CCGS HUDSON FALL CRUISE 2010, HUD10049
REPORT ON THE RECOVERY AND DEPLOYMENT OF RAPID-WAVE MOORINGS IN THE SCOTIAN SLOPE-RISE
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INTRODUCTION

This cruise is the sixth RAPID-WAVE cruise in the area of the Scotian Slope/Rise. WAVE, which stands for West Atlantic Variability Experiment, is a NERC funded project to study the variability of the Meridional Overturning Circulation in the Northwest Atlantic. The five previous cruises took place in 2004, 2006, 2007, 2008, and 2009 (see respective cruise reports).

The 2010 RAPID-WAVE cruise onboard CCGS Hudson consisted in the recovery and redeployment of the RS Line, an array of six moorings first deployed in 2008. The ship sailed at 22:00 GMT on the 15th December and returned to port in the morning of the 22rd December. Five moorings were recovered. It was not possible to communicate with the mooring release at mooring site RS5 and, although it was repeatedly blind-released, the mooring could not be recovered. All recovered instruments were in good state. However, six CTD recorders had run out of batteries well before the expected time, which suggest that CTD sampling rates should be decreased. The data was downloaded and examined to detect potential instrument problems or malfunctions and deemed to be generally of good quality.

RS ARRAY RECOVERY

Recovery work was carried out throughout 28-09-2009 and 29-09-2009. The entire line was recovered without incidents. The following three tables summarise relevant information for all recoveries.

MOORINGS RECOVERED

SITE	LATITUDE (N)	LONGITUDE (W)	DATE & TIME ONBOARD	DEPTH (m)	MOORING TYPE
RS1	42 51.2223	61 37.9196	16-12-2010, 13:20 Z	1082 (cor.)	Short
RS2	42 44.4343	61 34.4546	16-12-2010, 15:00 Z	1669 (cor.)	Short
RS3	42 39.5690	61 27.4136	16-12-2010, 16:20 Z	2266 (cor.)	Short
RS4	42 33.4088	61 22.1512	16-12-2010, 18:13 Z	2749 (cor.)	Short
RS5	42 23.4680	61 16.6267		3391 (cor.)	Short
RS6	42 09.9145	61 04.6658	17-12-2010, 12:10 Z	3836 (cor.)	Long

Notes. Positions were calculated during the previous cruise HUD09048 using M-Cal triangulations (see SEANAV's website http://www.seanav.com/). Echosounder depths were corrected using Carter tables. Mooring RS5 was not recovered (we were unable to communicate with the release).

EQUIPMENT RECOVERED

	RS1	RS2	RS3	RS4	RS5 (lost)	RS6
Casabel Iridium beacon	300034012204210					300034012204150
Iridium Sable beacon		300034012484560	300034012482560	300034012298970	300034012483560	
Aanderaa RCM11[1]						563
SBE37 MicroCAT	2165					4614
SBE37 MicroCAT		3680				3709
SBE37 MicroCAT			3681			3710
SBE37 MicroCAT				3675		3682
SBE37 MicroCAT					3676	3713
SBE37 MicroCAT						3714
WHADCP	11432	11433	13153	13152	12491	12455
Benthos 965-A acoustic release	47461 Rx 12.0 kHz E/F Tx 10.0 kHz	47463 Rx 13.5 kHz B/G Tx 10.0 kHz	47459 Rx 11.0 kHz A/B Tx 10 kHz	47462 Rx 13.0 kHz G/D Tx 10.0 kHz	40081 Rx 11.5 kHz D Tx 10.0 kHz	47464 Rx 14.0 kHz F/A Tx 10.0 kHz
RBR BPR DR-1050	14581					14580
SBE53 BPR	24	52	51	47	46	25
POL RAPID LANDER						TRL04 DQ93161

