.5N 06 54.9W	Wind Lt & Variable
1030	47 46.0N 07 15.0W	Musters @ Emergency & Boat stations
1200	47 33.4N 07 26.9W	Wind SW 9 knots
1600	46 59.3N 08 01.2W	Wind SW 10 knots
2000	46 27.6N 08 40.6W	Wind SW 10 knots
2400	45 56.4N 09 18.9W	Wind SW 12 knots

2007-10-08

0400	45 26.5N 09 55.1W	Wind SSW 15 knots
0800	44 54.3N 10 34.0W	Wind SWxS 10 knots
1200	44 23.4N 11 10.9W	Wind SW 8 knots
1600	43 51.9N 11 48.1W	Wind Lt & Var
2000	43 19.1N 12 26.6W	Wind NW 5 knots
2400	42 45.4N 13 05.8W	Wind NW 8 knots

2007-10-09

0400	42 10.4N 13 35.0W	Wind NW 8 knots
0800	41 26.7N 13 35.0W	Wind NE 12 knots
0854	41 18.9N 13 35.1W	Hove-to for trials cast; CTD deployed
1128	41 18.5N 13 34.9W	CTD @ 5000m; commence hauling
		Wind NExN 17 knots
1236	41 18.5N 13 34.9W	CTD recovered
1242		V/l resumes passage
1522	40 55.8N 13 36.9W	Hove-to for 2nd trials cast; CTD deployed
1533		CTD recovered for adjustments
1549		CTD redeployed
		Wind NE 20 knots
1728	40 55.9N 13 38.2W	CTD @ 4500m; commence hauling
1942	40 55.9N 13 38.3W	CTD recovered; all secure; v/l resumes passage
		Wind NE 18 knots
2400	40 11.9N 13 40.4W	Wind NE 18 knots

2007-10-10

0400	39 28.9N 13 43.8W	Wind NE 20 knots
0800		Wind NE 14 knots

0915	38 35.0N	13 48.1W	Hove-to for 3rd trials cast; CTD deployed
1030			Safety Committee Meeting
1036	38 35.3N	13 48.1W	CTD @ 4000m; commence hauling
1148			PES fish deployed
1200			Wind NExN 18 knots
1306	38 35.8N	13 48.0W	CTD recovered; securing & resuming passage
1600	38 08.1N	13 50.2W	Wind NE 20 knots
2000	37 25.6N	13 53.4W	Wind NExN 16 knots
2400	36 44.2N	13 56.6W	Wind NExN 14 knots

2007-10-11

0400	36 02.1N	13 59.8W	Wind NExN 20 knots
0800	35 20.3N	14 11.5W	Wind NE 15 knots
1200	34 40.9N	14 29.3W	Wind NE 17 knots
1600	34 02.4N	14 41.9W	Wind NExE 15 knots
2000	33 21.2N	14 50.0W	Wind NExE 10 knots
2400	32 37.6N	14 58.6W	Wind NExE 10 knots

2007-10-12

0400	31 53.2N	15 07.3W	Wind NExE 10 knots
0800	31 09.4N	15 15.7W	Wind ENE 10 knots
1200	30 26.9N	15 23.9W	Wind ExN 6 knots Av spd for leg 10.61 knots
1600	29 45.5N	15 31.8W	Wind Lt & Variable
1615			Security Exercise & De-Fib re-familiarisation
2012	29 01.9N	15 39.9W	Hove-to for 4th trials cast; CTD deployed
			Wind SW 5 knots
2148	29 01.5N	15 39.3W	CTD @ 3600m; commence hauling
2204			PES recovered
2400	29 00.6N	15 38.4W	CTD recovered; Wind Lt & Variable

2007-10-13

0006			Resume passage towards Santa Cruz de Tenerife
0400	28 42.1N	15 55.5W	Wind Lt & Variable
0615			1 hrs notice to Pilot stn given to Tenerife Traffic

0650 Anchors cleared & pilot ladder rigged
0700 Critical equip tests (ME astern, BT & Strng gear) complete & satis
0706 ERSB; S b'water 278 degs x 4.5nm
0710 Call Tenerife Pilots
0724 Pilot boat approaching
0735 PoB Mr Simon
0754 Rounding b'water
0807 First line
0824 All fast 3&2 stbd side to Meulle Ribera; RFWE; Pilot away
0830 Armada Engineer on board to commence crane repair work
0915 Scientific party (8 persons) join & sign on
1030 Safety & Security briefing + tour for new joiners
1500 Decision to postpone earliest sailing until 1300hrs/14th
1900 Crane repair work ceases for day.

2007-10-14

0800 Crane repair work continues
1030 Decision to postpone sailing until 1800 hrs
1300 Meeting between HoDs & PS. C/E advises that aft cranes downrated to 2t max lift
1600 Crane repair & investigation work ceased
1730 ME, BT, Strng gear & Bridge equipment tested & satis.
1806 PoB Mr Lorenzo
1816 Springing off for'd
1818 Last line
1826 V/l swung off berth & heading down harbour; Pilot away
1834 Clearing breakwaters

1842	FAOP; S b'water 319 degs x 1.05 nm	
2000	28 15.3N 16 16.7W	V/l outbound for first mooring site – EBHi
		Wind NE 16 knots
2400	27 42.2N 16 50.9W	Wind NE 12 knots

2007-10-15

0400	27 16.9N 17 31.9W	Wind NE 10 knots
0800	26 52.0N 18 11.9W	Wind NNE 11 knots
1030		Musters @ Emergency & Boat stations
1200	26 27.3N 18 51.7W	Wind Lt & Variable
1600	26 02.9N 19 30.9W	Wind NExN 10 knots
2000	25 38.3N 20 10.1W	Wind NE 11 knots
2230	25 23.5N 20 33.7W	Hove-to for CTD station; Av spd for leg 10.9 knots
2236	25 23.5N 20 33.7W	CTD deployed
2354	25 23.5N 20 33.6W	CTD @ 4000m; commence hauling
		Wind E'ly 10 knots

2007-10-16

0200	**Clocks retarded 1 hr to UTC. Times continue in UTC**	
0114	25 23.5N 20 33.2W	CTD recovered; v/l continues transit towards EBHi
0400		Wind E'ly 10 knots
0552	25 57.2N 21 15.5W	V/l hove-to on site
0658		EBHi Mooring release confirmed
0736	25 57.1N 21 16.0W	1st buoyancy @ surface
		Wind E'ly 10 knots
0835	25 56.7N 21 15.9W	Grappled – port side recovery
0845		Buoyancy clumps streamed astern & recovery commenced
0918	25 56.6N 21 15.7W	All mooring gear inboard; v/l repositioning
0948	24 57.1N 21 16.7W	V/l repositioned 1nm downwind of deployment area
1008	24 57.1N 21 16.5W	Commence streaming EBHi
1035	24 57.129N 21 15.913W	EBHi released
1050		Set co 247 deg for vicinity EB1 mooring (165nm)
1200	24 52.3N 21 27.8W	Wind E'ly 11 knots
1600	24 34.6N 22 12.5W	Wind E'ly 12 knots
1710	24 30.3N 22 24.2W	V/l hove-to; PES deployed
1715		CTD deployed
1834	24 30.0N 22 24.4W	CTD @ 4000m; commence hauling
2000		Wind ESE 10 knots
2049	24 29.4N 22 24.9W	CTD recovered; resume passage towards mooring site
2400	24 18.3N 22 58.8W	Wind ExS 12 knots

2007-10-17

0400	24 01.7N 23 42.6W	Wind Lt & Variable
0600	23 53.9N 24 03.3W	V/l hove-to vic EBL3; commence acoustic interrogation
0625		EBL3 released & rising
0720	23 54.1N 24 02.8W	Lander mooring on surface
0737		Grappled
0755	23 54.5N 24 02.9W	Lander recovered; v/l repositioning to EB2
		Wind Lt & Variable
0850	23 52.0N 24 10.4W	V/l hove-to vic EB2; commence interrogation
0915		Mooring released
0950	23 52.2N 24 10.0W	First buoyancy sighted on surface
1050		Commence manoeuvring for recovery
1118	23 52.1N 24 10.6W	Grappled
1121		Streaming astern; commence recovery
1200		Wind Lt & Variable
1252	23 52.8N 24 10.8W	EB2 mooring fully recovered; v/l repositioning
1346	23 56.8N 24 03.9W	Comm ES run on reciprocal track thro' proposed lay positn.
1418	23 53.8N 24 00.7W	Complete ES run
1449	23 53.0N 23 59.5W	Commence streaming EB2 mooring; Ship's hdng 315 degs
1505		Argos buoy in water

1550		1100m of mooring streamed
		Wind Lt & Variable
1822	23 56.1N 24 03.3W	EB2 mooring released; v/l reciprocating track to monitor
1921	23 55.6N 24 02.9W	Commence triangulation to fix mooring position
2000		Wind E'ly 6 knots
2108	23 54.9N 24 01.0W	Triangulation complete; EB2 position 23 55.9N 24 03.0W
		V/l repositioning for CTD
2136	23 56.2N 23 59.4W	V/l hove-to & CTD deployed
2254	23 56.2N 23 59.4W	CTD @ 4000m; comm hauling
2400		Wind NExE 4 knots
2007-10-18		
0120	23 56.4N 23 59.4W	CTD recovered; v/l slow-steaming o'night
0400		Wind Lt & Variable
0555	23 48.5N 24 06.6W	V/l hove-to in vic EBP1
0640	23 48.5N 24 06.5W	Release unit inop; v/l relocating to EB1
0718	23 48.6N 24 08.8W	V/l hove-to; interrogating & releasing EB1
0800	23 48.8N 24 09.2W	Initial buoyancy sighted on surface
		Wind NExE 10 knots
0830		Manoeuvring towards pick-up line
0842	23 48.6N 24 09.2W	Grappled
0846		Buoyancy streamed astern; commence recovery
1146	23 48.9N 24 09.0W	Mooring recovered; v/l repositioning
		Wind ENE 9 knots
1258	23 51.2N 24 03.2W	Commence pre-lay ES run @ 8 knots
1346	23 49.1N 24 09.6W	Complete ES run; v/l repositioning
1417	23 49.1N 24 09.6W	Commence streaming EB1 mooring; Ship's hdng 070 degs
1434		Argos float in water
1508	23 49.5N 24 08.7W	2nd buoyancy set in water
1542	23 49.7N 24 08.0W	4th buoyancy set in water
		Wind ExN 12 knots
1625	23 50.0N 24 07.0W	6th buoyancy set in water
1705	23 50.2N 24 06.0W	8th buoyancy set in water
1734	23 50.5N 24 05.3W	Final buoyancy & accoustic releases in water
1752	23 50.63N 24 05.15W	Anchor wt released; {EB1 triang. positn 23 50.49N 24 05.37W}
1800		V/l round & reciprocating track
1832 – 2100		V/l engaged in EB1 triangulation exercise
		Wind NExE 10 knots
2100	23 49.1N 24 02.4W	Set co 270 degs for next area of operations
2400	23 50.6N 24 36.4W	Wind NExE 9 knots
2007-10-19		
0400	23 50.7N 25 24.0W	Wind NExE 10 knots
0800	23 50.7N 26 11.6W	Wind ENE 11 knots
1200	23 50.8N 26 58.2W	Wind ENE 10 knots
1600	23 50.8N 27 45.7W	Wind ENE 10 knots
1615		Emergency stns muster followed by Training Exercises
2000	23 50.8N 28 32.5W	Wind NExE 11 knots
2400	23 50.9N 29 19.6W	Wind ENE 12 knots
2007-10-20		
0200	**Clocks retarded 1 hr to UTC -1. Times continue in UTC -1**	
0400	23 51.0N 30 19.4W	Wind NExN 10 knots
0800	23 51.0N 31 07.0W	Wind NE 10 knots
1200	23 51.0N 31 54.4W	Wind NE 10 knots
1600	23 51.4N 32 42.5W	Wind NExE 10 knots
2000	23 51.5N 33 29.6W	Wind NE 10 knots
2400	23 51.5N 34 16.4W	Wind Lt & Variable
2007-10-21		

0400	23 51.6N 35 03.9W	Wind Lt & Variable
0800	23 51.7N 35 51.0W	Calm
1200	23 51.7N 36 37.8W	Calm
1600	23 51.8N 37 23.7W	Calm
2000	23 51.8N 38 09.2W	Wind Lt & Variable
2100		Wind gusting to 35 knots in heavy squalls. Hourly met obs 'til p.m. 22nd. Switch to Navarea IV forecasts.
2400	23 51.9N 38 55.7W	Wind NW 15 knots
2007-10-22		
0400	23 52.0N 39 41.8W	Wind Lt & Variable
0800	23 52.0N 40 29.0W	Wind Variable 5 knots
1118	23 51.8N 41 05.6W	V/l in vic MARL2; lander interrrogated & released
		Wind NW 6 knots Av spd for leg 10.8 knots
1222		Lander on surface
1236	23 52.0N 41 05.6W	Grappled
1247		MARL2 recovered
1315		MAR3 mooring interrogated and released
1337	23 51.0N 41 06.0W	1st buoyancy package on surface
1403		Further buoyancy on surface; v/l commences approach
1424	23 51.7N 41 06.2W	Grappled
1434		All surfaced buoyancy astern; commence recovery
1514	23 51.7N 41 06.3W	Mid-point of recovery process
1558	23 51.9N 41 06.3W	Recovery complete
1600		V/l repositioning for ES survey ahead of sediment trap deployment
		Wind N'ly 16 knots
1630	23 48.7N 41 05.6W	Commence ES run
1730	23 44.2N 41 05.6W	Deployment site established; v/l repositioning
1801	23 45.4N 41 05.6W	Comm streaming sediment trap mooring; Ship's hdng 360 degs
1812		1st trap streamed astern
1820	23 45.6N 41 05.6W	2nd trap streamed astern
1912	23 46.2N 41 05.6W	Acoustic release streamed
1921	23 46.20N 41 05.67W	Sediment trap anchor clump released
1933	23 46.2N 41 05.6W	Deck secure; v/l repositioning for o'night CTDs
		Wind N'ly 14 knots
2040	23 55.1N 41 02.3W	V/l on station
2056		CTD deployed
2315	23 55.2N 41 02.3W	CTD @ 5500m & commence hauling
2400		Wind NxW 14 knots
2007-10-23		
0151	23 55.1N 41 02.7W	CTD recovered
0252	23 52.0N 41 05.6W	CTD redeployed
0407	23 51.9N 41 05.9W	CTD @ 3500m; commence hauling
		Wind NW 12 knots
0556	23 51.6N 41 06.3W	CTD recovered & secure; v/l repos. for MARL2 deployment
0618	23 51.9N 41 05.5W	V/l on station
0640		Commence streaming MARL2 lander
0644	23 51.95N 41 05.53W	MARL2 anchor clump released
0655		V/l repositioning for MAR3 mooring deployment
0740	23 50.1N 41 03.6W	V/l in position
0802	23 50.3N 41 03.7W	Commence streaming MAR3 mooring; Ship's hdng 335 degs
		Wind NWxN 12 knots
0850		Mid-point of deployment; V/l spd 1.1kn; dist to go 1.4nm
1002	23 52.27N 41 04.80W	MAR3 anchor clump released; acoustic 'pinging' on descent
1022		Commence transit w'ward towards MAR2 @ PS request
1200	23 52.9N 41 22.3W	Wind NNW 21 knots
1600	23 54.6N 42 08.5W	Wind NWxN 20 knots
2000	23 56.2N 42 53.9W	Wind NNW 14 knots
2400	23 57.8N 43 37.8W	Wind NWxN 11 knots

2007-10-24		
0200	**Clocks retarded 1 hr to UTC -2. Times continue in UTC -2.**	
0400	23 59.8N 44 31.7W	Wind NNW 14 knots
0800	24 01.4N 45 19.7W	Wind NxW 14 knots
1200	24 03.0N 46 05.6W	Wind NxE 19 knots
1600	24 05.3N 46 52.9W	Wind N'ly 20 knots
2000	24 07.0N 47 39.8W	Wind N'ly 16 knots
2400	24 08.7N 48 24.4W	Wind NxE 12 knots
2007-10-25		
0400	24 10.4N 49 09.6W	Wind N'ly 18 knots
0709	24 12.0N 49 44.1W	V/l hove-to & pinging for MAR1; Av spd for leg 10.2 knots
0716		Mooring released
0718		Top buoyancy on surface
0800	24 11.9N 49 44.1W	Most of buoyancy on surface; comm approach Wind N'ly 18 knots
0820	24 11.7N 49 44.0W	Grappled
0843	24 11.8N 49 44.1W	Argos float inboard
0938		1800m buoyancy inboard
1022	24 11.8N 49 44.1W	3500m buoyancy inboard
1100		5000m buoyancy inboard
1130	24 11.9N 49 44.0W	All recovered; v/l repositioning for MAR2 recovery
1210	24 10.1N 49 41.6W	V/l hove-to & pinging for MAR2 Wind NxE 20 knots
1213		Mooring released
1245		Top buoyancy on surface
1330	24 10.2N 49 41.7W	Most of buoyancy on surface; comm approach
1340	24 10.8N 49 41.9W	Grappled
1345		Top buoyancy inboard
1442	24 10.8N 49 42.0W	Mid-point of recovery
1530	24 10.8N 49 42.1W	Recovery complete; v/l repositioning for MARL1 dep.
1600		Wind NNE 18 knots
1630	24 11.7N 49 42.6W	V/l hove-to & CTD deployed
1750	24 11.7N 49 42.6W	CTD @ 4000m; comm hauling
1954	24 11.7N 49 42.6W	CTD recovered
2002		Comm deployment of MARL1 Wind NExN 14 knots
2006	24 11.67N 49 42.63W	Lander released
2010		Deck secure; v/l in transit towards MARL1(2006) recovery site
2055	24 17.5N 49 47.3W	#2 Generator lost due to fuel pipe failure; red to 115 rpm Duty Eng C/E; Master informed; #3 Generator started & put in PMS sequence; incr back to 150 rpm
2400	24 41.0N 50 07.2W	Wind NE 16 knots
2007-10-26		
0400	25 11.1N 50 32.4W	Wind NExN 10 knots
0742	25 37.4N 50 55.2W	V/l hove-to at MARL1(2006) as advised by Sci info
0754		Erroneous positn; v/l in transit to corrected site
0800		Wind NE 16 knots
1040	25 37.3N 50 25.2W	V/l hove-to over MARL1; pinging
1050		Possible release
1200		On surface; Wind NxW 6 knots
1214	25 37.6N 50 24.9W	Grappled
1230	25 37.8N 50 25.0W	MARL1 recovered; v/l in transit towards MAR0 deployment
1600	25 27.7N 57 03.3W	Wind NNW 14 knots
2000	25 15.9N 51 48.3W	Wind NWxN 10 knots
2125	25 11.4N 52 03.0W	Request for ES run (S'ly track) as v/l heaving-to for MAR0
2156	25 08.3N 52 03.1W	A/c to 225 degs on ES run
2210	25 06.5N 52 05.1W	A/c to 090 degs

2302	25 06.0N 52 00.5W	V/l heaving-to & comm deployment; Ship's hdng 340 degs
2319	25 06.36N 52 00.60W	MAR0 released
2330		Deck secure; v/l in transit towards next site; Co 114 degs
2400		Wind NNW 14 knots

2007-10-27

0400	24 48.6N 51 16.0W	Wind NNW 14 knots
0800	24 31.7N 50 33.6W	Wind NWxN 10 knots
1200	24 14.6N 49 51.2W	Wind NNW 9 knots
1239	24 12.7N 49 44.0W	Comm ES run vicinity of MAR1
1309	24 07.3N 49 42.4W	V/l rounding at end of ES run
1323	24 07.3N 49 42.4W	Comm streaming MAR1 mooring; Ship's hdng 345 degs
1335		Argos buoy overboard
1432	24 08.4N 49 42.8W	1793m buoyancy outboard
1518	24 09.5N 49 43.1W	3484m buoyancy outboard
1556	24 10.5N 49 43.4W	4750m buoyancy outboard
1600		Wind WSW 10 knots
1635	24 10.73N 49 43.48W	MAR1 anchor clump released; v/l to reciprocal track
1709	24 09.9N 49 43.7W	V/l hove-to monitoring mooring descent
1734		V/l repositioning for ES survey prior MAR2 deployment
1800	24 11.8N 49 45.0W	Comm ES run
1830		Run comp; v/l round & approaching start point
1837	24 08.3N 49 45.1W	Comm streaming MAR2 mooring; Ship's hdng 360 degs
1907	24 09.0N 49 45.1W	1787m buoyancy outboard
1948	24 09.7N 49 45.1W	2745m buoyancy outboard
2000		Wind Lt & variable
2056	24 10.8N 49 45.0W	5142m buoyancy outboard
2115	24 10.94N 49 45.01W	MAR2 anchor clump released; v/l hove-to monitoring descent
2136	24 11.0N 49 45.0W	Monitoring ceases; deck secure; v/l sets co 090 degs for EBL3
2400	24 10.6N 49 18.8W	Wind Lt & variable

2007-10-28

0400	24 10.1N 48 32.5W	Wind S'ly 10 knots
0800	24 09.6N 47 45.5W	Wind SW 10 knots
1200	24 09.1N 46 59.8W	Wind SW 9 knots
1600	24 08.6N 46 12.6W	Wind S'ly 12 knots
2000	24 08.0N 45 27.0W	Wind SExS 18 knots
2400	24 07.6N 44 44.7W	Wind SE 16 knots

2007-10-29

0400	24 07.1N 44 00.1W	Wind SExS 16 knots
0800	24 06.6N 43 15.4W	Wind SE 12 knots
1200	24 06.2N 42 32.7W	Wind SE 14 knots
1600	24 05.7N 41 50.1W	Wind E'ly 12 knots
2000	24 05.2N 41 07.6W	Wind E'ly 14 knots
2400	24 04.7N 40 28.0W	Wind E'ly 21 knots

2007-10-30

0200	**Clocks advanced 1 hr to UTC-1. Times continue in UTC-1**	
0400	24 04.5N 39 58.6W	Wind ExN 20 knots
0800	24 04.1N 39 20.5W	Wind NE 18 knots
1200	24 03.6N 38 42.3W	Wind ENE 20 knots
1600	24 03.3N 38 04.6W	Wind ENE 22 knots
1615	24 03.0N 38 02.0W	Emergency exercise & Lifeboat Muster
2000	24 02.8N 37 27.6W	Wind NExE 16 knots
2400	24 02.4N 36 49.1W	Wind ENE 18 knots

2007-10-31

0400	24 01.9N 36 08.4W	Wind E'ly 20 knots
0800	24 01.5N 35 28.3W	Wind ExN 16 knots

1200	24 01.1N 34 49.7W	Wind ExN 18 knots
1600	24 00.7N 34 10.6W	Wind NExE 18 knots
2000	24 00.2N 33 30.6W	Wind ENE 18 knots
2400	23 59.8N 32 50.3W	Wind E'ly 16 knots
2007-11-01		
0400	23 59.3N 32 08.6W	Wind ExS 16 knots
0800	23 58.8N 31 26.6W	Wind ExS 12 knots
1200	25 58.4N 30 46.6W	Wind E'ly 20 knots
1600	23 58.0N 30 05.8W	Wind E'ly 18 knots
2000	23 57.5N 29 24.0W	Wind ExN 14 knots
2400	23 57.1N 28 41.4W	Wind ExN 15 knots
2007-11-02		
0200	**Clocks advanced 1 hr to UTC. Times continue in UTC**	
0400	23 56.7N 28 08.5W	Wind ExN 15 knots
0800	23 56.2N 27 24.8W	Wind ENE 14 knots
0922	23 56.0N 27 11.0W	V/l hove-to on station
0926		CTD deployed
1058	23 56.0N 27 11.0W	CTD @ 3500m; commence hauling
1200		Wind ENE 14 knots
1317	23 56.0N 27 10.8W	CTD recovered
1320		Deck secure; v/l resumes passage towards Stn EBL3
1600	23 55.7N 26 41.9W	Wind ExN 10 knots
2000	23 54.7N 25 57.9W	Wind ExN 10 knots
2400	23 54.0N 25 14.4W	Wind ExN 15 knots
2007-11-03		
0400	23 53.5N 24 30.8W	Wind ENE 15 knots
0620		V/l slowing on approach to station; Av spd for leg 9.5 knots
0628	23 53.1N 24 04.4W	Comm streaming EBL3
0632	23 53.16N 24 04.34W	EBL3 released; v/l resumes passage towards Stn EBH0
		Co 066 degs
0800	23 59.0N 23 49.8W	Wind NExE 10 knots
1200	24 15.4N 23 08.8W	Wind ENE 11 knots
1600	24 31.6N 22 28.3W	Wind NExE 10 knots
2000	24 48.1N 21 47.1W	Wind NE 8 knots
2400	25 05.0N 21 04.5W	Wind N'ly 8 knots
2007-11-04		
0400	25 22.0N 20 21.5W	Wind NE 8 knots
0800	25 39.6N 19 37.1W	Calm
1200	25 57.3N 18 52.4W	Calm
1407	26 05.9N 18 30.7W	Hove-to & CTD deployed
1524	26 05.7N 18 31.0W	CTD @ 3380m; commence hauling
1600		Calm
1730	26 05.3N 18 31.5W	CTD recovered; deck secure & v/l res passage twds EBH0
2000	26 15.8N 18 05.3W	Calm
2400	26 33.4N 17 20.6W	Calm
2007-11-05		
0400	26 51.3N 16 35.2W	Wind NE 8 knots
0600	26 59.4N 16 13.9W	V/l hove-to; interogating EBH0; released @ 0604hrs
0624	26 59.4N 16 13.9W	On surface
0655	26 59.3N 16 13.8W	Grappled
0712		EBH0 recovery completed; v/l in transit to EBH1
0800	27 02.1N 16 06.8W	Wind NE 8 knots
1150	27 16.7N 15 25.7W	V/l hove-to; EBH1 interogated & release activated
1200		Wind NE 16 knots
1215	27 16.8N 15 25.7W	On surface

1236	27 17.0N 15 25.7W	Grappled
1257		EBH1 recovery completed; v/l repositioning
1310		EBL4 interrogated & release activated
1343	27 17.1N 15 25.8W	On surface
1400	27 17.2N 15 25.7W	Grappled
1412		Recovered; v/l repositioning
1450	27 16.8N 15 25.9W	Comm deploying EBH1 mooring; Ship's hdng 045 degs
1500	27 16.92N 15 25.65W	EBH1 anchor released
1526	27 17.2N 15 25.7W	Comm deploying EBL4 lander
1529	27 17.18N 15 25.74W	EBL4 lander released
1542	27 17.25N 15 25.83W	Argo float released; v/l in transit towards EBH2
1600		Wind NE 14 knots
1755-1820		Temp heave-to for Artistic photograph
2000	27 22.3N 15 06.1W	Wind NExN 12 knots
2400	27 28.3N 14 42.9W	Wind NE 11 knots

2007-11-06

0400	27 34.0N 14 21.4W	Wind NExE 12 knots
0538	27 36.5N 14 13.1W	V/l hove-to for deployment of EBH2
0552		Commence deployment
0607	27 36.71N 14 12.76W	EBH2 anchor weight released; v/l repositioning
0631	27 35.9N 14 13.2W	EBH2 (old) interogated & released
0650		Buoyancy on surface
0718	27 36.2N 14 13.1W	Grappled
0740		Recovery completed; deck secure; v/l in transit to EBH3
0800		Wind NE 18 knots
1040	27 48.5N 13 44.9W	V/l hove-to on station
1050		EBH3 interogated & released
1102		Initial buoyancy on surface
1125	27 48.6N 13 44.7W	Grappled
1132		All buoyancy streaming astern; comm recovery
1150		EBH3 recovered; Wind NExE 14 knots
1210	27 48.8N 13 44.6W	Comm streaming EBH3 (new)
1223	27 48.84N 13 44.45W	EBH3 anchor weight released; v/l in transit to EBH4
1330		V/l hove-to; EBH4 interogated & released
1345	27 50.8N 13 32.7W	Buoyancy on surface
1359		Grappled
1412	27 50.8N 13 32.4W	EBH4 recovered; v/l in transit towards EBM1
1520	27 53.6N 13 24.8W	V/l hove-to & initial interogation conducted
1543	27 53.6N 13 24.6W	V/l 'taking closer order' for re-interogation & release
1555		EBM1 on surface; Wind NE 14 knots
1604	27 53.5N 13 24.6W	Recovered; v/l repositioned to EBM2
1654	27 54.0N 13 23.5W	Nil response from EBM2; repositioning to EBM3
1720	27 54.3N 13 22.5W	Nil response from EBM3; repositioning to EBM4
1735	27 54.5N 13 22.2W	EBM4 interogated & released
1745		EBM4 surfaced & recovered; repositioning to EBM5
1804	27 54.6N 13 21.6W	Release command sent to EBM5
1816		EBM5 'no show'; verified still on bottom; repositioning to EBM6
1857	27 55.1N 13 20.0W	EBM6 verified on bottom; not released due loss of daylight
1900		Temp hove-to investigating EBM surface signal; tracked to Lab.
1924	27 55.1N 13 20.0W	V/l in transit to EBM7
2018	27 54.4N 13 13.6W	Hove-to & interogating EBM7; Wind NE 14 knots
2030		Nil response from EBM7; instructions to return to EBM2
2202	27 53.1N 13 23.9W	Commence hydrophone interogation search pattern, EBM2&3
2328	27 54.8N 13 23.1W	Complete first search line thro' EBM2
2400		Wind NE 16 knots

2007-11-07

0011	27 53.5N 13 22.8W	Comm second line thro' EBM3
0208	27 55.2N 13 21.9W	Complete second line

0249	27 53.3N 13 23.4W	Comm third line thro' bisection of EBM2&3
0400		Wind NE 20 knots
0418	27 54.9N 13 22.5W	Complete third line; v/l repositioning to EBM6
0620	27 55.1N 13 20.0W	V/l hove-to @ EBM6 awaiting daylight
0648		EBM6 released
0708	27 54.9N 13 20.0W	EBM6 recovered; v/l repositioning to EBM5
0748		V/l hove-to on station
0806	27 54.6N 13 21.5W	Commence triangulation; Wind NExN 12 knots
0900	27 54.6N 13 21.7W	Complete triangulation
0930		Further unsuccessful attempt to release EBM5; setting up for dragging ops
1035	27 54.6N 13 21.5W	Comm lowering drag gear – initial clump
1100	27 54.6N 13 21.6W	500m drag wire laid
1125	27 54.7N 13 21.5W	1000m drag wire laid; hove-to for 2nd clump & trans to Trawl wire
1140		Res veering
1152	27 54.7N 13 21.48W	2nd clump on bottom
1200		Wind NE 16 knots
1217		Cease veering @ 800m trawl wire out; v/l cont. @ 0.5 knots
1325	27 55.1N 13 20.65W	V/l hove-to; comm hauling
1355	27 55.1N 13 20.68W	Clump recovered; transfer back to deck winch
1405	27 55.1N 13 20.7W	Res hauling; v/l dropping astern to ease load
1435	27 55.0N 13 20.9W	500m mark
1503	27 55.0N 13 21.1W	Dragging gear all recovered
1525		V/l repositioned over EBM5 for resumed release attempts
1540		EBM5 on surface
1548	27 54.5N 13 21.6W	EBM5 recovered; v/l repositioning to 500m water depth
1600		Wind NE 15 knots
1625	27 55.2N 13 24.7W	CTD frame deployed for instrument calibration
1720	27 55.0N 13 20.7W	CTD frame recovered; v/l repositioning for Mini mooring redeployments
1806	27 55.1N 13 20.0W	V/l hove-to awaiting mooring deployment
1845	27 55.2N 13 19.9W	M6 deployed; v/l transitting Mini mooring line
1910	27 54.6N 13 21.6W	M5 deployed
1922	27 54.4N 13 22.1W	M4 deployed
1941	27 53.7N 13 24.4W	M1 deployed; v/l in transit to EBH4
2000		Wind NE 14 knots
2042	27 50.9N 13 32.5W	Comm mooring deployment; Ship's hdng 045 degs
2107	27 51.03N 13 32.37W	EBH4 mooring deployed
2115		Deck secure; v/l in transit to Argo launch site
2400	28 17.8N 13 19.7W	Wind NE 18 knots
2007-11-08		
0054	28 25.7N 13 16.0W	Argo float launched; v/l in transit for Santa Cruz via final CTD calibration site.
0400	28 10.4N 13 48.2W	Wind NE 18 knots
0800	Pta Jandia brng 008 degs x 7.7nm; Wind NE 10 knots	
1200	28 17.2N 15 11.4W	Wind NE 11 knots
1354	28 34.0N 15 21.1W	V/l hove-to for final CTD frame dep for calibration
1415		PES recovered
1430		Delay due to CTD cable jumping traction winch prior launch
1542	28 34.1N 15 21.1W	CTD rig deployed for calibration of instruments
1600		Wind NExE 12 knots
1700		CTD @ 3500m
1908	28 34.2N 15 21.0W	CTD recovered
1912		Deck secure; End of Science; v/l slow-steaming for Santa Cruz
2000	28 33.1N 15 22.6W	Wind NExN 8 knots
2400	28 24.2N 15 38.7W	Wind NE 12 knots
2007-11-09		
0256	28 18.0N 15 50.0W	A/c to 299 degs; crossing TSS to east of Santa Cruz

0400 28 19.8N 15 53.7W Wind NE 15 knots
0715 Anchors cleared
0730 1 hours notice to Port Control; S. b'water brng 287 degs x 4.4nm
0800 ME tested astern, BT & Strng Gear tested – all satis. EoP; ERSB
0815 S. b'water 281 degs x 2.2nm
0828 PoB Mr Vorento
0844 Entering Darsena de Los Llanos
0855 Swinging to stbd off berth
0900 Manoeuvring onto berth
0906 1st line – sternline
0919 All fast 4&2, port side-to Los Llanos cross berth
0920 RFWE
0922 Pilot away

6. Shipboard Measurements

6.1 Computing and Underway Data Logging

Martin Bridger

Below is a summary of the data logging and computing systems used on D324.

Logged Data (RAW)

GPS_4000 Trimble Navigator 4000 *Techsas
Lat = lat
Lon = lon
Gndcourse = hdg
Gndspeed = hvel

Logged but not used:
Alt
Prec
Nbseen
Nbused
HDOP
VDOP
PDOP

GPS_G12 Fugro G12 GPS *LevelB
Type
Svc
Utc
Lat
Lon
Alt
Cmg
Smg
Vvel
Pdop
Hdop
Vdop
Tdop

GPS_ASH Ashtec Attitude Detection Unit 2 *Techsas & *LevelB

Sec
Lat
Lon
Hdg
Pitch
Roll
Mrms
Brms
Attf

WINCH Cable Monitoring System *Techsas & *LevelB
Cabltype
Cablout
Rate
Tension
Btension
Comp
Angle

EA500D1 10kHz Echo Sounder *Techsas
Depth
Rpow
Angfa
Angps

GYRONMEA Gyrocompass *Techsas
Heading

LOG_CHF Chernikeef Log (EM LOG) *Techsas
Speedfa
Speedps

SURFMET Surface and Meteorlogical Instruments *Techsas & *LevelB
Temp_h
Temp_m
Cond
Fluo
Trans
Pres
Ppar
Spar
Speed
Direct
Airtemp
Humidty
Ptir
Stir

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

Processed Data (PRO)
RELMOV Inputs: GYRONMEA, LOG_CHF
Output: RELMOV
Vn
Ve

Pfa
Pps

BESTNAV inputs: RELMOV, GPS_4000, GPS_G12, GPS_ASH
Output: BESTNAV
Lat
Lon
Vn
Ve
Cmg
Smg
Dist_run
Heading

BESTDRF
Vn
Ve
Kvn
Kve

WINDCALC inputs: bestnav, surftmp*
Outputs: pro_wind
Abswspd (knots)
Abswdir

PROTSG inputs: surftmp
Output: protsg
Temp_m
Temp_h
Cond
Salin
Sigmat

PRODEP inputs: EA500D1
Output: PRODEP
Uncdepth
Cordepth
Cartarea

- Some temporary files were created to aid data editing SURFTMP is a editing copy of SURFMET
- RAWDEP is a editing copy of EA500D1.

Level C

All data processing was completed on the Sun Workstation 'Level C' using rvs data format and rvs data processing tools. Data was converted from NetCDF where necessary.

