Seismology Experiment During MomarSat2010 (31 Sept. – 15 October. 2010)

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Version October 26. 2010 13:30

Introduction:

OBSs (Ocean Bottom Seismometers) deployed during BBMOMAR-I (18-27 July, 2006), BBMOMAR-II (8-17 Aug. 2008) have provided information about the distribution of seismicity at the Lucky-strike segment of the Mid-Atlantic ridge. It was decided to continue the seismology survey at the same sites by re-deployment of 5 new OBSs for another year.

5 OBSs (4 Short period and one broadband) that has been deployed last year (mission Bathyluck2009, 31 Aug. – 28 Sept. 2009) were recovered.

4 autonomous OBS short period and a mix station (JPP*/OBS) with a surface communication has been deployed during this cruise.

(1) Instruments deployed during BATHYLUCK09 recovered in MomarSat Cruise

Name	Lat.(°)	Long.(°)	Notes
C1 (SP)	37°19.2148	-32°16.6964	array N
C2 (SP)	37°17.8499	-32°19.4913	array W
C3 (SP)	37°17.4767	-32°17.3593	array central
C4 (SP)	37°16.8423	-32°14.5015	array E
C7 (BB)	37°15.6146	-32°17.8856	array south

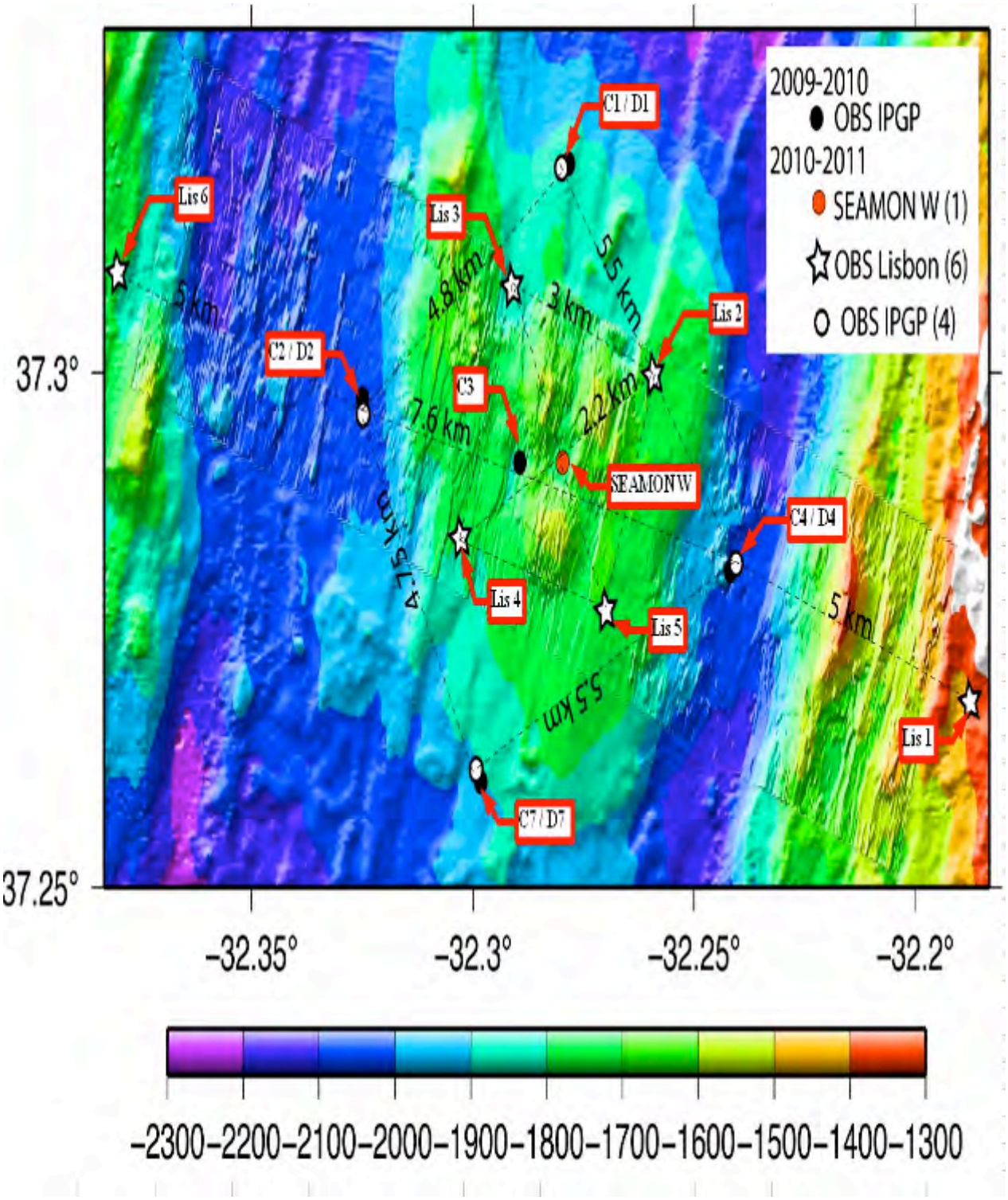
***SP short period, BB : Broad Band.**

(2) Instruments deployed during Momarsat to be recovered in summer 2011

Name	Lat.(°)	Long.(°)	Notes
D1	37°19.3000	-32°16.639	array N
D2	37°17.918	-32°19.426	array W
D3	37°17.565	-32°17.288	array central (SP)
D4	37°16.967	-32°14.476	array E (SP)

***SP short period, BB : Broad Band. JPP Jauge de pression**

Important note: It has been impossible to relocate the OBSs due to lack of time. Therefore it is absolutely necessary to do this operation within the next cruise, before recovering the OBSs.