1. This current meter is BIO's and not part of the RAPID-WAVE project.

SUMMARY OF INSTRUMENT SET-UP

Instrument	Site	Sampling interval (seconds)	Averaging interval (seconds)	Number of bins/ bin size (m)	Time of first record (Z)	Time of last record (Z)
SBE37-SM 2165	RS1	600	4 samples	-	02 Oct 2009, 13:30:01	16 Dec 2010, 14:45:00
SBE37-SM 3675	RS4	600	4 samples	-	01 Oct 2009, 18:00:01	28 May 2010,04:00:01
SBE37-SM 3676	RS5	600	4 samples	-		
SBE37-SM 3680	RS2	600	4 samples	-	02 Oct 2009, 12:00:01	16 Dec 2010, 16:20:01
SBE37-SM 3681	RS3	600	4 samples	-	02 Oct 2009, 10:00:01	16 Dec 2010, 17:10:01
SBE37-SM 3682	RS6	600	4 samples	-	30 Sep 2009, 15:00:01	17 Dec 2010, 16:00:01
SBE37-SM 3709	RS6	600	4 samples	-	30 Sep 2009, 15:00:01	18 Jun 2010, 23:00:45
SBE37-SM 3710	RS6	600	4 samples		30 Sep 2009, 15:00:01	19 May 2010,14:20:00
SBE37-SM 3713	RS6	600	4 samples	-	30 Sep 2009, 15:00:01	04 Jun 2010, 09:40:46
SBE37-SM 3714	RS6	600	4 samples	-	30 Sep 2009, 15:00:01	25 May 2010,17:30:02
SBE37-SM 4614	RS6	600	4 samples	-	30 Sep 2009, 15:00:01	17 Dec 2010, 16:20:00
WHADP Sentinel 12455	RS6	3600		30/4	30 Sep 2009 13:00:00	17 Dec 2010 22:00:00
WHADP Sentinel 12491	RS5	3600		30/4		
WHADP Sentinel 11432	RS1	3600		30/4	02 Oct 2009 11:00:00	18 Dec 2010 10:00:00
WHADP Sentinel 11433	RS2	3600		30/4	02 Oct 2009 10:00:00	19 Dec 2010 16:00:00
WHADP Sentinel 13152	RS4	3600		30/4	01 Oct 2009 11:00:00	14 Nov 2010 04:00:00
WHADP Sentinel 13153	RS3	3600		30/4	01 Oct 2010 11:00:00	28 Nov 2010 16:00:00
SBE53 24[1]	RS1	1200	300[2]	-	30 Sep 2009, 23:55:00	16 Dec 2010 16:20:00
SBE53 25[1]	RS6	1200	300[2]	-	30 Sep 2009, 13:20:00	19 Dec 2010 00:40:00
SBE53 46	RS5	1200	300[2]	-	30 Sep 2009, 22:15:00	
SBE53 47	RS4	1200	300[2]		30 Sep 2009, 22:15:00	16 Dec 2010 18:40:00
SBE53 51	RS3	1200	300[2]	-	30 Sep 2009, 22:55:00	16 Dec 2010 17:00:00
SBE53 52	RS2	1200	300[2]	-	30 Sep 2009 22:55:00	16 Dec 2010 17:00:00
RBR DR-1050 14580	RS6	20		-	30 Sep 2009, 13:20:00	05 Jan 2011 00:00:00
RBR DR-1050 14581	RS1	20		-	30 Sep 2009, 23:45:00	05 Jan 2011 00:00:00
TRL04	RS6	900	900	-	30 Sep 2009, 23:45:00	23 Dec 2010

1. Sea Bird provided drift estimates for SBE53s numbers 24 and 25, whose sensors where made using a manufacturing process different from (and, apparently, inferior to) that of the other sensors in the SBE53 series. Their estimated drifts are 0.6 dbar/year and 0.2 decibar/year, respectively. We are grateful to Norge Larson, from Sea Bird, for this information.
2. Sensor warming up period was set to 300 seconds too. The time stamp for SBE53 samples correspond to the beginning of each 300- second averaging interval. The reference frequency measurement was set to once per week. With these settings, and taking into account that all SBE53s were fitted with alkaline batteries, the estimated maximum battery endurance should be 805.6 days.

Notes on recovered instruments

1. BPRs

All 5 recovered SBE53 BPRs had complete time series with very little drift. Data from the RBRs was not downloaded until after the cruise, but was also complete and found to be of similar quality to previous years. Likewise for the TRL04 data.