Data Integrity

Gaps in data of more than 60 seconds

GPS_4000
None
GPS_ASH
time gap : 07 280 12:05:33 to 07 280 12:06:35
time gap : 07 284 11:30:34 to 07 284 11:31:36

time gap : 07 286 12:24:53 to 07 286 12:25:55
time gap : 07 286 13:11:17 to 07 286 13:16:29
time gap : 07 286 13:42:09 to 07 286 13:49:12
time gap : 07 288 13:38:30 to 07 288 13:39:37
time gap : 07 288 13:52:01 to 07 288 13:55:01
time gap : 07 288 13:55:29 to 07 288 13:56:49
time gap : 07 288 15:42:32 to 07 288 15:47:07
time gap : 07 288 15:47:55 to 07 288 15:49:49
time gap : 07 291 13:26:11 to 07 291 13:28:07
time gap : 07 291 13:51:14 to 07 291 13:53:25
time gap : 07 292 16:54:20 to 07 292 16:55:52
time gap : 07 299 17:54:19 to 07 299 18:15:53
time gap : 07 300 21:03:45 to 07 300 21:06:50
time gap : 07 300 21:06:52 to 07 300 21:15:59
time gap : 07 300 21:36:38 to 07 300 21:42:03
time gap : 07 301 11:39:28 to 07 301 11:41:59
time gap : 07 305 10:08:37 to 07 305 10:46:16
time gap : 07 307 14:37:23 to 07 307 14:38:27
time gap : 07 311 06:38:50 to 07 311 08:12:18
time gap : 07 311 18:52:17 to 07 311 18:53:37

LOG_CHF
None
GYRONMEA
None

GPS_G12
time gap : 07 300 19:06:00 to 07 300 19:19:21
time gap : 07 300 19:32:59 to 07 300 19:34:08
time gap : 07 300 22:32:01 to 07 300 22:33:11
time gap : 07 300 22:42:10 to 07 300 22:45:07
time gap : 07 300 22:54:25 to 07 300 23:00:03
time gap : 07 301 16:01:04 to 07 301 16:06:56
time gap : 07 301 16:14:32 to 07 301 16:17:31
time gap : 07 303 19:17:23 to 07 303 19:18:58
time gap : 07 303 19:23:10 to 07 303 19:24:12
time gap : 07 303 19:42:56 to 07 303 19:49:19
time gap : 07 303 20:58:24 to 07 303 20:59:57
time gap : 07 303 21:04:54 to 07 303 21:06:19
time gap : 07 304 11:35:42 to 07 304 11:38:19
time gap : 07 304 11:38:38 to 07 304 11:41:58
time gap : 07 304 11:46:52 to 07 304 11:54:24
time gap : 07 304 11:55:58 to 07 304 12:05:27
time gap : 07 305 10:31:20 to 07 305 10:38:15
time gap : 07 311 07:16:36 to 07 311 07:17:37
time gap : 07 311 10:13:29 to 07 311 10:15:29

SURFMET
time gap : 07 279 03:05:30 to 07 279 03:07:00
time gap : 07 279 09:01:00 to 07 279 09:02:30
time gap : 07 279 09:02:30 to 07 279 09:07:00
time gap : 07 280 05:05:30 to 07 280 05:07:00
time gap : 07 280 09:47:00 to 07 280 09:48:30
time gap : 07 287 09:31:30 to 07 287 09:33:00
time gap : 07 287 14:50:30 to 07 287 19:26:30
time gap : 07 298 15:05:00 to 07 298 15:06:30

time gap : 07 299 06:00:00 to 07 299 06:01:30
time gap : 07 304 08:40:30 to 07 304 08:42:00
time gap : 07 304 09:50:30 to 07 304 09:52:00
time gap : 07 304 12:31:30 to 07 304 12:33:00
time gap : 07 307 08:44:00 to 07 307 08:45:30
time gap : 07 310 12:16:00 to 07 310 12:18:00
time gap : 07 311 07:16:30 to 07 311 07:18:00
time gap : 07 311 18:10:00 to 07 311 18:11:30

Master Clock Jump

A master clock jump occurred around 07 304 00:20. This required a level A reset on GPS_ASH, and GPS_G12 which occurred at 07 305 08:56.

Techsas NetCDF File Description

Techsas logs data onto local hard disk storage in the following directory structure:

/data/D324/NetCDF	NetCDF files for all instruments
/data/D324/$ASHT	raw NMEA sentences from Ashtec ADU2
/data/D324/EA500	raw messages from EA500D1 echosounder
/data/D324/GPRMC	raw NMEA sentences from Trimble 4000 GPS
/data/D324/HEHDT	raw NMEA sentences from Gyrocompass
/data/D324/SURFM	raw messages from Surfmet

The Winch/CLAM system is only logged to NetCDF.

NetCDF files

NetCDF files are cycled at midnight GMT and produce files for each 24 hour period. The filenames describe the creation date and time for each file.

E.g. These files were created on 7th November 2007 at 00:01:29.

20071107-000129-satelliteinfo-4000.gps
20071107-000129-position-4000.gps
20071107-000129-DWINCH-CLAM.DWINCH
20071107-000129-SURFMET-Surfmet.met
20071107-000129-ADU2-ASH.gps
20071107-000129-logchf-log.logchf
20071107-000129-gyro-GYRO.gyr
20071107-000129-PES-Simrad.PES

The rest of the file name describes the instrument data that is held in that file.

satelliteinfo-4000.gps	Trimble 4000 satellite information
position-4000.gps	Trimble 4000 position information
DWINCH-CLAM.DWINCH	Winch data from CLAM system
SURFMET-Surfmet.met	Underway measurements from Surfmet
ADU2-ASH.gps	Ashtec Attitude Detection Unit
logchf-log.logchf	Chernikeef Log (EM LOG)
gyro-GYRO.gyr	Gyrocompass heading
PES-Simrad.PES	Simrad EA500 Precision Echo Sounder

Daily Data Administration & Processing

In order for the Techsas logged instrument data to be used with level C processing tools its necessary to convert the NetCDF files into RVS format.

The first step is to convert the NetCDF file into a Listit text file identical to the output from the rvs listit command. This file can be used directly by software that support data in tabular format text files e.g. Microsoft Excel.
Before this can take place, an environment variable must be setup on the Level C terminal to point the NetCDF conversion utilities to the correct location of the NetCDF files. Cross mounting the data from Techsas1 to Discovery1 removes the need for ftp file transfers.

NFS mounting the data from Techsas1 to Discovery1
An NFS share was setup on Techas1 sharing /data
Discovery1 had the following line included in the /etc/vfstab file

```
techsas1:/data  - /rvs/pro_data/TECHSAS  nfs  - yes rw,bg
```

Setting the NC environment variable.
In addition to the LCBASE environment variables setup in the `rvs .cshrc` file, it is necessary to create one for the NFS mounted Techsas data.

```
setenv NCRAWBASE /rvs/pro_data/TECHSAS
```

Once this is done, a few NetCDF become are available:

```
ncinfo -f -l -p<path> -m                          similar to dfinfo

nclistit -s<start_time> -e<end_time> -i -h -n -l -u -v -k
-b -m  <name> <vars>                              similar to listit

ncvars [-u][-p datapath] stream [stream2...]  similar to vars
```

Converting between NetCDF files and RVS data files is made easier and more consistent using script files such as the following used during D324.

1) make_nc2txt

```
ls -rt1 $NCRAWBASE | awk '{print "nclistit "$1 " - >
/rvs/pro_data/ascii/" $1".txt"}
' > nc2txt
```

This produces a file named nc2txt which has a list of commands which perform a listit of each NetCDF file and produces (in the current directory) files the same as the original NetCDF file with a .txt filename extension appended.

2) nc2txt
Generated by the first script and produces the listit compatible files.

3) make_titsil

```
echo #!/bin/sh

ls -rt1 *position* | awk '{print "cat "$1" | cut -c 1-
17,34-68,120-153 | sed s/long/lon/ | sed s/gndcourse/hdg/
| sed s/gndspeed/hvel/ | titsil -o gps_4000 lat lon hdg
hvel"}'
```

```
ls -rt1 *GYRO* | awk '{print "cat "$1" | titsil -o
gyronmea heading"}'

ls -rt1 *logchf* | awk '{print "cat "$1" | titsil -o
log_chf speedfa speedps"}'

ls -rt1 *ADU2* | awk '{print "cat "$1" | sed s/lat1/lat/
| sed s/lon1/lon/ | titsil -o adu2 - "}'

ls -rt1 *PES*  | awk '{print "cat "$1" | sed s/snd/depth/
| titsil -o ea500d1 depth "}'

ls -rt1 *CLAM* | awk '{print "cat "$1" | sed
s/cableout/cablout/ | titsil -o winch2 cabltype cablout
rate tension btension angle "}'
```

This script is used to generate another script called do_titsil.

4) do_titsil

Generated by do_titsil, it puts each listit file through sed to rename some header variables to be compatible with the standard rvs data files, then creates the rvs data files by using titsil.

It is important that these files are processed in data order (for each instrument), starting with oldest first. If for some reason the dates for these files are out of sequence, it is important to 'touch' the files to make sure they list in the correct order.

Bestnav

Takes navigation inputs from multiple navigation files and generates a continuous navigation file.

Relmov

Relmov is used to calculate the relative motion of the ship from gyro and log data.

Pro_wind

Used to derive absolute wind speed and direction from relative wind speed and direction, course and speed made good, and ships heading

Protsg

Used to derive Salinity from Surfmet Data.

Depth Processing

The following process was applied to the echo sounder data stream EA500D1.

`copyit -v0 -l1 ea500d1 rawdep depth`

Copies depth data with depth greater than 1m to working file rawdep. RVSEDIT was used to edit spikes and other obviously bad data.

Calculates average depth data and placed in 1 minute bins.

`Prodep` (menu driven)

Performs Carter Area Correction on the depth data from rawdep.

Backups

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

Data Cleaning

Data was manually edited to flag out bad data. Each variable is given a status flag of:

20 = REJECT
30 = SUSPECT
50 = GOOD

A value of less than 50 indicates that it is suspect value and is likely to have been flagged out or rejected.

Surfmet (Continuous Surface Water and Meteorological Measurements)

Surfmet consists of a thermosalinograph (temperature, conductivity) Transmissometer, Fluorometer, and a remote temperature sensor connected to the ships non-toxic system in the wet lab.

Meteorological instruments are located on the fore mast. They consist of Port and Starboard PAR and TIR sensors. A temperature and humidity sensor. Wind speed and direction sensors, and a barometric pressure sensor.

TSG Calibration.

Water samples were taken by scientists during watch, and salinity measured without using softsal.

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

D324 Clock Synchronisation System

There are two satellite clock systems onboard Discovery. One outputs the time over RS232 and the other provides a network timeserver.

The Satellite Synchronised Time & Frequency Standard (GPS 8000)

The The Satellite Synchronised Time & Frequency Standard receives time base information via GPS satellites and uses an Intelligent Submaster Clock (SMC 8000) to distribute UTC time via Slave Clock Type 520/1311 and Computer Systems Clock. The Computer Systems Clock supplies time to the Level A interfaces and to the SSDS (Ship Scientific Display System -green displays). This clock makes use of a clock buffer to also supply time to the Surfmet and CLAM systems.

The Steatite Timeserver MM3S GPS Network Timeserver

Timeserver MM3S provides a high precision time base to a TCP/IP network (Stratum- 1-Server). The NTP (Network Time Protocol) is used to synchronize all NTP clients with the reference. Timeserver MM3S/GPS is a set of equipment composed of a satellite controlled clock GPS167, a single-board computer with integrated network board and a power supply, all installed in a metal 19" modular chassis and ready to operate. A simplified LINUX operating system is installed on the single-board computers flash disk. Four push buttons and a 2 x 40 character LC display can be used to configure and monitor the time server. After the network connection has been established the time server can also be configured and monitored remotely from a workstation via TELNET or FTP. An integrated HTTP server

enables access to the Timeserver MM3S by using an ordinary WEB browser. Onboard the Discovery, computers can make use of the timeserver by entering **time.discovery** as the time server.
The Techsas logging system makes use of the time.discovery timeserver to time stamp all incoming data to sub second accuracy.

Trimble 4000
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).
On day 300 the Trimble 4000 lost its position, displaying [OLD POSITION] on the LC display. The receiver was switched off, but failed to power up properly when switching it back on. Further investigation showed that the unit had lost its firmware due to possible failure of the internal backup battery. Attempts were made to make the unit operational, but according to Trimble the unit must return to them for repair.
The Ashtec G12 GPS receiver was subsequently configured to accept RTCM differential corrections from the Fugro Seastar differential receiver. The GPS position from the G12 was reconfigured to feed into the SSDS and Level A at 4800 baud in order to maintain a satisfactory navigation input.

6.2 CTD

6.2.1 Introduction

Paul Provost

A total of 13 CTD casts were conducted on cruise D324 (see tables 6.1 and 6.2). CTD casts were taken in combination with a variety of instruments recovered from the moorings as a pre and post deployment calibration procedure. Up to twelve bottles were removed from the rosette to accommodate these instruments, while still providing an adequate number of bottle samples for salinity calibrations. On casts of appropriate depth, Ixsea acoustic releases were shackled to the outside of the CTD frame to test their release mechanisms at their planned deployment depths. Details of the CTD sensor configuration are given in table 6.1.

After the attachment of all instruments requiring calibration and the normal CTD frame set up, the SeaBird SeaSave logging software was initiated and data recording begun while the instrument package was still on deck. Subsequently the package was lifted from deck, lowered over the side of the ship and taken to a depth of 10 meters to purge pumps of air and allow the logging instrumentation to stabilise. After three minutes, the package was raised to the surface and thereafter began a downcast to a depth suitable for instrument testing. When the CTD was lowered to a close proximity to the seabed, the package was stopped at a suitable depth based on echo sounder measurements and Carter Table corrections.

Five minute bottle stops were repeated at intervals throughout the upcast; additionally some stops on the upcast were for instrument cross-calibration only and no water

samples were collected. At the end of the cast the conductivity and temperature sensors on the main instrument package were flushed with MilliQ water.

statnum	Year yyyy	Month mm	Day dd	Time hhmmss	Lat deg	Lat min	Lon deg	Lon min	pmin dbar	pmax dbar	depth m
002	2007	10	9	162559	40	55.94	-13	38.23	1	4579	5345
003	2007	10	10	093055	38	35.28	-13	48.14	1	4073	4272
004	2007	10	12	204538	29	01.53	-15	39.32	1	3653	3626
005	2007	10	15	225407	25	23.47	-20	33.59	1	4069	4349
006	2007	10	16	183449	24	30.00	-22	24.44	1	4067	4771
007	2007	10	17	225339	23	56.24	-23	59.41	1	4069	5074
008	2007	10	23	001339	23	55.21	-41	02.29	1	5619	5693
009	2007	10	23	050730	23	51.89	-41	05.97	1	3553	5002
010	2007	10	25	194957	24	11.70	-49	42.59	1	4067	5204
011	2007	11	2	105814	23	56.06	-27	10.94	1	3555	5507
012	2007	11	4	152420	26	05.72	-18	31.02	3	3431	3411
013	2007	11	8	165813	28	34.35	-15	21.15	1	3547	3565

Table 6.1: Summary of CTD stations times and positions

6.2.2 Narrative

Paul Provost

5/10/07
The CTD was set up as an all stainless system in the following configuration, and several deck tests were performed to confirm satisfactory build.

9/10/07 (CTD001 & CTD002)
At first CTD station (001) to test 24 bottle CTD system and 6 acoustic releases. On deployment at surface Stuart Cunningham was critical of the reading of the secondary conductivity reading, stating it was too high for the water body. The calibration coefficients and software settings were checked for the sensor to confirm an error had not been made, but none was observed. The cast continued at the request of Stuart Cunningham. All went well until the unit reached 1050m water depth, where the primary temperature sensor failed and gave a constant reading of 98.97 deg C. The Primary conductivity continued to read normally as did the Secondary temperature sensor.

The first modulo error appeared at 1350, but there were very few for the rest of the cast. The secondary conductivity sensor read between 0.11 and 0.16 S/m different to the primary conductivity sensor. During the down cast the computer tech switched on the NMEA output to the CTD deck unit, but this did not appear on the Seasave display as the NMEA string option was not checked. Once at the bottom of the cast (5000m wire out) the carousel did not respond to the Seasave commands. These were tried several times and the fire button was pressed on the deck unit but no confirmation lights showed on the deck unit so it was unclear what had happened. The Seasave software was reset (PC reboot) and the deck unit was switched off and on again, but this had no effect on the problem..

Once the releases were tested the package was returned directly to 10m (at 80m/min) and brought inboard.

The package was inspected on deck and washed in fresh water. The plugs were checked on the JB end of the 9+ unit but all were dry and free of obvious signs of water ingress. The primary temperature sensor was removed and put aside and replaced with the secondary temperature sensor. A fresh temperature sensor was put on as a secondary unit and the secondary conductivity sensor was replaced with a fresh unit also.

The cable to the carousel was removed and checked, but no water ingress was visible and it was concurred that lack of modulo errors was indicative that water ingress was unlikely to be the main problem. A deck test was then performed and all seemed to work well. It was postulated that the switching on of the NMEA output was the reason for the carousel failure, and this problem was attempted to be replicated, but unsuccessfully. Once back in the main lab, it was noted that the primary temperature sensor that had been removed did either rattle or shake. The sensor was wrapped up in protective packaging and left alone.

A second CTD cast at station 2 was planned for the afternoon. Prior to then a 10m cast was suggested to confirm the full firing function of the carousel. When switched on for this cast the new primary sensor read 98.97 deg C. The Seasave software and deck unit was reset and this cleared the fault. The 10 m cast was performed and all bottles fired as planned. The package was returned aboard and the bottles re-cocked and 6 further releases were attached.

On the full depth cast (CTD002d) the primary sensor failed at approx. 1700m with the same response of going to 98.97 deg C. The cast continued and at the bottom (4500m) the carousel failed to operate using the Seasave software, so the manual control was used, but without confirmation lights. On return to the surface all 24 bottles had fired. The primary temperature cable was tested for continuity and also had a Megaohmeter applied, but there was no sign of cable failure.

It was decided that the main CTD 9+ unit was to be replaced with a spare unit (0637 - titanium). The standard unit was removed from the frame and stripped down and the sensors were all replaced in the same configuration. This was done in the evening of the 9th October. The titanium 9+ unit was built up with the same cables etc., as before except for the replacement of the primary temperature sensor cable which was replaced with a brand new one. The con file was also updated with the configuration shown in Table 6.2.

10/10/07 (CTD003)
The unit was replaced into the CTD frame and the altimeter, seacable and carousel were connected, and the unit tested. 12 bottles and 12 SBE37s were positioned on the frame.

On deployment (CTD003) it was apparent that there was considerably less noise between the primary and secondary temperature sensors. The package was sent to 4000m to confirm calibration of 12 SBE37 MicroCATs which were attached to the

frame, and all looked well. Unfortunately at 4000m the carousel did not respond to the Seasave bottle firing command and the deck unit manual fire button was used, but without any confirmation lights. On return to deck, all bottles had fired as expected (23) and samples were taken. The existing carousel cable was removed and examined for water ingress, but none was observed. The bulkhead connectors were cleaned and regreased and a new carousel (SBE32) to CTD (9+) cable was fitted. All deck tests were performed and the next CTD cast is planned for 12 October 2007.

12/10/07 (CTD004)
After careful investigation of the T&C data by Stuart Cunningham there appeared to be an offset of approximately 0.0035 psu, but the individual "noise" steps were identically observed between the primary and secondary channels. The primary pair of sensors were connected to the secondary channel and the secondary sensors were placed on the primary channel. The sensors were not physically moved from their mounting on the instrument, rather the cables were swapped over. The new configuration is as given in Table 6.2.

CTD cast 004 was fine until at 1700m the secondary conductivity sensor became noisy with occasional values of 0 and 990 mS/cm (i.e. full scale deflections). At around 2000m the conductivity sensor failed to give data and a constant reading of 990 mS/cm was recorded until 500m on the upcast where readings very similar to the primary conductivity prior to the sensor dropout returned. Stuart Cunningham requested that this sensor be replaced when the CTD returned to the surface. No modulo errors were recorded.

At 3272m communications were lost with the SeaSave PC (RS232 timed out), but the 11+ deck unit continued to operate correctly and read apparent data from the CTD. The SeaSave software was restarted and the communications were resumed with no errors. The CTD was hauled a few 10's of meters to 3250, and then veered to continue the cast to the maximum depth of 3594m. On the ascent, the RS232 communications timed out once more at 2974, with no other errors. The SeaSave software was reset and the upcast was resumed. As mentioned earlier the secondary conductivity sensor came back on line at around 500m. All bottles were fired with the SeaSave software and fired as expected.

15 October 2007 (CTD005)
The secondary conductivity sensor (s/n 2231) was replaced with a fresh unused (on this cruise) conductivity sensor (s/n 2841) at the request of Stuart Cunningham. Additionally the T/C cable was replaced for this sensor and the plugs cleaned and re-greased, however no sign of water ingress or pin corrosion was observed. The sea cable from the CTD unit to the wire termination was also replaced. The con file was updated and the ctd was put through a deck test (rtitest5.dat) prior to deployment.

The cast was performed successfully, with 8 modulo error counts being returned by a maximum depth of 4003m.

16 October 2007 (CTD006)
The cast was performed with a repeated configuration of CTD005, and no problems were encountered.

17 October 2007 (CTD007)
The cast was performed with a repeated configuration of CTD006, and no problems were encountered.

22 October 2007 (CTD008)
The cast was performed with a repeated configuration of CTD007. However, due to the pressure required to test the additional instruments, the BBLADCP was removed to prevent possible damage to the instrument (although it should be rated to 6000m). No problems with the system were encountered.

23 October 2007 (CTD009)
The cast was performed with a repeated configuration of CTD008, and no problems were encountered.

25 October 2007 (CTD010)
Upon switching on the deck unit, the error light came on after cycling through the word display. The unit recycled a couple of times and then settled to an error displaying P 7 7 on the word display. The unit was powered on and off three times, the second time the unit started as normal, then within 2 seconds of reading expected primary temperature bits the error signal occurred and the same P 7 7 error was displayed. The third time, the error occurred after the word display was cycled.

The connections on the back of the deck unit were checked, and the sea cable terminations with the winch wire and the 9+ unit were checked, cleaned and greased. Whilst the sea cable was isolated from the 9+ unit the ctd cable from the back of the deck unit to the termination had its integrity checked by applying a megaohmeter to it, infinite resistance was recorded. The deck unit was powered with the same error occurring. The carousel cable was removed, inspected, cleaned and replaced, as was the altimeter cable. In all cases, no sign of water ingress was observed. When the deck unit was powered the same error occurred once more.

The deck unit was then connected to the other 9+ unit, and upon powering the same error was recorded. The spare (Scanfish) deck unit was then connected to the spare 9+ unit and was started as expected. The Scanfish unit was connected to the 9+ unit on deck through the CTD wire and communications were established. However once the NMEA cable was connected to the Scanfish unit (whilst not powered) and switched on, the system did not power up correctly, and a different error was shown. The original deck unit was then reconnected to the CTD without the NMEA connected and powered up correctly. The Computer Technician was asked to check the NMEA output, but nothing was noted, it was in the standard GGA string, but this continued to cause problems. The Computer Technician was asked to change the string to a different (yet compatible) format (GLL). These data seemed to not cause an error to the deck unit, and the cast was started with no change to the deck unit or the main SeaBird system.

On the upcast the 16 errors occurred at around 300m water depth, there was no obvious errors, but it was noted that the on board computer network had a few ‘connection problems’ at the same time, and a link between the network and the NMEA data stream was postulated, however there has been no confirmation as to whether this is an actual effect or just perceived.

Other than these problems listed above, the CTD cast was performed with no further problems.

01 November 2007
The RD Instruments 150kHz BBLADCP was refitted to the stainless steel frame.

02 November 2007 (CTD011)
The cast was performed with a repeated configuration of CTD010. During the downcast no problems were experienced. On theup cast the deck unit showed an error 7 P P and reset itself with no user input at 2486m at which point the SeaSave software on the PC stopped logging. The winch was stopped immediately and held at that depth whist the SeaSave software was restarted. The subsequent file was CTD011b. Once logging the up cast was continued and no further problems were experienced.

04 November 2007 (CTD012)
The cast was performed with a repeated configuration of CTD011. At 32m on the down cast the primary SeaSave software logging PC crashed for no obvious reason with no error messages appearing on the deck unit. The winch was stopped immediately and held at that depth whist the SeaSave software was restarted. The subsequent file was CTD012b. Once logging the down cast was continued and no further problems were experienced.

08 November 2007 (CTD013)
The cast was performed with a repeated configuration of CTD012. On initial deployment there were problems with the ctd winding, which resulted in slack turns of wire. Once resolved the cable had its integrity checked with a Megaohmeter. On the down cast 37 modulo errors were recorded by 160m, but after that no further problems were recorded.

CTD	Configuration	No. of bottles	Wire out	Additional instruments	PES depth
1	9+ - 0636, 32 – 0518, Alt – 1040, Pri T – 4151, Pri C – 2231, Sec T – 2674, Sec C - 2450	24	5000	BB LADCP s/n: 1503 AR861 s/n: 819, 820, 821, 822, 823, 824	5286
2	9+ - 0636, 32 – 0518, Alt – 1040, Pri T – 2674, Pri C – 2231, Sec T – 4301 ,Sec C - 2580	24	4500	BB LADCP s/n: 1503 AR861 s/n: 818, 252, 826, 354, 327, 827	5291
3	9+ - 0637, 32 – 0518, Alt – 1040, Pri T – 2674, Pri C – 2231, Sec T – 4301, Sec C - 2580	12	4000	BB LADCP s/n: 1503 SBE37 s/n: 3225, 3234, 3247, 3254, 3255, 3256, 3265, 3266, 3269, 3270, 3271, 3274 AR861 s/n: 327, 825, 244	4170
4	9+ - 0637, 32 – 0518, Alt – 1040, Pri T – 4301, Pri C – 2580, Sec T – 2674, Sec C - 2231	12	3600	BB LADCP s/n: 1503 SBE37 s/n: 3252, 3257, 3277, 3479, 3480, 3482, 3484, 5484, 5485, 5486, 5487, 5488 RBR s/n: 9656, 9657	3608
5	9+ - 0637, 32 – 0518, Alt – 1040, Pri T – 4301, Pri C – 2580, Sec T – 2674, Sec C - 2841	18	4000	BB LADCP s/n: 1503 SBE37 s/n: 3224, 3251, 3268, 3272	4322
6	9+ - 0637, 32 – 0518, Alt – 1040, Pri T – 4301, Pri C – 2580, Sec T – 2674, Sec C - 2841	18	4000	BB LADCP s/n: 1503 SBE37 s/n: 3253, 4472, 4475	4735
7	9+ - 0637, 32 – 0518, Alt – 1040, Pri T – 4301, Pri C – 2580, Sec T – 2674, Sec C – 2841	18	4000	BB LADCP s/n: 1503 SBE37 s/n: 4718, 4719, 4720, 4721, 4722, 4723	5031
8	9+ - 0637, 32 – 0518, Alt – 1040, Pri T – 4301, Pri C – 2580, Sec T – 2674, Sec C – 2841	12	5500	AR861 s/n: 361, 260, 262, 368, 825, 244, 320, 818 SBE37 s/n: 4720, 4721, 4722, 4723, 4178, 4179, 4180, 4181, 4183, 4708, 4709, 4710	5630
9	9+ - 0637, 32 – 0518, Alt – 1040, Pri T – 4301, Pri C – 2580, Sec T – 2674, Sec C - 2841	12	3500	SBE37 s/n: 3207, 3208, 3209, 3112, 3213, 3214, 3215, 3216, 3217, 4711, 4712, 4713	4991
10	9+ - 0637, 32 – 0518, Alt – 1040, Pri T – 4301, Pri C – 2580, Sec T – 2674, Sec C – 2841	12	4000	SBE37 s/n: 3912, 3910, 3918, 3890, 4715, 4717, 4461, 4714, 3282, 4464, 4462, 4466	5154
11	9+ - 0637, 32 – 0518, Alt – 1040, Pri T – 4301, Pri C – 2580, Sec T – 2674, Sec C - 2841	12	3500	BB LADCP s/n: 1503 SBE37 s/n: 3239, 3248, 3249, 3259, 3264, 3284, 3483, 3486, 3891, 3892, 3900, 4474	5450
12	9+ - 0637, 32 – 0518, Alt – 1040, Pri T – 4301, Pri C – 2580, Sec T – 2674, Sec C - 2841	12	3380	BB LADCP s/n: 1503 SBE37 s/n: 3901, 3902, 3903, 3904, 3913, 3914, 3915, 3916, 3919	3403
13	9+ - 0637, 32 – 0518, Alt – 1040, Pri T – 4301, Pri C – 2580, Sec T – 2674, Sec C - 2841	12	3500	BB LADCP s/n: 1503 SBE37 s/n: 3218, 3250, 3276, 3481, 3928, 3930, 3931, 3932, 3933, 3934, 4305, 4306, 4307, 4470, 4799, 4800	3550

Table 6.2: CTD configuration for each cast

6.2.2 Processing Path

María Paz Chidichimo, Sandra Forrest, Stuart Cunningham

Raw data from the CTD were directly logged to a PC from the SeaBird deck unit using the SeaBird software Seasave Win32 v5.35. The data then underwent the following routines in SBE Data Processing to apply instrument calibrations and convert from frequency data to physical units.

1. *Data conversion*: Files in: CTD*nnn*.CON (instrument configuration file), CTD*nnn*.dat (data file), files out: ctd324*nnn*.cnv, ctd324*nnn*.ros.
2. *WildEdit*: File in/out: ctd324*nnn*.cnv. The mean and standard deviations were computed on blocks of 500 points. Points lying outside two standard deviations were excluded. Points then lying outside two standard deviations of a new mean were then replaced by absent data.
3. *Cell Thermal Mass*: File in/out: ctd324*nnn*.cnv. Removed conductivity cell thermal mass effects with a recursive filter, alpha = 0.03, tau = 7.0.
4. *Translate*: File in/out: ctd324*nnn*.cnv. Converted file from binary to ascii.

The final conversion file (.cnv) was then transferred to sohydro6 via ftp for further processing in PSTAR, where the following executions were performed:

ctd0: File in: ctd324*nnn*.cnv. File out: ctd324*nnn*.24hz. Read ascii file to PSTAR format.

ctd1: File in: ctd324*nnn*.24hz. Files out: ctd324*nnn*.1hz, ctd324*nnn*.10s. Averages 24hz file to 1hz and 10s.

ctd2: File in: ctd324*nnn*.1hz. File out: ctd324*nnn*.ctu. Create 1hz up/down file with bad datacycles at beginning and end of cast excluded. File out: ctd324*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: Files in: ctd324*nnn*.ros, ctd324*nnn*.cnv, ctd324*nnn*.10s. File out: fir324*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: fir324*nnn*, sam.masterD324, ctd324*nnn*.24hz. File out: sam324*nnn*. Create a blank sample file, paste in firing data and heading data from the .24hz file.

win0: File in: RVS format "winch" string. File out: win324*nnn*. Read 10T winch data for period of CTD cast.

6.2.3 Salinity Sample Processing

María Paz Chidichimo, Sandra Forrest, Stuart Cunningham

The sample path consists of converting text files containing bottle salinities into PSTAR files that can then be used to calibrate the CTD. Bottle sample data are entered in an Excel file as text (tab delimited) files and then saved as .csv files, after that they are transferred to the UNIX system through ftp.

sal.exec: converts the .csv files into binary PSTAR format. File in:sal324*nnn*.csv, Files out: sal324*nnn* and sal324*nnn*.txt.

passal: pastes salinity from the sal files into the same files. File in: sal324nnn, File out: sam324nnn

botcond.exec: i) Calculates the salinity sample conductivity using CTD pressure and temperatures at the bottle stops, File out: sam324*nnn*.cal. ii) creates an appended file of sample data from all casts, File out: sam.append.cal.

The appended sample file was loaded into MATLAB using the *pload* function and then converted into .mat file.

6.2.4 CTD Calibration

María Paz Chidichimo, Sandra Forrest, Stuart Cunningham

CTD conductivities are calibrated by comparing them to bottle conductivities derived from salinity samples obtained during the CTD upcast.

ctd_cal_3.m: MATLAB script that reads appended .mat file to determine CTD calibration parameters. Input data from PSTAR file sam.append.cal.AX converted to matlab file sam_append_cal_AX.mat.

As a first step to correct CTD conductivity, basic statistics were applied for rejecting bad data.

Variables involved are: C_{BOT} (Bottle conductivity obtained from the measured bottle salinity), C_{CTD} (CTD upcast conductivity averaged over the 10 s around the bottle fire time),
C_{BOT} /C_{CTD} (conductivity ratio), C_{BOT} -C_{CTD} (conductivity difference).

Data were first rejected when the conductivity differences were greater than ± 0.02 mS/cm and for conductivity ratios less than 0.9999 and greater than 1.0006. For the remaining bottles, the mean (μ) and standard deviation (sigma) were computed and bottles with differences and ratios greater than (μ ± 3 sigma) were rejected. 129/149 samples (86.6%) were used in the calibration.

The usual correction applied to CTD conductivity is a slope correction to account for sensor drift (usually to lower values with time). This is calculated first taking the

station mean ratio of bottle to CTD conductivity for each station, and then calculating the mean K over all stations:

$Ks = < C_{BOT} / C_{CTD} >$, <> denotes the station mean

$K = < Ks >$, <> denotes the mean over all stations. **K=1.000107**.

and C_{CTD} corrected$_1$ = C_{CTD}* K.

After the slope value calibration, a second order polynomial fit was fitted to C_{BOT} /C_{CTD} as function of C_{CTD}, giving:

$K1 = a + b \times C_{BOT} + c \times C_{BOT}^2$ **(a=1.000536, b=-2.1578E-5, c=1.8946E-7)**

where a, b and c are the coefficients of the second order polynomial.

and C_{CTD} corrected = C_{CTD} corrected$_1$* K1.

Following the conductivity slope and polynomial corrections we carefully examined the remaining station-by-station bottle-ctd conductivities. Apart from station 11 the mean station residuals were within one standard deviation of zero. Extensive examination of the salinometer analysis of station 11 samples and the SSW measurements and drift did not suggest that the problem was with the bottle samples. Plotting the CTD theta/S profile of station 11 with its near neighbours 5, 6 and 7 suggests that station 11 CTD data are in agreement with those stations to about 0.001 in salinity at fixed potential temperatures. Therefore we could find no justification for an individual offset to be applied to station 11. The final station average residuals are given in Table 6.3.

Statnum	btc-uc mS/cm mn	btc-uc mS/cm sigma	btc-uc (P>2500db) mS/cm mn	btc-uc mS/cm sigma
003	-0.0008	0.0027	0.0003	0.0019
004	0.0021	0.0038	-0.0015	0.0009
005	-0.0006	0.0017	-0.0002	0.0024
006	-0.0002	0.0016	-0.0010	0.0012
007	-0.0001	0.0019	0.0005	0.0014
008	-0.0001	0.0018	0.0004	0.0025
009	0.0009	0.0033	-0.0006	0.0021
010	0.0001	0.0010	-0.0003	0.0001
011	0.0037	0.0010	0.0038	0.0014
012	0.0012	0.0039	-0.0016	0.0000
013	-0.0006	0.0028	0.0020	0.0000

Table 6.3: Mean and standard deviation of bottle – ctd conductivities station by station.

ctd.positions.exec: File in: ctd324*nnn*.1hz. File out: *nnn*.position. Extract time using data cycles at time of start of downcast, end of downcast and end of upcast in 1hz file, and merge with a 30s navigation file. Times are the bottom of the down cast. Pmin and pmax are the limit of the 1hz downcast file. Depth is the echosounder depth.