2009-2010
OBS IPGP
2010-2011
SEAMON W (1)
OBS Lisbon (6)
OBS IPGP (4)
C1 / D1
Lis 6
Lis 3
Lis 2
C2 / D2
C3
SEAMON W
C4 / D4
Lis 4
Lis 5
Lis 1
C7 / D7
5 km
4.8 km
3 km
5.5 km
7.6 km
2.2 km
4.7 km
5 km
5.5 km
37.3°
37.25°
-32.35°
-32.3°
-32.25°
-32.2°
-2300 -2200 -2100 -2000 -1900 -1800 -1700 -1600 -1500 -1400 -1300

Description of work done during MomarSat2010 for the OBSs:

OBS recovery:

To recover the OBSs from ocean-bottom, an acoustic signal corresponding to the particular OBS was sent using EdgeTech equipment (model 8011XS). Acoustic transducer were tested before deployment on 31st Aug. and 1st Sept for communication between the command unit and the OBSs, both on-board and hanging the acoustic unit at a depth of 1000 m. 4 Edgetech transponders have been tested for validation orders, distances measurement and deactivation.

On 10 October 2010, 3 OBSs short period have been recovered. These OBS were deployed during Bathyluck 2009 on the position C3, C1 and C2. 2010. On 12 Oct., we recovered two more OBSs (1SP and 1BBOBS) on the position C4 and C7.

The acoustic signal activates the start of the burn wire process: It electrically corrodes a wire link between the OBS and its heavy metallic platform, and within 10 minutes the wire breaks. The OBS then moves upward because of buoyancy of the floaters.
Once on the ocean-surface, the OBS is brought back to the ship, and is washed with fresh water, after investigating the signs of corrosion, etc. The data-logger was then extracted from the unit, it was de-vacuumed and clock-drift was measured using Zyfer GPS antenna. We used OBSDUMP software to copy the raw data from the data-logger to the external hard-disk. After correction de Raw-data with fix software (Lcheapo bug), the Fix-data is then converted to SAC format using ANYPLOT software module, to be able to be read by analysis software. The same procedure is adopted for each OBS recovered during the cruise.

Site	Deployment Site	C1	C2	C3	C4	C7
OBS	Number	13	2	3	4	22
deployment	File name	BBMM3_C4_13	BBMM3_C1_02	BBMM3_C2_03	BBMM3_C3_04	BBMM3_C7_22
parameters	sample rate	62,5	62,5	62,5	62,5	62,5
	nb channel	4	4	4	4	4
	année	2009	2009	2009	2009	2009
	Jour Julien	244	244	244	244	244
	Synch time (JJ/MM/AAAA HH:MM:SS)	01/09/2009 10:50:00	01/09/2009 14:10:00	01/09/2009 15:04:00	01/09/2009 17:49:00	01/09/2009 20:06:00
	Wake up time (JJ/MM/AAAA HH:MM:SS)	03/09/2009 12:00:00	03/09/2009 12:00:00	03/09/2009 12:00:00	03/09/2009 12:00:00	03/09/2009 12:00:00
	Lat deployment (format °,m)	37°19,3000 N	37°17,918 N	37°17,565 N	37°16,967 N	37°15,6354 N
	Long deployment (format °,m)	32°16,639 E	32°19,426 E	32°17,288 E	32°14,476 E	32°17,8473 E
	Lat deployment	37,322	37,299	37,293	37,283	37,261
	Long deployment	32,277	32,324	32,288	32,241	32,297
	depth	1816	2043	1764	1986	1925
recovery parameters	année	2010	2010	2010	2010	2010
	Jour Julien	282	282	282	285	285
	heure largage	11:15	14:30	09:38	13:21	15:24
	Time at surface	12:02	15:16	10:23	14:13	16:27
	Time on board	12:13	15:26	10:43	14:43	16:38
	Vitesse de remontée m/s	0,80	0,87	0,77	0,74	0,57
	Lat recovery	37°19,3211 N	37°17,8376 N	37°17,4972 N	37°17,0809 N	37°15,821 N
	Long recovery	32°16,5701 E	32°19,2623 E	32°170844 E	32°14,6110 E	32°17,670 E
Synchronisation	checked at (inst) (JJ/MM/AAAA HH:MM:SS)	09/10/2010 12:25:25		09/10/2010 10:50:00	12/10/2010 14:58:00	12/10/2010 17:12:00
	time tag (GPS) (JJ/MM/AAAA HH:MM:SS.mmm)	09/10/2010 12:25:24,669	09/10/2010 15:53:00,436	09/10/2010 10:50:00,875	12/10/2010 14:58:02,223	12/10/2010 17:11:58,067
	drift (inst - GPS)	0,331	-3369484380,436	-0,875	-2,223	1,933
	clock drift rate	9,505E-09	1,010E+00	-2,514E-08	-6,339E-08	5,512E-08
Site	Deployment Site	C1	C2	C3	C4	C7
OBS	Number	13	2	3	4	22