2. SBE37 Microcats

Many, but not all, microcats with a pumped conductivity cell run out of batteries well before recovery. In the future, the sampling rate should be increased from 1/10 minute^{-1} to 1/20 minute^{-1} to avoid this kind of problem. All microcats, recovered and deployed, underwent calibration dips on the 17th, 18th and 20th December 2010; see table below for a summary of calibration dips). The microcats were clamped to the Hudson's CTD rosette and submerged to a predetermined maximum depth. As the rosette was being brought up to the surface, five 15-minute stops were made in order to allow the microcats to record at reasonably constant and uniform conditions. The sampling interval was 15 seconds. The nominal sampling depths were: 3900 m, 3300 m, 2700 m, 2200 m, 1600 m and 1000 m.

	Instrument	Date	Sampling depths (m)
Recovered	SBE37-SM 2165	17/12/10	1000, 1600, 2200, 2700, 3300
	SBE37-SM 3675	18/12/10	1000, 1600, 2200, 2700
	SBE37-SM 3676		
	SBE37-SM 3680	17/1210	1000, 1600, 2200, 2700, 3300
	SBE37-SM 3681	17/12/10	1000, 1600, 2200, 2700, 3300
	SBE37-SM 3682	20/10/10	1000, 1600, 2200, 2700, 3300, 3900
	SBE37-SM 3709	20/10/10	1000, 1600, 2200, 2700, 3300, 3900
	SBE37-SM 3710	20/10/10	1000, 1600, 2200, 2700, 3300, 3900
	SBE37-SM 3713	20/10/10	1000, 1600, 2200, 2700, 3300, 3900
	SBE37-SM 3714	20/10/10	1000, 1600, 2200, 2700, 3300, 3900
	SBE37-SM 4614	20/10/10	2200, 1600, 1000
Deployed	SBE37-SM 1785	17/12/10	1000, 1600, 2200, 2700, 3300
	SBE37-SM 6433	18/12/10	1000, 1600, 2200, 2700
	SBE37-SM 6436	17/12/10	1000, 1600, 2200, 2700, 3300
	SBE37-SM 6467	17/12/10	1000, 1600, 2200, 2700, 3300
	SBE37-SM 6468	18/12/10	1000, 1600, 2200, 2700
	SBE37-SM 8263	18/12/10	1000, 1600, 2200, 2700
	SBE37-SM 8264	18/12/10	1000, 1600, 2200, 2700
	SBE37-SM 8265	18/12/10	1000, 1600, 2200, 2700
	SBE37-SM 8109	18/12/10	1000, 1600, 2200, 2700
	SBE37-SM 9021	18/12/10	1000, 1600, 2200, 2700
	SBE37-SM 8110	17/12/10	1000, 1600, 2200, 2700, 3300
	SBE37-SM 8111	18/12/10	1000, 1600, 2200, 2700

3. WHADCP

The ADCP data was of similar quality to previous years. Three of the ADCPs run out of batteries about one month before recovery, which was not unexpected.

4. CTD data

CTD casts were made adjacent to all six RS mooring sites.

RS ARRAY REDEPLOYMENT

The redeployment of the RAPID-WATCH-WAVE line took place between 18-12-2010 and 19-12-2012 without any incidents.

The table below and Figure 7 summarise these deployments.

MOORINGS DEPLOYED

SITE	LATITUDE (N)	LONGITUDE (W)	DATE RECOVERED	DEPTH (m)	MOORING TYPE
RS1	42 51.1856	61 37.9276	18/12/10	1108 (cor.)	Short
RS2	42 44.3552	61 34.4191	18/12/10	1725 (cor.)	Short
RS3	42 39.3148	61 27.3821	18/12/10	2313.5 (cor.)	Short
RS4	42 33.3851	61 22.2472	18/12/10	2777 (cor.)	Short
RS5	42 23.5292	61 16.6110	18/12/10	3418.2 (cor.)	Short
RS6	42 09.6849	61 04.2094	19/12/10	3880 (cor.)	Long

Note. Positions were calculated from M-Cal triangulations (see SEANAV's website http://www.seanav.com/). Depths are corrected using Carter tables.