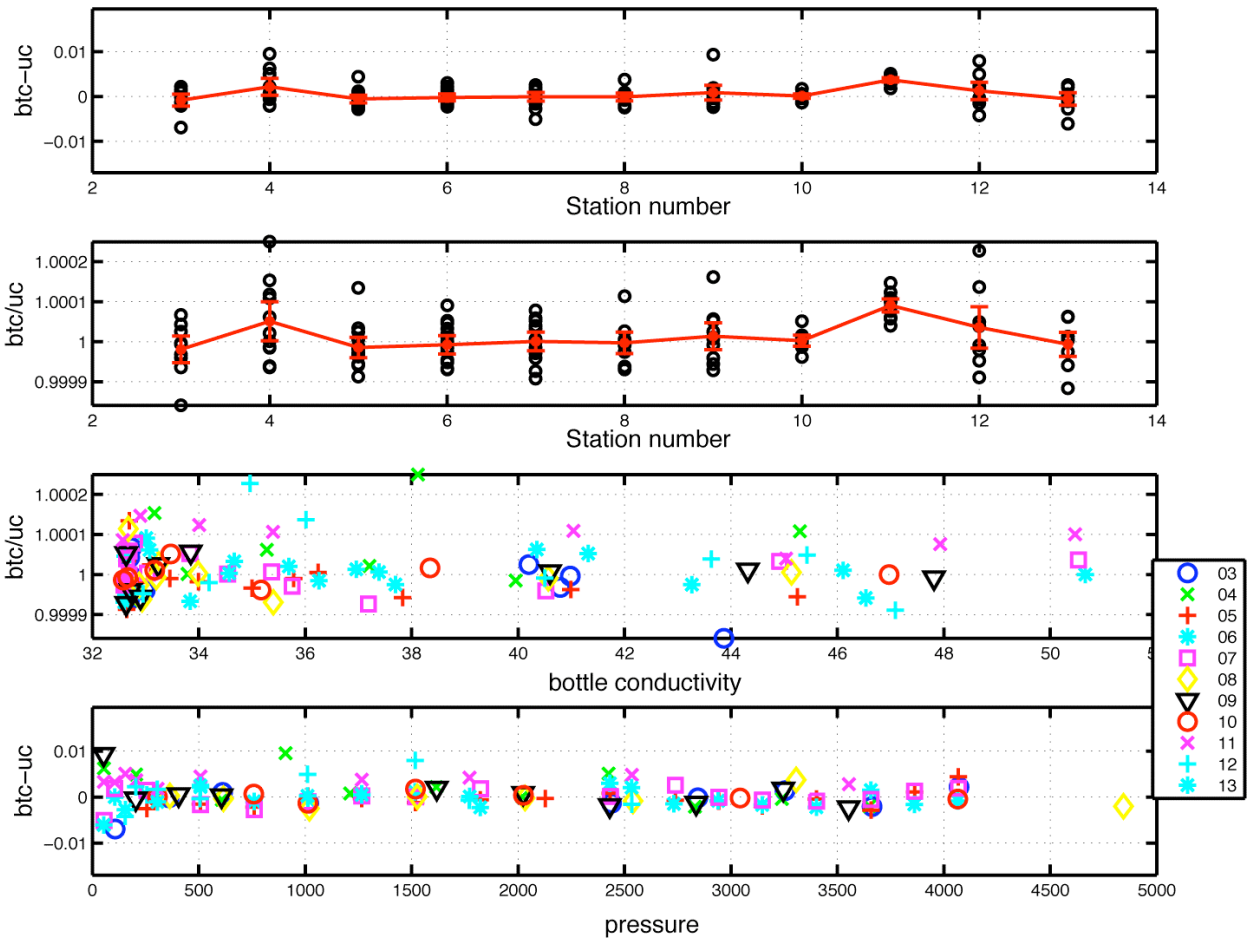

Figure 6.1: Calibrated CTD data after slope correction and 2nd. order polynomial fit correction: i. (btc-uc) v station number, ii. (btc/uc) v pressure, iii. (btc/uc) v btc and, iv (btc-uc) v pressure. btc is bottle conductivity and uc is CTD upcast conductivity.

6.3 Salinity Sample Analyis

Wing Yue Young, Zoe Aston and Maria Paz Chidichimo

6.3.1 Sample Collection

Surface sampling

Surface samples were drawn and collected every four hours during the cruise from 8am to 8pm whilst underway. These were drawn from the ship's non-toxic supply for

the purpose of the thermosalinograph (TSG) calibration. No samples were drawn during mooring operations or CTD stations.

CTD
From each CTD cast, water samples were collected from the frame mounted Niskin bottles using 200ml glass bottles and then dried with paper towels to ensure no salt crystals could form in the neck of the bottle from evaporation of sea water. They were then sealed with plastic stoppers to prevent further evaporation of the sample itself before being capped with screw top lids. Bottles were then placed in metal wire crates and put in the constant temperature (CT) laboratory for a minimum of 24 hours prior to analysis.

6.3.2 Sample Analysis Procedure

The Guildline 8400B (60889) was the main instrument used for the analysis of CTD and TSG discrete samples. This operated at a temperature of 24°C and was set up in the constant temperature laboratory (set at a temperature of 20°C). The equipment was opened for examination and the lights and fan were checked to be in working order before standardisation of the instrument. Standardisation was performed by adjusting the dial to a Seawater standard after flushing through five times. The Seawater standard used was from batch P147 and had a K_{15} value of 0.99982.

Salinity analysis followed the standard procedure. All samples and standards were homogenized by inverting or shaking the bottle before opening. For calibration a seawater standard was run before and after each TSG crate and each set of samples from a CTD station. The salinity of each sample was measured after flushing each sample three times and readings were taken successively until a stable conductivity ratio that was within 0.00003 of the previous readings for that sample.

Following analysis, the conductivity ratios were typed into an Excel spreadsheet, which converted them into salinity values whilst accounting for variations in the standard readings. Figure 6.2 shows the stability of the Guildline salinometer during the cruise and the corrections applied to the conductivity ratio for each CTD station. The graph shows the averaged value of the differences between the expected standard reading and the readings measured at the beginning and end of each crate analysis.

The correction values shown at station numbers 0 and 6.5 refer to the initial calibration of the salinometer, before any seawater was analysed, and the recalibration of the machine between stations 6 and 7, respectively. Two dips were carried out at station 2, but the standard measured at the end of the analysis of dip 2/station 2 was deemed unsuitable for use for the CTD calibration and so is shown as a separate series on the graph (using the initial standard value). The values shown at station number 9.25, 9.75, 12.25, 12.75 refer to the standards measured when analysing TSG crates 1, 2, 3, and 4.

The calculated salinities were then saved as comma separated value files under the name ‘sal324*iii*.csv’.

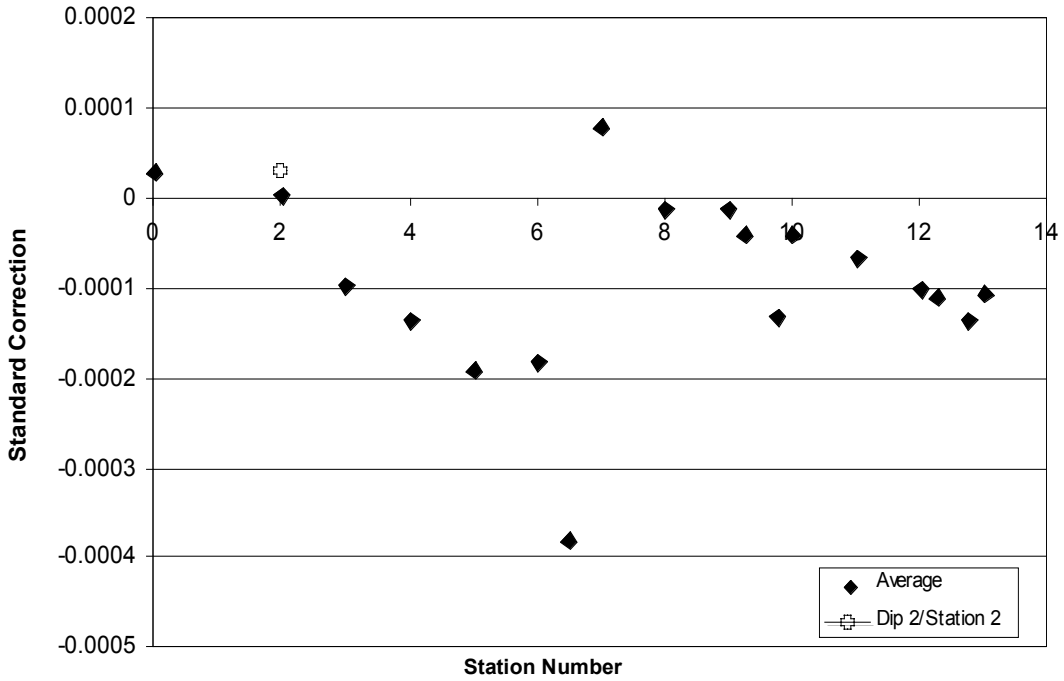

Figure 6.2: Standard correction applied to the conductivity ratio for each CTD station

6.4 Bathymetry

Zoe Aston and Sandra Forrest

6.4.1 Single Beam Bathymetry Data

Single beam bathymetry data were obtained using a Simrad EA500 hydrographic echosounder and a Precision Echosounding transducer (PES) mounted in a 'Fish'.

The system was run almost continuously throughout the cruise, being hull mounted on the transit leg from Falmouth to Tenerife, and then via the PES fish from Santa Cruz de Tenerife onwards. The system was turned off when acoustic quietness was necessary for communications with acoustic releases (including release tests at the bottom of a CTD cast) and during use of the Pinger with CTD casts. The EA500 was re-started as soon as possible after each event.

The echosounder raw data ('*ea500d1*') were logged on the Techsas logger and checked regularly. The EA500 is configured for a constant velocity of sound profile of 1500ms^{-1} and, therefore, produces depth data that are uncorrected for velocity of sound *in situ*. The initial raw data were processed daily via the RVS program '*prodep*' to correct it for regional variations in the speed of sound using Carter tables. After this initial processing, the '*simexec0*' program was used to read the RVS format raw data containing time, uncorrected depth, corrected depth and Carter area into PSTAR format. This program uses '*datapup*' and '*pcopya*' to create the file 'sim324*ii*.cal' which was then manually edited in '*plxyed*' to remove any errors and anomalous data. Following this screening process, the '*simexec1*' program was run; this calls '*pintrp*' to interpolate any missing data in the 'sim324*ii.*cal' file, and '*pmerg*' to combine the bathymetry and navigational dataset 'gp432401'. *simexec1* then produces an output file 'sim324*ii*.nav' which contains data in intervals of 6-10 seconds depending on the

echosounder ping return time and comprises the parameters: time, latitude, longitude, uncorrected depth, corrected depth, Carter area and speed made good. '*pavrge*' is the final step in the '*simexec1*' program, whereby the 'sim324*ii*.nav' file is averaged into 5 minute intervals, producing an output file 'sim324*ii*.5min'.

Following the failure of the Trimble 4000 GPS unit on day 300, the combined bathymetric and navigational files were instead created using the AshTech GPSG12 navigational dataset 'gpsg1232401'.

The daily output files produced were:

- sim324*ii* – uncorrected depth using a constant speed of sound (1500ms^{-1}).
- sim324*ii*.cal – corrected data from 'prodep' and manual plot editing.
- sim324*ii*.nav – combined bathymetric and navigational data.
- sim324*ii*.5min – 5 minute interval averaged data.

6.4.2 Comparison of the EA500 with the Etopo2 Dataset

The Simrad EA500 bathymetry data was compared to satellite bathymetry data from Etopo2 using Matlab. This matched the latitude and longitude of the 5 minute averaged EA500 data to the appropriate grid for Etopo2 data, and plotted the corresponding water depths for each. Etopo2 data was averaged in 2 x 2 minute grid. Eastwards of 30°W, the two datasets were in reasonable agreement, though with occasional differences in depth of up to approximately 300 m. Further west than this, approaching the Mid-Atlantic Ridge, the differences were much greater, sometimes exceeding 1000 m.

6.5 Navigation

Chris Atkinson

6.5.1 Navigation Summary

High quality navigation data is essential for making accurate underway measurements of ocean current and various meteorological parameters. Ship location is necessary to orient measurements in space while ship speed and heading are necessary to create absolute measurements of ocean currents and winds that are measured relative to ship motion. The *RRS Discovery* has three GPS receivers: the Trimble 4000 (data stream: *gps_4000*), which is a differential GPS; the Ashtech (*gps_ash* & *adu2*); and the GPS G12 (*gps_g12*). The ship also uses a gyrocompass (*gyronmea*) and Chernikeeff current profiler (*log_chf*) to measure speed and heading. GPS, gyro and Chernikeeff data from the TECHSAS data logger were updated daily and processed. GPS G12 data from the Level ABC system was also processed after the Trimble 4000 GPS failed on day 300 (Nov 27th).

6.5.2 Trimble 4000 and Ashtech GPS G12

Data from the Trimble 4000 and GPS G12 were logged each second to give ship position and speed. Each day, old master GPS files were deleted and new master files

gps432401 and gpsg1232401 were created (as opposed to appending daily) to ensure continuous calculation of distrun (distance run) for the duration of the cruise. GPS data from the Trimble 4000 were extracted and processed using the PEXEC script *gps4exec0*. Values considered poor for positioning are removed in *gps4exec0* according to the parameter PDOP (Position Dilution of Position, a unitless figure of merit) when values are greater than 5. At 17:55 (GMT) on day 300, the Trimble 4000 stopped working due to hardware failure. Data from the Ashtech GPS G12 were therefore extracted and processed for the duration of the cruise using the PEXEC script *gpsg12exec0*. Master files gpsg1232401 and gpsg1232401.5min (data averaged into 5 minute bins) were produced daily and included calculation of parameter distrun. Data with values of PDOP > 5 were removed in *gpsg12exec0* by the PEXEC datpik. Investigation of ship speeds produced by the G12 revealed frequent erroneous spikes when recorded values of longitude and latitude momentarily dropped to 0. *gpsg12exec0* was subsequently edited to remove data with longitude and latitude outside the ranges of -100 to -1 and 1 to 90 respectively.

Ship positions measured by the G12 and Trimble 4000 were compared for the period while moored in Tenerife. Scatter about the mean position for each instrument is shown in figure 6.3**.** Comparison of ships mean position recorded by the G12 and Trimble 4000 reveals a difference in both longitude and latitude of approximately 1 metre. Standard Deviation of longitude/latitude for the Trimble 4000 and G12 were 0.43/0.56 metres and 2.34/2.19 metres respectively. The G12 also showed brief spikes in longitude and latitude resulting in spurious positions about the mean of up to 40 metres. To reduce noise and improve accuracy of the G12, the instrument was configured to receive RTCM differential corrections from the Fugro SeaStar differential receiver (day 303).

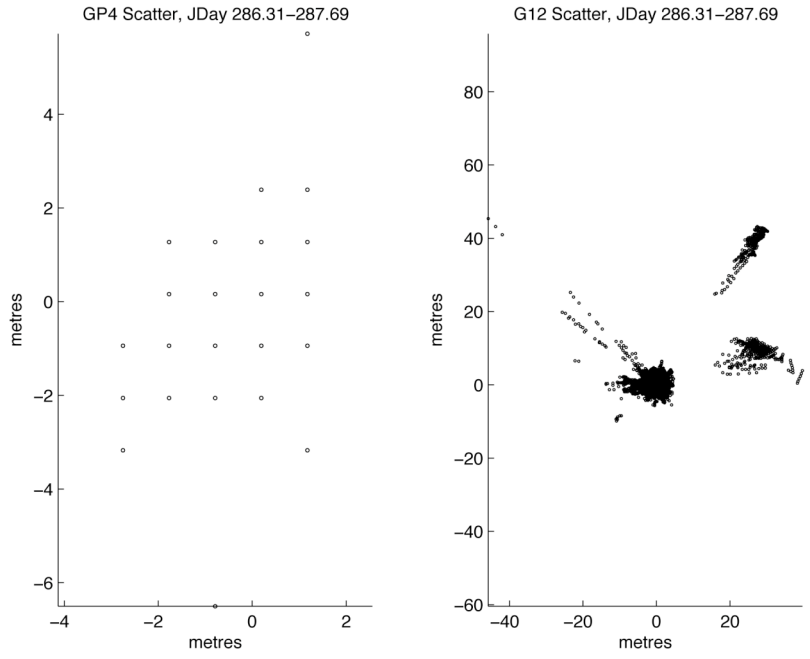

Figure 6.3: Scatter plots showing deviation about mean position measured by the GPS G12 and Trimble 4000 while moored in Tenerife. Note difference in scale. Recording of Trimble 4000 data into bins is evident. The apparent multi-centred distribution of G12 data is due to brief spikes in the signal with most points clustered around the mean. Scatter in the Trimble 4000 is far smaller due to a differential correction.

6.5.3 Gyrocompass

The ship's gyrocompass provides a reliable estimate of ship's heading (i.e. not dependent on transmissions external to the ship). However the instrument is subject to a latitudinal dependent error, a heading dependent error and also an inherent oscillation following a change in heading. Measurements computed using Gyrocompass data (e.g. OS75 ocean currents) require a correction to the more accurate but less reliable Ashtech ADU2 heading. Ship's gyrocompass data was logged every second on the Techsas system and a new master file gyr32401 created daily after the old master file was removed. Gyrocompass data were extracted and processed using PEXEC script *gyroexec0*, including removal of data with headings outside the 0-360 degree range.

6.5.4 Ashtech 3DF GPS Attitude Detection Unit (ADU)

The Ashtech GPS comprises four 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 satellite signals. These data are used in post-processing to correct the ADCP for heading error. Post-processing is necessary as in real time the ADCP uses the less accurate but more reliable gyro heading to resolve east and north components of current. Ashtech data are used to derive an Ashtech-Gyro heading correction (a-ghdg), which is applied to ADCP data and eliminates small drifts and biases in the ship gyro.

Ashtech data were processed daily after transfer from the Techsas system. A master file ash324i1.int was updated daily using *ashapend.exec*. Daily transfer of gyronmea and adu2 data from the Techsas system often left one data stream more advanced than the other by several seconds. Care was taken to process data streams of equal length to avoid gaps in the data when gyro and Ashtech files were merged.

Processing

ashexec0 Acquire Ashtech data

ashexec1 Merge gyro and Ashtech data, calculate a-ghdg, set difference in range -180 to 180, creates .mrg file.

ashexec2 Quality control data using datpik, creates .edit file, data removed outside following limits

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

Create 2 minute averaged .ave file. Further quality control using datpik, data removed outside following limits

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

plxyed Use ash.pdf to manually edit remaining outliers in a-ghdg.
pintrp Interpolate across missing data points.

Where bad data occurred at the time-limits of a file, interpolation was not possible across missing data points and a smaller file was produced. This led to gaps in the master file and problems when applying a-ghdg to ADCP or meteorological data. Where this was the case, Ashtech and gyro data were processed over extended time limits to facilitate interpolation.

6.5.5 Chernikeeff

The Chernikeeff EM log is a 2-axis electromagnetic water speed log. It measures both longitudinal (forward-aft) and transverse (port-starboard) ships water speed. Chernikeeff data were acquired and processed using *chfexec0* and a new master file chf32401 created after deletion of the previous. Chernikeeff data were averaged over two minute periods using the PEXEC routine *pavrge* to create chf32401.av. This was used to compare measurements of ship speed through water made by the Chernikeeff to ship speed through water made by the OS75 ADCP in the surface bin (prior to removal of ship velocity to establish absolute ocean currents). During transit to the Mid Atlantic Ridge, the Chernikeeff recorded a relatively constant speed through water of around 11 knots (as the ship is driven by speed through water recorded by the Chernikeeff). The ADCP recorded ship speed through water with a variable difference of between 0 to 0.6 knots relative to the Chernikeeff.

6.5.6 Ship Speed

Ship speed was calculated for the duration of the cruise using the Ashtech GPS G12. Figure 6.4 shows a six-hour running mean of this data. Periods of low speed were recorded when preceded by ship manoeuvres for mooring work and CTD deployment. During periods of steaming, ship speeds of between 10 to 11.5 knots were recorded for the majority of the cruise. From approximately day 302 to 307, deteriorating sea conditions led to a drop in ship speed to a minimum of 8.5 knots. This was marked by a wider scatter of ship speed about the mean as ship motion became more erratic. The decrease in ship speed was also coincident with an increasing head-on wind speed up to a maximum of 8 ms^{-1}. This increase in wind speed was not exceptional over the duration of the cruise, however it was the only period over which wind direction was near head-on to ship motion. Regardless, deteriorating ship speeds were chiefly attributed to swell originating in more northerly latitudes.

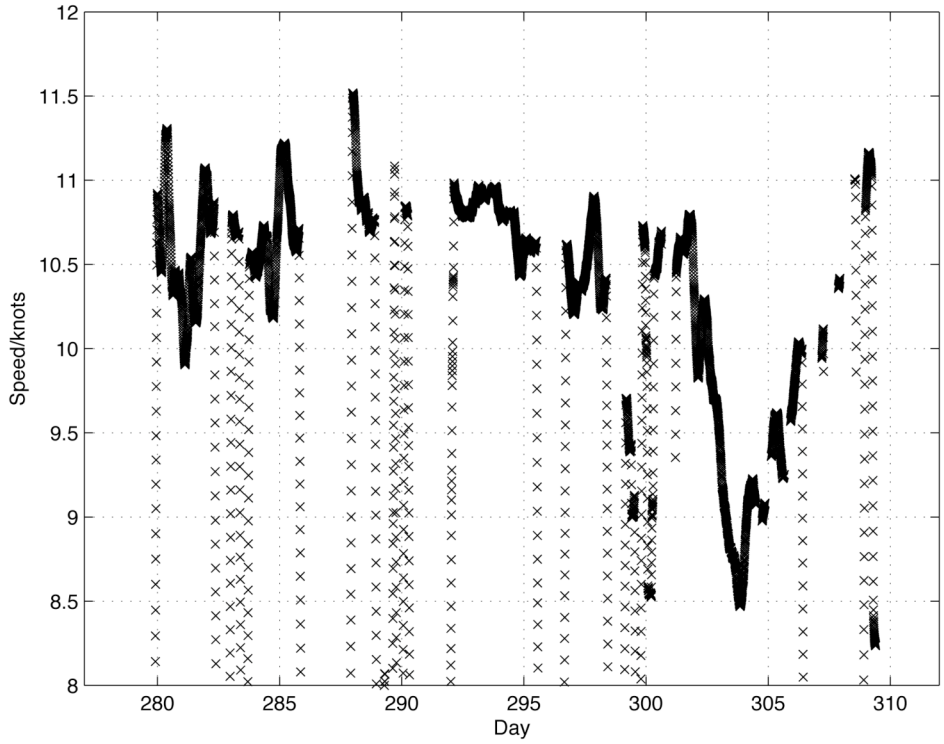

Figure 6.4: Six hour running mean of ship speed recorded during D324 by the Ashtech GPS G12. Periods of low speed outside axis range correspond to manoeuvring during mooring and CTD operations

6.6 D324 Ocean Surveyor 75kHz Shipboard ADCP

6.6.1 Setup

Chris Atkinson

The 75kHz ADCP is a narrow band phased array with a 30-degree beam angle. Data were logged on a PC, using RDI data acquisition software. The instrument was configured to sample over 120 second intervals, with 60 bins of 16m thicknesses, and a blank beyond transmit of 8 m. Data were 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 data streams. Gyro heading, GPS Ashtech heading, location and time were fed as NMEA messages into the software, which was configured to use gyro heading for coordinate transformation. During post-processing, gyro heading was corrected to the more accurate but less reliable Ashtech heading.

6.6.2 Bottom Track Calibration

Andrew Cunningham

Bottom track calibration allows amplitude correction (A) and angular correction (Φ) of the measured currents using the Matlab routine *calibration_coeffs.m*.

Calculation of the mean A and Φ were completed using sound data input selected by inspection to remove spurious data from the OS75. The data set used was from file sbt2342.abs2 and included the data set from data cycle 35 to 512, corresponding to a Julian date range of 279.8396 to 280.4549.

The calculation used the previously determined coefficients:
A = 1.00020 and Φ = -59.4636, from cruise D321 to determine if there was any need for a change in the calibration.

The routine output gave the required correction factors as:

	Amplitude Correction A (scalar to multiply coefficient form D321)	Angular Correction Φ (value to be added to coefficient from D321)
Mean Value	1.001	0.0057079
Standard deviation	±0.0024223	±0.16666

Table 6.4: Results of Bottom Track Calibration

This means that the offsets required for this cruise are in excellent agreement with the previous results and illustrate the robustness of the calibration.

Figure 6.5 show the scatter of the actual values of A and ϕ over the period while Figure 6.6 shows the scatter of A compared with ϕ.

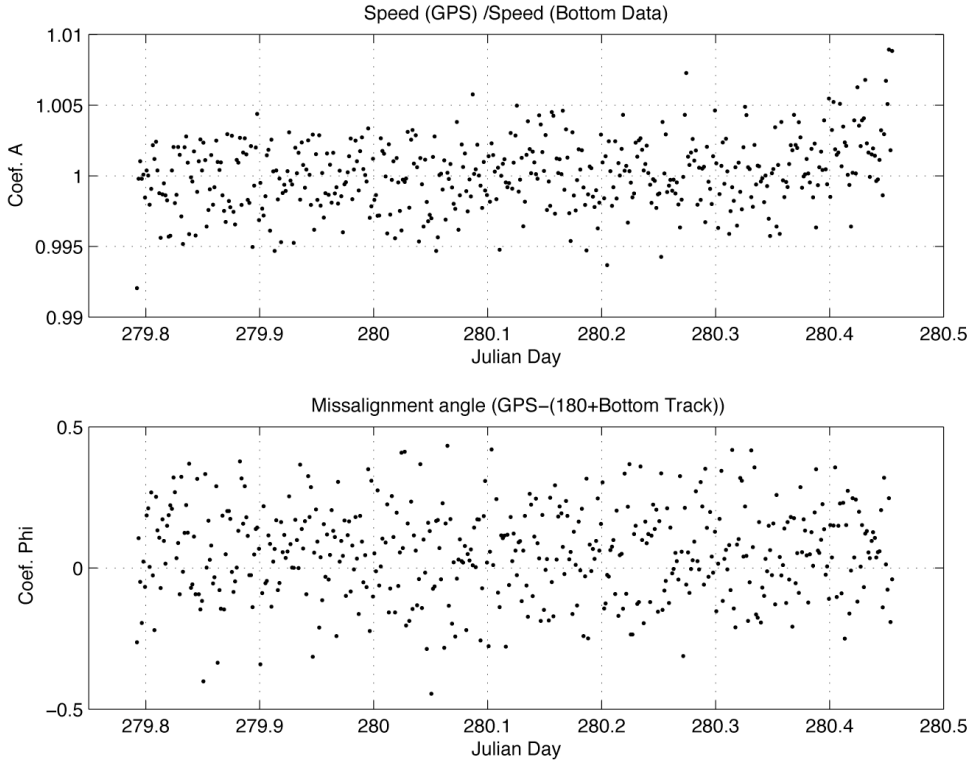

Figure 6.5: Scatter of calculated bottom track calibration coefficients

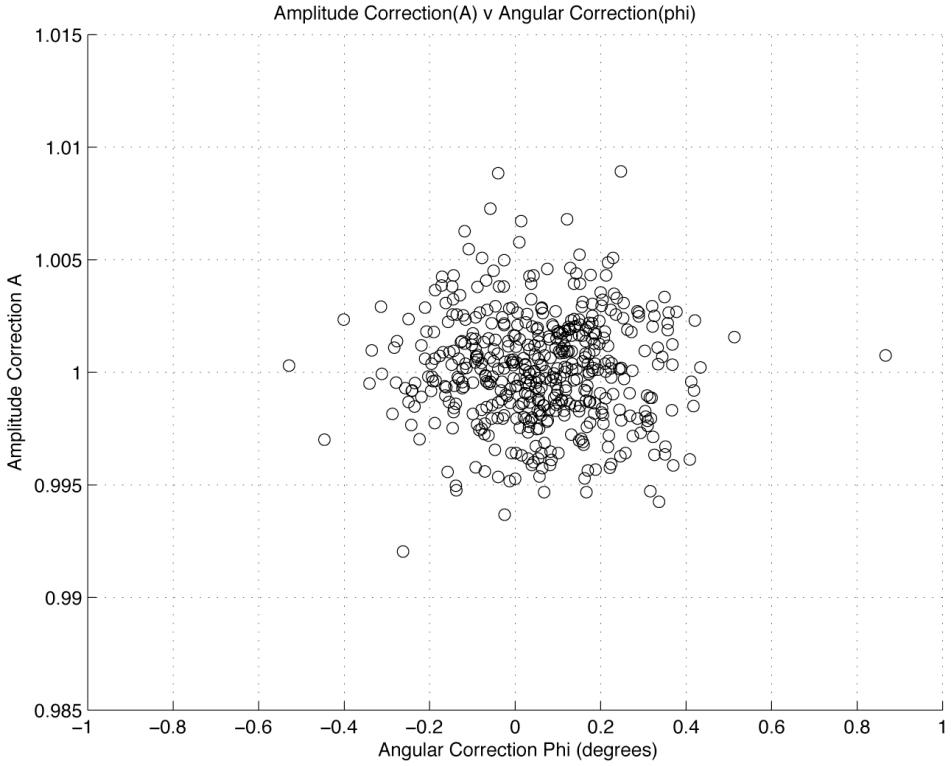

Figure 6.6: Bottom track amplitude correction (A) vs angular correction (Phi)

It was decided to examine the relationship with time of both the ship's speed and heading as determined by the GPS and by bottom. Therefore these were plotted from the same data set against time in days and are shown in Figure 6.7.

In these plots, for clarity, the ship's speed by bottom track is separated by 10cm/s from the GPS in the speed plot and heading by 190° from the GPS heading. These plots show the close agreement achieved between the GPS and the bottom track data.

Figure 6.7: Comparison of speed and heading determined from GPS and bottom track (bottom track offset by 10cm/s for speed, and 190° for heading)

6.6.3 Processing

Chris Atkinson

Data were logged on the OS75 PC and transferred by ftp to the UNIX workstation Discovery2ng (cross-mounted with UNIX workstation Sohydro6). Data processing was as follows:

surexec0 — *Performed on Discovery2ng*. Reads data into PSTAR format from RDI data file and edits header information. Writes water track data into the file sur324*nn*.raw where *nn* is a user defined code. Scales velocities to cm/s, tracking depth and beam range to metres. Sets bindepth including an offset for depth of transducer and blank beyond transmission. Calculates time in seconds and combines GPS data to correct for PC clock drift.

All further routines performed on Sohydro6.

surexec0b — Extracts data corresponding to one day to create a raw file for this day only, using raw files from *surexec0*.

surexec1 — Edit out bad data and replace with absent data (-999). Data removed where beam 1 status (status1) is flagged as one (bad data) and 2+bmbad parameter is > 25% (percentage of pings where 2 or more beams were bad therefore no velocity computed). Time stamp moved to end of each ensemble.

surexec2 Merge data with Ashtech-Gyro heading correction (from master Ashtech file ash324i1.int, see section 6.5) to correct heading and find true North and East components of current velocity.

surexec3 Calibrate velocities by scaling factor A and by ADCP misalignment angle Phi.

surexec4 Calculate absolute current velocities by merging with navigation data and removing ship speed over ground from calibrated velocities. Up to day 299, navigation data from the Trimble 4000 were used. After failure of this instrument on day 300, *surexec4* was edited to use Ashtech GPS12 data instead.

Finally, *surapend.exec* was used to append all final absolute velocity files into one master file sur324apend.abs. sur324apend2.abs and sur324_apendsurf.abs master files were also created containing absolute velocity in the format speed/heading and surface bin data for comparison to the Chernikeeff. *plot_os75_d324.m* was used to load and plot OS75 data averaged over 3 hours (sur324apend2.3hr), to remove velocities outside limits of +/- 100 cms^{-1} (when the GPS did not receive a differential correction term), and to interpolate over longitude to create longitudinally averaged velocities. *CTD_OS75.m* was used to load, plot and compare OS75 velocities to geostrophic velocities calculated from CTD dips using the PEXECs *pgridp* and *pgeost*. OS75 velocities were rotated into components parallel and perpendicular to the plane of a CTD section, edited for velocities outside limits of +/-100 cm/s, interpolated longitudinally and averaged over each depth bin.

Analysis of the ADCP data from cruise D324 revealed several interesting features, notably the effects of bubbles, a strong eddy field and a high intensity backscattering horizon. A detailed discussion of the data can be found in the NOCS Internal Report: Analysis of shipboard ADCP data from RRS *Discovery* Cruise D324: RAPID Array Eastern Boundary. Southampton, UK, National Oceanography Centre Southampton, 16pp. (National Oceanography Centre Southampton Internal Document, 10) *http://eprints.soton.ac.uk/63317*/.

6.7 Surface Meteorology Data

Daniel Klocke

The meteorological data was processed by the following execs:

smtexec0 transfers the underway surfmet data from RVS to PSTAR format

smtexec1a changes absent data values from 99999 to -999, computes the surface salinity and merges in bestnav positions of gps4000, which stopped working on day 302. Calibrations were changed at the beginning of the cruise due to replaced instruments.

smtexec1aa replaced smtexec1a from day 302 on to merge gp12 data as bestnav positions instead of gps4000, otherwise identical to smtexec1a.

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 the new variables true wind speed and true wind direction.

smt_plot.m plots the surfmet data and applies basic quality control. Changes time in seconds to julian days.

The processing was done on a daily basis. After the failure of gps4000, the gp12 data was merged as bestnav positions from Day 302 00:00:00 on. Due to significant jumps to position 0°N/0°W of up to three hours in the gp12 GPS positions, resulting in much too high wind speeds, all positions south of 20°N were excluded in smt_plot.m.

A smt324i1.master.met file and a smt324i1.master.av file were created manually using *papend* to merge all data in one file. The smt324i1.master.av is used for the calibration of the underway salinity and smt324i1.master.met was created for easier handling of the data when loading into other programs.

The meteorological sensors configuration is given in Table 6.5. Sensors that have a new calibration in the comment section were replaced before the cruise. The new calibration is applied in smtexec1a/smtexec1aa.

SENSOR	**MANUFACTURER**	**SERIAL NO**	**COMMENTS**	**CALIBRATION** (Y = A + BX)
OTM temperature	FSI	1374	Housing (h_temp)	A = -1.99151E-3 B = 1.00117
OTM temperature	FSI	1401	Remote (r_temp)	A = -8.86735E-3 B = 1.00053
OCM conductivity	FSI	1376	Not calibrated	
Barometer PTB100A	Vaisala	Z4740021	New calib	A = 4.64399E-2 B = 9.99388E-1
Temp/humidity HMP44L	Vaisala	U1850014	New calib	A = 0.02/0.15 B = 1.0228/1.0189
PAR	Sky	28561	Port, new calib	B = 98039.2
PAR	Sky	28562	Stb, new calib	B = 98039.2
TIR CMB6	Kipp and Zonen	973135	Port, new calib	B = 85763.3
TIR CMB6	Kipp and Zonen	973134	Stb, new calib	B = 98039.2
Anemometer WAA	Vaisala	P50421	Defective, needs replacement	- -
Wind vane WAV	Vaisala	S21214	Not calibrated	- -

Table 6.5: Meteorological sensors configuration and calibrations

The anemometer stopped turning in low winds. Resulting from this are the gaps in the wind speed and direction data from day 285 up to day 289. Although there were spare anemometers on board, the replacement also failed, because the connecting plug was corroded and could not be attached to another instrument. Rudimentary cleaning and oiling helped the original anemometer to work again. From day on 289 the wind data does not show any gaps and kept measuring in wind speeds down to 0.5 m/s.

6.8 Surface Temperature and Salinity

Daniel Klocke

The sea surface temperature was measured with a high precision FSI temperature sensor approximately five meters below the surface at the ships bow. From the same water conductivity and again temperature were measured after passing a de-bubbling system. Information on the colletion of water samples is given in section 6.3.1. The collected bottled water samples were analyzed with the salinometer (see section 6.3). Results were entered in an Excel table and saved as a CVS file. Data was converted from CSV files to PSTAR format and the calibration was applied to the underway measured conductivity.

The underway salinity data was processed with the following execs:

tsg.exec	reads .csv file to a txt file and converts it to pstar format for further processing.
tsg.2exec	calculates time in seconds from julian day (jday,hh,mm,ss) and appends the data to the master data file.
tsg3.exec	merges the 10 min averages of the smt.av master file into the tsg master file.
calib_salin.m	calibrates conductivity using sw_c3515. Saves time and the filtered difference in conductivity as ascii for conversion to PSTAR. Used only for sanity check and to see if the data is biased.
tsgcalib.exec	creates a PSTAR file from the saved Matlab ascii files and merges with smt.av master file.

In Figure 6.8 the uncalibrated underway conductivity is plotted including the conductivity measured from the bottle samples for comparison. The constantly measured conductivity showed a bias of about -0.4 mmho/cm to the conductivity from the bottle samples. The results of the applied calibration are also shown in Figure 6.8. Jumps in the underway conductivity are a result of absent values at these times.