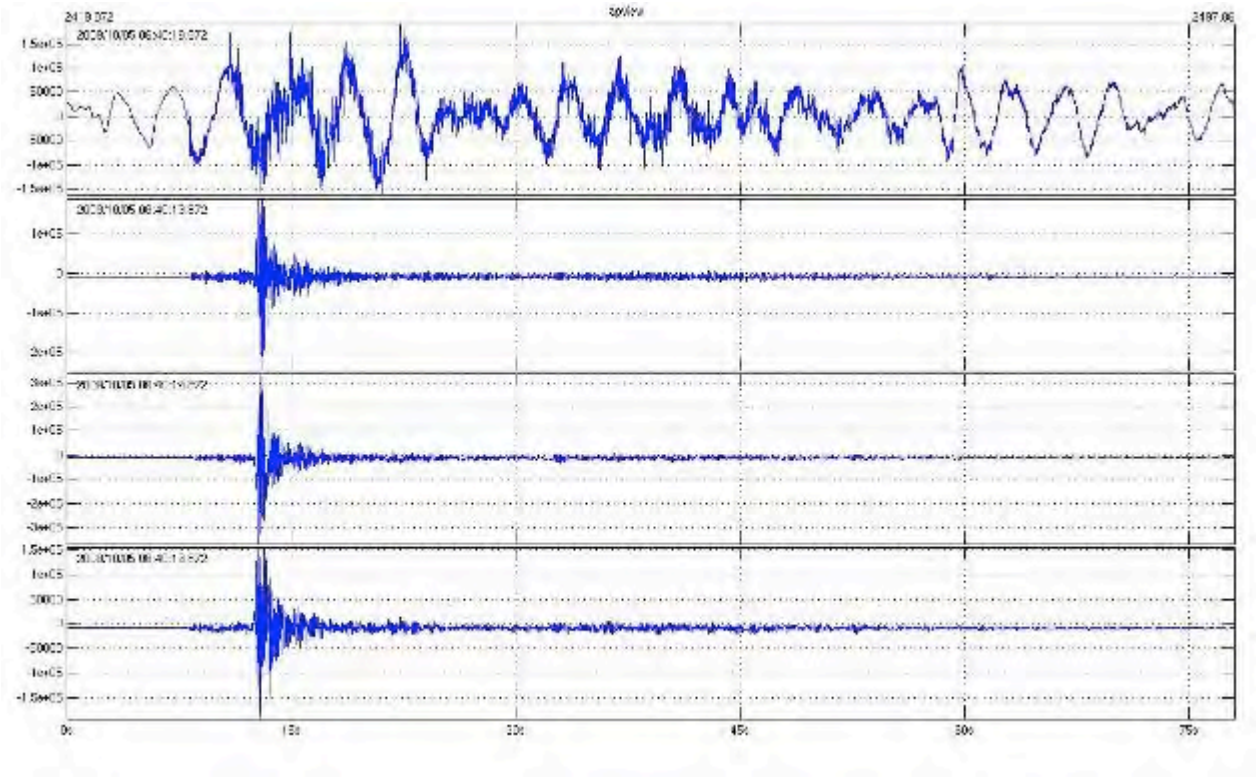
Summary	EOF at (Shift D)	09/10/2010 12:29:00	??	09/10/2010 10:58:55	12/10/2010 15:00:15	12/10/2010 17:15:58
	Closing Block Number	52445469	??	52175181	52587349	52600209
	Poids fichier (octects)	26852080128	#VALEUR!	26713692672	26924722688	26931307008
	MOctects/jour	66,96	#VALEUR!	66,62	66,62	66,63
	seconds sync to sync	34648140,000	#VALEUR!	34642735,000	34916415,000	34924558,000
	days recorded	401,02	#VALEUR!	400,96	404,13	404,22
	comments					
Determination Position	Lat (format °,m)	37°19,2148 N	37°17,8499 N	37°17,4767 N	37°16,8423 N	37°15,6146 N
(par ping)	Long (format °,m)	32°16,6964 E	32°19,4913 E	32°17,3593 E	32°14,5015 E	32°17,8856 E
	Lat décimal	37,3202	37,2975	37,2913	37,2807	37,2602
	Long décimal	32,2783	32,3249	32,2893	32,2417	32,2981
	depth	1817	2045	1775	1985	1924
	erreur (m)	246,7	194,4	237,8	267,2	151,1

sauvegarde disk 1	MomarDISK1	ok	ok	ok	ok	ok
sauvegarde disk 2	MomarSatDisk2	ok	ok	ok	ok	ok

Data recovery and quality analysis:

OBS 02 position C2:

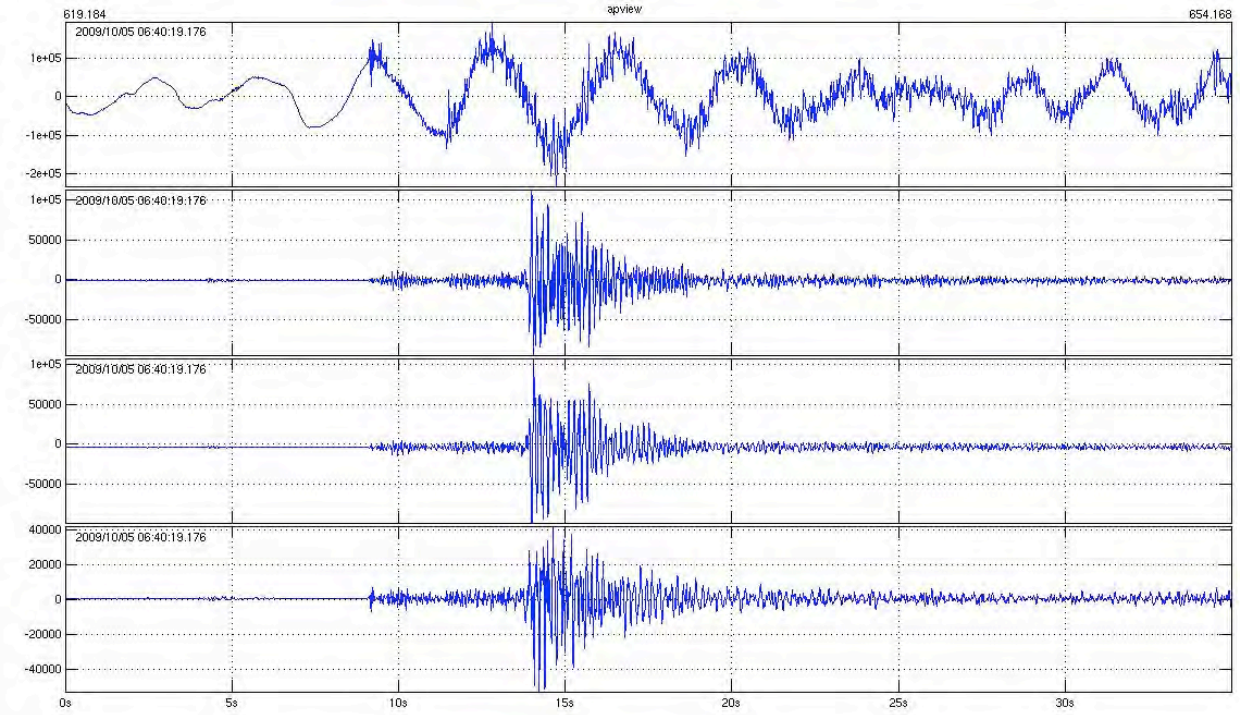
This OBS did not answer to the terminal requests apparently due to battery exhaustion.
The clock drift could not be done, however the GPS indicated a time tag (see the EXCEL recovery table)
The recording was done from 2009/09/03 12:00:00 to the 2010/05/18 02:57:29



On this seismic event of the 2009/10/05 06:40:33 (P wave 06:40:28 S wave: 06:40:33) , the x,y,z channels and the hydrophone seem to be working properly.