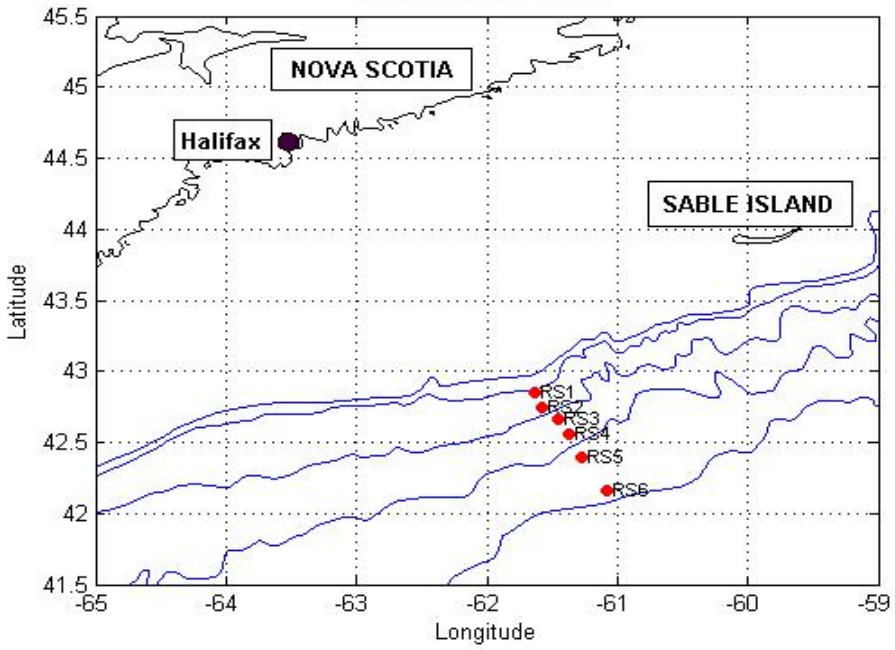


Figure 1: Location of moorings deployed in 2010. The blue lines correspond to the bathymetric contours: 500 m, 1000 m, 2000 m, 3000 m and 4000 m.

The following table includes the serial number of all the instruments, beacons and releases deployed in the line. Mooring schematics can be found in the Appendix.

EQUIPMENT DEPLOYED

Instrument	RS1	RS2	RS3	RS4	RS5	RS6
Casabel Iridium beacon	300034012408360	300034012155420	300034012612500	300034012722800	300034012190230	300034012126050
Aanderaa RCM11[1]						679
SBE37 MicroCAT	6433					8110
SBE37 MicroCAT		8263				1785
SBE37 MicroCAT			8264			8111
SBE37 MicroCAT				8265		6436
SBE37 MicroCAT					8109	6467
SBE37 MicroCAT						6468
WHADCP	13592	13873	13874	10941	13983	10942
Aanderaa RCM11[1]	678					
SBE37 MicroCAT with Oxygen Sensor	9021					
Benthos 965-A acoustic release	40081 8.5 kHz D/-/E	890 10.5 kHz A/B/C	40083 9 kHz E/-/H	40047 8.0 kHz A/-/B	44302 13.5 kHz C/-/D	809 9.5 kHz E/F/D
SBE53 BPR	50	45	48	66	49	51