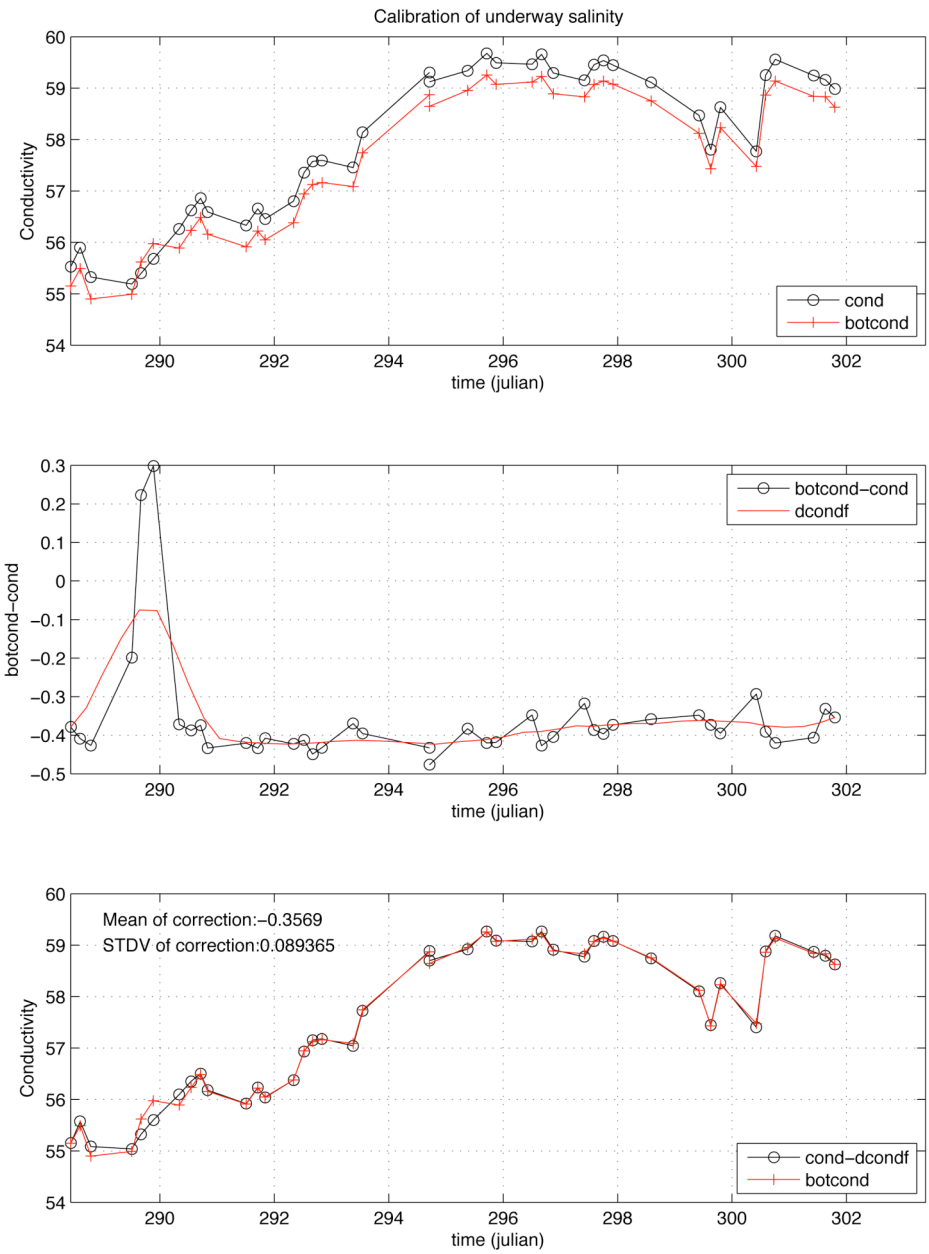

Figure 6.8: Calibration of underway salinity measurements

6.9 Argo Float Deployments

Darren Rayner

Two Webb APEX Argo floats were deployed on D324. Details are given in table 6.6. The second float, deployed in 1000m, of water was set to complete normal depth profiles to 2000m in the hope that it would ground between profiles and therefore minimise the displacement from the deployment area.

Hull serial number	3169	2710
Hex Argos ID	8D92BBE	3E0A7BE
Argos ID	73067	64299
Park depth (m)	1000	1000
Profile depth (m)	2000	2000
Float activation time	6/11/07 15:14	7/11/07 23:53
Deployment time	6/11/07 15:42	8/11/07 00:53
Latitude	27° 17.3'N	28° 25.69'N
Longitude	15° 25.8'W	13° 15.98'W
Deployment corrected water depth (m)	3000	1048

Table 6.6: Argo float details as deployed on D324

6.10 The Ocean: Between Arts and Science

The Ocean: Between Arts and Science is a project initiated by the British Council, Berlin. Martin Mlecko participated in the cruise to further develop links between scientists and artists following on from the Tipping Point conference at the Potsdam Institute of Climate Change Research, earlier this year (http://www.britishcouncil.de/tippingpoint/). The purpose of encouraging links between scientists and artists is to explore how the role of the Atlantic circulation in climate and the potential impacts of rapid climate change can be communicated to a wider public. It is proposed that the results of this collaboration will be shown in an exhibition in the near future.

7. Rapic-MOC Mooring Operations

7.1 Mooring Aims and Objectives

Darren Rayner

The primary aim of cruise D324 was to service the eastern boundary and Mid-Atlantic ridge components of the Rapid-MOC mooring array. To do this we sailed from Tenerife to the EBHi mooring site and worked our way westwards recovering and deploying moorings along the way. After reaching the furthest west mooring of the Mid-Atlantic ridge sub-array we returned eastwards with an approximate 8-day steam back to EBH1 from which we continued servicing the moorings eastwards into EBM6. Although this left little time to pack everything up following recovery and deployment of the last mooring, the cruise seemed to work well in this order as it gave time for people to acclimatise to life onboard prior to the intensive period of moorings work for the eastern most moorings.

CTD casts were conducted with MicroCATs attached to the frame to give pre-deployment and post-recovery endpoint calibrations. These casts were also used to test acoustic releases to their intended deployment depths or deeper. Following

recovery of the last moorings a CTD cast was conducted in the deep water between Tenerife and Gran Canaria just prior to docking in Santa Cruz de Tenerife.

It was also intended to acoustically download the PIES deployed on *RRS Charles Darwin* cruise CD177 (NOCS Cruise Report, No 5). However the Benthos deck unit that was required died the night before the first telemetry was to be conducted. No PIES data were therefore downloaded on D324.

7.2 Mooring Array Design Changes

Darren Rayner

As with previous service cruises there were a number of design changes made to the array during this cruise. These changes are brought about in response to mooring losses and assessing the scientific needs of the project.

Working from east to west the changes were as follows:

EBM7 – removed due to loss of this mooring

EBM2 and **EBM3** – removed due to loss. There is a history of mooring loss from the Rapid-MOC array at about this depth, and on D324 the echosounder trace showed what could be a rocky reef to the north of the EBM2 and EBM3 mooring sites. It is thought that this could be causing intensified fishing activity at these depths and creating a "death zone" where no moorings are surviving.

EBH4 – to account for removing EBM2 and EBM3, EBH4 was extended up to 325m (the previous depth of EBM3).

EB1 and **EB2** – the EB2 mooring recovered on D324 was a short emergency mooring that was deployed on *RV Poseidon* cruise P345. The replacement deployed on D324 was extended to 50m depth and was almost identical to EB1 in design. The instrument spacing of EB1 and EB2 was adjusted so that they matched the previously deployed EB1 down to 400m, but then alternated depths deeper. EB1 and EB2 act as a complete backup to each other in the more vulnerable upper waters (<400m) but below this depth to obtain the same instrument spacing as the previous EB1 both moorings need to be recovered and merged into one profile. This was done to reduce the number of instruments required on these moorings.

MAR0 – a new mooring added to attempt to measure the influence of Antarctic Bottom Water (AABW) on the MOC variability, in conjunction with WB6 deployed on *RV Ronald H. Brown* cruise RB0701 (NOCS cruise report, No 29). The choice of site for MAR0 is explained in more detail in section 7.6.

7.3 Day-to-Day Mooring Operations

Rob McLachlan

6th October

Mobilisation complete and everything lashed down and secured ready for sea, sailed at 18:00. We need to look at the bolting down holes on the chain cages.

7th October
Wound moorings EB1 and EB2 on to separate reelers. We used this winding on time to train Neil on starting up and using the double barrel winch system.
The lab was set up at this time and we began installing batteries in to seabirds, Argos beacons, vhf and lights; then tested them.
Bench tested all of the new acoustic releases including battery voltage check, all ok.
Bench tested the 4 releases that had been back to Ixsea for repair including battery voltage test, all ok.
During the mobilisation it became apparent that the aft cranes were not functioning correctly. During a meeting with the Captain, Principal Scientist, Chief Engineer (CE) and Mobilisation Officer we discussed the starboard crane issues. The CE has recommended that the crane is not to be used, this is obviously not an option so the suggestion is to have the new ram sent to Tenerife and installed, possibly 2 day port call. I offered the opinion that this was the best course of action. I also mentioned that the problem might occur again unless the followers are also replaced, the CE did not agree with this.

8th October
We wound on moorings MAR1 and MAR3. Adapted the titanium clamps we have to suit the Sonardyne Compatt 5 if it is needed.
We attached 6 releases to the CTD frame ready for a wire test tomorrow, serial numbers: 819, 820, 821, 822, 823 and 824.

9th October
We wound on mooring MAR2, tested releases down to 5000m, all worked fine.
Problems were encountered with the CTD frame instrumentation.
A second CTD was carried out, dip tested acoustic release serial numbers 327, 354, 252, 826, 818 and 827, all worked to 4500m apart from SN 327, this is the fifth time this release has failed, four times on the RV Ron Brown and once on here, it has been back to Ixsea for service/repair and works on deck.
We set up the seabirds for a cal dip in the morning, 10s sample interval to start later at 0800 GMT (0900 local).

10th October
It was decided that we would only cal dip 12 of the seabirds on this mornings CTD cast, the others were reset. All seabirds were recovered with full data sets.

11th October
We wound on 1500m of dragging wire on to port deck winch ready for dragging operations if it's needed.
Prepared EBH1, EBH2, EBH3 and EBH4 ropes ready for deployment.
We then started doubling up releases for EB1, EB2 and EBL3.

12th October
We prepared EBHi mooring ready for deployment and took some time to produce final mooring diagrams and allocating releases, instrumentation and beacons.

13th October

We docked in Tenerife.

14th October
We sailed from Tenerife.

15th October
We prepared all of the glass for moorings EB2 and EBHi. We then set up the deck ready for mooring recovery operations in the morning.

16th October
Started interrogation of EBHi at 0615, we could not get any communication established through the hull transducer so we dipped the transducer over the side and ranges came in.
The mooring was released at 0650; recovery commenced from the port side, all went ok.
We then readied everything for the EBHi deployment. We started deployment at 1008 and finished at 1035, using the 5t Lebus deck winch to deploy the anchor.
The afternoon was used preparing the steel spheres and the buoyancy for EB1.

17th October
We arrived at the EBL3 site and started interrogation at 0609; released at 0617. The lander was then recovered and all was on deck at 0754.
We then headed for the EB2 site to commence recovery.
Started communication with EB2 at 0850; released at 0914. Recovery was delayed as the bridge wanted to wait until all the mooring was on the surface, recovery commenced at 1137.
During recovery the port crane cut out and would not restart, we then switched to the starboard crane, recovery continued and then the starboard crane cut out and would not start. We quickly made the decision to use a floating block through the gantry but we were told we couldn't use the gantry as it was leaking heavily through the ram seals on the starboard side.
We decided to recover by dragging equipment over the stern, this worked ok; but not ideal. Whilst this was going on the ships engineers fixed the port crane and we continued the recovery using this crane. All finished and on deck at 1251.
3 of the 6 glass spheres above the release had imploded.
We then readied the deck, machinery and instrumentation for the EB2 deployment. Deployment started at 1449. All went well with the aft cranes working fine; we had to use the 5T Lebus again for the anchor deployment, anchor away at 1822.

18th October
We arrived at the EBP1 site at 0600, the deck unit was found to be inoperable despite working the previous evening prior to being put on charge overnight. The decision was made to proceed to the EB1 recovery site.
We arrived at EB1 at 0719, with the mooring being released at 0756.
Recovery commenced at 0843, using the starboard crane as the engineers were working on the port crane.
All went well apart from the crane cutting out towards the end due to high temperature of the hydraulic tank; we have decided to switch off the cranes during mooring ops to avoid overheating. All finished at 1145.
We then readied the deck and instrumentation for the EB1 deployment.

Deployment was delayed whilst the engineers were working on the starboard crane.
Deployment commenced at 1417.
All went well and the anchor was deployed at 1752.

19th October
We started inspecting the recovered glass spheres and then making up the glass sphere packs for MAR3 and the NOG sediment trap mooring. Serviced and installed new batteries in to the recovered MicroCATs ready for cal dip and eventual deployment.
We checked through the Mid Atlantic bathymetry to decide on where to deploy the NOG mooring.

20th October
A mooring position for the NOG has been selected with a depth of 4250m, the design was altered to take account of this. We then wound on the NOG mooring ready for deployment.
We continued with the servicing and new battery installation of the seabirds.

21st October
All of the recovered acoustic releases were serviced today with new batteries installed. We built up MARL2; readied deck for recovery operations in the morning and prepared the instrumentation.
We spent some time trying to establish why the acoustic release deck unit won't work through the hull or fish. We have now got it going through the hull but it is still not working through the fish.
Set up the current meters and got the sediment traps ready for the NOG mooring.

22nd October
We arrived on the MARL2 site and started communication with the release at 1215. Recovery commenced and all was onboard at 1340.
We then steamed to MAR3 site and started communication with the release at 1400, mooring released and recovery commenced, all on board at 1646.
We then prepared the deck for the deployment of the NOG mooring.
Deployment commenced and all went well.
The seabirds were set up ready for the cal dip tonight down to 6200m along with 8 releases.

23rd October
All 8 releases worked fine. All the seabirds had good data sets.
Started deployment of MARL2 at 0742, all went well and all done at 0744.
We then set up ready for MAR3 deployment, deployment commenced at 0900 and the anchor was away at 1104.
All the recovered glass spheres were inspected and then the sphere packs were made up for MAR1 and MAR2.

24th October
Whilst we were heading to the MAR1 recovery site we spent the time doubling up the releases, preparing hardware on deck, building up the lander frames for MAR0 and MARL1 and servicing and installing batteries in the instrumentation.

25th October

We arrived at MAR1 site at 0906, release command sent at 0914. Recovery commenced by hooking in to the shackle on the 24" sphere, recovery went well.
We then headed for the MAR2 recovery site, release command sent at 1413. All went well.
We then set up for a CTD cast down to 3500m with Seabirds on the frame. When this finished we started to deploy MARL1, all went well.

26th October
We arrived at the MARL1 recovery site, there was a communication issue with the bridge and we found ourselves 30 miles away, so we had to steam to the correct position.
Arrived at the real MARL1 site and started communication with release, released at 1249, recovery went well with a minor tangle to deal with.

We are now heading for MAR0 deployment site, preparing ropes and instrumentation whilst steaming.
Arrived at MAR0 site and carried out an echo sounder survey to find the correct depth, this took quite a while but we found a spot in the end. We then deployed the mooring at 0055 and the anchor was away at 0119.

27th October
We arrived at the MAR1 deployment site and conducted an echo sounder survey, we then commenced deployment at 1522, all went well and the anchor was away at 1834. We followed the sphere packages through the water and observed them submerge. We then started communication with the releases, this proved troublesome and we only got a few accurate ranges.
We then prepared everything for the MAR2 deployment whilst the echo sounder survey was carried out. Deployment was started at 2037 and the anchor was away at 2314, all went well. We established communication with the release and got good ranges, we then attempted communication with MAR1 that is only 1.5 miles away, and we got a few accurate ranges from.

28th October
The day was spent clearing the aft deck, inspecting recovered glass spheres and billings floats and servicing recovered instrumentation including Argos beacons and lights.

29th October – 1st November
These days were spent heading back to the Eastern Boundary.
The time was spent servicing recovered equipment, building up landers, doubling up releases, packing up equipment that is no longer needed.

2nd November
We carried out a CTD cast to 3500m with 12 MicroCATs and 7 releases, all of the releases worked but SN 246 did not give a confirmation of releasing and communication was bad all round for this release.
All of the MicroCATs had worked fine.
We then set up the Sonardyne LRT's with their identities; they are now ready for a wire test.

3rd November
We arrived at the EBL3 site and got the lander ready for deployment, deployment commenced at 0628, and was all done at 0631.
We are now heading for the EBH0 site.

4th November
We prepared hardware and deck for recovery operations. Set up MicroCATs for a calibration cast, CTD cast down to 3500m with 12 MicroCATs on, all came back with good data sets.

5th November
Whilst heading towards the EBH0 site we started communication with the release. Upon arrival at the site the ranges were indicating that the release was already at 2213m, this proved consistent and it was concluded that the release had either been accidentally fired or there was some sort of fault, we will investigate this further when we have time. Recovery commenced at 0703 and was all on board at 0711.
We then headed to EBH1 site and started communication with the release; it was fired at 1149 and was all on board at 1258.
We then headed to EBL4 site, communication was started with the release and was fired at 1302, recovery started and was all done at 1412.
We the headed back to start the EBH1 deployment, the mooring was prepared whilst we were steaming. We started deployment at 1450 and was all done at 1500.
The lander (EBL4) was then deployed 1530. We then got EBH2 mooring ready for deployment in the morning.
One of the Argo floats was deployed at this time.

6th November
Up early to get EBH2 ready for deployment, deployment started at 0545 and the anchor was away at 0607.
We then started communication with the release of EBH2 to recover at 0626 whilst we were manoeuvring the ship. The release was fired at 0631 and all was on board at 0737.
We are now heading for EBH3 recovery site.
It was difficult establishing communication with the release, we had no ranges using the hull transducer. We decided to try over side and had no real luck. Eventually we got a confirmation of release at 09:51, we only got one reasonable range. The release command was sent a number of times. The top buoyancy was seen on the surface at around 10:05. According to the deployment sheet the release was dropped from 1m during deployment, this may be why communication was difficult. Further investigation of this release required.
The mooring was recovered and was all on board at 1149.
We then got everything ready for the EBH3 deployment. Commenced at 1210 and was all done at 1223. We deployed the anchor using a link in the top of the release rather than on the anchor to prevent the release slapping around and getting damaged.
We are now heading to EBH4 recovery site.
Started communication with release on the way there, good ranges, released at 1337, started recovery at time all on board at 1411.
We then headed towards the EBM moorings, EBM1 gave no ranges, so we moved closer, good ranges were received and the mooring was released and all recovered.

We then tried EBM2; we could get no communication with the release despite moving closer.
EBM3 gave us the same results as 2, no communication.
EBM4 responded well to communication and was released and recovered ok.
EBM5 gave good communication and confirmed released but would not rise, we believe this could be due to bio-fouling. After a number of attempts we gave up and headed towards EBM6 and 7, it was too dark to release them but we wanted to start communication.
EBM6 gave good ranges but EBM7 gave us nothing. It was decided we would recover EBM6 in the morning.

7th November
We released EBM6 at 0707, recovered ok but the bottom float and Seabird were missing.
We then set up for dragging operations for EBM5, whilst the dragging was going on we got the mini moorings ready. We also changed the design of the EBH4 mooring, using the spare 4mm wire we had with us to go in the top section of the mooring thus creating a weaker top section.
After the dragging we went back to EBM5 site to see if it had moved and it had but was still on the seabed. We sent the release command and it came up, but the MicroCAT and bottom float were missing. The mooring had been hit by our dragging efforts and moved enough for the release to work. Close inspection of the bottom of the release showed that the dragging wire had scraped the biofouling off the release block which then allowed it to be fired properly. This is why despite the mooring being moved it did not surface until the release command was sent again.
We then carried out a CTD cast to 500m to test the replacement LRTs.
We then fitted the LRTs to the mini moorings. We started deployments at 1845 and finished at 1941.
We then got EBH4 ready and started deployment at 2043, all done at 2106.

8th November
Heading back to Tenerife with a CTD cal dip in deep water between Tenerife and Gran Canaria to calibrate the recovered MicroCATs from the shallow moorings.

Mooring	NMFD mooring number	Deployment Cruise	Anchor Drop Position		Anchor Seabed Position		Corrected Water Depth (m)	Deployment Date	Deployment Time (GMT)	Argos ID *
			Latitude N	Longitude W	Latitude N	Longitude W				
EBM6	2007/39	D324	27° 55.17'	13° 19.92'			95	7/11/07	18:43	
EBM5	2007/38	D324	27° 54.6'	13° 21.6'			176	7/11/07	19:06	
EBM4	2007/37	D324	27° 54.46'	13° 22.08'			279	7/11/07	19:20	
EBM1	2007/36	D324	27° 53.68'	13° 24.33'			495	7/11/07	19:38	
EBH4	2007/33	D324	27° 51.014'	13° 32.380'			1045	7/11/07	20:42	
EBP2	2005/65	CD177	27° 51.86'	13° 31.16'			1010	20/11/05	11:04	
EBH3	2007/32	D324	27° 48.846'	13° 44.450'			1407	6/11/07	11:50	
EBH2	2007/31	D324	27° 36.71'	14° 12.75'			2011	6/11/07	05:45	
EBH1	2007/30	D324	27° 16.93'	15° 25.65'			3009	5/11/07	14:49	
EBL2	2006/46	P343	27° 16.79'	15° 25.21'				16/10/06	07:39	
EBL4	2007/35	D324	27° 17.18’	15° 25.75’			3001	5/11/07		
EBHi	2007/20	D324	24° 57.14'	21° 15.92'			4501	16/10/07	10:35	
EB2	2007/21	D324	23° 56.13'	24° 03.34'	23° 55.92'	24° 03.18'	5089	17/10/07	18:22	46243 & 42746
EB1	2007/22	D324	23° 50.63'	24° 05.14'	23° 50.49'	24° 05.37'	5088	18/10/07	17:52	59620 & 42747
EBL1	2006/45	P343	23° 53.49'	24° 05.14'			5092	12/10/06	19:20	
EBL3	2007/34	D324	23° 53.2’	24° 04.3’			5091	3/11/07		
EBP1	2005/64	CD177	23° 48.52'	24° 06.50'			5094	25/11/05	04:06	
MAR3	2007/24	D324	23° 52.27'	41° 04.79'			5027	23/10/07	11:05	
MARL2	2007/25	D324	23° 51.95’	41° 05.54’			5045	23/10/07		
MARL4	2006/25	D304	23° 51.57'	41° 05.69'			5036	28/5/06	14:12	
MAR2	2007/29	D324	24° 10.938'	49° 45.008'			5212	27/10/07	23:14	
MAR1	2007/28	D324	24° 10.744'	49° 43.474'			5212	27/10/07	18:34	60202 & 46242
MARL1	2007/26	D324	24° 11.68’	49° 42.64’				25/10/07		
MARL3	2006/24	D304	24° 12.62'	49° 43.64'			5218	25/5/06	21:27	
MAR0	2007/27	D324	25° 06.35'	52° 00.60'			5523	27/10/07	01:20	
NOG Sed Trap*	2007/23	D324	23° 46.2'	41° 05.7'			4254	22/10/07	20:20	

Table 7.1: Mooring locations, deployment dates and Argos beacon details for year 4 moorings – where 2 Argos IDs, 1st is upper beacon (*NOG sediment trap mooring deployed for Richard Lampitt – not for use in Rapid-MOC project)

Mooring	NMFD Mooring number	Deployment Cruise	Deployment Date	Deployment Time (GMT)	Release Date	Release Time (GMT)
EBM7	2006/53	P343	5/10/06	21:33	Not found	Not found
EBM6	2006/52	P343	5/10/06	20:36	7/11/07	06:48
EBM5	2006/51	P343	5/10/06	20:16	7/11/07	15:30
EBM4	2006/50	P343	5/10/06	19:46	6/11/07	17:35
EBM3	2006/49	P343	5/10/06	19:39	Not found	Not found
EBM2	2006/48	P343	5/10/06	19:25	Not found	Not found
EBM1	2006/47	P343	5/10/06	19:11	6/11/07	14:57
EBH4	2006/43	P343	7/10/06	08:34	6/11/07	13:30
EBH3	2006/12	D304	13/5/06	16:37	6/11/07	10:50
EBH2	2006/13	D304	14/5/06	12:55	6/11/07	06:31
EBH1	2006/14	D304	14/5/06	20:33	5/11/07	11:49
EBH0	2006/15	D304	15/5/06	07:48	5/11/07	05:35
EBL4	2006/18	D304	14/5/06	20:45	5/11/07	13:02
EBHi	2006/44	P343	9/10/06	14:58	16/10/07	06:53
EB1	2006/54	P345	1/12/06	11:49	18/10/07	07:56
EB2	2006/55	P345	2/12/06	09:52	17/10/07	09:14
EBL3	2006/17	D304	1/6/06	13:10	17/10/07	06:17
MAR3	2006/23	D304	28/5/06	14:41	22/10/07	14:00
MARL2	2005/21	CD170	16/4/05	15:56	22/10/07	12:16
MAR2	2006/22	D304	26/5/06	09:19	25/10/07	14:13
MAR1	2006/21	D304	25/5/06	16:38	25/10/07	09:14
MARL1	2005/25	CD170	23/4/05	19:22	26/10/07	12:58

Table 7.2: Moorings recovered on D324 with recovery dates

7.4 Anchor Triangulation

The anchor positions of the EB1 and EB2 tall moorings were triangulated following deployment to allow potential future dragging. Slant ranges were determined using the release deck unit. These ranges and the positions when the ranging took place were entered into a text file and input into the Matlab routine *Anchor.m*.

Anchor.m was first created on cruise CD170 (NOCS Cruise Report, No 2) and has been subsequently modified on CD177 (NOCS Cruise Report, No 5) and this trip. *Anchor.m* was altered on cruise D324 to give ranges that were corrected for regional variations in the speed of sound in seawater. This was done using the Matlab routine carter.m, which used the look up tables BOUNDARY2.DAT and CORRECTN2.DAT, together with the latitude, longitude and uncorrected water depth. The fallback distance in nm and km was also calculated, from the lat and lon coordinates of the seabed and anchor release positions, using the routine sw_dist.m.

7.5 Bathymetry at Mooring Sites

Stuart Cunnigham

Four datasets were available for choosing a site for the moorings; the single beam bathymetry collected during this and previous *RRS Discovery* cruises (D277, D304),

swath bathymetry collected during *RRS Charles Darwin* cruise CD170, Etopo5 satellite derived bathymetry data (five minute gridded data), and Etopo2 satellite derived bathymetry (two minute gridded data).

Figures 7.1 to 7.4 show the bathymetry plotted for the mooring sites where depth is more critical to the mooring design and positioning.

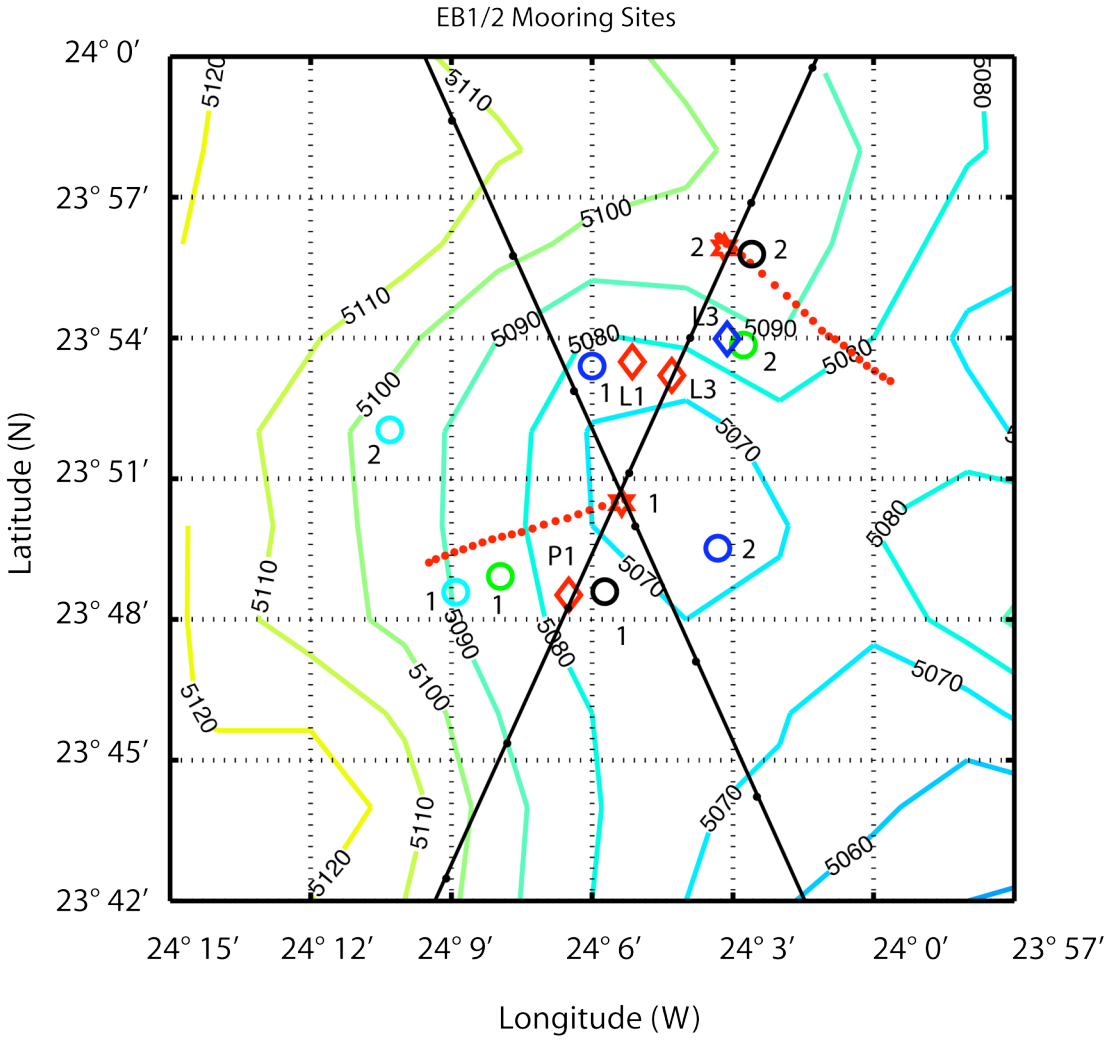

Figure 7.1: Bathymetry in a region of approximately 18 nm square in the location of the eastern boundary showing the EB1, EB2 and EBL1 and EBL3 locations. Depths from the ETOPO 2 min resolution data. The location of moorings and landers currently in the water are shown in red. EB1 and EB2 are denoted by red stars, EBL1, EBL3 and EBP1 by red diamonds. Previous sites for EB1 and EB2 are given by circles and for EBL3 by a blue diamond. The deployment tracks of EB1 and EB2 are shown in red with each dot representing positions every 10minutes. Different colours indicate which cruise a mooring was deployed on as follows: red D324, green D304, blue CD177, black, CD170. Ground tracks for Topex/Poseidon are shown by the black lines and the centre of each datum by the black dot.

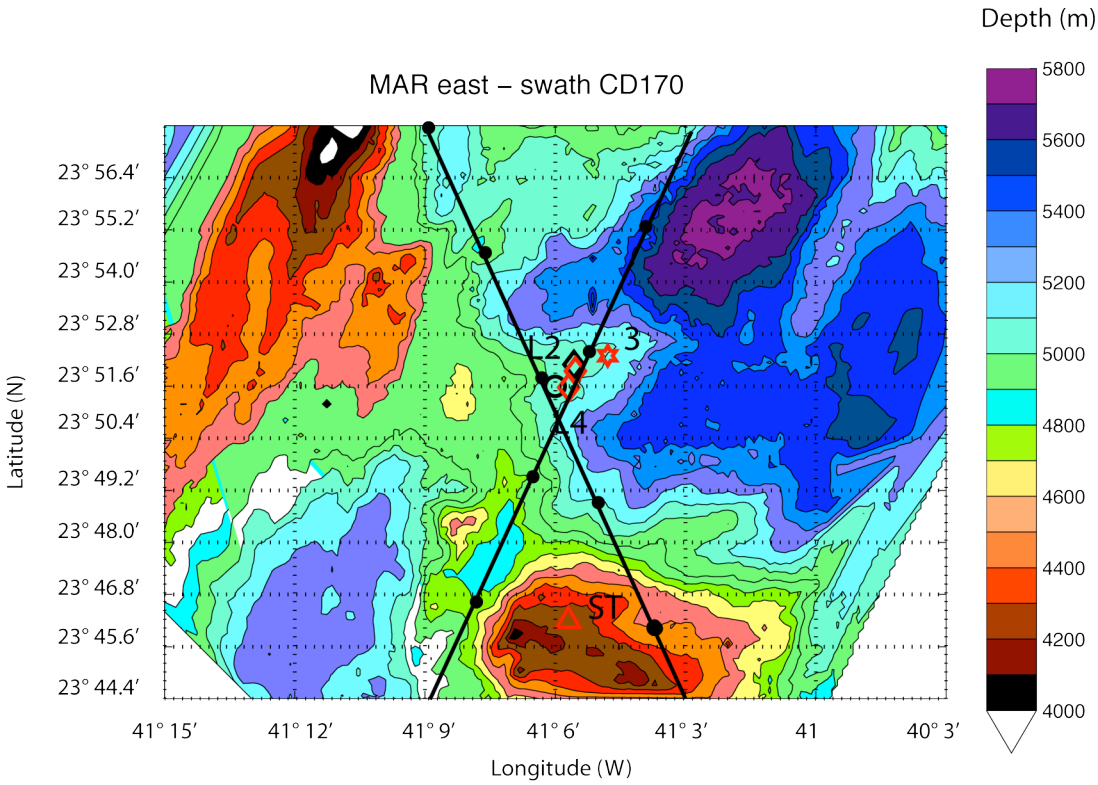

Figure 7.2: Bathymetry on the eastern side of the Mid-Atlantic Ridge in the vicinity of the MAR3 mooring and lander sites. Depths obtained from a swath survey conducted during cruise CD170. The horizontal resolution is approximately 100 m by 100 m. Moorings and landers currently in the water in red. MAR3 is denoted by a red star, MARL2 (deployed on D324) and MARL4 (deployed on D304) by red diamonds. The NOG sediment trap mooring is shown by the red triangle. Previous sites are MAR3 (black circle) and MARL2 (black diamond). Ground tracks for Topex/Poseidon are shown by the black lines and the centre of each datum by the black dot. The deep hole to the north east is up to 5800 m deep and is ideal for deep acoustic release tests.

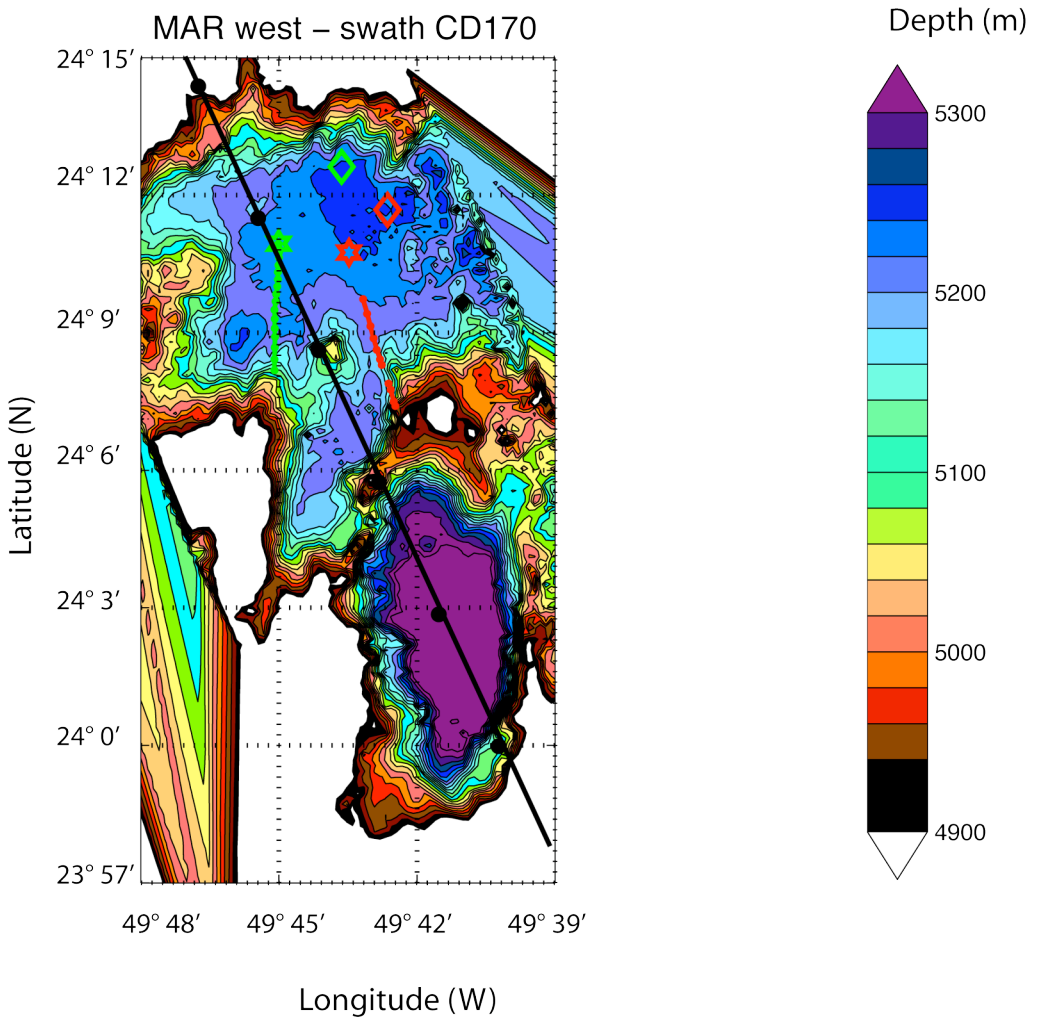

Figure 7.3: Bathymetry on the western side of the Mid-Atlantic Ridge in the vicinity of the MAR1 and MAR2 mooring sites and MARL1 and MARL3 lander sites. Depths obtained from a swath survey conducted during cruise CD170. The horizontal resolution is approximately 100 m by 100 m. MAR1 given by a red star, MAR2 by a green star, MARL3 (deployed on D304) and MARL1 (deployed on D324) by green and red diamonds respectively. Ground tracks for Topex/Poseidon are shown by the black lines and the centre of each datum by the black dot.