OBS 03 position C3

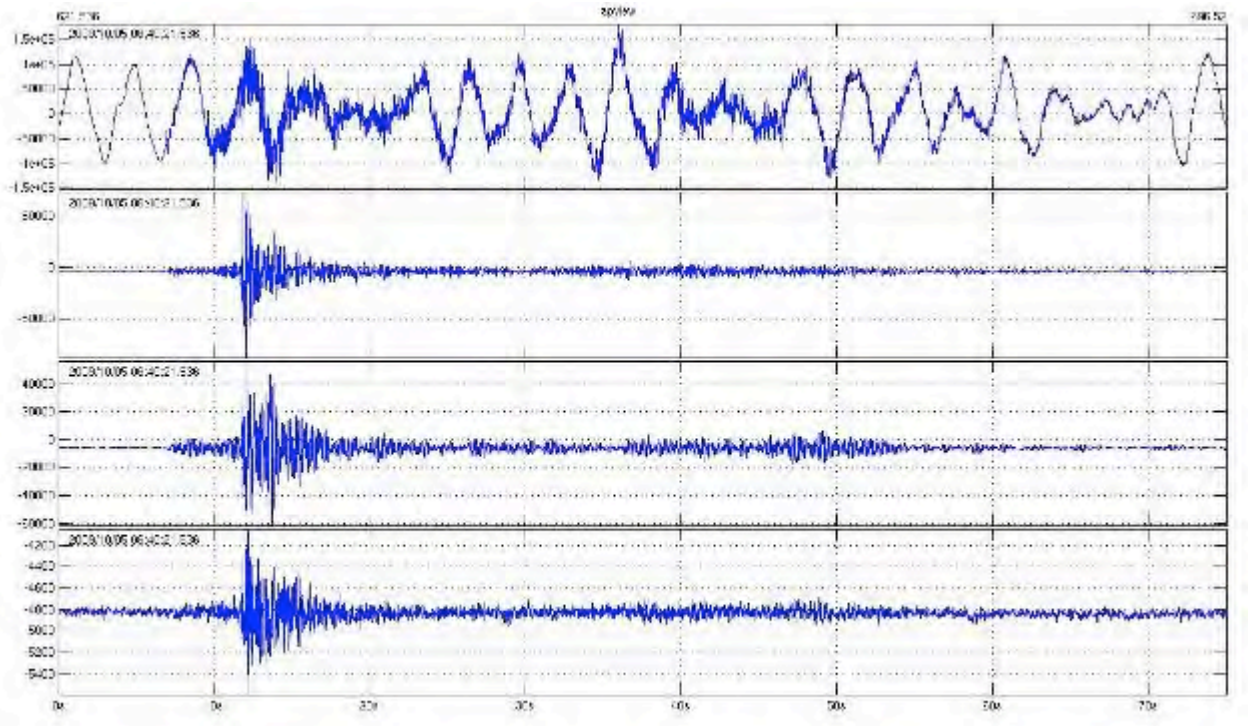
The recording was properly done on the 4 channels from the 2009/09/03 12:00:00 to the 2010/10/09 10:58:55



Seismic event of the 2009/10/05 06:40:33

OBS 04 position C4

The recording was properly done on the 4 channels from the 2009/09/03 12:00:00 to the 2010/10/12 15:00:15



But the vertical z channel of the geophone is very attenuated, most probably due to platform leveling oil leakage inside, preventing the mobile mass to move normally.

OBS 13 position C1

The data on this hard dick are actually unreadable: the header has been damaged.
But there is still a possibility to recover the data in the l'IPGP saint Maur lab.

Copy of the header:

Description: BFMM3_C4_53
Software Version: 9.0<a-OLDBFMM3_C4_53
Ram Size: 12 MB
Disk Size: 78 GB
Disk Number (0 or 1): 4

Sampling
Number of Channels: 4
Sample Rate: 62
Start Channel: 4
Compression Type: 6 (24-Bit No Compression)

Normal Data
Data Start Block: 264541
Data block length: 52180948
Next write block: 52445489
Next write byte: 157089796

Slow Data
Allocated Blocks: 262148
Start Block Number: 262148
Current write block: 262148
Current write byte: 262148
Data Rate: 4
Number of channels: 4
Start Channel: 4

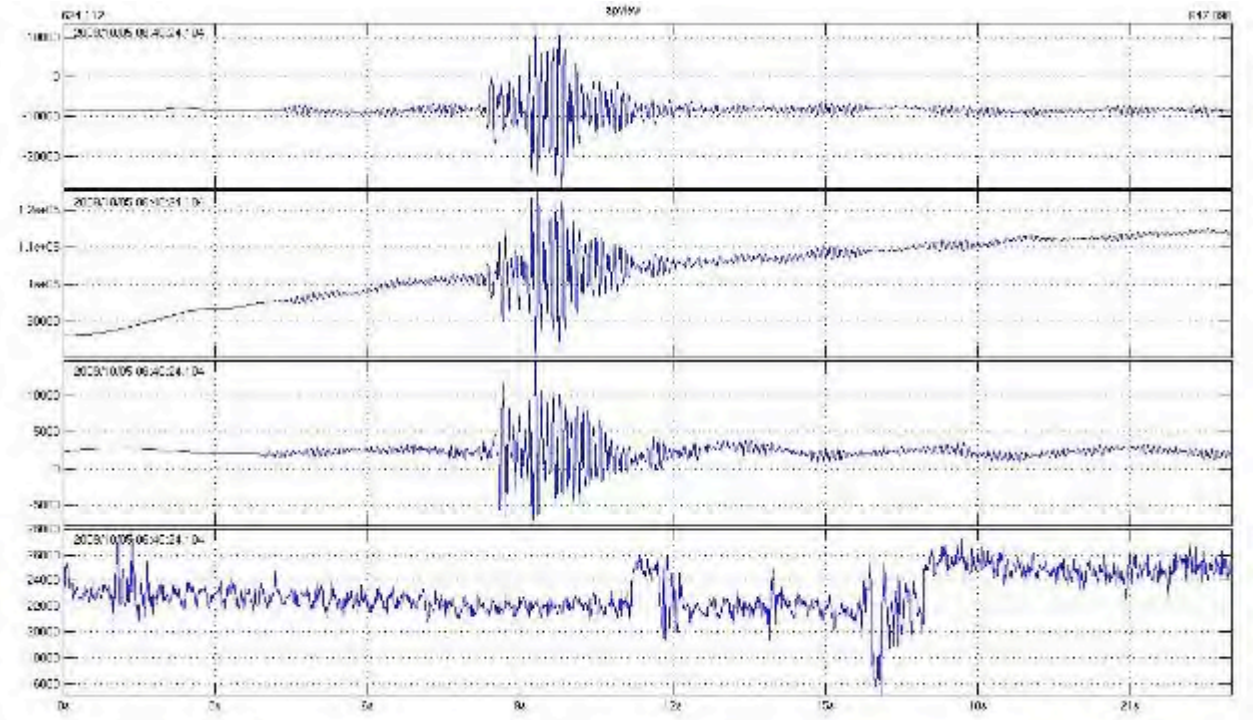
Log Data
Allocated Blocks: 262148
Start Block Number: 262148
Current write block: 262148
Current write byte: 262148