1. This current meters are BIO's and not part of the RAPID-WAVE project.

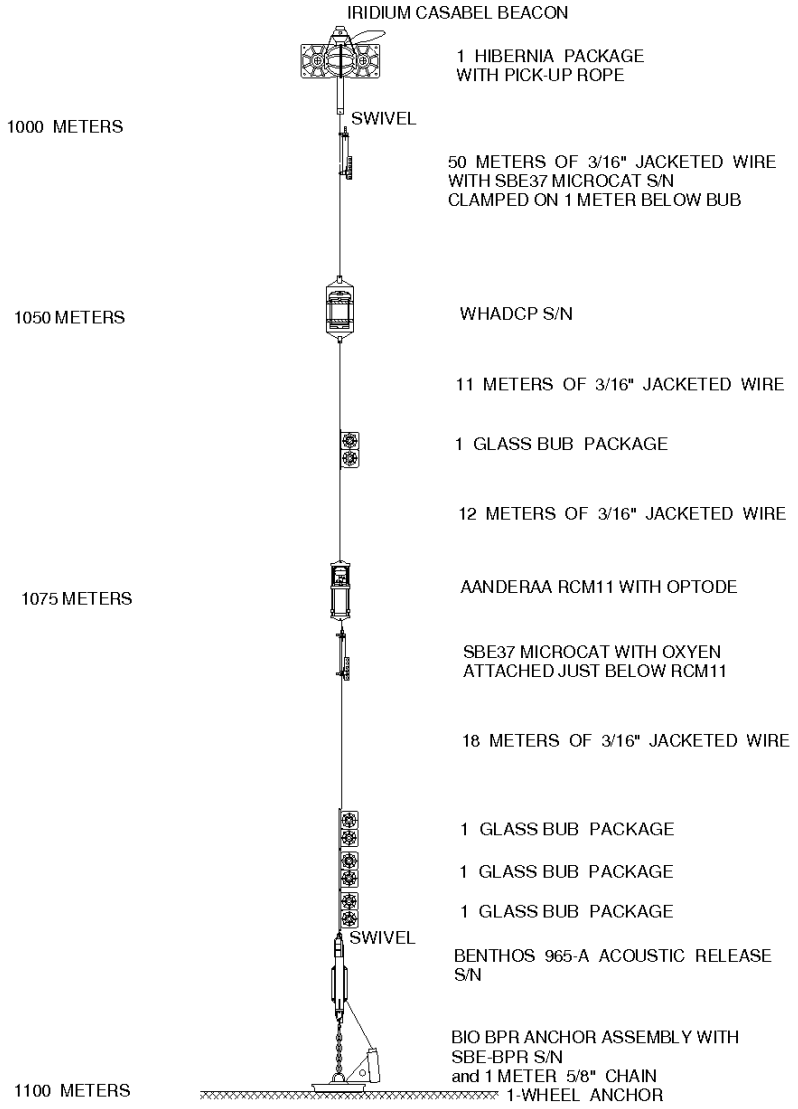
SUMMARY OF INSTRUMENT SET-UP

Instrument	Site	Sampling interval (seconds)	Averaging interval (seconds)	Number of bins/ bin size (m)	Time of first record (Z)	Time of last record (Z)
SBE37-SM 1785	RS6	1200	-	-	13 Dec 2010, 11:00:01	
SBE37-SM 6433	RS1	1200	-	-	18 Dec 2010, 20:40:01	
SBE37-SM 6436	RS6	1200	-	-	19 Dec 2010, 11:00:01	
SBE37-SM 6467	RS6	1200	-	-	19 Dec 2010, 11:00:01	
SBE37-SM 6468	RS6	1200	-	-	19 Dec 2010, 11:00:01	
SBE37-SM 8263	RS2	1200	-	-	18 Dec 2010, 20:20:01	
SBE37-SM 8264	RS3	1200	-	-	18 Dec 2010, 20:00:01	
SBE37-SM 8265	RS4	1200	-	-	18 Dec 2010, 17:20:01	
SBE37-SM 8109	RS5	1200	-	-	18 Dec 2010, 14:00:01	
SBE37-SM 9021	RS1	3600	-	-	19 Dec 2010, 01:00:51	
SBE37-SM 8110	RS6	1200	-	-	19 Dec 2010, 11:00:01	
SBE37-SM 8111	RS6	1200	-	-	19 Dec 2010, 11:00:01	
WHADP Sentinel 10941	RS4	3600	-	30/4	13 Dec 2010, 1:00:00	
WHADP Sentinel 10942	RS6	3600	-	30/4	13 Dec 2010, 19:00:00	
WHADP Sentinel 13592	RS1	3600	-	30/4	13 Dec 2010, 19:00.00	
WHADP Sentinel 13873	RS2	3600	-	30/4	13 Dec 2010, 19:00.00	
WHADP Sentinel 13874	RS3	3600	-	30/4	13 Dec 2010, 19:00:00	
WHADP Sentinel 13893	RS1	3600	-	30/4	13 Dec 2010, 19:00:00	
SBE53 45	RS2	1200	300[1]	-	15 Dec 2010, 20:20:00	
SBE53 48	RS3	1200	300[1]	-	15 Dec 2010, 16:20:00	
SBE53 49	RS5	1200	300[1]	-	15 Dec 2010, 17:00:00	
SBE53 50	RS1	1200	300[1]	-	15 Dec 2010, 17:20:00	
SBE53 51	RS6	1200	300[1]	-	18 Dec 2010, 23:40:00	
SBE53 66	RS4	1200	300[1]	-	15 Dec 2010, 20:00:00	

1. Sensor warming up period was set to 300 seconds too. The time stamp for SBE53 samples correspond to the beginning of each 300- second averaging interval. The reference frequency measurement was set to once per week. With these settings, and taking into account that all SBE53s were fitted with alkaline batteries, the estimated maximum battery endurance should be 805.6 days.