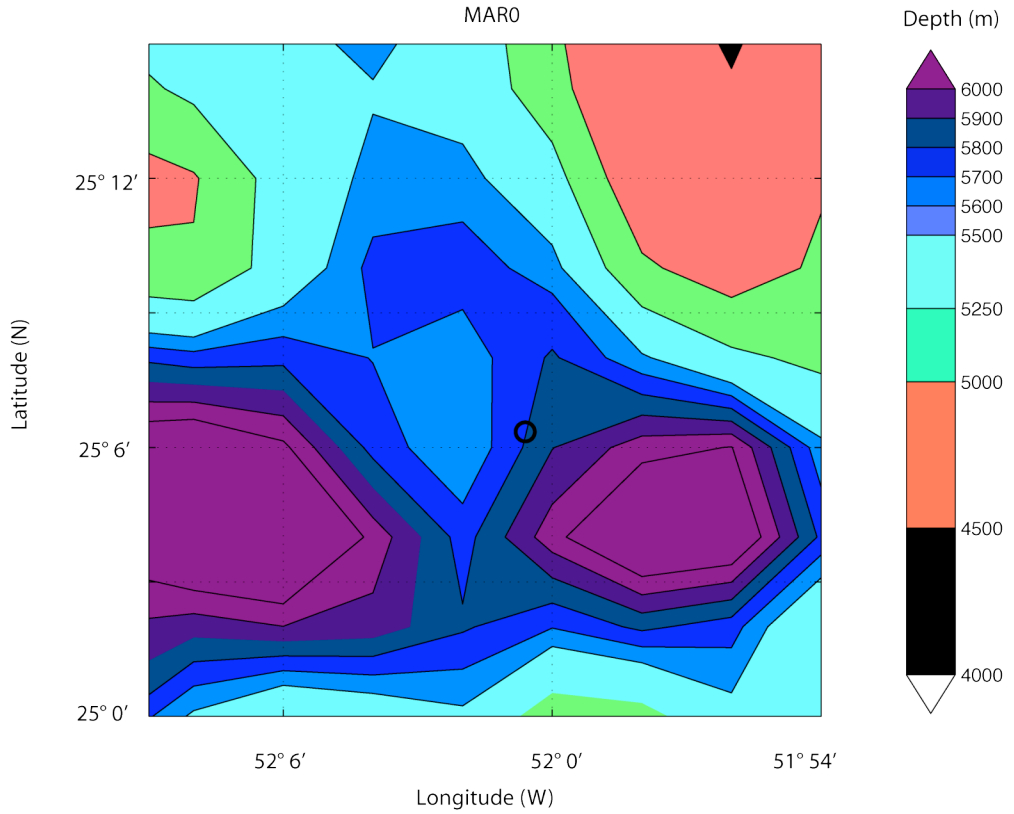

Figure 7.4: Bathymetry at the MAR0 site on the western side of the Mid-Atlantic Ridge from the ETOPO 2 min resolution data. MAR0 shown as a black circle.

The site of MAR0 was chosen as a trade off between the likelihood of the site being connected with the western basin of the North Atlantic at depths shallower than the base of the mooring, and the extra time required to steam further west and back from the MAR1/MAR2 site. Figure 7.5 shows the Etopo2 data on the west side of the ridge with depths greater than 5500m clearly shown. It is hoped that the fracture in which MAR0 was placed is linked through a series of channels to the western basin.

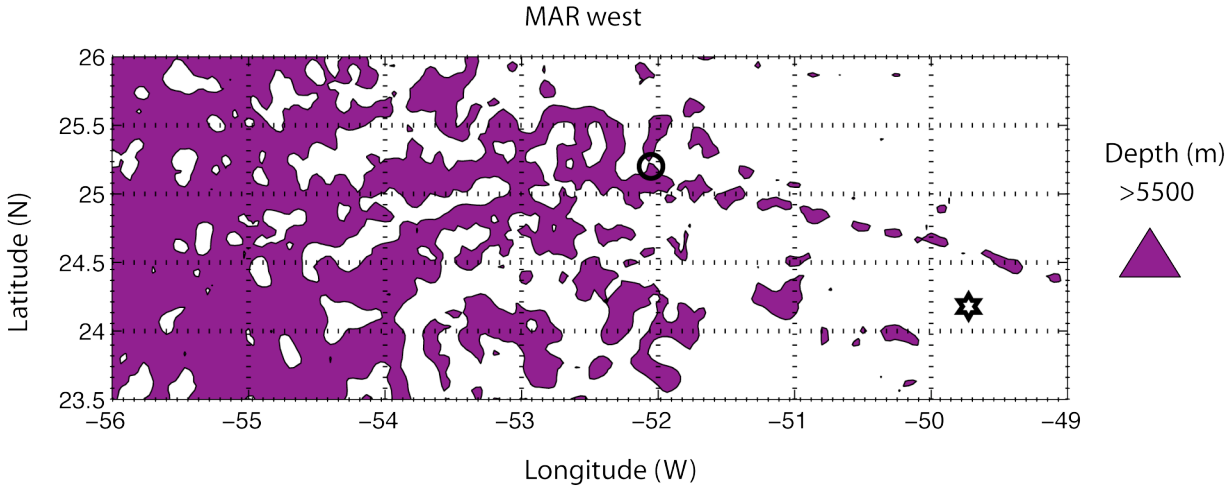

Figure 7.5: Bathymetry on the west side of the Mid-Atlantic Ridge showing depths greater than 5500 m from the ETPOP2 2min resolution data set. MAR0 is shown by the circle and MAR1 by the star.

7.7 Moored Instrumentation

Darren Rayner

Table 7.3 gives a summary of the instruments deployed and recovered on cruise D324. Complete setup details of deployed instrumentation 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 Seabird SBE37 IMP MicroCAT RBR XR-420 CTD	51 35 0	47 34 0	4 1 0	58 30 2
Single point current meter	Interocean S4	3	3	0	3
BPR	Seabird SBE26 Seabird SBE53	6 0	6 0	0 0	4 3

Table 7.3: Summary of instruments recovered and deployed on D324

Aside from those instruments that flooded (see section 7.7.1), all instruments collected full records. Some of the shallower instruments had light biofouling, and the deepest MicroCAT at the base of MAR2 (sn 3284) had the pressure sensor capped for deployment on cruise D304. Therefore there is no pressure data collected by this instrument.

7.7.1 Instrument Problems

A SBE26 BPR (sn: 388) suffered a low pressure flood on EBL3 that led to corrosion of the batteries and battery terminals. The battery compartment, although in the same pressure case as the main electronics, is separated by a glue seal. This seal and the upright deployment orientation of the BPR is thought to have saved the main electronics from coming into contact with the small amount of water that ingressed. In the hope that some valid data had been collected by the instrument the unit was powered externally and a number of scans downloaded using the "dd1,24100" command, but these data were just noise and no valid data could be recovered. This instrument has since been returned to Seabird and repaired.

Three Seabird MicroCATs (SMP sn 3893 and 3911, and IMP sn 4468) were recovered flooded. These instruments have been returned to Seabird for repair.

An S4 (sn: 35612573) had corroded bulkhead connector pins, which had to be switched with a second unit in order to recover the data. This instrument requires a replacement bulkhead connector fitted.

The Benthos deck unit used for downloading data from the PIES failed the night before it was due to be used. I tested it to remind myself of how to use it, and then left it connected to the clean power supply overnight to ensure that the battery was fully charged. When trying to turn it on the following morning there was no response. Further investigation back in NOCS tracked the fault down to a failed dc-dc converter and pico-fuse. The unit has since been repaired.

A glitch was found in the IMPDownload routine: sometimes a data block is missed and then the next data block is downloaded without any problems (e.g. dd501,750 does not respond with that data, but software continues after allotted time as usual). This causes a problem during conversion from hex to ascii format with a run time error. The IMPDownload routines should be modified to be more robust in handling missing data and should inform the user that data have been missed during the download so that the relevant data block can be re-downloaded and edited into the main data file.

MicroCAT 3902 had a memory pointer problem whereby when the instrument was rebatteried prior to a CTD calibration cast the memory pointer moved approximately 56,000 scans on from the end point of the mooring data. The mooring data had been downloaded ok but when re-downloaded to check the change in memory pointer it was found that the record was truncated by 8½ records. So not only had the memory pointer moved whilst the instrument had new batteries fitted, it also lost some of the stored data. The memory should therefore be treated as volatile and no batteries should be changed until the mooring data have been recovered. Seabird were contacted about this and the instrument returned for investigation but they found nothing untoward and suggested that the instrument could have been logging when the batteries were changed. However, this is not possible as all instruments are downloaded immediately on recovery from the moorings and not serviced until this has been completed.

7.7.2 CTD Calibration Dips

As with previous cruises all MicroCATs were lowered on the CTD frame to provide pre- and post-deployment cross calibrations with the shipboard CTD system. The instruments are clamped to the CTD rosette using bespoke brackets in place of 12 Niskin bottles. Table 6.1 in section 6.2 gives a summary of the instruments on each cast.

7.8 Dragging Operations

Darren Rayner

On cruise D324 one mooring was recovered by dragging. This was EBM5 which although one of the shortest moorings was deemed important enough to attempt recovery as EBM2, EBM3 and EBM7 were lost, and EBM6 was recovered without a MicroCAT. As EBM5 was giving good communications but not releasing it was hoped that recovering the mooring by use of dragging wire would allow a more complete profile at the shallow part of the eastern boundary.

The position of EBM5 was checked by triangulation prior to the drag (see figure 7.6). Although it appears that there is a displacement from the deployment position it is only 43m and this is thought to have been caused by the offset in the GPS antenna position and the actual deployment position on the ship. On D324 the transducer was lowered over the side very close to the position of the antenna, so it is assumed that these ranges are more accurate.

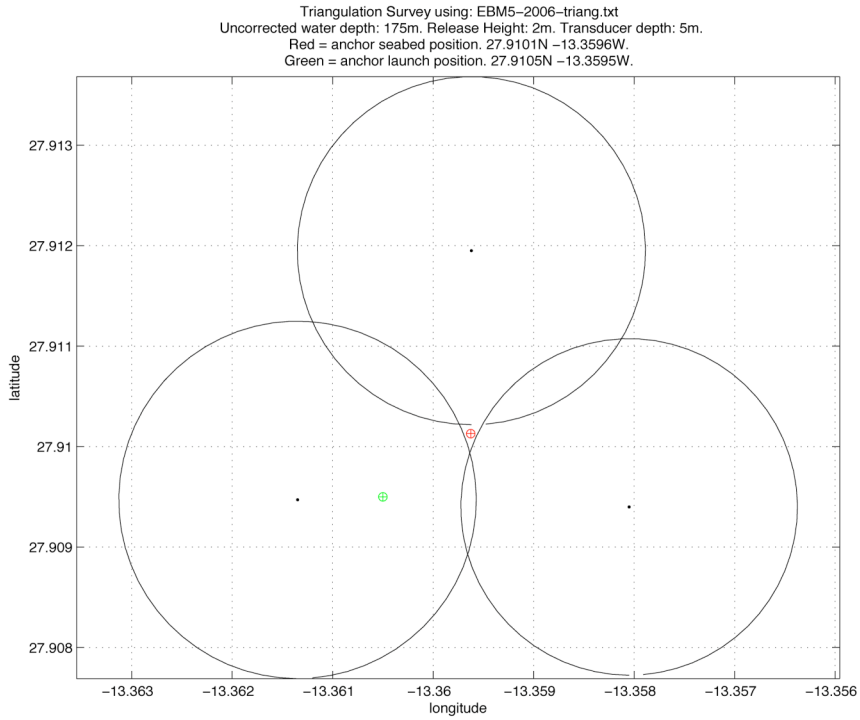

Figure 7.6: Triangulation of EBM5 prior to dragging

Table 7.4 summarises the main events during the dragging operation, with the ship track shown in figure 7.7.

Time	Description
10:35	1st weight in water, start paying out dragging gear with portable Lebus winch. Water depth 150m. Ship heading 45°. Approx 127m east of mooring.
10:45:20	1st weight on bottom. Ground speed ½kt astern – paying out wire drifting backwards
10:55	Starting to crab sideways (south of mooring)
10:59	500m of dragline paid out – therefore 330m on seabed (167m wd)
11:06	Heading into wind again
11:25	1000m paid out from ship – 830m wire on seabed. Stopping ship to transfer wire to trawl winch and deploying 2nd pig weight
11:33	Load transferred with weight in line
11:38	Take weight on trawl to disconnect stopper
11:40	Veering with trawl winch at 20m/min. 0.60T on cable
11:52:30	Tension dropped as 2nd weight hit bottom – now 0.16T
11:55	Increase veer to 30m/min
12:13	Stop veering of trawl with 800m wire out (plus groundline)
12:15	Start dragging wire
12:29	Big jump in tension as start to drag 2nd pig weight
13:21	Second increase in tension as start to drag 1st pig weight too
13:23	Stop ship and start hauling
13:55	Second weight recovered. Transfer back to Lebus deck winch
14:05	Resume hauling
15:03	All dragging gear recovered.

Table 7.4: Dragging operations at EBM5

Once the dragging gear was recovered the ship repositioned to the mooring site to see if anything was visible on the surface. The mooring was ranged to using the deck unit and it was found to still be on the bottom but it had evidently been moved by the drag as the slant ranges were higher than we were getting previously. The release command was sent again and this time it was seen to have released as the ranges were decreasing without the vessel moving. The mooring was spotted on the surface and grapneled at 15:47.

The mooring was recovered but there was no bottom collar float or MicroCAT attached to the release. The extent of growth on the release showed that the collar float fell off some time previously. Close inspection of the bottom of the release showed that the drag wire had rubbed against it and brushed off sufficient biofouling that the release block could then fall away when the release command was resent. Fouling was still present on the other side of the release and is a clear indication that the fouling was preventing the mooring from releasing. All mini-moorings deployed on D324 were coated with a blend of chilli and curry powder mixed with silicone grease in an attempt to reduce bio-fouling of the releases.

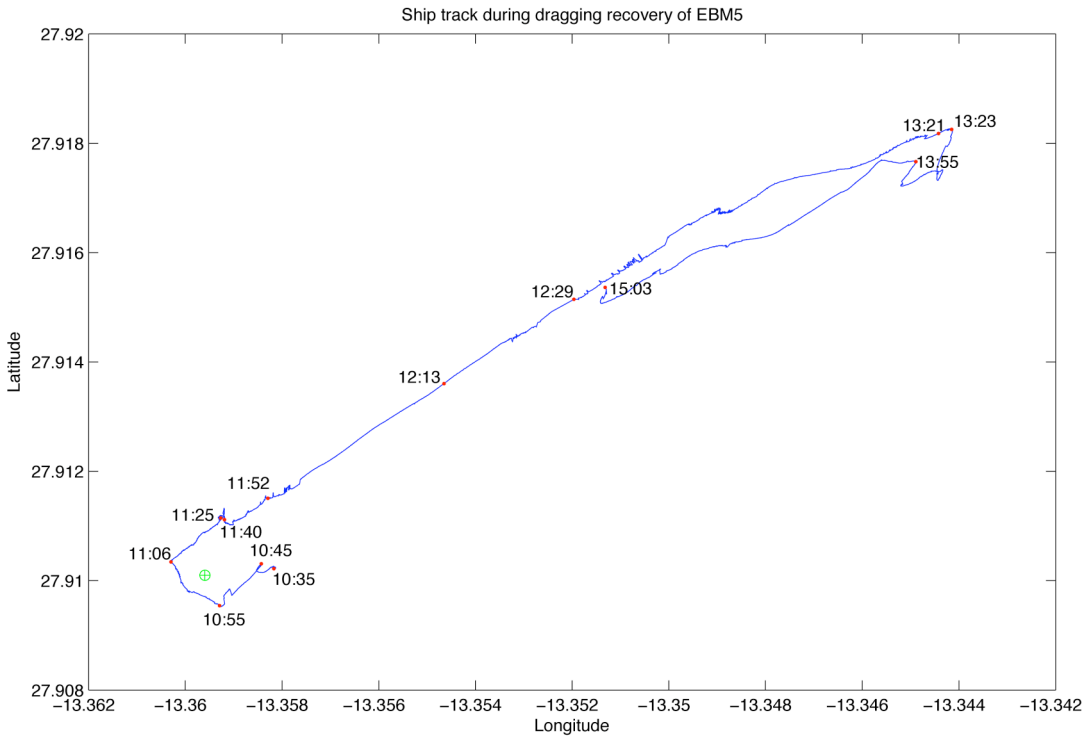

Figure 7.7: Ships track during dragging for EBM5. Red indicates significant events as given in table 7.3. Green indicates triangulated position of EBM5 prior to dragging

Appendix A: Extra Figures

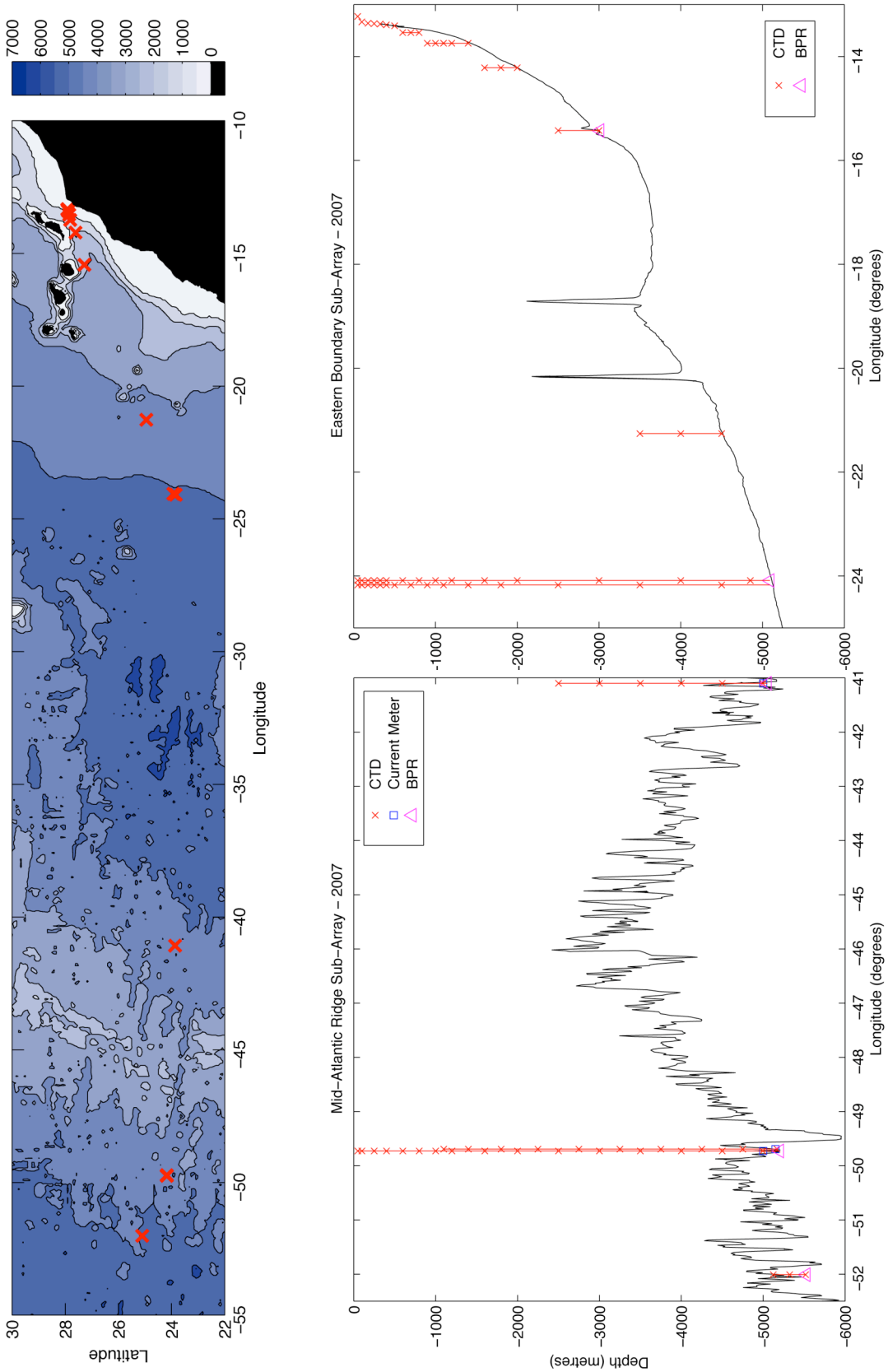

Figure A.1: Locations and instrument vertical distribution of Rapid-MOC moorings as deployed on D334