Directory
Allocated Entries: 300300
Current Entries: 265785
Start Block: 262156
Next write block: 262379
==========

==========
COPY PROCESS

OBS 22 position C7

The OBS 22 is a large band.
The recording was properly done on the 4 channels from the 2009/09/03 12:00:00 to the 2010/10/12 17:12:00



OBS deployment:

To deploy the OBS important preparation and check have been done to maximize the recovery in the good condition. During this cruise four new short period instruments have been moored at almost the same locations (D1, D2, D3 and D7).

Preliminary acoustic tests

According to the usual procedure, the acoustic modules of the release devices of the OBS must be tested at 1000 meters depth, at the begin of each campaign before the mooring.

To do so, we use a frame called "rosette". It consists of 12 PE tubes in which we insert each acoustic module. These modules are kept prisoner between rings which are fixed to the tubes with screws or push pins.

2 OBS weights are fixed at the base using straps so that the assembly sinks.

Batteries

The number of batteries depends on the estimated consumption based on the number of channel (hydrophone & seismometer) and the sampling frequency provided for the duration of the mission.

For this calculation, we use a table in excel. Variables in this table reflect the average consumption recorded during the previous missions.

For this mission it is decided to put 4 batteries Analog 4DD (30Ah) and 5 Batteries Digital 4DD (30Ah) (details see Appendix).

Site	Deployment Site	D1	D2	D4	D7	Seamon West
OBS	Number	1	5	6	12	Station mixte OBS/JPP
Disk	Type (SCSI or IDE)	IDE	IDE	IDE	IDE	IDE
acoustique	Number	1	5	6	12	x
Desired Position	Lat (format °,m)	37°19,2148 N	37°17,8499 N	37°16,8423 N	37°15,6146 N	37°18,56076 N
	Long (format °,m)	32°16,6964 E	32°19,4913 E	32°14,5015 E	32°17,8856 E	32°17,45682 W
deployment parameters	File name	MomarSat01	MomarSat05	MomarSat06	MomarSat12	MD_MIXTE
	sample rate	62,5	62,5	62,5	62,5	62.5
	nb channel	4	4	4	4	4
	year	2010	2010	2010	2010	2010
	Julien day	284	282	286	283	276
	Synch time (JJ/MM/AAAA HH:MM:SS)	12/10/2014 12:52:00	10/10/2014 11:29:00	14/10/2014 16:16:00	11/10/2014 17:03:00	02/10/2014 21:22:00
	Wake up time (JJ/MM/AAAA HH:MM:SS)	15/10/2014 12:00	12/10/2014 12:00	15/10/2014 12:00	12/10/2014 12:00	05/10/2014 15:00
	Lat (format °,m)	37°19,234 N	37°17,7956 N	37°16,856 N	37°15,602 N	
	Long (format °,m)	32°16,727 W	32°19,4734 W	32°14,504 W	32° 17,920 W	
	Deploy at (JJ/MM/AAAA HH:MM:SS)	15/10/2010 10:23:00	09/10/2010 15:59:06	15/10/2010 09:38:00	13/10/2014 16:53:00	
	depth	1500	1763	1526		

Description of work done during MomarSat2010 for the Station (OBS/JPP):

The preparation of the station is similar to an OBS for the acquisition system part(see closing checklist and deploy for more info). The calculation of the batteries it was decided to put 5 batteries 12DD Digital and 4 Analog DD batteries 12 (see appendix for calculation)

Weighing in the Horta harbor

We have weighted the complete equipment in the Horta harbor in order to have the weight in the air and in the water.
The weighted equipment is composed of:
1 sphere floater with its mast and ballast
1 flash & 1 radio
4 cylindrical floaters
1 OCEANO release device
The complete station with its 4 branch sling
Several slings and shackle
A bag of 25kg steel iron shot

The float + ballast + station assembly weighted 653kg in the air and 5kg in water.
The station alone weighted in water from 145kg to 150kg.

We've added two iron shot bag, one divided into two. So there are 2 bags (2x25kg) on ballast float and 2 bags (2x12, 5kg) on the station weight. These last two bags can be removed if needed by the ROV. The final set weighs 45kg to 50kg in water.

Comment for the on board & ROV handling

The originally planned line was 32m lenght:

For manipulation at the bottom of the ocean, the pilots of the ROV ask that the length of the line should be as short as possible.

In addition, the rear release portal of the deck has a height of 9m Max

We packed the line in order to reduce the length to 6 or 7m, thus the line could be deployed from the stern gantry at once.

Deployment Operations

Le 03/10/2010 An OCEANO and another IXSEA AR661 transponder have been tested for release operation.
These transponders have been mounted on the mooring line of the combined station OBS/JPP.

04/10/2010 at 14:36 The station is launched on the starboard of 'pourquoi pas ?'. Hooked to a cable (the ship's bottom line on the back porch), its rate of descent is 0.3 to 0.5 m / s to be placed at the bottom. It is equipped with a release device lend by IFREMER with a BUC head for positioning. This release device makes the link of the entire set (float station) to the bottom line.

At 16: 32 the cable is stopped, the depth is indicated by the pollster of 1751 m. Acoustic interrogation is sent, the BUC indicates
X = 032°16,783 W
Y = 037°17,467 N
Z = 1710 meters.