APPENDIX. MOORING DIAGRAMS

MOORING # 1777 RS1 LODER/POL SCOTIAN SLOPE DEC 2010



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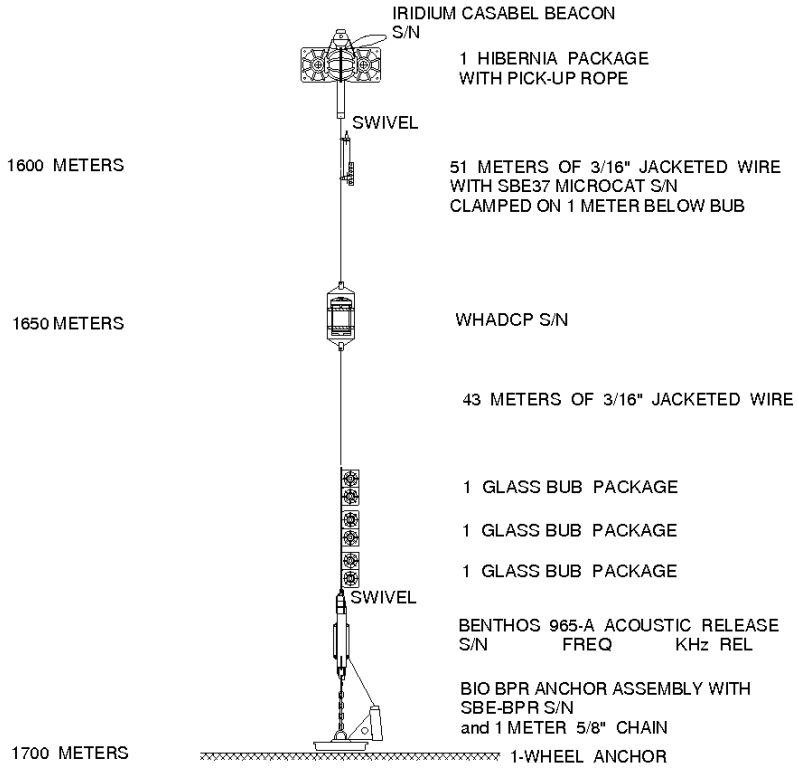

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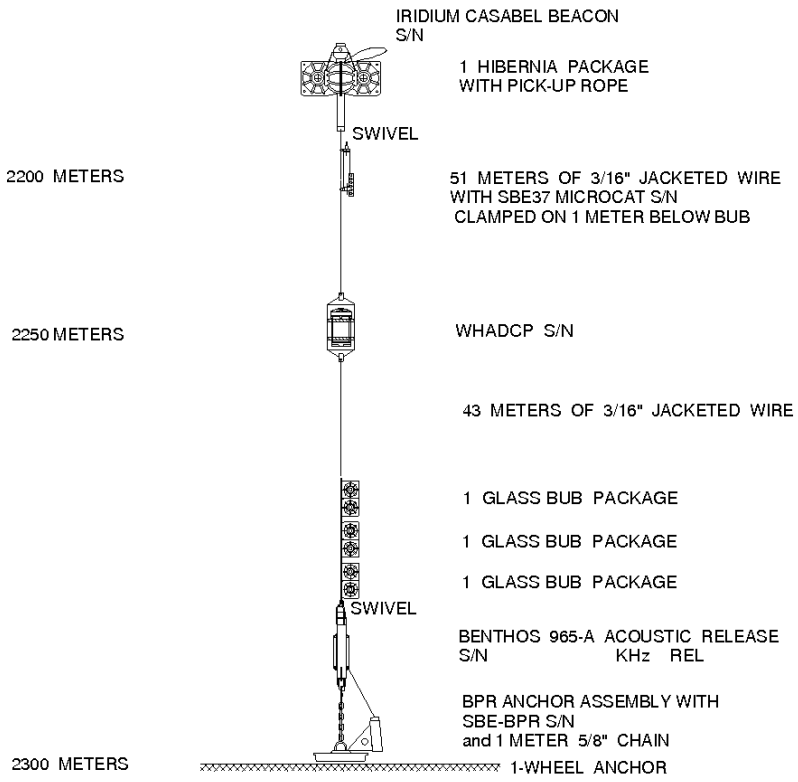