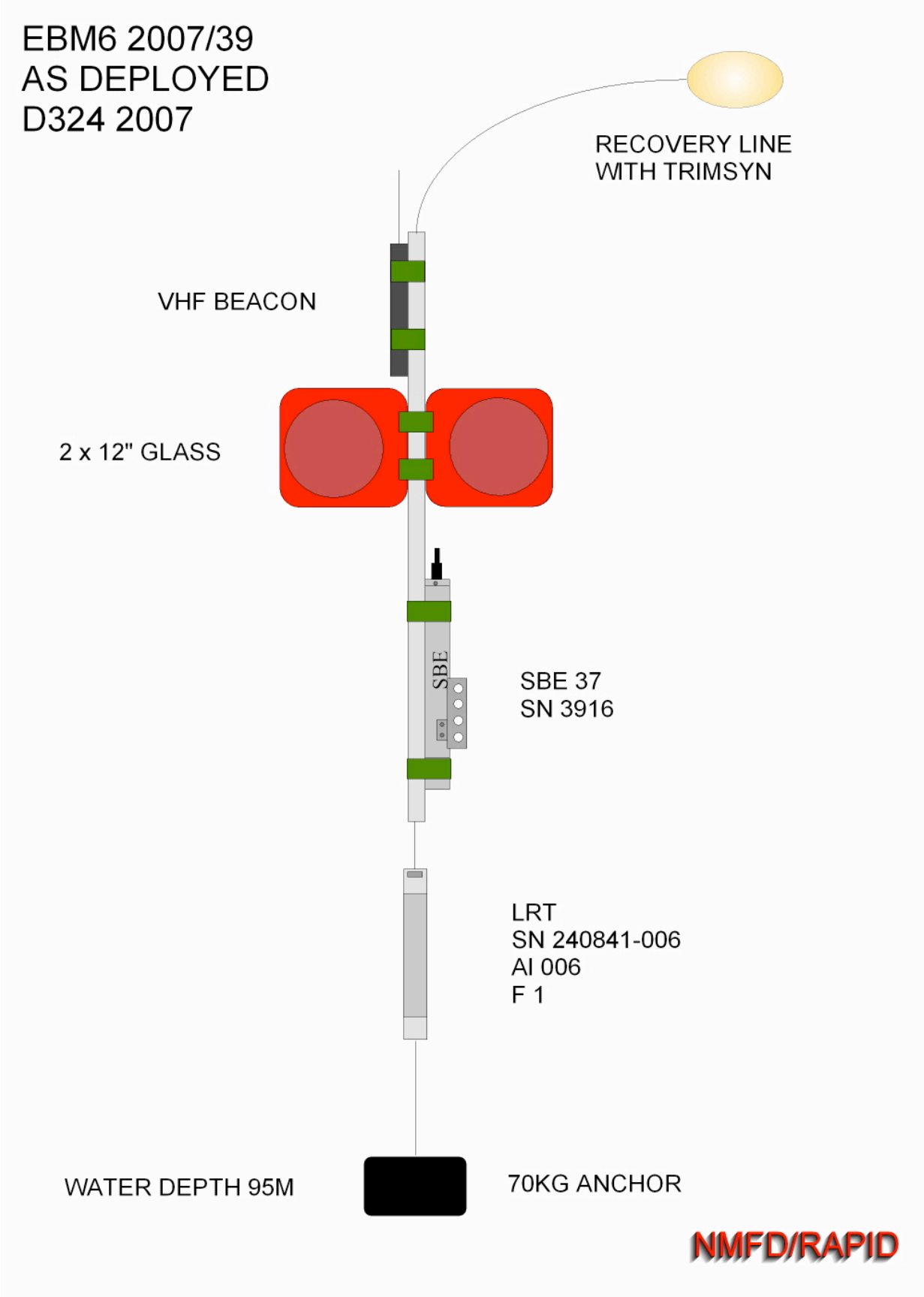

Figure A.2: Mooring diagram of EBM6 as deployed on D324

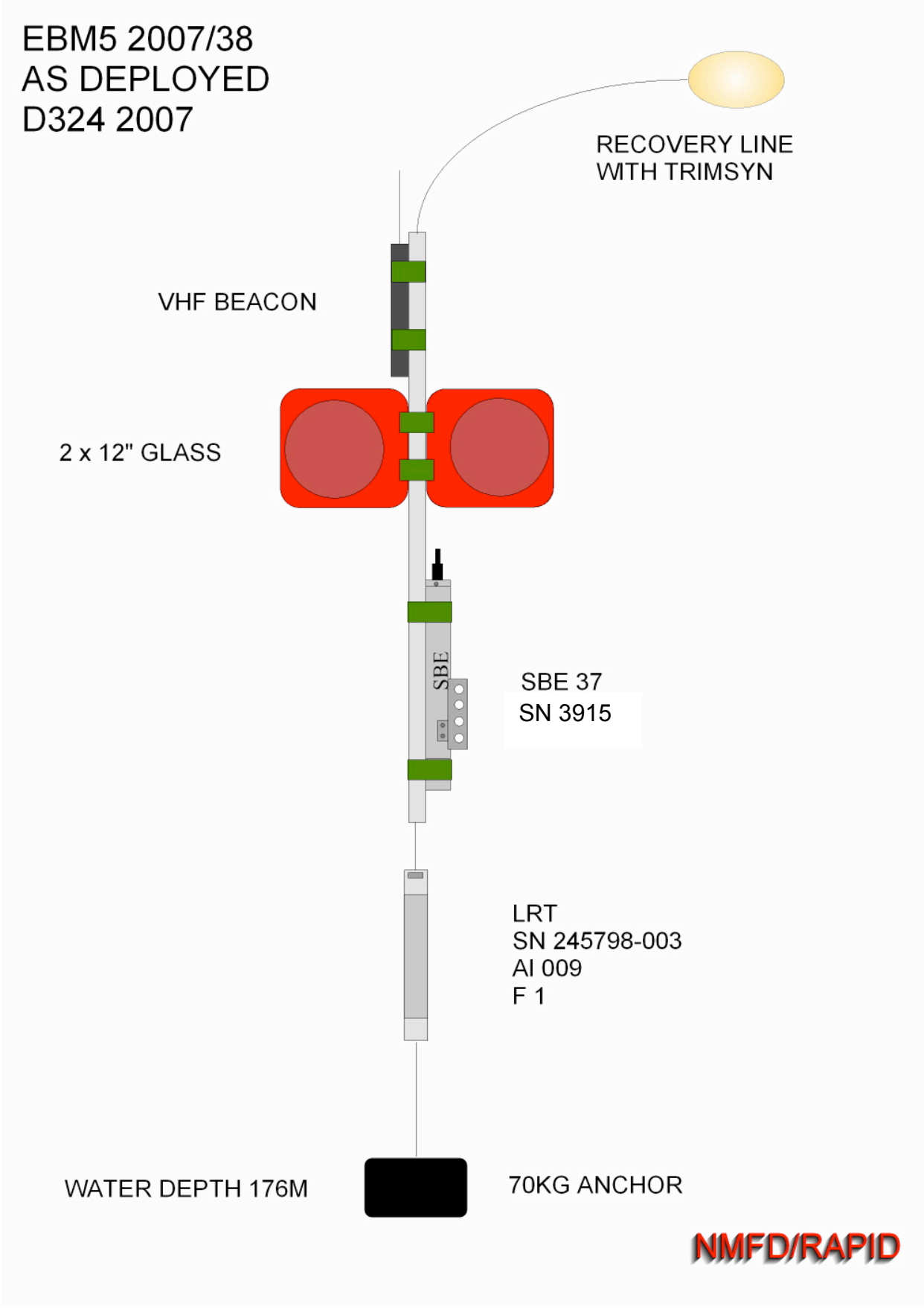

Figure A.3: Mooring diagram of EBM5 as deployed on D324

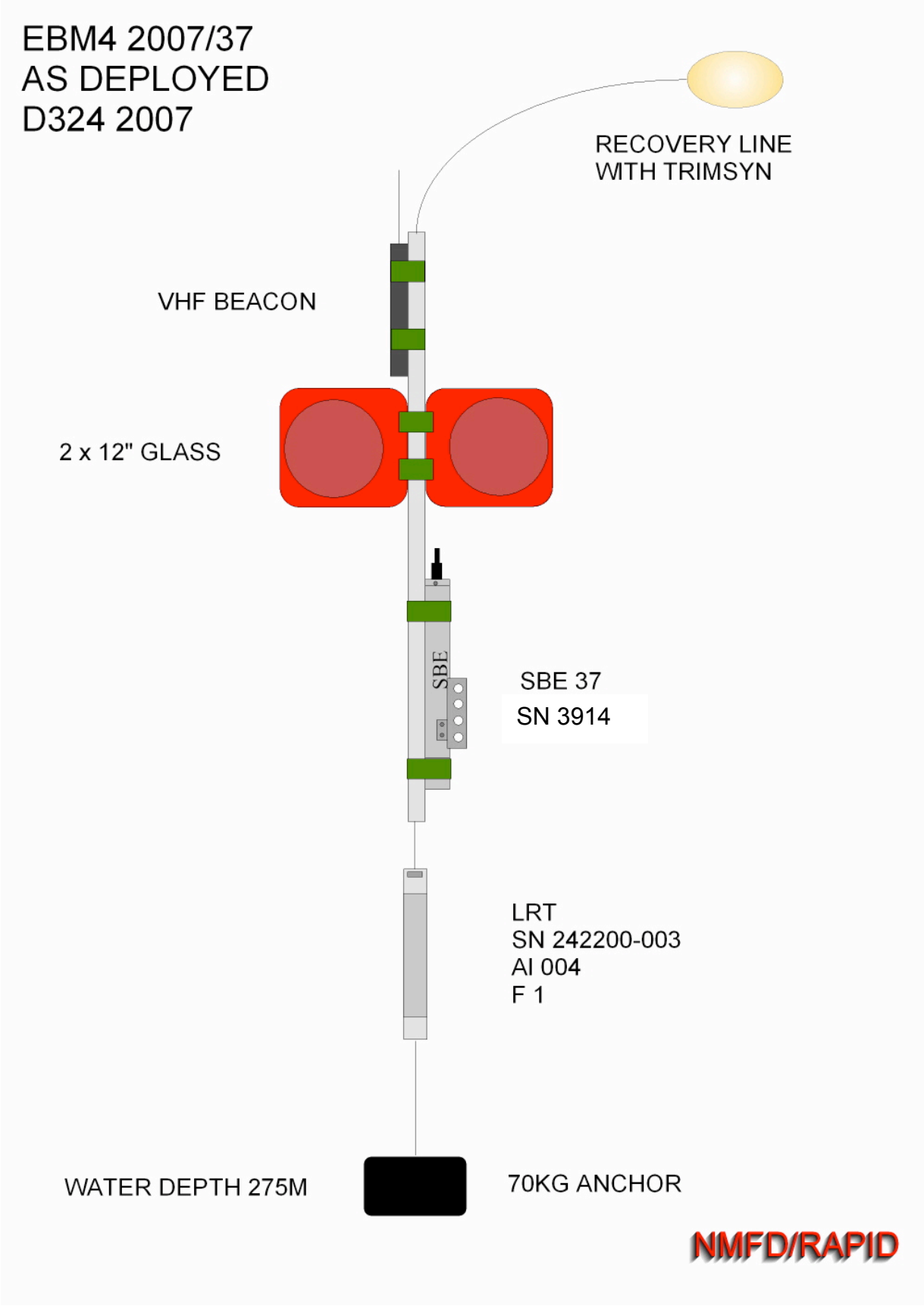

Figure A.4: Mooring diagram of EBM4 as deployed on D324

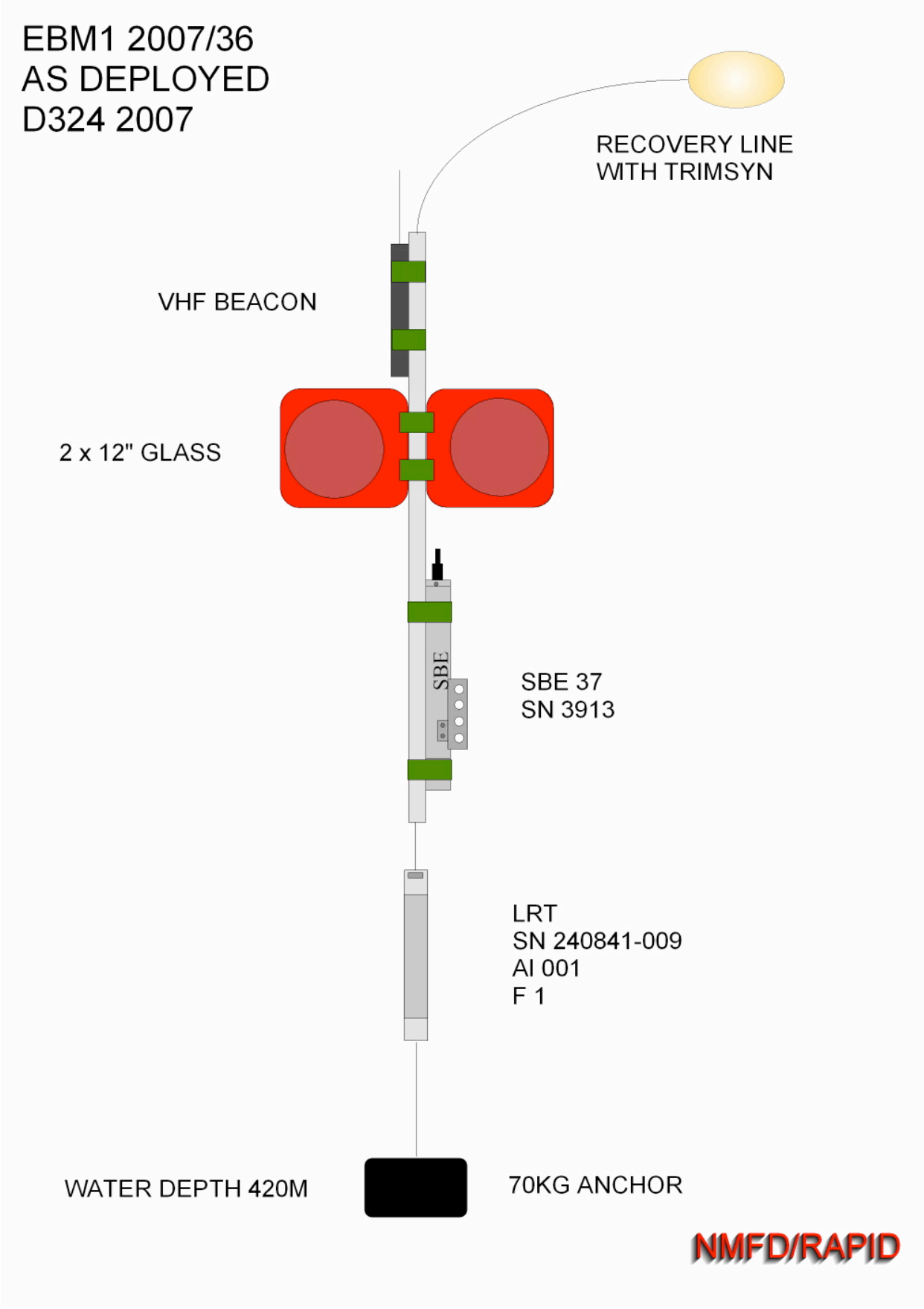

Figure A.5: Mooring diagram of EBM1 as deployed on D324

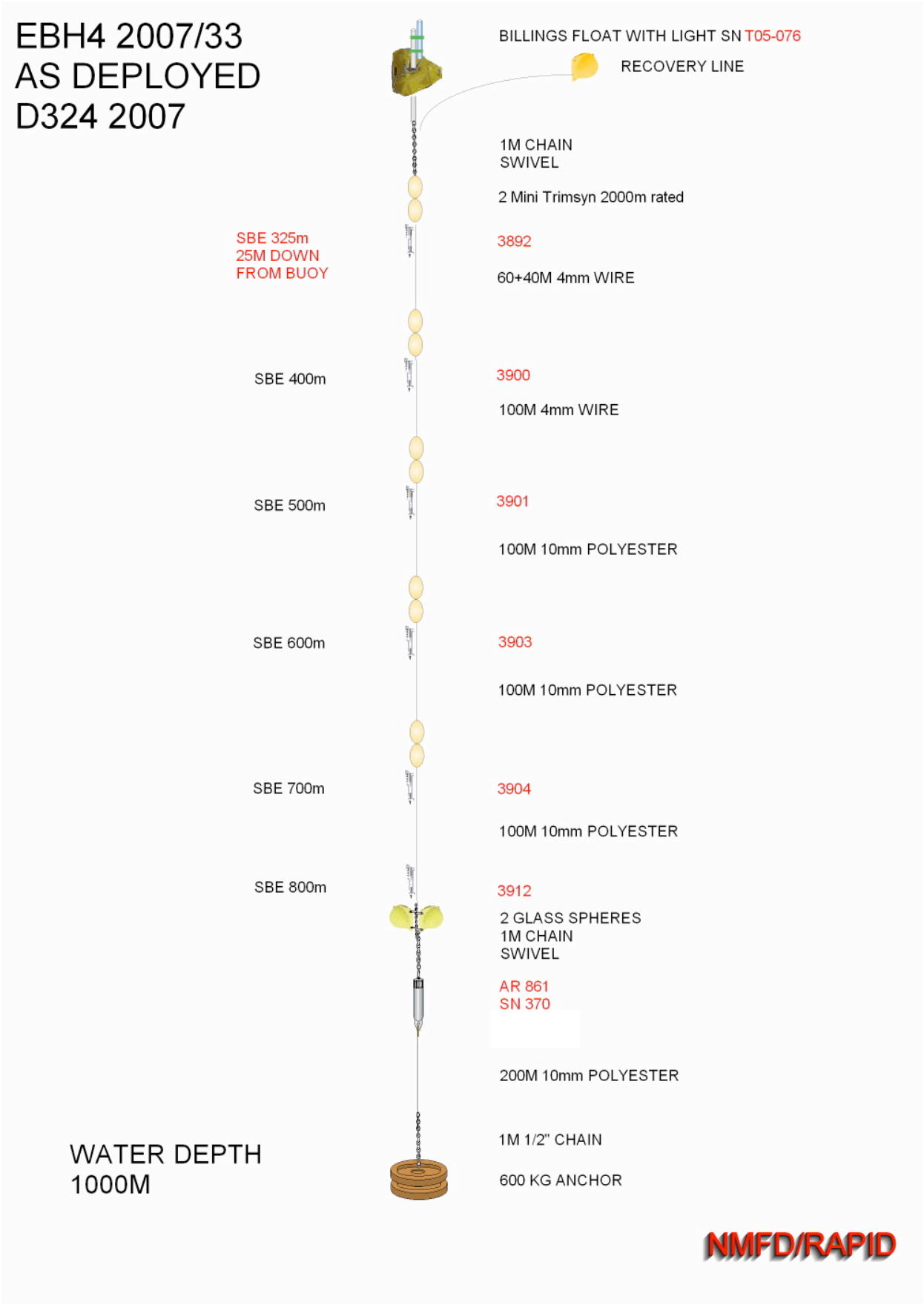

Figure A.6: Mooring diagram of EBH4 as deployed on D324

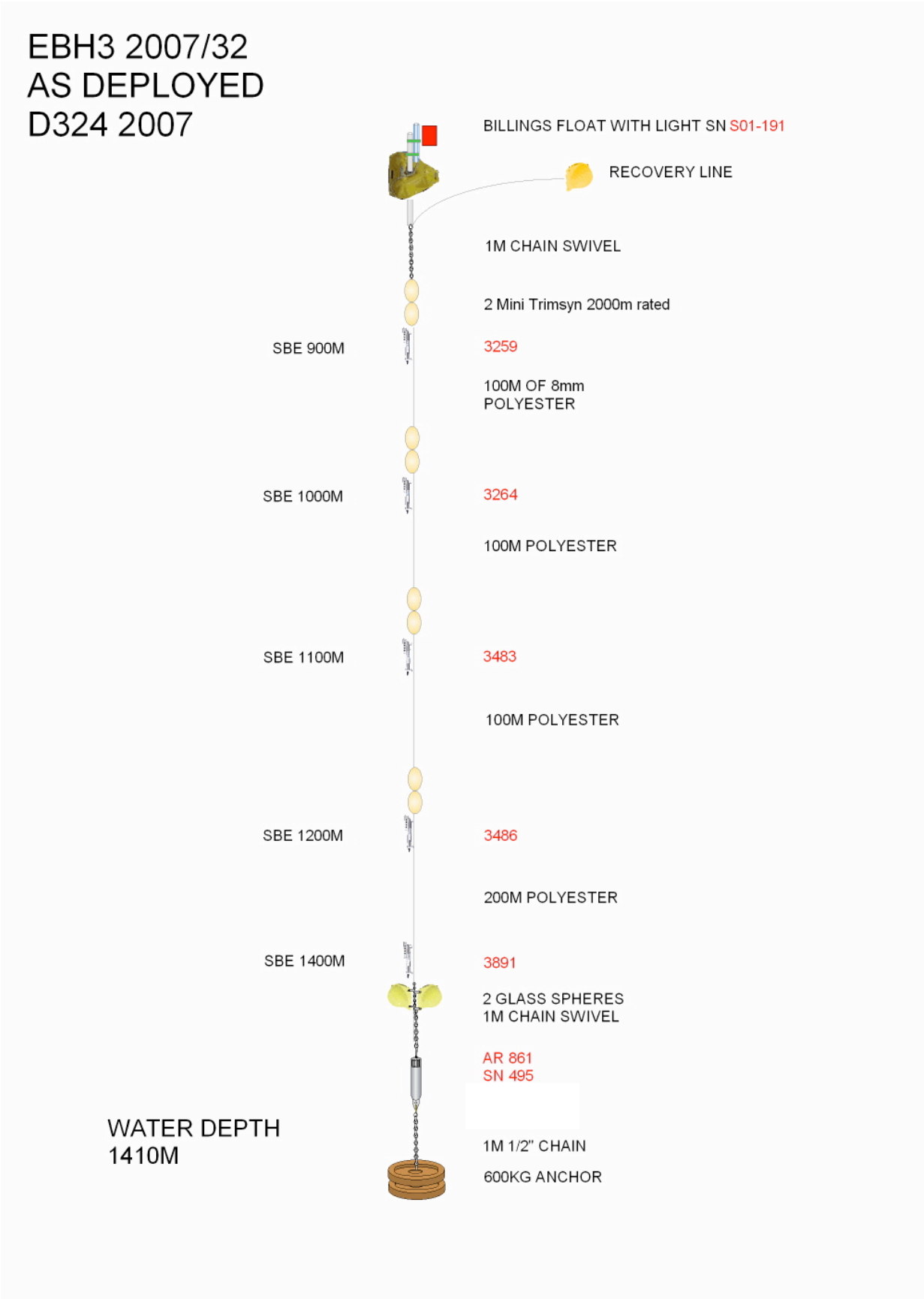

Figure A.7: Mooring diagram of EBH3 as deployed on D324

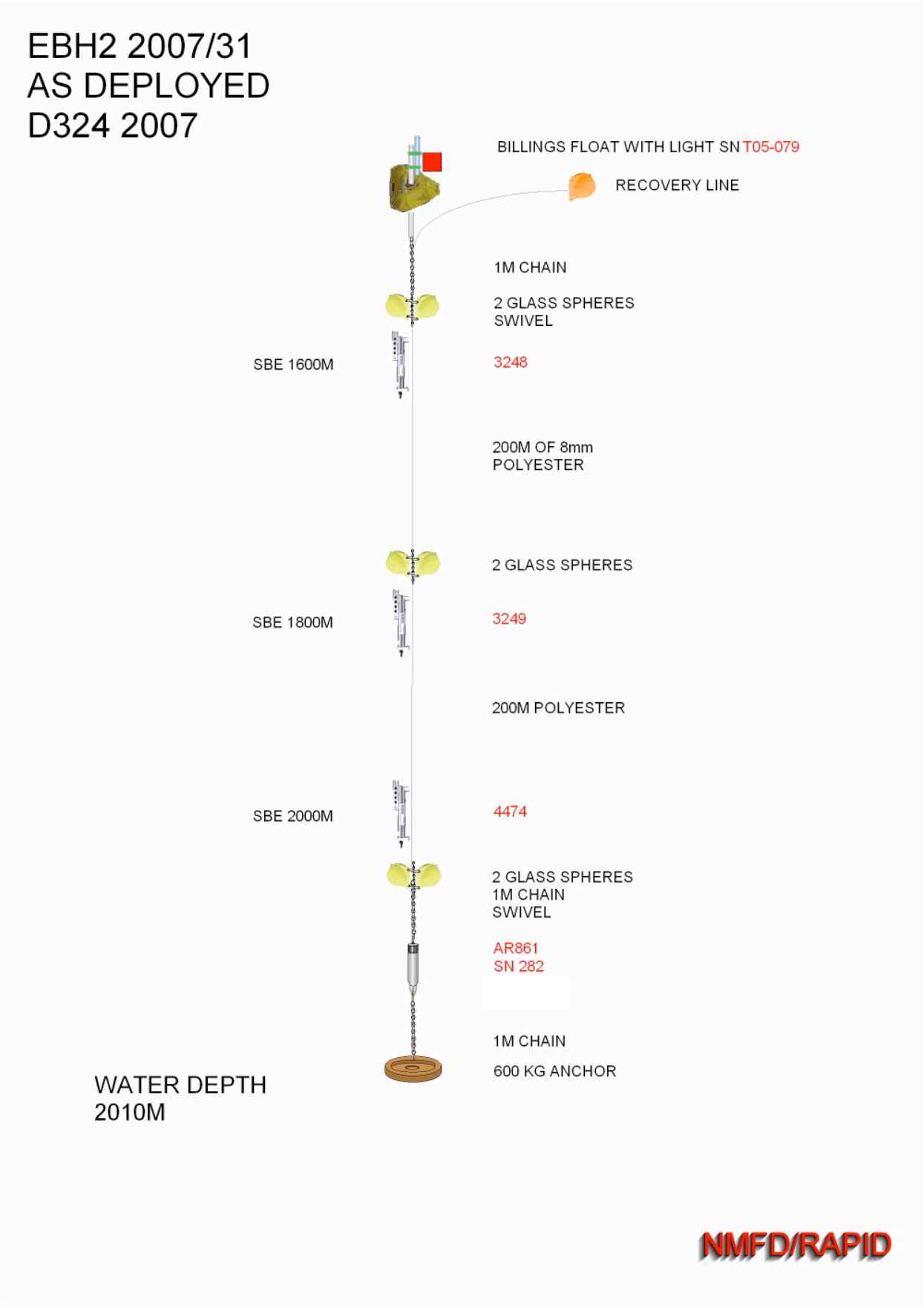

Figure A.8: Mooring diagram of EBH2 as deployed on D324

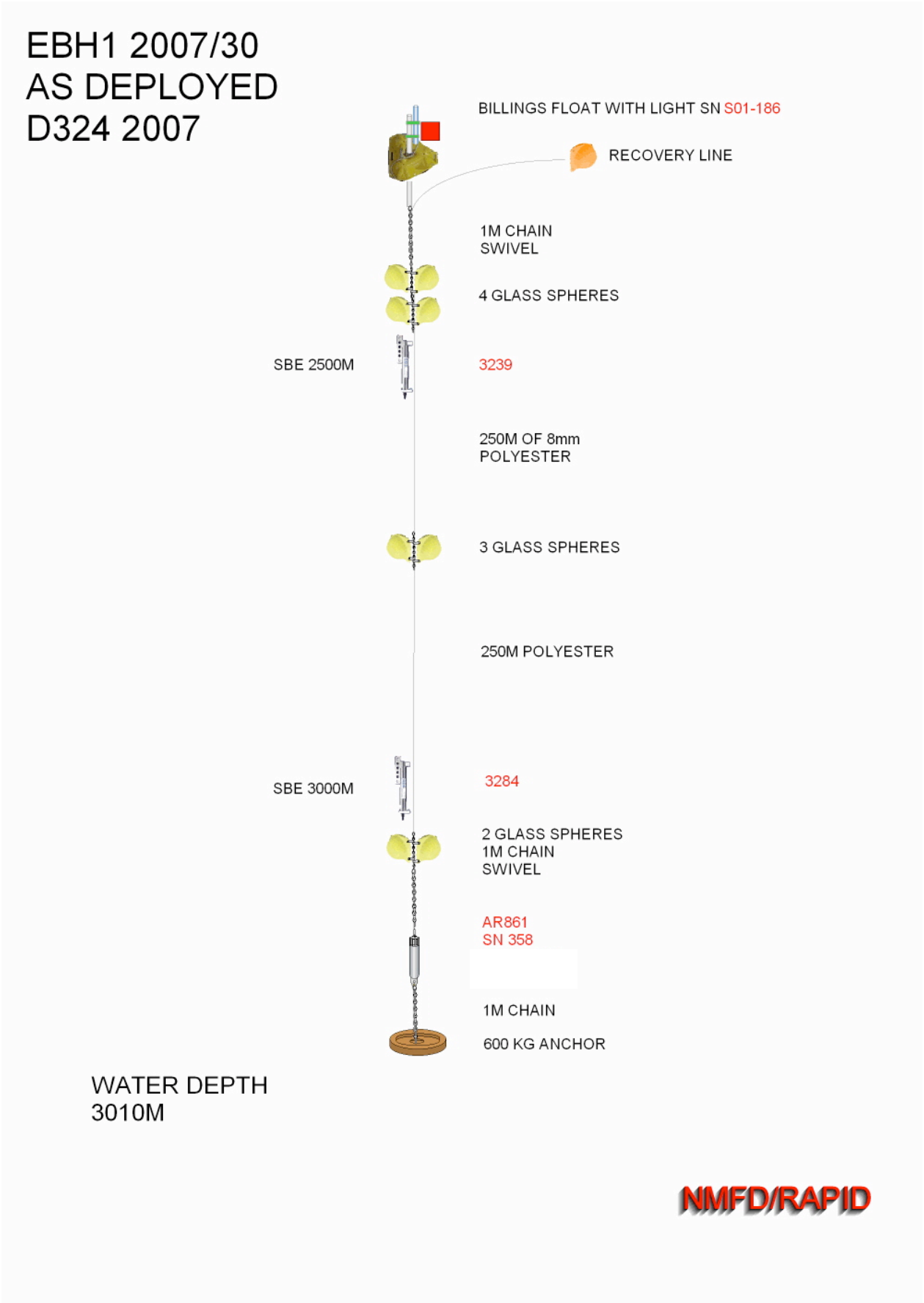

Figure A.9: Mooring diagram of EBH1 as deployed on D324

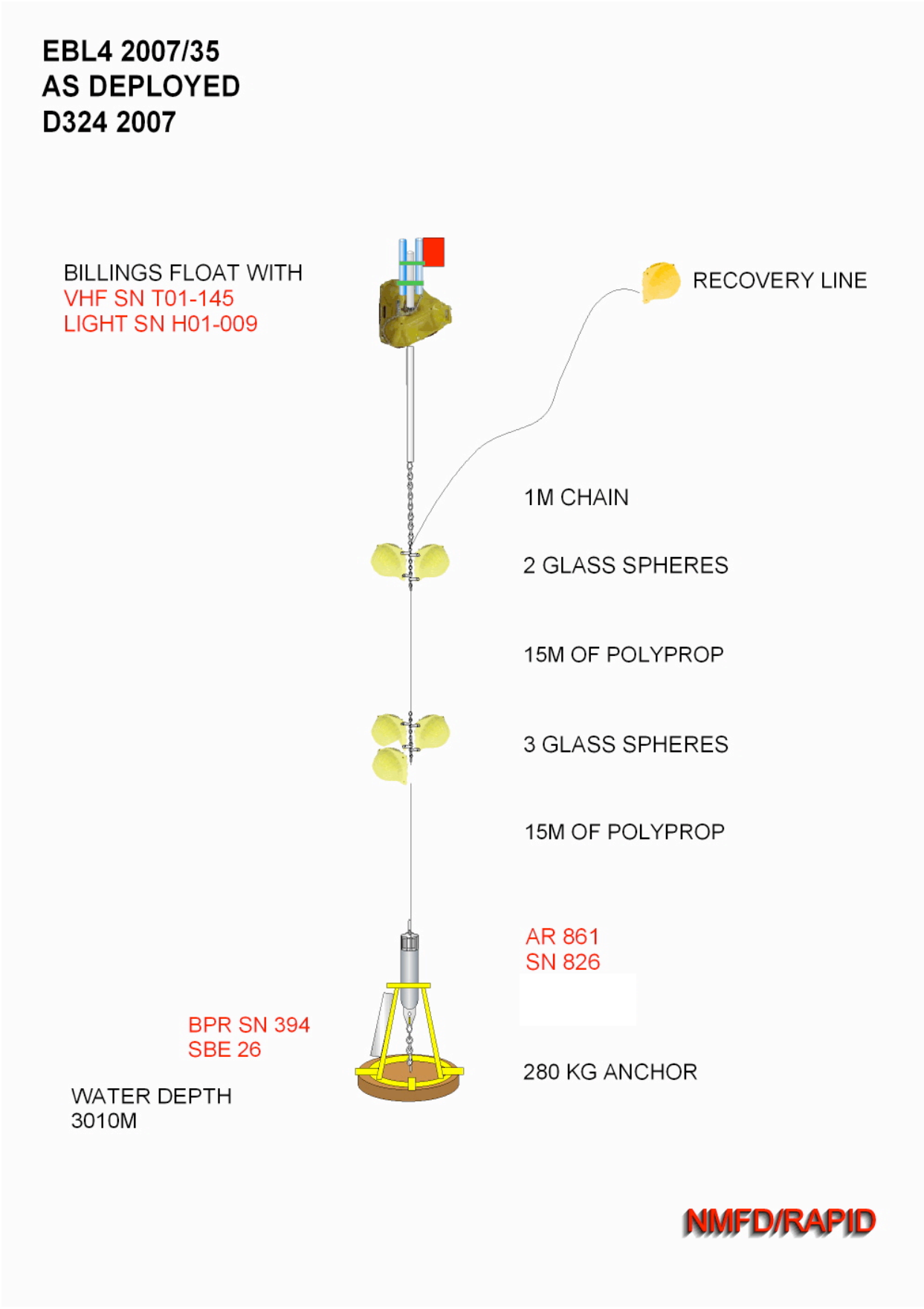

Figure A.10: Mooring diagram of EBL4 as deployed on D324

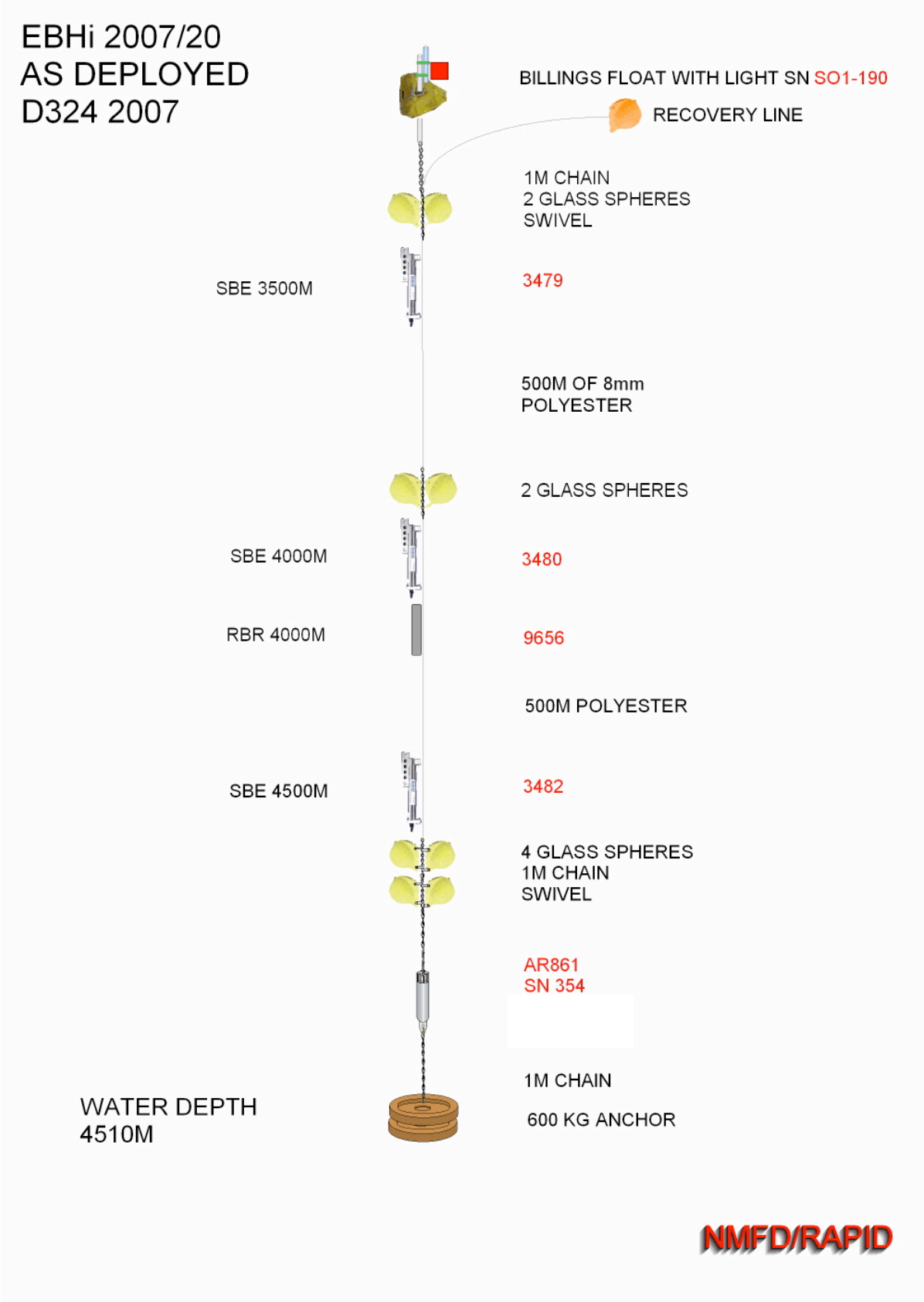

Figure A.11: Mooring diagram of EBHi as deployed on D324

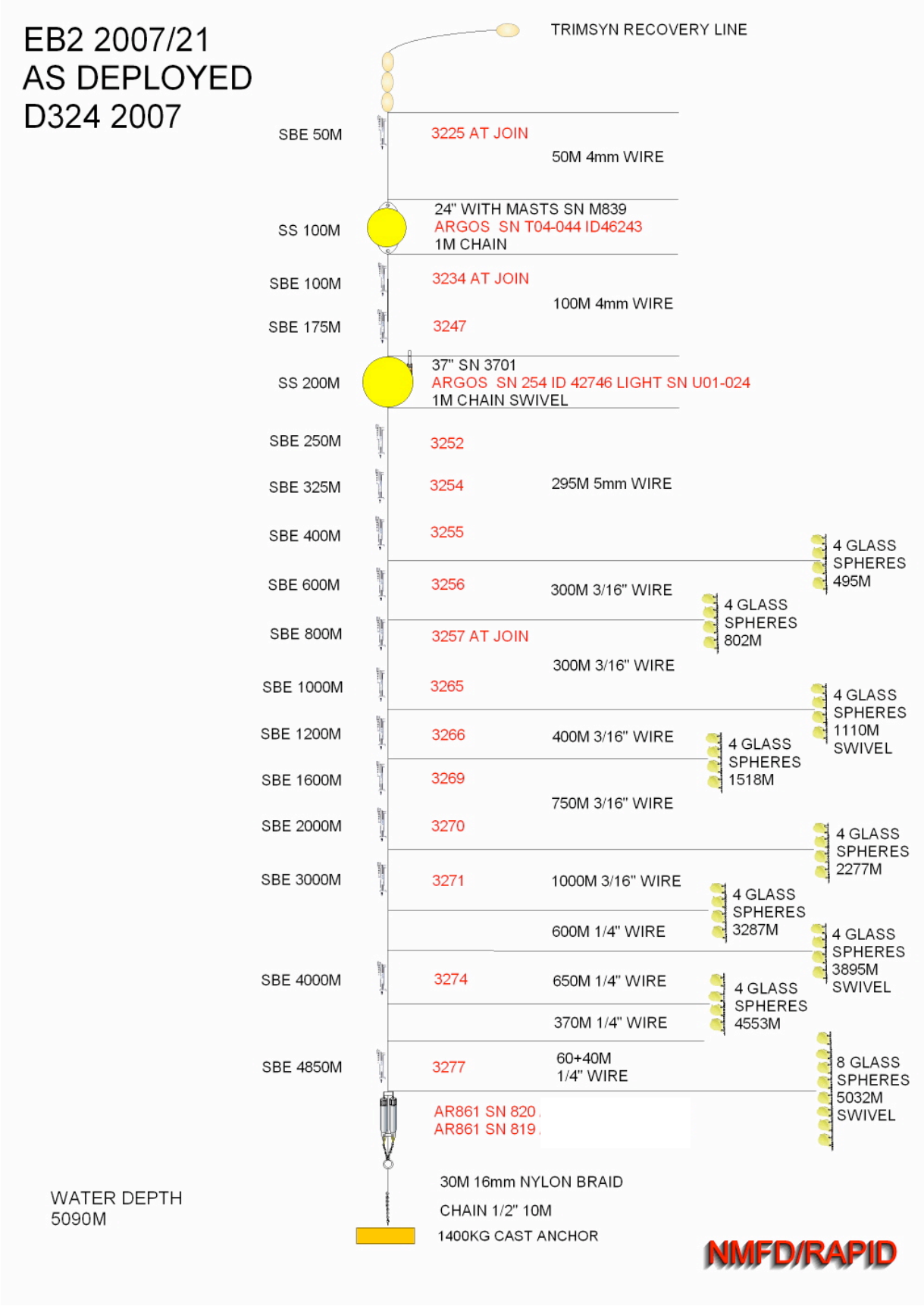

Figure A.12: Mooring diagram of EB2 as deployed on D324

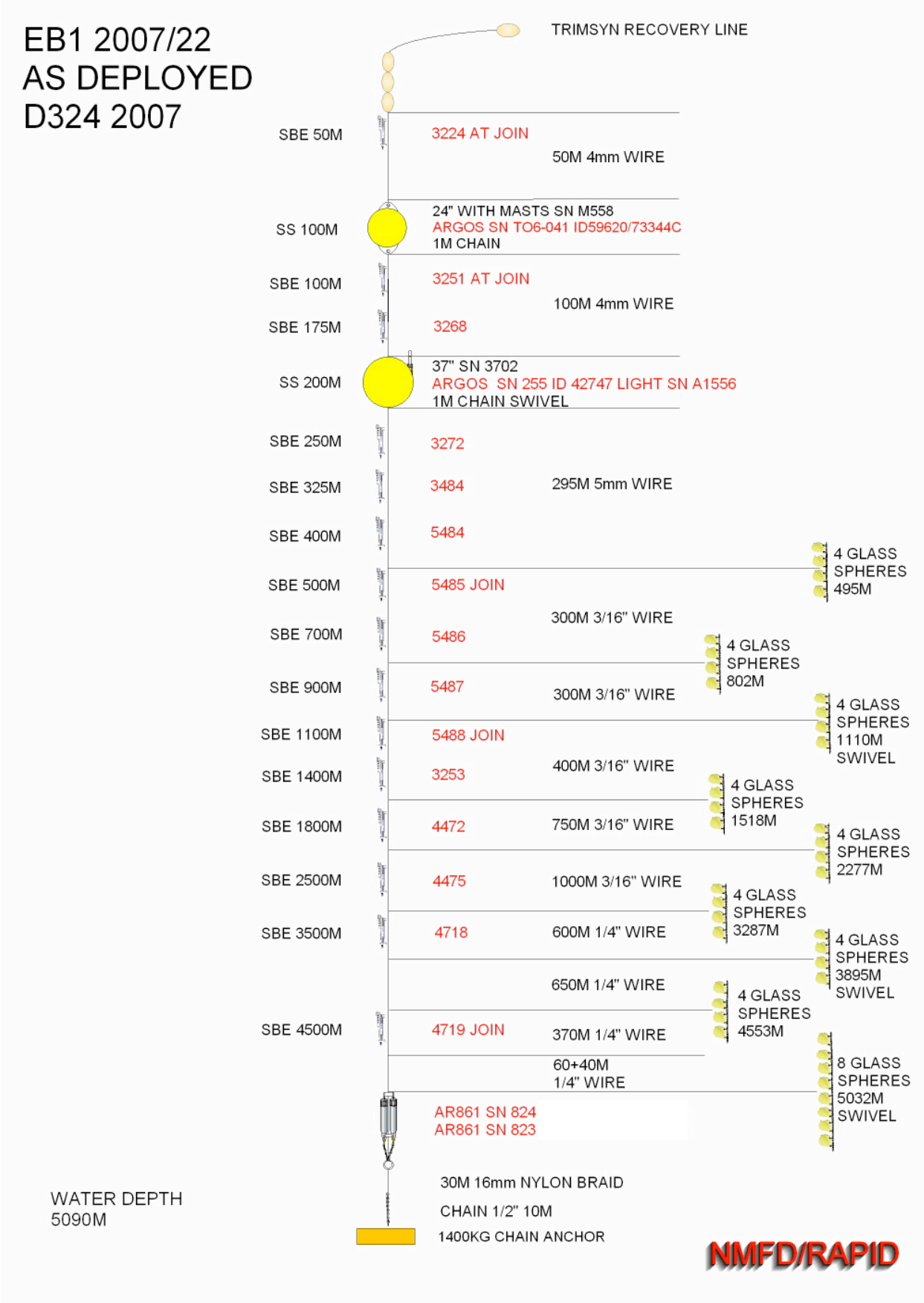

Figure A.13: Mooring diagram of EB1 as deployed on D324

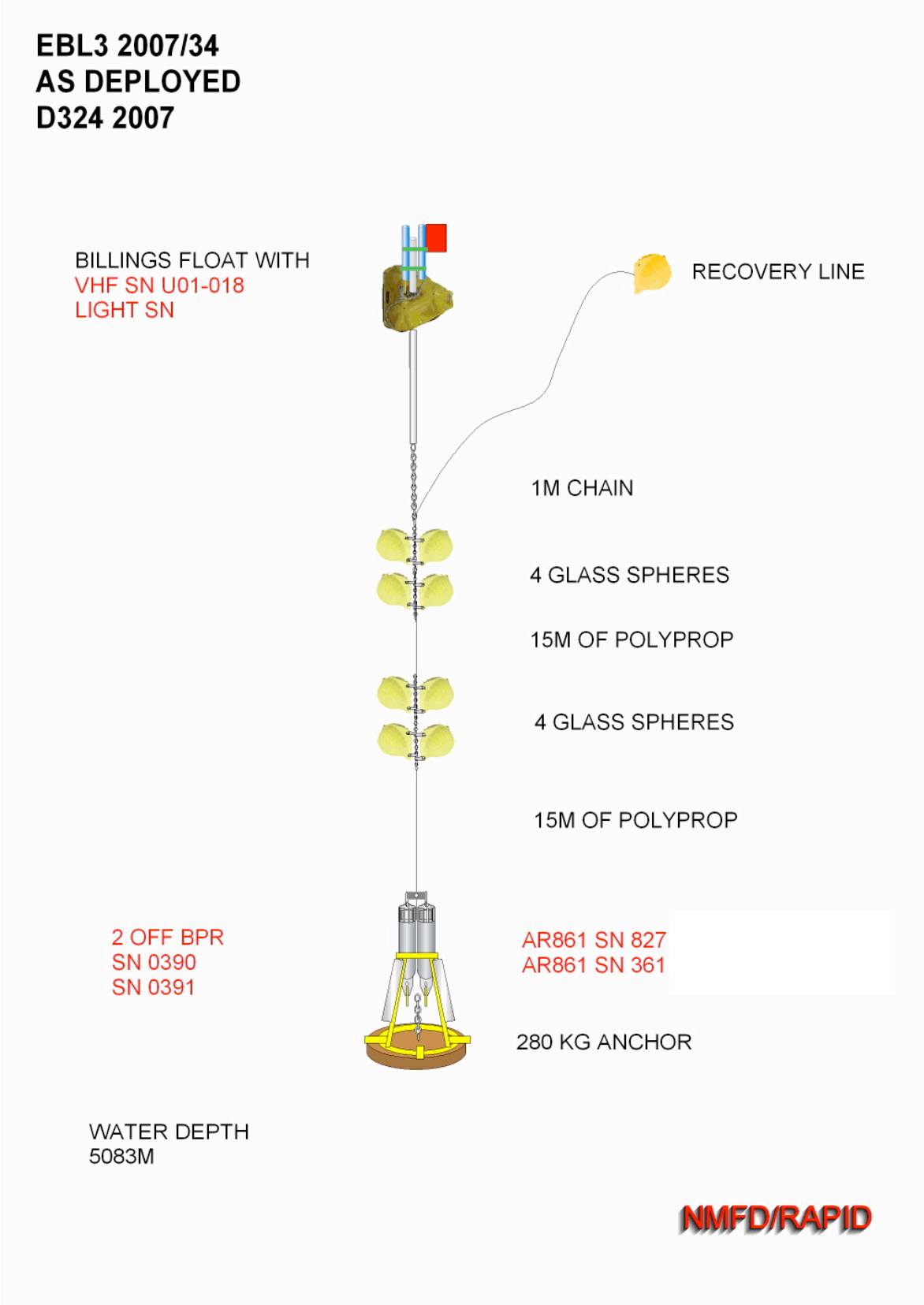

Figure A.14: Mooring diagram of EBL3 as deployed on D324

Figure A.15: Mooring diagram of MAR3 as deployed on D324

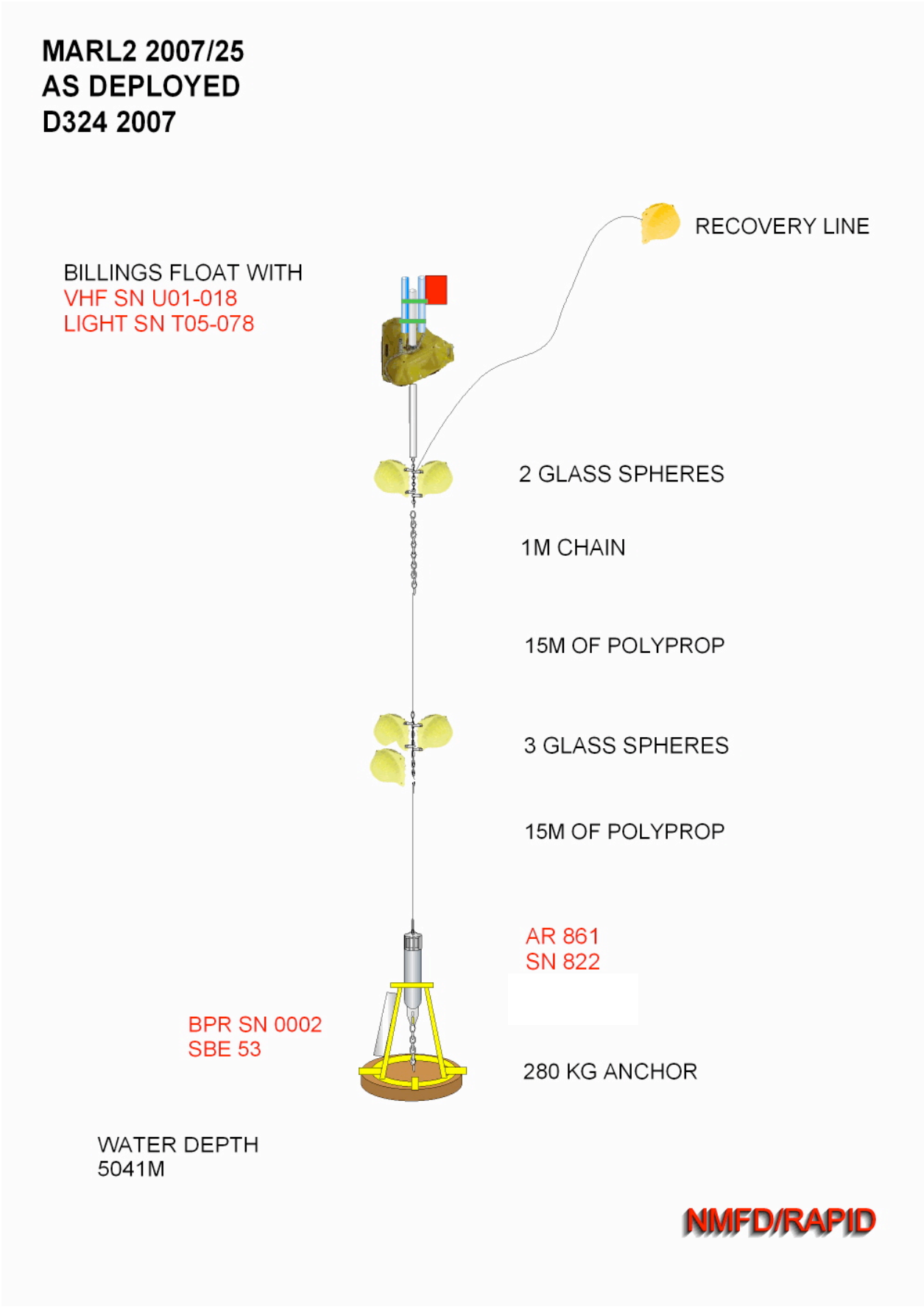

Figure A.16: Mooring diagram of MARL2 as deployed on D324

Figure A.17: Mooring diagram of MAR2 as deployed on D324

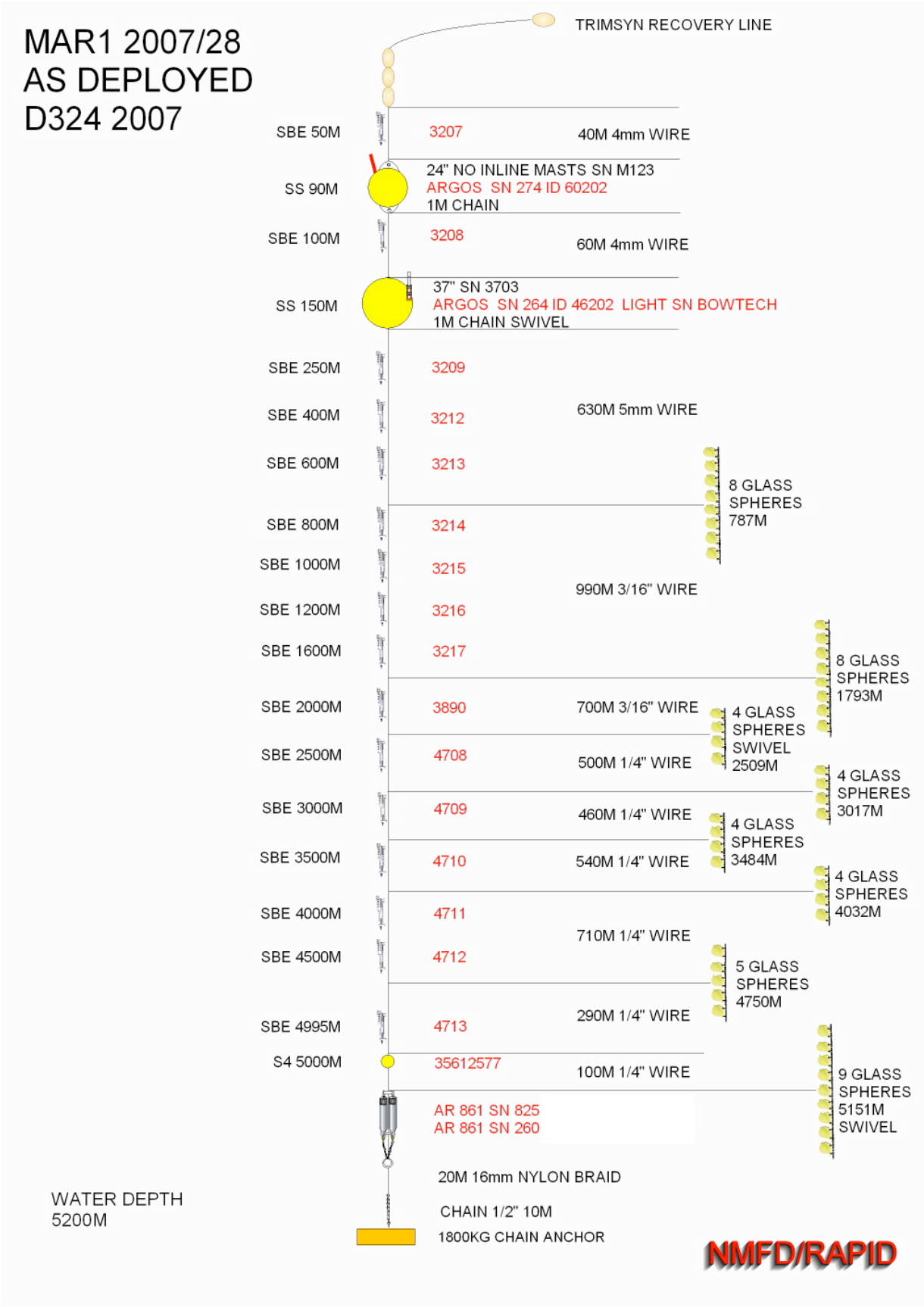

Figure A.18: Mooring diagram of MAR1 as deployed on D324

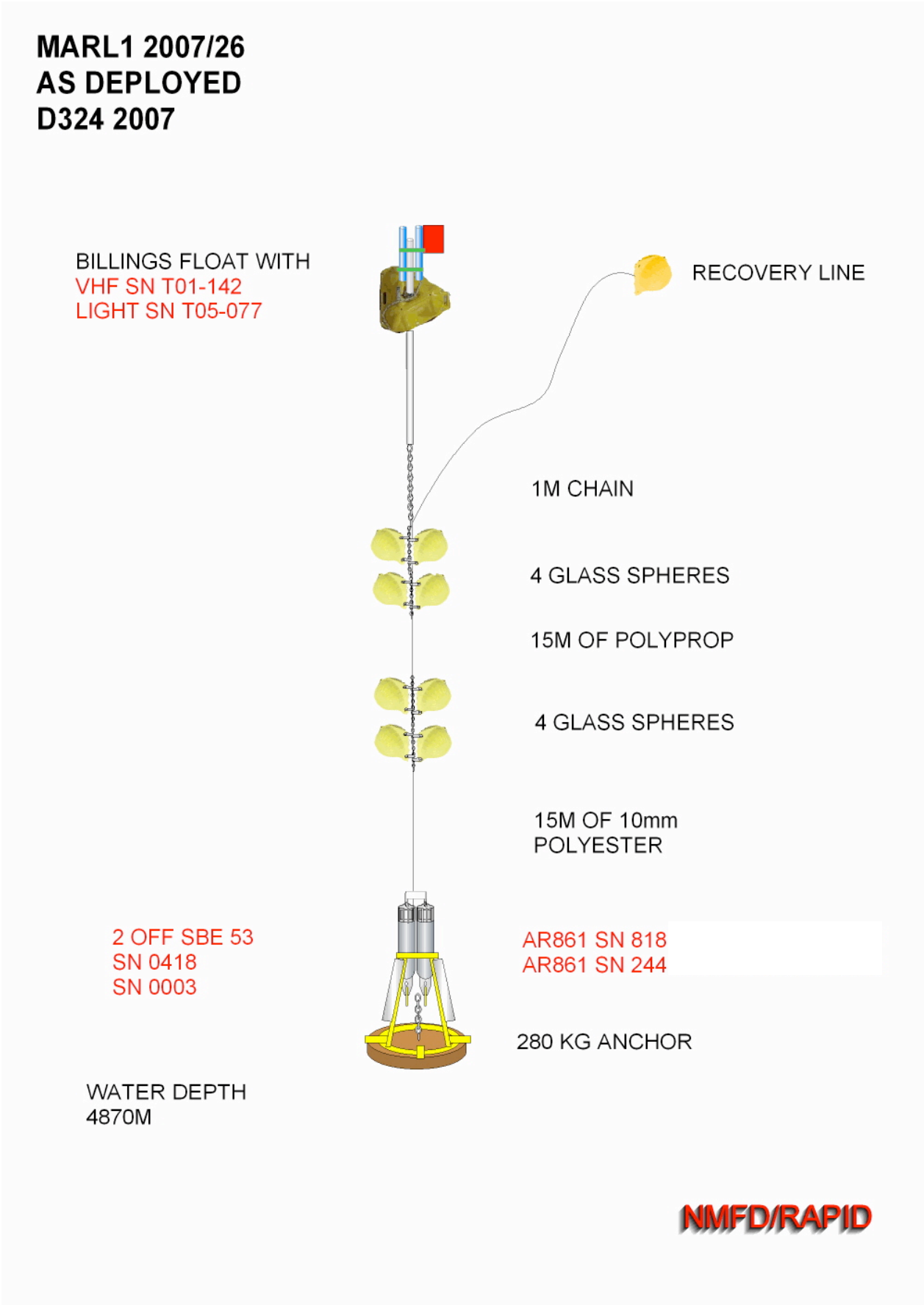

Figure A.19: Mooring diagram of MARL1 as deployed on D324

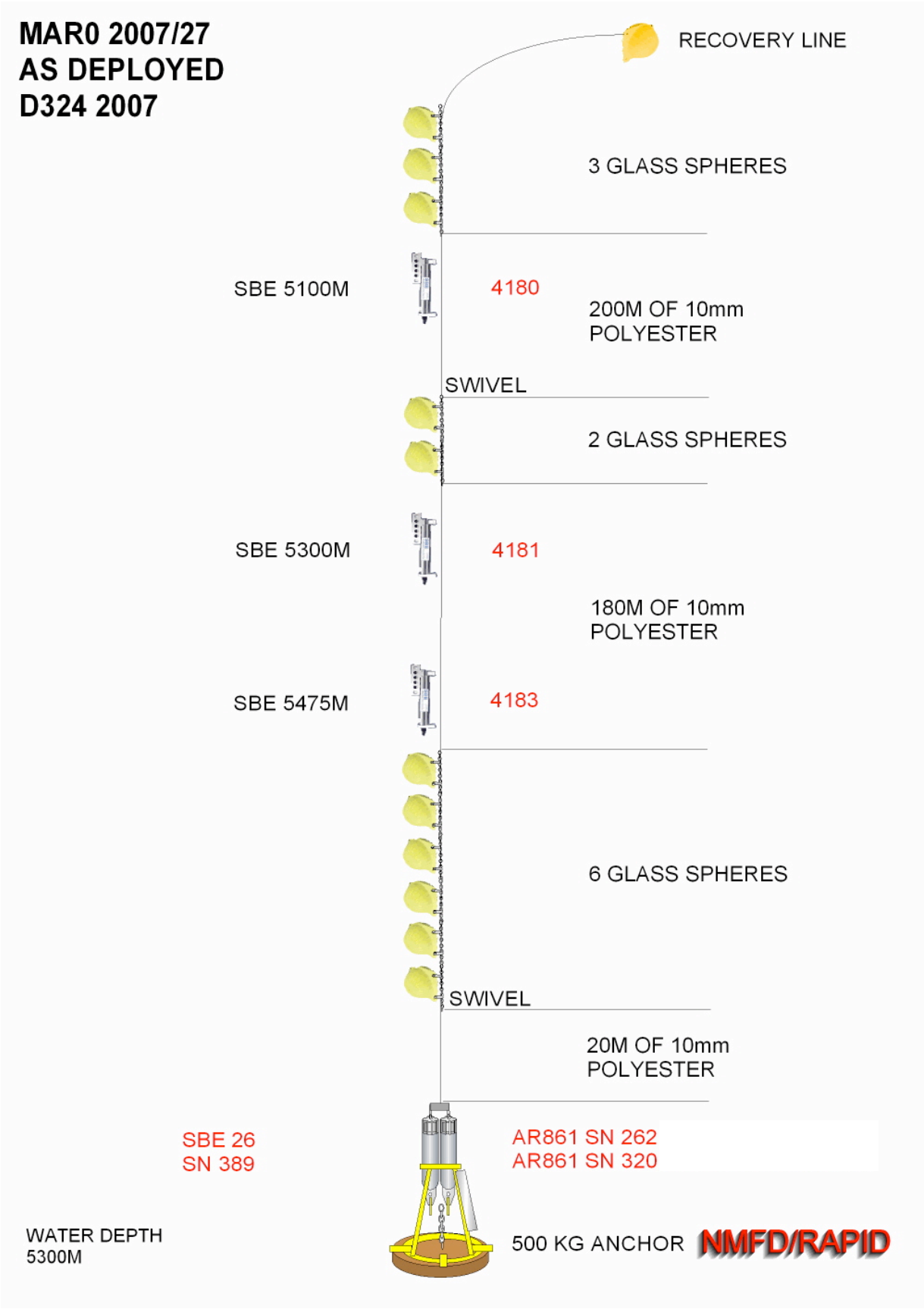

Figure A.20: Mooring diagram of MAR0 as deployed on D324

Appendix B: Instrument Setups

EBM6

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

Sample interval	1800 seconds
Start date	7/11/07
Start time	17:00

EBM5

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

Sample interval	1800 seconds
Start date	7/11/07
Start time	17:00

EBM4

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

Sample interval	1800 seconds
Start date	7/11/07
Start time	17:00

EBM1

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

Sample interval	1800 seconds
Start date	7/11/07
Start time	17:00

EBH4

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

Sample interval	1800 seconds
Start date	7/11/07
Start time	18:00

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

Sample interval	1800 seconds
Start date	7/11/07
Start time	18:00

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

Sample interval	1800 seconds
Start date	7/11/07
Start time	18:00

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

Sample interval	1800 seconds
Start date	7/11/07
Start time	18:00

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

Sample interval	1800 seconds
Start date	7/11/07
Start time	18:00

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

Sample interval	1800 seconds

Start date	7/11/07
Start time	18:00

EBH3

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

Sample interval	1800 seconds
Start date	6/11/07
Start time	18:00

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

Sample interval	1800 seconds
Start date	6/11/07
Start time	18:00

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

Sample interval	1800 seconds
Start date	6/11/07
Start time	18:00

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

Sample interval	1800 seconds
Start date	6/11/07
Start time	18:00

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

Sample interval	1800 seconds
Start date	6/11/07
Start time	18:00

EBH2

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

Sample interval	1800 seconds
Start date	6/11/07
Start time	05:30

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

Sample interval	1800 seconds
Start date	6/11/07
Start time	05:30

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

Inductive ID	40
Sample interval	1800 seconds
Start date	6/11/07
Start time	05:30

EBH1

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

Sample interval	1800 seconds
Start date	5/11/07
Start time	14:00

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

Inductive ID	35
Sample interval	1800 seconds
Start date	5/11/07
Start time	14:00

EBL4

Seabird SBE 26 BPR – serial number **394**

Tide sample interval	30
Tide measurements per wave burst	9999
Wave samples/burst	68
No. of 0.25s periods to integrate waves	33
Start date	5/11/07
Start time	13:00

EBHi

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

Sample interval	1800 seconds
Start date	16/10/07
Start time	10:00

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

Sample interval	1800 seconds
Start date	16/10/07
Start time	10:00

Seabird SBE37 SMP CTD – serial number **3482**

Sample interval	1800 seconds
Start date	16/10/07
Start time	10:00

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

Start date	16/10/07
Start time	10:00
End date	16/10/11
End time	10:00
Sampling period	30 mins

EB2

Seabird SBE37 SMP CTD – serial number **3225**

Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00

Seabird SBE37 SMP CTD – serial number **3234**

Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00

Seabird SBE37 SMP CTD – serial number **3247**

Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00

Seabird SBE37 SMP CTD – serial number **3252**

Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00

Seabird SBE37 SMP CTD – serial number **3254**

Sample interval	1800 seconds
Start date	17/10/07

Start time	12:00
Seabird SBE37 SMP CTD – serial number **3255**	
Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00
Seabird SBE37 SMP CTD – serial number **3256**	
Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00
Seabird SBE37 SMP CTD – serial number **3257**	
Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00
Seabird SBE37 SMP CTD – serial number **3265**	
Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00
Seabird SBE37 SMP CTD – serial number **3266**	
Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00
Seabird SBE37 SMP CTD – serial number **3269**	
Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00
Seabird SBE37 SMP CTD – serial number **3270**	
Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00
Seabird SBE37 SMP CTD – serial number **3271**	
Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00
Seabird SBE37 SMP CTD – serial number **3274**	
Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00
Seabird SBE37 SMP CTD – serial number **3277**	
Sample interval	1800 seconds
Start date	17/10/07
Start time	12:00
RBR XR-420 CTD – serial number **9657**	
Start date	17/10/07
Start time	12:00
End date	17/10/10
End time	12:00
Sampling period	30 mins

EB1

Seabird SBE37 SMP CTD – serial number **3224**	
Sample interval	1800 seconds
Start date	18/10/07
Start time	13:00
Seabird SBE37 SMP CTD – serial number **3251**	
Sample interval	1800 seconds
Start date	18/10/07
Start time	13:00
Seabird SBE37 SMP CTD – serial number **3268**	
Sample interval	1800 seconds
Start date	18/10/07
Start time	13:00
Seabird SBE37 SMP CTD – serial number **3272**	
Sample interval	1800 seconds
Start date	18/10/07
Start time	13:00
Seabird SBE37 SMP CTD – serial number **3484**	
Sample interval	1800 seconds
Start date	18/10/07
Start time	13:00
Seabird SBE37 SMP CTD – serial number **5484**	
Sample interval	1800 seconds
Start date	18/10/07
Start time	13:00
Seabird SBE37 SMP CTD – serial number **5485**	
Sample interval	1800 seconds
Start date	18/10/07
Start time	13:30
Seabird SBE37 SMP CTD – serial number **5486**	
Sample interval	1800 seconds
Start date	18/10/07
Start time	13:30
Seabird SBE37 SMP CTD – serial number **5487**	
Sample interval	1800 seconds
Start date	18/10/07
Start time	14:00
Seabird SBE37 SMP CTD – serial number **5488**	
Sample interval	1800 seconds
Start date	18/10/07
Start time	14:00
Seabird SBE37 SMP CTD – serial number **3253**	
Sample interval	1800 seconds
Start date	18/10/07
Start time	14:00
Seabird SBE37 IMP CTD – serial number **4472**	
Inductive ID	42
Sample interval	1800 seconds
Start date	18/10/07
Start time	15:00
Seabird SBE37 IMP CTD – serial number **4475**	

Inductive ID	39
Sample interval	1800 seconds
Start date	18/10/07
Start time	15:00

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

Inductive ID	11
Sample interval	1800 seconds
Start date	18/10/07
Start time	15:00

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

Inductive ID	12
Sample interval	1800 seconds
Start date	18/10/07
Start time	15:00

EBL3

Seabird SBE26 BPR – serial number **390**

Tide sample interval	30
Tide measurements per wave burst	9999
Wave samples/burst	68
No. of 0.25s periods to integrate waves	33
Start date	2/11/07
Start time	17:30

Seabird SBE26 BPR – serial number **391**

Tide sample interval	30
Tide measurements per wave burst	9999
Wave samples/burst	68
No. of 0.25s periods to integrate waves	33
Start date	2/11/07
Start time	17:30

MAR3

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

Inductive ID	13
Sample interval	1800 seconds
Start date	23/10/07
Start time	08:30

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

Inductive ID	14
Sample interval	1800 seconds
Start date	23/10/07
Start time	08:30

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

Inductive ID	39
Sample interval	1800 seconds
Start date	23/10/07
Start time	09:00

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

Inductive ID	16
Sample interval	1800 seconds

Start date	23/10/07
Start time	09:00
Seabird SBE37 IMP CTD – serial number **4178**	
Inductive ID	22
Sample interval	1800 seconds
Start date	23/10/07
Start time	09:00
Seabird SBE37 IMP CTD – serial number **4179**	
Inductive ID	23
Sample interval	1800 seconds
Start date	23/10/07
Start time	09:00
InterOcean S4AD – serial number **35612571**	
Header	MAR3-2007DEPLOY
On time	1 mins
Cycle time	30 mins
Average count	120
Channels at average	Hx, Hy, C, T, D
Special Record Block count	48
Channels at SRB	Hx, Hy, C, T, D
Start date	23/10/07
Start time	10:00

MARL2

Seabird SBE53 BPR – serial number **0002**	
Header	marl2 deployed 2007
Tide interval	15
Tide measurement duration	15
Frequency of ref measurements	96
Start date	23/10/07
Start time	04:00

MAR2

Seabird SBE37 SMP CTD – serial number **3918**	
Sample interval	1800 seconds
Start date	27/10/07
Start time	19:00
Seabird SBE37 SMP CTD – serial number **3910**	
Sample interval	1800 seconds
Start date	27/10/07
Start time	19:00
Seabird SBE37 IMP CTD – serial number **3282**	
Inductive ID	
Sample interval	1800 seconds
Start date	27/10/07
Start time	19:00
Seabird SBE37 IMP CTD – serial number **4461**	
Inductive ID	52
Sample interval	1800 seconds
Start date	27/10/07

Start time	19:00
Seabird SBE37 IMP CTD – serial number **4462**	
Inductive ID	52
Sample interval	1800 seconds
Start date	27/10/07
Start time	19:00
Seabird SBE37 IMP CTD – serial number **4464**	
Inductive ID	50
Sample interval	1800 seconds
Start date	27/10/07
Start time	19:00
Seabird SBE37 IMP CTD – serial number **4714**	
Inductive ID	07
Sample interval	1800 seconds
Start date	27/10/07
Start time	19:00