At 4:56 p.m. A second measurement is made before release. Pollster says 1742 m
X = W 032 ° 16.803
Y = 037 ° 17.467 N
Z = 1739 meters.

The station is supposed to be on the merits, the BUC is 3 m from the ground for a total height of the mooring line of 7 meters:

The line from the top
BUC: 0.5 meter.
Flotta: 2.5 meters.
1,5 m cable.
0.5 meter width.

Station straps 2 meters

At 17:00 the order to release all hovered + Station is sent.

At 10:52 p.m. Victor descended upon area. The station is marked on the bottom. The bucket in which was coiled cable communication between OBS Station Joint Node Seamon and West had been torn (by the straps on the descent). A portion of the cable is placed under the weight of the combined station.

At 11:14 p.m. Victor raises the combined station with his arm while with his second CHERPA MAESTRO arm releases the cable beneath the station. The cable is not damaged.

Victor starts reeling JPP cable but when connecting to the COS WEST Seamon, the ROV had a breakdown and started in safe mode (drift to the surface). When control was recovered, the cable was in tension because the clip did not release its hold.
...

Victor connected the OBS cable in second.

At 2:47 the OBS cable is connected to the COSTOFF Seamon West node. The remote COSTOFF communication interface is connected and a first interrogation of the OBS is made. 39 Earthquakes have been detected in total since its launch.

Polling Station via mixed Seamon WEST

Earthquake three files are downloaded via the link to CLSI dated 15 earthquakes on 32 earthquakes detected since the start of the combined station.

Around 4:00 VICTOR returns to the OBS/JPP for seism event simulation. It land roughly on the bottom, and hits with his arm the weight of the station.

Due to lack of time, the end of JPP/OBS deployment operations was decided.

14/10/2010 After the buoy mooring, at 13:00 the ROV is in the water. In the afternoon the second seismic events has trigger by the ROV (hits with this arm). At 23:30 another events has trigger, we had no time to connect the SLCI link with the COSTOF.

Polling of the mixed station via SEAMON WEST

Three earthquake files are downloaded via the CLSI link, for 15 dated earthquakes on 32 earthquakes detected since the start of the combined station.

10/10/04 12:20:47,07 51
10/10/04 12:23:18,55 21
10/10/04 12:24:26,48 41
10/10/04 14:03:50,58 37
10/10/04 14:17:46,15 17
10/10/04 14:34:53,00 01
10/10/04 15:28:25,47 61

10/10/04 17:00:16,55 82 Release.
10/10/04 17:00:48,06 91
10/10/04 17:00:59,41 66
10/10/04 17:01:04,18 81
10/10/04 17:01:12,15 23
10/10/04 17:01:33,00 44 Stabilisation of the station on the bottom.

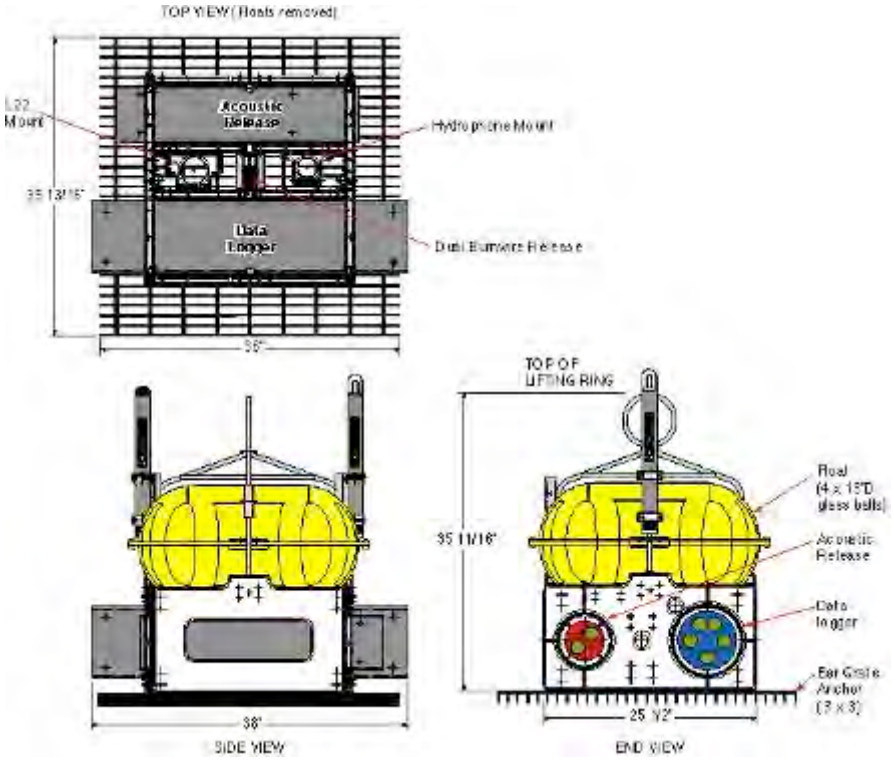
Since then no other seism events has been detected, even though VICTOR has delivered chocks on the instrument.

Recovery :

it will be necessary to have a float having a buoyancy greater than 150kg (including the topsides and the release device). And a releasable ballast weight of 50Kg in addition for the descent.
The same equipment, without bags sling shot or the metal ropes may be used according to availability of INSU:
1 Float sphere with a thud and the ballast (INSU)
1 Flash & 1 radio (IPGP or INSU)
4 cylinder floats with slings and shackles (IPGP)
A release device (INSU)
A weight 200kg (150kg + 50kg bags chain shot?)
1 "BUC" release device on the bottom line of the vessel (IFREMER Brest)

Annex: Description of material:

Short period OBS:



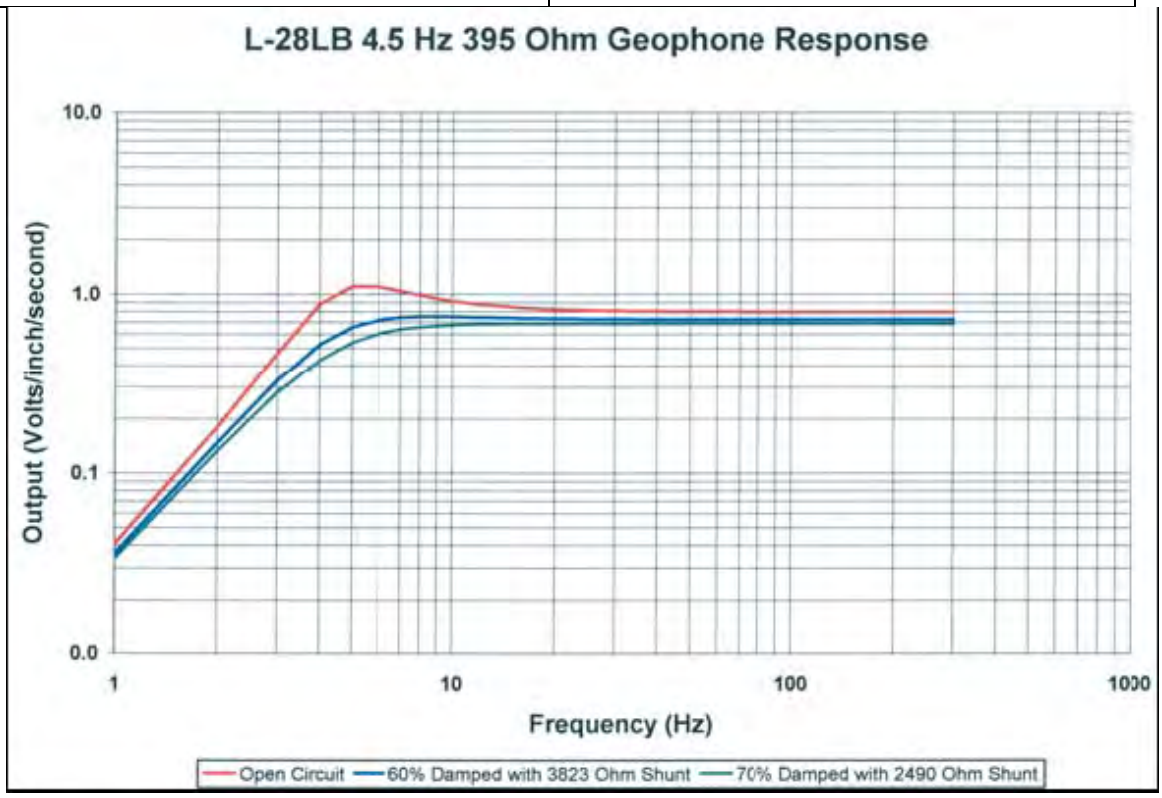
Characteristics of short-period sensors:

Sensors Three axis Geophone Mark Products L-28 Hydrophone Hitech HYI-90-U Mechanical layout: Dimensions: 1m x 1m x 1m Maximum depth: 6000 meters Material of cylinders: Aluminium 7075 Hard anodised and epoxy paint Weight In air without drop weight: 72 Kg In air with drop weight: 110 Kg In water without drop weight: -14 Kg In water with drop weight: 19 Kg	Electronics Nb of real bits: 21 at 16 Hz or 20 à 125 Hz Number of channels: 4 Available sampling rate: 1000 - 500 - 250 - 125 - 62,5 - 32,25 - 16,125 s/s Crystal – CS5321 – CS5322 Data storage: HD 80 Gb Clock: Seascan MCXO SISMTB4SC Surface gear Flag Radio beacon Flash light Reflectors

Seismometer short period L28B:

The sensor is composed of seismometers L-28LB (manufactured by Sercel). It's characteristics are the following:

Natural frequency (f0)	**4.5 Hz**
Frequency Tolerance	**±0.5 Hz**
Standard Coil Resistance (Rcoil)	**395 Ω**
Resistance Tolerance	**6.5%**
Maximum Distortion @ 0.7 in/sec **peak-to-peak @ 12 Hz**	**0.2%**
Transduction Constant **V/in/s ±10%**	$0.040 \cdot \sqrt{R_{coil}}$
Open Circuit Damping ±10%	$\frac{1.726}{f}$
Coil Current Damping	$\frac{10.40 \cdot R_{coil}}{f.(R_{coil} + R_{shunt})}$
Suspended Mass (m)	19.00 g
Power Sensitivity	1.60 mW/in/s
Cast-to-Coil Motion	0.160 inch. Peak to peak



Item	Symbol	Value
Natural Frequency	f_0	4.50 Hz
Resistance Shunt	*Rshunt*	2490 Ω

Open loop dumping coefficient	δ_0	$\frac{1.726}{f_0} = 0.384$
Coil damp coefficient		$\frac{10.40 \cdot R_{coil}}{(R_{coil} + R_{shunt}) f_0} = 0.316$
Damp Factor	δ	0.70 = 70%
Sensitivity or Tran conduction +/- 10%	-	.040 * √(R_{coil}) volts/in/second = 1.5748 * √(R_{coil}) volts/m/second = 31.3 volts/meter/second

The Hydrophone

The hydrophone used in the lCheapo OBS is a HTI-90u manufactured by High Tech, Inc.
Sensitivity:

Without preamp	-186 dB re: 1 V/uPa 50.1 V/Bar
With preamp	(max) -155 dB re: 1 V/uPa (max) 1778 V/Bar (min) -240 dB re: 1 V/uPa (min) 0.1 V/Bar

Frequency response: 2 Hz to 20 KHz
Equivalent input coil noise:

RMS from 1 Hz to 1000 Hz	63 dB re: 1 uPa 0.015 uBar
Spectral	54 dB re: 1 uPa/sq.root Hz @ 10 Hz 35 dB re: 1 uPa/sq.root Hz @ 100 Hz 26 dB re: 1 uPa/sq.root Hz @ 1000 Hz

LCheapo Power Calculations

Sample Info							
Sample Rate (SPS)	# Chan	Samples Collected per second	Bytes/Sample	Bytes/Second	Bytes/Day	Bytes/Month	Bytes/Year
62,5	4	250	3	750	6,48E+07	1,94E+09	2,37E+10

Digital Power		Analog Power					
Digital Voltage (V)	Digital Current (mA)	+Analog Voltage (V)	+Analog Current (mA)	-Analog Voltage (V)	-Analog Current (mA)	Analog Voltage (V)	Average Analog Current (mA)
15,05	9,62	7,62	13	-7,61	-11,9	15,23	12,45

Digital/Analog current values off of the checkout sheets must be divided by 10 (measurements are across a 10-Ohm resistor).