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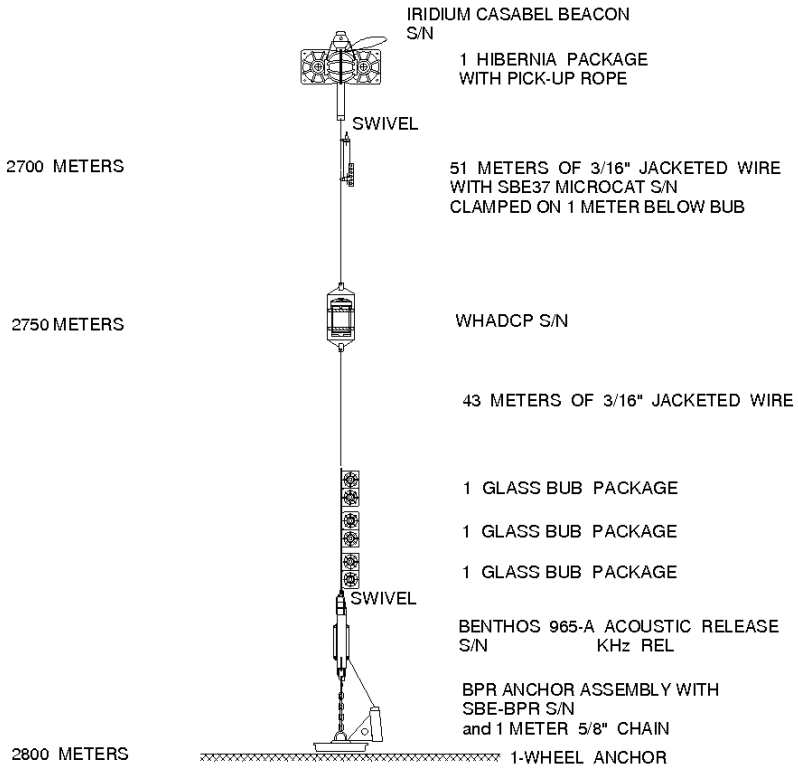
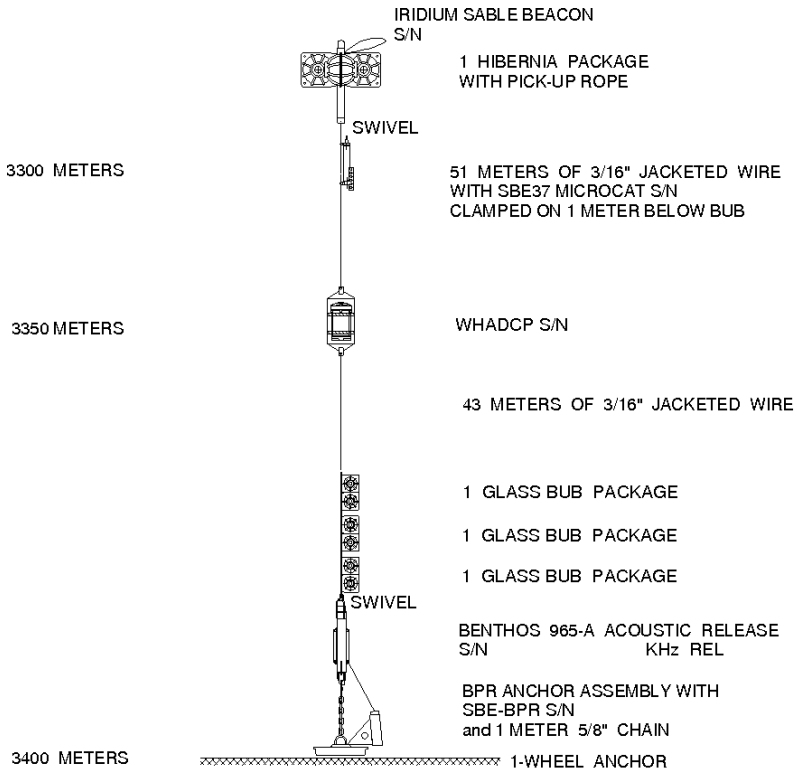


MOORING # 1781 RS5 LODER/POL SCOTIAN SLOPE DEC 2010



MOORING # 1782 RS6 LODER/POL SCOTIAN SLOPE DEC 2010