Seabird SBE37 IMP CTD – serial number **4715**	
Inductive ID	08
Sample interval	1800 seconds
Start date	27/10/07
Start time	19:00
Seabird SBE37 IMP CTD – serial number **4717**	
Inductive ID	10
Sample interval	1800 seconds
Start date	27/10/07
Start time	19:00
Seabird SBE37 IMP CTD – serial number **4466**	
Inductive ID	48
Sample interval	1800 seconds
Start date	27/10/07
Start time	19:00
InterOcean S4AD – serial number **35612576**	
Header	MAR2_D324
On time	1 min
Cycle time	30 mins
Average count	120
Channels at average	Hx, Hy, C, T, D
Special Record Block count	48
Channels at SRB	Hx, Hy, C, T, D
Start date	27/10/07
Start time	20:00

MAR1

Seabird SBE37 SMP CTD – serial number **3207**	
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 SMP CTD – serial number **3208**	
Sample interval	1800 seconds
Start date	27/10/07

Start time	14:00
Seabird SBE37 SMP CTD – serial number **3209**	
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 SMP CTD – serial number **3212**	
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 SMP CTD – serial number **3213**	
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 SMP CTD – serial number **3214**	
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 SMP CTD – serial number **3215**	
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 SMP CTD – serial number **3216**	
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 SMP CTD – serial number **3217**	
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 SMP CTD – serial number **3890**	
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 IMP CTD – serial number **4708**	
Inductive ID	01
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 IMP CTD – serial number **4709**	
Inductive ID	02
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 IMP CTD – serial number **4710**	
Inductive ID	48
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 IMP CTD – serial number **4711**	
Inductive ID	40

Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 IMP CTD – serial number **4712**	
Inductive ID	05
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
Seabird SBE37 IMP CTD – serial number **4713**	
Inductive ID	06
Sample interval	1800 seconds
Start date	27/10/07
Start time	14:00
InterOcean S4AD – serial number **35612577**	
Header	MAR1_D324
On time	1 min
Cycle time	30 mins
Average count	120
Channels at average	Hx, Hy, C, T, D
Special Record Block count	48
Channels at SRB	Hx, Hy, C, T, D
Start date	27/10/07
Start time	16:00

MAR0

Seabird SBE37 IMP CTD – serial number **4180**	
Inductive ID	24
Sample interval	1800 seconds
Start date	26/10/07
Start time	22:00
Seabird SBE37 IMP CTD – serial number **4181**	
Inductive ID	25
Sample interval	1800 seconds
Start date	26/10/07
Start time	22:00
Seabird SBE37 IMP CTD – serial number **4183**	
Inductive ID	27
Sample interval	1800 seconds
Start date	26/10/07
Start time	22:00
Seabird SBE26 BPR – serial number **389**	
Tide sample interval	30
Tide measurements per wave burst	9999
Wave samples/burst	68
No. of 0.25s periods to integrate waves	33
Start date	26/10/07
Start time	21:00

Appendix C: Mooring Recovery Logsheets

RAPID MOORINGS **CRUISE D324** **MRG ID:** EBM6_1_2006

Eastern Atlantic
26N

RECOVERY

NMFSS ID ID 2006/52

LATITUDE

DATE 07/11/07

LONGITUDE

DAY 311

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

SITE ARRIVAL

COMPLETION TIME

TIME Overnight

WATER DEPTH

RELEASE TIME

ITEM	SER NO	COMMENT	TIME
VHF Beacon	SN U08-012		0707
LRT	SN 240841-010		0707
SBE	37 SN 3211	Lost	
STAUFF Clamp		lost	
Clamp		Not recovered	
ANCHOR		Not recovered	

COMMENTS

Check position at night
142m range at 1908 06/11/07
Fired at 1st daylight

07/11/07
Grappled 0707 - difficulty hooking
No bottom float
Amount of growth on release indicates float lost a long time ago

RAPID MOORINGS CRUISE D324

MRG ID: EBM5_1_2006

Eastern Atlantic
26N

RECOVERY

NMFSS ID ID 2006/51

LATITUDE

DATE 06/11/07

LONGITUDE

DAY 310

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

SITE ARRIVAL

COMPLETION TIME

TIME 1759

WATER DEPTH

RELEASE TIME 1800

ITEM	SER NO	COMMENT	TIME
VHF Beacon	SN U08-007		1547
LRT	SN 242200-004		1547
SBE	37 SN 3203	Not recovered	
STAUFF Clamp		Not recovered	
Clamp		Not recovered	
ANCHOR		Not recovered	

COMMENTS

1800
189.6m release confirmed
185m
range not changing, release possibly jammed by fouling
running out of daylight
Abandon the mooring

07/11/07
0811 position for dragging
Attempt recovery again at 0928
Still not coming up
Attempt dragging

Ranged within 30m horizontal distance - Should have slant ranges of 170m
Was within ranges of 260m. Too far so think moved by drag.
Retry releasing.
Spotted on surface and grappled at 15.47 07/11/07
No bottom float and MicroCAT
Growth indicates long since lost

Close inspection of release shows that bottom of the release was hit by drag wire which scraped off enough growth to allow release block to drop

RAPID MOORINGS CRUISE D324

MRG ID: EBM4_1_2006

Eastern Atlantic
26N

RECOVERY

NMFSS ID ID 2006/50

LATITUDE

DATE 06/11/07

LONGITUDE

DAY 310

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

SITE ARRIVAL

COMPLETION TIME

TIME 1730

WATER DEPTH

RELEASE TIME 1732

ITEM	SER NO	COMMENT	TIME
VHF Beacon	SN U08-014	A lot of growth	1747
LRT	SN 242200-003		
SBE	37 SN 3250		
STAUFF Clamp			1747
Clamp		Not recovered	
ANCHOR		Not recovered	

COMMENTS 271m confirmed

1733:40 232m
1734:40 13.5m
1739:00 on surface

Grappled 1747

RAPID MOORINGS **CRUISE D324** **MRG ID:** EBM1_1_2006

Eastern Atlantic 26N **RECOVERY** **NMFSS ID** ID 2006/47

LATITUDE 27 53.52'N **DATE06/11/07**

LONGITUDE 13 24.83'W ***DAY 310***

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

SITE ARRIVAL

COMPLETION TIME ***TIME*** 1519

WATER DEPTH

RELEASE TIME 1544

ITEM	SER NO	COMMENT	TIME
VHF Beacon	SN U08-013	Aerial broken on recovery	1603
LRT	SN 240841-009		
SBE	37 SN 3481		
STAUFF Clamp			
Clamp			1603
ANCHOR		Not recovered	

COMMENTS

1st Attempt at recovery 1522

1544 514.4m
1545 515.9m
1547 480.2m confirmed release
154830 426m
46m/min
154930 380.3m
45m/min
155030 335m
1557 spotted approx 50m away

Grappled 1603

RAPID MOORINGS CRUISE D324

MRG ID: EBH4_4_2006

Eastern Atlantic
26N

RECOVERY

NMFSS ID ID 2006/43

LATITUDE 27 50.79'N

DATE 06/11/07

LONGITUDE 13 32.73'W

DAY 310

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1401

SITE ARRIVAL

COMPLETION TIME 1414

TIME 1331

WATER DEPTH 1041m u/c 1045m corr

RELEASE TIME 1337

ITEM	SER NO	COMMENT	TIME
Billing float with light	S01-180	√	1403
17' glass		√	1400
Ceramic swivel		√	1403
SBE	4470	√	1403
SBE	4799	√	1407
SBE	4800	√	1411
2x17' glass		√	1411
Titanium swivel		√	1411
ACOUSTIC RELEASE	RT861 SN 323 ARM 14D3 REL 1455	√	1411
ANCHOR	600KG	Not recovered	

COMMENTS

1345 on surface
grappled at 1359

RAPID MOORINGS CRUISE D324

MRG ID: EBH3

RECOVERY

Eastern Atlantic 26N

NMFSS ID 2006/12

LATITUDE 27 048.62'N

DATE 06/11/07

LONGITUDE 13 44.78'W

DAY 310

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

COMMENCE TIME 1125

TIME 1035

COMPLETION TIME 1150

WATER DEPTH

RELEASE TIME 1050

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	n/a		1125
RECOVERY LINE	n/a		1133
BILLINGS FLOAT	n/a		1133
LIGHT BEACON	TO5-076		1133
CHAIN	n/a		1133
SWIVEL	n/a		1133
2 OFF FLOATS	n/a		1133
SBE 37	3218		1133
2 OFF FLOATS	n/a		1133
SBE 37	3276		1137
2 OFF FLOATS	n/a		1137
SBE 37	3928		1141
2 OFF FLOATS	n/a		1144
SBE 37	4307		1144
SBE 37	3930		1149
2 OFF FLOATS	n/a		1149
SWIVEL	n/a		1149
CHAIN	n/a		1149
ACOUSTIC RELEASE	AR861 SN265		1149
CHAIN	n/a	Not recovered	
600KG ANCHOR	n/a	Not recovered	

COMMENTS

No contact
1050 try blind release
1057 confirm release 1126.5
but then spurious ranges and no more comms

sighted at 1103 on surface
release reluctant o talk
Grappled 1125
Delay as concern over the lie of mooring
Start hauling 1130

RAPID MOORINGS **CRUISE D324** **MRG ID:** EBH2

RECOVERY

Eastern Atlantic 26N **NMFSS ID** 2006/13

LATITUDE 27 35.9'N **DATE** 06/11/07

LONGITUDE 14 13.2'W **DAY** 310

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

COMMENCE TIME 0710 **TIME** 0626

COMPLETION TIME 0738

WATER DEPTH 2010m corr **RELEASE TIME** 0631

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	n/a		0722
RECOVERY LINE	N/a		0722
BILLINGS FLOAT	N/a		0722
LIGHT BEACON	SO1-191		0722
CHAIN	n/a		0722
SWIVEL	n/a		0722
2 OFF FLOATS	n/a		0722
SBE 37	3931		0722
2 OFF FLOATS	n/a		0730
SBE 37	3932		0730
SBE 37	3933		0736
2 OFF FLOATS	n/a		0737
SWIVEL	n/a		0737
CHAIN	n/a		0737
ACOUSTIC RELEASE	SN 497	AR861	0737
CHAIN	n/a	Not recovered	
600KG ANCHOR	n/a	Not recovered	

COMMENTS

Grappled 0719

Shackle at swivel very rusty

RAPID MOORINGS CRUISE D324

MRG ID: EBH1

RECOVERY

Eastern Atlantic 26N

NMFSS ID 2006/14

LATITUDE 27 16.74'N

DATE 05/11/07

LONGITUDE 25 25.67'W

DAY 309

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

COMMENCE TIME 1230

TIME 1105

COMPLETION TIME 1258

RELEASE TIME 1149

WATER DEPTH 2995m u/c

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	n/a		123630
RECOVERY LINE	n/a		1241
BILLINGS FLOAT	4 PACK H01-009		1241
LIGHT BEACON	S01-186	√	1241
CHAIN	n/a		1241
SWIVEL	n/a		1241
4 OFF FLOATS	n/a		1241
SBE 37	3934	√	1241
2 OFF FLOATS	n/a		1250
SBE 37	4305	√	1258
2 OFF FLOATS	n/a		1258
SWIVEL	n/a		1258
CHAIN	n/a		1258
ACOUSTIC RELEASE	SN 319	AR861√	1258
CHAIN	n/a		1258
600KG ANCHOR	n/a		

COMMENTS

ARM and ARM
14CF + 14CF
114630 3125.2
3120
3096

ARM + DIAG
114850 3058 VERT 8.9V
ARM + ARM
114930 no reply
115100 no reply
115300 release ok
115600 2426m 1838m rel ok
115700 no
115800 2228
115900 2124
1215 on surface
1219 2nd pack on surface
1223 3rd pack on surface

99m/min

RAPID MOORINGS CRUISE D324 MRG ID: EBL4

RECOVERY

Eastern Atlantic 26N NMFSS ID 2006/18

LATITUDE 27 17.1'N **DATE** 309

LONGITUDE 15 25.7'W **DAY** 05/11/07

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

COMMENCE TIME 1400 **TIME** 1300

COMPLETION TIME 1412

WATER DEPTH 2990 m u/c

RELEASE TIME

ITEM	SER NO	COMMENT	TIME
Pickup float	n/a		1400
Pickup line	n/a		
Billings float	4 pack	Upside down in water	1404
Radio beacon on float	U01-022	Yes	
Light on float	T05-099	T05-079	
Raft of glass	N/a	5 OFF 17" Glass	1407
SBE26 BPR	397	yes	1412
Acoustic release	498	AR 861 yes	1412
Anchor 280KG	n/a		

COMMENTS

Release 1302
70m/min
ETA 1345
13.42 seen surface

RAPID MOORINGS CRUISE D324

MRG ID: EBH0

RECOVERY

Eastern Atlantic 26N

NMFSS ID 2006/15

LATITUDE 26 25.37

DATE 5/11/07

LONGITUDE 16 13.93

DAY 309

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

COMMENCE TIME 0703

TIME 0555

COMPLETION TIME 0711

RELEASE TIME unknown

WATER DEPTH

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	n/a	Hooked with boathook	0703
RECOVERY LINE	n/a		
BILLINGS FLOAT	4 PACK	Upside down	0708
LIGHT BEACON	H01-009	working	
CHAIN	n/a		
SWIVEL	n/a		
4 OFF FLOATS	n/a		
SBE 37	4306		0708
2 OFF FLOATS	n/a		0711
SWIVEL	n/a		
CHAIN	n/a		
ACOUSTIC RELEASE	SN 318	AR861	
CHAIN	n/a		
600KG ANCHOR	n/a		

COMMENTS

Release command not sent at 0558 but ranges approx 1300m
Shallower than expected. 1st telem command was sent whilst approaching at about 0535 but not a release
Range decreasing at 80m/min so assume ranges accurate

Spotted 0624
Still dark, spotted with llight.

RAPID MOORINGS CRUISE D324

MRG ID: EBHi_2006

Eastern Atlantic 26N

RECOVERY

NMFSS ID ID 2006/44

LATITUDE 24 56.9105

DATE 16/10/07

LONGITUDE 21 15.59701

DAY 289

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME

SITE ARRIVAL

COMPLETION TIME 0917

TIME 0611

WATER DEPTH

RELEASE TIME 0653

ITEM	SER NO	COMMENT	TIME
Billing float with light	SN T05-077		0848
12' glass			0836
2x17' glass			0848
SBE	3253 √		0853
2x17' glass			0901
SBE	4472	Wrong way round, same as deployment	0915
SBE	4475 √	logsheet so deployment not strictly wrong tangled (see photo)	0901
4x17' glass			0917
ACOUSTIC RELEASE	RT861 SN 282	ARM 14BA REL 1455	0917
ANCHOR	600KG	Not retrieved for some reason	

COMMENTS

1st Attempt at communications 0614 16/10/07
No comms using hull mounded transmitter
Good comms using overside 0634
Confirms release 0653

065712 4131 80m/min
065812 4048 80m/min
065912 2605 x
065943 x 84m/min
070012 388184m/min
Estimated surface at 0735

Suspect low battery on release
0736 on surface
Grappled 0836

Long time delay because of awkward lie of mooring

RAPID MOORINGS Cruise D324

MRG ID: EB1

Eastern Atlantic 26N ***RECOVERY***

NMFSS ID

LATITUDE

DATE 18/10/07

LONGITUDE

DAY 291

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

COMMENCE TIME 0842 Grapel

TIME 0719

COMPLETION TIME

WATER DEPTH

RELEASE TIME 0756

ITEM	SER NO	COMMENT	TIME
Glass Pickup Float	n/a	Yes	0843
15m polyprop recovery line	n/a	√	0846
24” Steel sphere	n/a	√ light growth	0846
SBE37 MicroCAT (SMP)	3207	√	0846
Argos Beacon		√ s/n 094 ID 24027	0846
Light		√ no light fitted	0846
SBE37 MicroCAT (SMP)	3208	√no growth	0854 30
SBE37 MicroCAT (SMP)	3209	√	0858
40” Steel Sphere	n/a	1m chain + swivel below	0901
Argos Beacon		√ s/n 079 ID 24335	0901
Light		√ s01 - ?	0901
SBE37 MicroCAT (SMP)	3212	√	0906
SBE37 MicroCAT (SMP)	3213	√	0908
SBE37 MicroCAT (SMP)	3214	√	0912
4 x glass string	n/a	√	0915
SBE37 MicroCAT (SMP)	3215	√ sensor guard loose 4x/5 screws missing, strumming?	0915
SBE37 MicroCAT (SMP)	3216	√	0921
SBE37 MicroCAT (SMP)	3217	√	0923
4 x glass string	n/a	√	0926
SBE37 MicroCAT (SMP)	3890	√	0926
SBE37 MicroCAT (IMP)	4178	√	0933
SBE37 MicroCAT (IMP)	4179	√	0935

5 x glass string	n/a	√ tangled together	0938
SBE37 MicroCAT (IMP)	4180	√ tangled together	0938
SBE37 MicroCAT (IMP)	4181	√	0944
SBE37 MicroCAT (IMP)	4183	√	0947
4 x glass string	n/a	√	0951
SBE37 MicroCAT (IMP)	4708	√	0956
SBE37 MicroCAT (IMP)	4709	√	1001
SBE37 MicroCAT (IMP)	4710	√	1003
4 x glass string	n/a	√	1010
SBE37 MicroCAT (IMP)	4711	√	1018
SBE37 MicroCAT (IMP)	4712	√	1028
4 x glass string	n/a	√	1034
SBE37 MicroCAT (IMP)	4713	√	1043
SBE37 MicroCAT (IMP)	4714	√	1053
5 x glass string Main Buoy on surface (08:02)	n/a	√ Top 3 glass imploded. MicroCAT tangled in with glass during recovery and knocked on deck a few times	1103
SBE37 MicroCAT (IMP)	4715	√ tangled in with glass floats	1103
SBE37 MicroCAT (IMP)	4717	√ Problem with aft starboard crane. Lost power. MicroCAT left suspended above deck from 1124 to 1132. Crane overheated, cut out at 75	1124-1132
Adjustment wires (50+50+20+20+10m)	n/a		
8 x glass string	n/a	√	1145
Acoustic release (dualled)	AR 861	260 + swivel √	1145
Acoustic release (dualled)	AR861	262 √	1145
30m Nylon (should be nylon but might be polyester	n/a		
10m Chain	n/a		

Recovery time 3 hrs: From arrival at site 4.5hrs

COMMENTS

RAPID MOORINGS Cruise D324

MRG ID: EB2

RECOVERY

Eastern Atlantic 26N

NMFSS ID 2006/55

LATITUDE 23 52.03'N

DATE 17/10/07

LONGITUDE 24 10.39'W

DAY 290

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

COMMENCE TIME 1119

TIME 0850

COMPLETION TIME 1254

RELEASE TIME 091430

WATER DEPTH

ITEM	SER NO	COMMENT	TIME
Glass Pickup Float	n/a		1137
15m polyprop recovery line	n/a		
2 x glass parallel	n/a		
SBE37 (IMP) MicroCAT	4718	√	1138
SBE37 (IMP) MicroCAT	4719	√	1203
2 x glass string	n/a	√	1215
SBE37 (IMP) MicroCAT	4720	√	1215
SBE37 (IMP) MicroCAT	4721	√	1228
2 x glass string	n/a	√	1238
SBE37 (IMP) MicroCAT	4722	√ twisted around glass string above	1238
SBE37 (IMP) MicroCAT	4723	√	1248
Swivel	n/a	√	1251
6 x glass string	n/a	3 imploded	1251
Acoustic release (Dualled)	AR861	361√	1251
Acoustic release (Dualled)	AR861	365√	1251
30m nylon braid (should be nylon but might be polyester)	n/a	Not recovered	
10m chain	n/a	Not recovered	
Anchor 340KG	n/a	Not recovered	

COMMENTS

1. No answers from other release on ship's Tx [s/n 027]
2. Moved to o/s Tx at 0908. Inconsistent ranges and low voltage
3. Release at 091403 [Release ok]

4. Diagnostics
   091645 4604 54m./min
   091745 4550 54m./min
   091845 ---
   091945 4442 54m./min

   ETA 1000

5. On surface 0950
6. Bottom pack of glass not visible
7. Grappled 1119

8. Port Aft crane stopped 112210
9. Stb. Aft crane used 1123
10. Going at 1126. New block mouted stb. Aft/u/s
11. Aframe not usable due to hydraulic leaks
12. Rigging stopper on deck. Pull mooring over back using Lebus ST portable
13. Port crane usable again 1152
14. Rope stuck in winch and released 1218
15. Glass and 4722 twisted. Rope shackled together 1240

RAPID MOORINGS CRUISE D324

MRG ID: EBL3

RECOVERY

Eastern Atlantic 26N

NMFSS ID 2006/17

LATITUDE 23 53.99'N

DATE 17/10/07

LONGITUDE 24 03.16'W

DAY 290

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

COMMENCE TIME 0617

TIME 0609

COMPLETION TIME

WATER DEPTH

RELEASE TIME 0617

ITEM	SER NO	COMMENT	TIME
Pickup float	n/a		0737
Pickup line	n/a		
Billings float	n/a	4 pack	0741
Radio beacon on float	SN U01-021	Yes, removing recovery line	0741
Light on float	SN T05-078	yes	0741
4 OFF 17" Glass	n/a	Yes	0741
4 OFF 17" Glass	n/a	Yes	0741
SBE26 BPR	389	Yes	0754
SBE26 BPR	388	Yes, but flooded	0754
Acoustic release	AR861 368		0754
Acoustic release	AR861 320		0754
Anchor 280KG	n/a	Not recovered	

COMMENTS

RAPID MOORINGS CRUISE D324

MRG ID: MAR3

RECOVERY

Eastern Atlantic 26N

NMFSS ID 2006/23

LATITUDE 23 50.97'N

DATE 22/10/07

LONGITUDE 41 5.96'W

DAY 295

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL TIME

COMMENCE TIME 1436 On surface

COMPLETION TIME 1657

WATER DEPTH

RELEASE TIME 1400

ITEM	SER NO	COMMENT	TIME
RECOVERY BUOY			1525
LIGHT			1535
BILLINGS			1535
6x17" GLASS SPHERES			1535
SBE	3282		1540
SBE	4461		1549
SBE	4462		1558
SBE	4464	Parafil tangles with 3/16	1613
4x17" GLASS SPHERES		Swivel	1614
SBE	4466		1632
S4	35612567		1650
SBE	4468	End cap off, but retrieved by clamp	1650
4x17" GLASS SPHERES		No swivel	1657
4x17" GLASS SPHERES		Swivel	1632
ACOUSTIC RELEASE	LOWER	AR861 SN=370 ARM 14FA REL 1455	1646 pulled in by hand
ANCHOR			

COMMENTS

Deployed D304 (spring 06)
Ascent rate around 76m/min
1st range 1353

RAPID MOORINGS CRUISE D324

MRG ID: MARL2

RECOVERY

Mid Atlantic 26N

NMFSS ID MARL2-1-200521

LATITUDE 23 51.309'N

LONGITUDE 41 05.583'W

DATE 22/10/07

DAY 295

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1319 Came to surface

COMPLETION TIME 1346

SITE ARRIVAL TIME 1215

WATER DEPTH

RELEASE TIME 1216

ITEM	SER NO	COMMENT	TIME
Recovery float	n/a		1335
Billings float	n/a	imploded	1340
Radio beacon on float		Radio beacon did not work	1340
6 x 17" glass	n/a		1346
1st SBE26	390		1340
2nd SBE26	391	s/n 391 not 420	1340
Acoustic release	358	CAF 14EE	
Tripod Assembly			
Anchor			

COMMENTS

80m/min

RAPID MOORINGS CRUISE D324

MRG ID: MAR1

RECOVERY

Eastern Atlantic 26N

NMFSS ID 2006/21

LATITUDE 24 11.93'N

DATE 25/10/07

LONGITUDE 49 44.11'W

DAY 298

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL TIME 0906

COMMENCE TIME 1025 Grapel to 24" [one hook caught a

COMPLETION TIME 1330 Shackle]

WATER DEPTH 1330

RELEASE TIME 0914

ITEM	SER NO	COMMENT	TIME
SBE	3918	Pulled aboard by hand, lots of growth on wire	1028
24" STEEL SPHERE		With swivel	1034
SBE	3910		1039
ARGOS BEACON	SN253	ID42745	1039
48" STEEL SPHERE		With Swivel	1039
SBE	3911		1039
SBE	3912		1100
SBE	3913		1105
SBE	3914		1111
SBE	3915		1117
SBE	3916		1123
SBE	3900		1133
8X17" GLASS SPHERES		With Swivel, big knot	1138
SBE	3901		1149
SBE	3902		1200
SBE	3903		1211
SBE	3904	Tangled with all of below	1220
8X17" GLASS SPHERES		With Swivel, tangled with above MicroCAT	1220
SBE	3891	Tangled	1326
SBE	3892	Tangled	1317
SBE	3893	Broken ad tangled	1250
S4	35612573	Tangled	1250
6X17" GLASS SPHERES		With Swivel tangled with all of above	1306
ACOUSTIC RELEASE	AR861	SN246	1312
ACOUSTIC RELEASE	RT661	SN163	1312
ANCHOR		Not recovered	

COMMENTS

1. Knot around 8Xglass spheres (1800m) 1138
2. Spheres at 3500m and mircrocat knotted together 1221
3. Wire cut to open knot 1226
4. Change of wire drum 1230-123
5. All from 3500m not in order

RAPID MOORINGS CRUISE D324

MRG ID: MAR2

RECOVERY

Eastern Atlantic 26N

NMFSS ID 2006/22

LATITUDE 24 10.07'N

DATE 25/10/07

LONGITUDE 49 41.56'W

DAY 298

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

COMMENCE TIME 1538

TIME 1409

COMPLETION TIME 1732

WATER DEPTH 5132m

RELEASE TIME 1413

ITEM	SER NO	COMMENT	TIME
BILLINGS + LIGHT		Light √	1548
RECOVERY BUOY		√	1546
8X17" GLASS SPHERES		Swivel below glass√	1546
SBE	3264	√	1552
SBE	3239	√	1559
SBE	3483	√	1608
SBE	4474	√	1516
6X17" GLASS SPHERES		√ chain, wire and swivel tangled	1618
SBE	3486	√	1631
SBE	3248	√	1642
SBE	3249	√ tangled with glass,wire is taped for further recovery	1652
6X17" GLASS SPHERES		√	1652
SBE	3259	√	1706
SBE	3919	√	1716
S4	35612572	Tangled with below	1727
4X17" GLASS SPHERES		Tangled	1727
SBE	3284	Tangled, MicroCAT hit side of ship	1727
4X17" GLASS SPHERES		Swivel below tangled with above	1727
ACOUSTIC RELEASE	495	RT861 ARM: 15A4 REL 1555	1727

COMMENTS

Approx 1435 main buoyancy on surface
1514 second pack on the surface

RAPID MOORINGS CRUISE D324

MRG ID: MARL1

RECOVERY

Mid Atlantic 26N

NMFSS ID

LATITUDE

DATE 26/10/07

LONGITUDE

DAY 2999

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL TIME 1240

COMMENCE TIME 1418

COMPLETION TIME 1430

RELEASE TIME 1249 (not confirmed)

WATER DEPTH

ITEM	SER NO	COMMENT	TIME
Recovery float	n/a		1418
Billings float	n/a		
Radio beacon on float			
6 x 17" glass	n/a		
1st SBE26	394		
2nd SBE26	414		
Acoustic release	249	CAF 14A6	
Tripod Assembly			1430
Anchor			

COMMENTS

Release ok 1250 but poor comms do not know if correct
No consistent ranges

Trying X-Dir over side
Rob has wrong codes
Start new release using correct code at 1258 35
But still poor comms
Measured ascent approx 75m/min

Spotted on surface at 1403

Remarkably clean considering been in water for 2.5 years slight cover of green slime on release

On surface 1403

Appendix D: Mooring Deployment Logsheets

RAPID MOORINGS **CRUISE D324** **MRG ID:** EBM6

Eastern Atlantic 26N

DEPLOYMENT

NMFSS ID

LATITUDE 27 55.17'N **DATE 07/11/07**

LONGITUDE 13 19.92'W ***DAY 311***

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1843

SITE ARRIVAL TIME

COMPLETION TIME 184520

WATER DEPTH 95m

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT		√	1843
RECOVERY LINE		√	
VHF BEACON		√	
2 X GLASS SPHERE		√	
SBE37	3916		
SONARDYNE LRT RELEASE	841010	1D 006, F1	
ANCHOR			1845

MOORING METHOD

COMMENTS Target 27 55.17'N
Wd = 100 13 19.92'W

All SBE tied to release with blue rope, then to mast and through buoyancy.
Chris's 'special' chilli paste smeared around the release end.

M6 to M5 1.6
M5 to M4 0.4
M4 to M1 2.5

RAPID MOORINGS

CRUISE D324

MRG ID: EBM5

Eastern Atlantic
26N

DEPLOYMENT

NMFSS ID

LATITUDE 27 54.6'N

DATE 07/11/07

LONGITUDE 13 21.6'W

DAY 311

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1907

SITE ARRIVAL

COMPLETION TIME 1910

TIME 1906

WATER DEPTH 176

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			1907
RECOVERY LINE			
VHF BEACON			
2 X GLASS SPHERE			
SBE37	3915		
SONARDYNE LRT RELEASE	245798-003	1D 009, F1	
ANCHOR			

MOORING METHOD

COMMENTS
Wd =175

Target 27 54.63'N
13 21.57'W

RAPID MOORINGS CRUISE D324

MRG ID: EBM4

Eastern Atlantic
26N

DEPLOYMENT

NMFSS ID

LATITUDE 27 54.46'N

DATE 07/11/07

LONGITUDE 13 22.08'W

DAY 311

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1920

SITE ARRIVAL

COMPLETION TIME 1922

TIME 1920

WATER DEPTH 275m

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			
RECOVERY LINE			
VHF BEACON			
2 X GLASS SPHERE			
SBE37	3914		
SONARDYNE LRT RELEASE	242200-003	1D 004 F1	
ANCHOR			

MOORING METHOD

COMMENTS
Wd=250

Target 27 54.50'N
13 21.97'W

RAPID MOORINGS CRUISE D324

MRG ID: EBM1

Eastern Atlantic
26N

DEPLOYMENT

NMFSS ID

LATITUDE 27 53.68'

DATE 07/11/07

LONGITUDE 13. 24.33'W

DAY 311

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1939

SITE ARRIVAL

COMPLETION TIME 194120

TIME 1938

WATER DEPTH 420m

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			
RECOVERY LINE			
VHF BEACON			
2 X GLASS SPHERE			
SBE37	3913		
SONARDYNE LRT RELEASE	240841-009	1D 001 F1	
ANCHOR			

MOORING METHOD

COMMENTS
Wd=500

Target 27 53.64'N
13 24.48'W

RAPID MOORINGS CRUISE D324

MRG ID: EBH4

Eastern Atlantic 26N

DEPLOYMENT

NMFSS ID

LATITUDE 27 15.014'N

DATE 07/11/07

LONGITUDE 13 32.380'W

DAY 311

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 2043

SITE ARRIVAL

COMPLETION TIME 210631

TIME 2042

WATER DEPTH 1041m

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT	√	40m +60m 4mm red	2043
RECOVERY LINE	√		2043
LIGHT	√		2043
BILLINGS FLOAT	√		2043
1M CHAIN SWIVEL	√		2043
2 MINI TRIMSYN	√		2043
SBE37	3892		2044
2 MINI TRIMSYN		100m of 4mm red	204840
SBE37	3900		204840
2 MINI TRIMSYN			2052
SBE37	3901		2052
2 MINI TRIMSYN			2054
SBE37	3903		2054
2 MINI TRIMSYN			2057
SBE37	3904		2057
SBE37	3912		2100
2 GLASS SPHERES			2100
1M CHAIN SWIVEL			2100
ACOUSTIC RELEASE	370		2100
1M CHAIN			2100
600KG ANCHOR		200m polyester adjustment above anchor	210631

MOORING METHOD

COMMENTS

Target 27 51.03'N

Wd=1047 13 32.37'W

RAPID MOORINGS CRUISE D324

MRG ID: EBH3

DEPLOYMENT

Eastern Atlantic 26N

NMFSS ID

LATITUDE 27 48.845621'N

LONGITUDE 13 44.45031'W

DATE 06/11/07

DAY 310

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

TIME 1150

COMMENCE TIME 1210

COMPLETION TIME 1223

WATER DEPTH 1405m

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			1210
RECOVERY LINE			1210
LIGHT BEACON	501-191		1210
BILLINGS FLOAT			1210
1M CHAIN		+ Swivel	1210
2 MINI TRIMSYN			1210
SBE37	3259		1210
2 MINI TRIMSYN			1213
SBE37	3264		1213
2 MINI TRIMSYN			1215
SBE37	3483		1215
2 MINI TRIMSYN			1217
SBE37	3486		1217
SBE 37	3891		1223
2 GLASS SPHERES			1223
1M CHAIN		+ Swivel	1223
ACOUSTIC RELEASE	495		1223
CHAIN			1223
600KG ANCHOR		700kg labeled	1223

MOORING METHOD

COMMENTS

RAPID MOORINGS **CRUISE D324** **MRG ID:** EBH2

DEPLOYMENT

Eastern Atlantic 26N **NMFSS ID**

LATITUDE 27 36.71'N **DATE** 06/11/07

LONGITUDE 14 12.75'W **DAY** 310

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

COMMENCE TIME 0552 **TIME** 0545

COMPLETION TIME 0608

WATER DEPTH 2011m u/c 2011 corr

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			0552
RECOVERY LINE			0553
LIGHT BEACON		yes	0553
BILLINGS FLOAT			0553
1M CHAIN			0553
2 GLASS SPHERES			0553
SWIVEL		?	0553
SBE 37	3248		0553
2 GLASS SPHERES			0558
SBE 37	3249		0558
SBE 37	4474	Wrong clamp, Stopped to change	0606
2 GLASS SPHERES			0606
1M CHAIN SWIVEL		Yes	0606
ACOUSTIC RELEASE	282		0606
1M CHAIN			060730
600KG ANCHOR			

MOORING METHOD

Basket

COMMENTS

Target 27 36.2'N 14 12.8'W with 2010 corr [correction = 0] p19 center
CHG 50°, wind speed and dawn?

RAPID MOORINGS CRUISE D324

MRG ID: EBH1

DEPLOYMENT

Eastern Atlantic 26N

NMFSS ID

LATITUDE 27 16.93'N

DATE 05/11/07

LONGITUDE 15 25.65'W

DAY 309

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

COMMENCE TIME 1450

TIME 1449

COMPLETION TIME 1500

WATER DEPTH 3001m u/c 3009m corr

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			1450
RECOVERY LINE			
LIGHT			
BILLINGS FLOAT			
1M CHAIN SWIVEL			
4 X 17" GLASS			
SBE37	3239	yes	
2 X 17" GLASS			1455
SBE 37	3284		1459
2 X 17" GLASS			
1M CHAIN SWIVEL			
ACOUSTIC RELEASE	358		
1M CHAIN			
ANCHOR 600KG			1500

MOORING METHOD

Release 1500

COMMENTS

Target: 27 17.02'N
15 25.41'W

RAPID MOORINGS CRUISE D324

MRG ID: EBL4

Eastern Atlantic
26N

DEPLOYMENT

NMFSS ID

LATITUDE 27 17.18'N

DATE 05/11/07

LONGITUDE 15 25.75'W

DAY 309

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1526

SITE ARRIVAL

COMPLETION TIME 1530

TIME 1522

WATER DEPTH 2993

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			1526
RECOVERY LINE			1526
LIGHT	H01 - 009		1527
VHF BEACON	T01 - 145		1527
BILLINGS FLOAT		McLane Type	1527
1M CHAIN			1527
2 X GLASS SPHERES			1527
ACOUSTIC RELEASE	826		1530
BPR	394		1530
TRIPOD ASSEMBLY			1530
ANCHOR 280 KG			1530

MOORING METHOD

COMMENTS
10m rope
3 glass

Target 27 17.20'N
15 25.33'W

RAPID MOORINGS CRUISE D324

MRG ID: EBHi

Eastern Atlantic 26N

DEPLOYMENT

NMFSS ID

LATITUDE 24 57.14N

DATE 16/08/07

LONGITUDE 21 15.92W

DAY289

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1008

SITE ARRIVAL

TIME 0950

COMPLETION TIME 1035

WATER DEPTH 4470m a/c [Area 18, 4501m corr]

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT		Yellow	1008
RECOVERY LINE		Yellow/black shackled to billings	
LIGHT		Novatech	
BILLINGS FLOAT		No flag	
1M CHAIN			
2 X GLASS SPHERES		Orange hats	
SWIVEL			1008 24
SBE37	3479* cell up		1008 40
2 X GLASS SPHERES			1019 11
SBE37	3480* cell up		1019 18
RBR		RBR s/n 009656 20cm below 3479	
SBE37	3482 cell down		1028 13
4 X GLASS SPHERES			1028 20
1M CHAIN			
SWIVEL		Elkins EEI (Marked Rapid)	
ACOUSTIC RELEASE	354	with stainless link insulated to	1034 12
1M CHAIN			
560 KG ANCHOR		Release 1455 Pinger 1447 Dianostic 1449	

MOORING METHOD

COMMENTS

Planned position
24 57.15N
21 15.46W

Ranges after release
103915 676m
(100m/min)
104015 770m
104215 n/a
104315 1057
(88m/min)
104415 1145

1. Chains down 1004
2. Start 0.8nm from planned position
3. On station to ping
4. 103715 middle buoyancy submerged
5. 104227 top submerged

RAPID MOORINGS CRUISE D324

MRG ID: EB1

DEPLOYMENT

Eastern Atlantic 26N

NMFSS ID

LATITUDE	23 50.63N	**DATE**	18/08/07
LONGITUDE	24 05.14W	**DAY**	291

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

COMMENCE TIME	1417	**TIME**	1400
COMPLETION TIME	1732		

WATER DEPTH

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT		TRIMSYN	1417
RECOVERY LINE		Black and yellow	1417
TRIMSYN X 3			1417
SBE37	3224		1417
24” STEEL SPHERE and ARGos BEACON	√	Argos PTT:59620	1421
SBE 37	3251		1421
SBE 37	3268		1427
ARGOS BEACON	√	s/n 255 ID 42747	1433
37” McLa STEEL SPHERE	√		1433
1M CHAIN SWIVEL	√		1433
SBE 37	3272	250m	1437
SBE37	3484	325m	1437
SBE37	5484	400m	1445
4 X 17” GLASS FLOAT	√		1453
SBE37	5485	500m	1453
SBE37	5486	700m	1501
4 X 17” GLASS FLOAT	√		1508
SBE37	5487	900m	1513
4 X 17” GLASS FLOAT	√	Plus swivel	1523
SBE37	5488	1100m	1523
SBE37	3253	1400m	1534
4 X 17” GLASS FLOAT	√		1541
SBE37	4472	1800m	1548
4 X 17” GLASS FLOAT	√		1601
SBE37	4475	2500m	1607
4 X 17” GLASS FLOAT	√		1626
SBE37	4718	3500m	1633
4 X 17” GLASS FLOAT	√	Plus swivel	1647
4 X 17” GLASS FLOAT	√		1707
SBE37	4719	4500m	1707
8 X GLASS FLOAT	√		1734
SWIVEL	√		1734
ACOUSTIC RELEASE 1	824		1734
ACOUSTIC RELEASE 2	823		1734
30M NYLON BRAID	√		1734-1752
10M CHAIN	√		1752

1400 KG ANCHOR	√	Chain anchor	1752

MOORING METHOD

COMMENTS

RAPID MOORINGS — CRUISE D324

MRG ID: EBL3

Eastern Atlantic
26N

DEPLOYMENT

NMFSS ID

LATITUDE 23 53‘9.88”N 23 53.2’N

DATE03/11/07

LONGITUDE 24 41’20.73”W 24 41.3’W

DAY307

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 062829

SITE ARRIVAL

COMPLETION TIME 063130

TIME 0620

WATER DEPTH 5045m

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT		Orange	062829
RECOVERY LINE		Yellow/black	
LIGHT	NONE	No light	
VHF BEACON	E (d=1) – (d=57)	Novatech uhf	
BILLINGS FLOAT		Type with flag	062900
CHAIN			
4 X GLASS SPHERES		Yes	
4 X GLASS SPHERES		Yes	062940
ACOUSTIC RELEASE	827		063130
ACOUSTIC RELEASE	361		
BPR	0390		
BPR	0391		
TRIPOD ASSEMBLY			
ANCHOR 280 KG		railwheel	

MOORING METHOD

By hand, tripod on crane

COMMENTS

Target 23 53.2’N
24 4.3’W

RAPID MOORINGS CRUISE D324

MRG ID: EB2

DEPLOYMENT

Eastern Atlantic 26N

NMFSS ID

LATITUDE 23 56.127N

DATE 17/10/07

LONGITUDE 24 03.344W

DAY 290

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

COMMENCE TIME 1449

TIME 1449

COMPLETION TIME 1822

WATER DEPTH 5089m

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT		TRIMSYN	1449
RECOVERY LINE			1449
TRIMSYN X 3			1449
SBE37	3225		1449
24” STEEL SPHERE		Argos T04-044 ID 46243	1452
SBE 37	3224		1452
SBE 37	3247		1458
ARGOS BEACON		254 TD 42746 light U01-024	1505
37” McLa STEEL SPHERE			1505
1M CHAIN SWIVEL			1505
SBE37	3252 + 0096	Plus RBR also 250m	1511
SBE37	3254		1514
SBE37	3255		1517
4 X 17” GLASS FLOAT			1524
SBE37	3256		1527
4 X 17” GLASS FLOAT			1538
SBE37	3257		1538
SBE37	3265		1544
4 X 17” GLASS FLOAT			1550
SBE37	3266		1553
4 X 17” GLASS FLOAT			1614
SBE37	3269		1619
SBE37	3270		1632
4 X 17” GLASS FLOAT			1641
SBE37	3271	Speed down up to 1.5km	1654
4 X 17” GLASS FLOAT			1703
4 X 17” GLASS FLOAT		Plus swivel	1719
SBE37	3274		1723
4 X 17” GLASS FLOAT		Speed down to 1.25Km	1742
SBE37	3277		1803
8 X GLASS FLOAT			1811
SWIVEL			1811
ACOUSTIC RELEASE 1	819		1811
ACOUSTIC RELEASE 2	820		1811
30M NYLON BRAID			1811-1820
10M CHAIN			1822
1400 KG ANCHOR	1420Kg		1822

MOORING METHOD

Total time: 3.5hr

COMMENTS

1604 Crane stopped
1607 Stb Crane used
1612 Back to port crane
1804 Cable stuck in winch 1804
1853 Main buoy submerged
1855 Small steel submerged
1857 All under

RAPID MOORINGS CRUISE D324

MRG ID: MAR3

Eastern Atlantic 26N

DEPLOYMENT

NMFSS ID

LATITUDE 23 52.27'N

LONGITUDE 41 04.79'W

DATE 23/10/07

DAY 296

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 0900

COMPLETION TIME 1105

SITE ARRIVAL TIME 0830

WATER DEPTH 4986m u/c 5027m corr

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT		yes	0900
RECOVERY LINE		Yes	
LIGHT		on	
BILLINGS FLOAT		Yes	
2 X GLASS SPHERES		Yes	
SWIVEL	C307	Yes	
SBE37	4720		
2 X GLASS SPHERES			0921
SBE37	4721	Yes	0921
2 X GLASS SPHERES		Yes	0938
SBE37	4722	Yes	0938
3 X GLASS SPHERES		Yes	0955
SWIVEL	C305	Yes	0955
SBE37	4723	Yes	0955
3 X GLASS SPHERES		Yes	1013
SBE37	4178	Yes	1013
SBE37	4179	Yes	1037
S4	35612571	Yes	1050
7 X GLASS SPHERES		Yes	1050
SWIVEL		Yes	1050
ACOUSTIC RELEASE	821		1101
10M CHAIN		Yes	
CHAIN ANCHOR 1000 KG			1104

DEPLOYMENT METHOD

COMMENTS

Target 23 52.1'N 41 5.6'W d=5041m corr (5000m u/c)
Slight muck near bottom of 540m 3/10" section
Deployed running due north

RAPID MOORINGS CRUISE D324

MRG ID: MARL2

Eastern Atlantic 26N

DEPLOYMENT

NMFSS ID

LATITUDE 23 57.95'N

DATE 23/10/07

LONGITUDE 41 5.54'W

DAY 296

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 0740

COMPLETION TIME 0744

SITE ARRIVAL TIME 0715

WATER DEPTH 5004 u/c 5045corr

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			0742
RECOVERY LINE			
LIGHT	T05-078		
VHF BEACON	U01-018		
BILLINGS FLOAT		McLane 4 ball + Flag	
1M CHAIN			
5 X GLASS SPHERES			
ACOUSTIC RELEASE	822		
BPR	0002		
TRIPOD ASSEMBLY			0744
ANCHOR 280 KG			

DEPLOYMENT METHOD

COMMENTS

RAPID MOORINGS CRUISE D324

MRG ID: MAR1

Eastern Atlantic 26N

DEPLOYMENT

NMFSS ID

Positions from bridge due to loss of GP4 and GP12 during deployment

LATITUDE 24 10.744'N

LONGITUDE 49 43.474

DATE 27/10/2007

DAY 300

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1522

COMPLETION TIME 1834

SITE ARRIVAL TIME 1522

WATER DEPTH

5162m u/c 5212m corr

ITEM	SER NO	COMMENT	TIME
TRIMSYN FLOAT			1522
RECOVERY LINE			1522
3 X TRIMSYN			1522
SBE37	3207		1522
24" STEEL SPHERE		+ Argos beacon sn 274 ID 620202	1527
SBE37	3208		1527
ARGOS BEACON	264	PTT-ID46242 Bowtech (no sn)	1535
37" STEEL SPHERE	3703		1535
1M CHAIN SWIVEL			1535
SBE37	3209		1541
SBE37	3212		1546
SBE37	3213		1552
8 X GLASS SPHERES			1602
SBE37	3214	800m	1602
SBE37	3215	1000m	1608
SBE37	3216	1200m	1614
SBE37	3217	1600m	1622
8 X GLASS SPHERES			1631
SBE37	3890	2000m	1636
4X GLASS SPHERES			1649
SWIVEL			1649
SBE37	4708	2500m	1649
4 X GLASS SPHERES			1704
SBE37	4709	3000m	1704
4 X GLASS SPHERES			1718
SBE37	4710	3500m	1718
4 X GLASS SPHERES			1734
SBE37	4711	4000m after glass of 4032!!	1734
SBE37	4712	4500m	1745
5 X GLASS SPHERES			1756
SBE37	4713	5050m	1812

S4	35612577		1812
9 X GLASS SPHERES			1826
SWIVEL			1826
ACOUSTIC RELEASE	260		1826
ACOUSTIC RELEASE	825		1826
20M NYLON BRAID			1826-1833
10M CHAIN			1834
CHAIN ANCHOR 1800 KG			1834

DEPLOYMENT METHOD

COMMENTS

Last trim-sym submerged at 190250

RAPID MOORINGS CRUISE D324

MRG ID: MARL1

DEPLOYMENT

Mid Atlantic 26N

NMFSS ID

LATITUDE 24 11.65' N

LONGITUDE 49 42.64'W

DATE 25/10/07

DAY 298

NOTE ALL TIMES RECORDED IN GMT

SITE ARRIVAL

TIME 2200

COMMENCE TIME 2202

COMPLETION TIME 2206

WATER DEPTH

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT		Orange	2202
RECOVERY LINE		Yes	2203
LIGHT		On	
VHF BEACON		Yes 4 ball McLane	
BILLINGS FLOAT			
1M CHAIN			
4 X GLASS SPHERES			
4 X GLASS SPHERES			
ACOUSTIC RELEASE	244		2204
ACOUSTIC RELEASE	818		2205
BPR	0003		
BPR	0418		
TRIPOD ASSEMBLY			
ANCHOR 280 KG			2205 53

DEPLOYMENT METHOD

COMMENTS

RAPID MOORINGS CRUISE D324

MRG ID: MAR2

DEPLOYMENT

Eastern Atlantic 26N

NMFSS ID

LATITUDE 24 10.938'N

DATE 27/10/07

LONGITUDE 49 45.008'W

DAY 300

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 2037

SITE ARRIVAL TIME 2025

COMPLETION TIME 2314 22

WATER DEPTH

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			2037
RECOVERY LINE			
LIGHT		No light! VHF beacon s/n	
BILLINGS FLOAT			
4 X GLASS SPHERES			
SWIVEL			
SBE37	3908		
SBE37	3910		2050
4 X GLASS SPHERES			2111
SBE37	3282		2111
3 X GLASS SPHERES			2130
SBE37	4461		2130
3 X GLASS SPHERES			2148
SBE37	4462		2159
SBE37	4464		2159
3 X GLASS SPHERES			2215
SWIVEL			2215
3 X GLASS SPHERES			
SBE37	4714		
3 X GLASS SPHERES			2230
SBE37	4715		2230
SBE37	4717	Graphite broken	2243
4 X GLASS SPHERES			2257
S4	35612576		2257
SBE37	4466		2301
5 X GLASS SPHERES			2305
SWIVEL			
ACOUSTIC RELEASE	368		2313
10M CHAIN			
ANCHOR 800 KG			2314

DEPLOYMENT METHOD 2hr 47min

COMMENTS

Descent rate
23:20:30 1077.6
23:21:30 1231.1 160m/min
23:23:30 1524.0 147m/min
23:23:30 1806.6 141m/min

RAPID MOORINGS CRUISE D324

MRG ID: MAR0

DEPLOYMENT

Eastern Atlantic 26N

NMFSS ID

LATITUDE 25 06.35'N

DATE 27/10/07

LONGITUDE 52 00.60'W

DAY 300

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 00:55

SITE ARRIVAL TIME

COMPLETION TIME 0120

WATER DEPTH 5523m corr

ITEM	SER NO	COMMENT	TIME
RECOVERY FLOAT			0055
RECOVERY LINE			0055
3 X GLASS SPHERES			0058
SBE37	4180		0101
2 X GLASS SPHERES			0106
SBE37	4181		0108
SBE37	4183	Mooring held until 0114	0116
6 X GLASS SPHERES			0117
ACOUSTIC RELEASE	320		0119
ACOUSTIC RELEASE	262		
BPR	SBE 26 389		
TRIPOD ASSEMBLY			
ANCHOR 500 KG			

DEPLOYMENT METHOD

COMMENTS

Deployed sat 27/10/07 01:20 GMT