Disk Voltage (V)	Disk Current (mA)	Buffer Size of Data Logger (MB)	RAM Buffer Size of Data Logger 512-Byte Blocks	Number of samples in a block 1Block = 512 Byte	Samples Written during a buffer write	Time to fill RAM Buffer (sec)	Measured Disk Drive Write Time of RAM Buffer (sec)	Duty Cycle of Disk Drive
14,08	270	7,340E+06	14336	166	2379776	9519,104	76	0,798%

Disk Current values off of the checkout sheets must be multiplied by 10 (measurements are across a 0.1-Ohm resistor).

Sensor Power
Hydrophone (mW)
-26

Broad Band OBS (BBOBS):

Characteristics of Broadband sensor:

Sensor	Electronics
Nanometrics Trillium T240	Nb of real bits: 21 at 16 Hz or 20 à 125 Hz
Differential pressure gauge	Number of channels: 4
Mechanical layout:	Available sampling rate: 1000 - 500 - 250 -
Dimensions: 1m x 1,5m x 1, 30m	125 - 62,5 - 32,25 - 16,125 s/s
Maximum depth: 6000 meters	Crystal – CS5321 – CS5322
Material of cylinders: Aluminium 7075	Data storage: HD 80 Gb
Hard anodised and epoxy paint	Clock: Seascan MCXO SISMTB4SC
Weight:	Surface gear:
In air without drop weight: 230 Kg	Flag
In air with drop weight: 310 Kg	Radio beacon
In water without drop weight:	Flash light
In water with drop weight:	Reflectors

Station OBS/JPP

Station Power Calculations

(All values in YELLOW are Required Inputs)

Sample Info							
Sample Rate (SPS)	# Chan	Samples Collected per second	Bytes/Sample	Bytes/Second	Bytes/Day	Bytes/Month	Bytes/Year
62,5	4	250	3	750	6,48E+07	1,94E+09	2,37E+10

Digital Power		Analog Power					
Digital Voltage (V)	Digital Current (mA)	+Analog Voltage (V)	+Analog Current (mA)	-Analog Voltage (V)	-Analog Current (mA)	Analog Voltage (V)	Average Analog Current (mA)
15	30	6	36	-6	-29	12	32,5

Digital/Analog current values off of the checkout sheets must be divided by 10 (measurements are across a 10-Ohm resistor).

Disk Power								
Disk Voltage (V)	Disk Current (mA)	Buffer Size of Data Logger (MB)	RAM Buffer Size of Data Logger 512-Byte Blocks	Number of samples in a block 1Block = 512 Byte	Samples Written during a buffer write	Time to fill RAM Buffer (sec)	Measured Disk Drive Write Time of RAM Buffer (sec)	Duty Cycle of Disk Drive
15	300	7,340E+06	14336	166	2379776	9519,104	80	0,840%

Disk Current values off of the checkout sheets must be multiplied by 10 (measurements are across a 0.1-Ohm resistor).

Seism Info							
Seism per day (estimation)	Alarm Seism per day (estimation)	Time seism process (estimation in Sec)	Time to alarm process (Sec)	Digital Current for seism process (mA)	Digital Current for ALARM via ASSEM Communication (mA)	Duty cycle Seism	Duty cycle Alarm seism
500	100	8	4,00E-02	97,00	107,00	4,63%	0,004630%

CIA Info							
ASSEM Comm. per day	Time to ASSEM Comm (Sec).	DUMP per day	Time dump Process (Sec)	Digital Current for ASSEM Comm.	Digital current for DUMP process	Duty cycle ASSEM Com.	Duty cycle DUMP Process.
4	0,50	10,00	90,00	107,00	97,00	0,0023%	0,93%

Sensor Power
Hydrophone (mW)
38

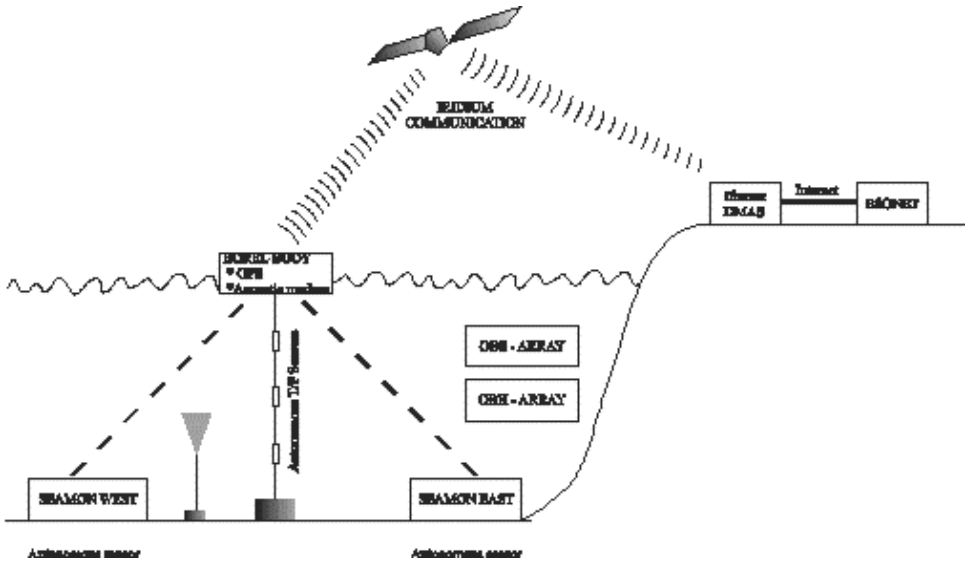
Long Period Battery Estimates

Sample Info	Digital						Analog			Total
Sample Rate	Number of Channels	Digital Power (mW)	Disk Power (mW)	Disk Write Duty Cycle	Average Disk Power (mW)	Total 1 Digital Power (mW)	Analog Power (mW)	Sensor Power (Hydrophone) (mW)	Analog Power (mW)	Total Power (Dig+Ana) (mW)
62,5	4	450,00	4500,00	0,84%	37,82	487,82	390,00	38,00	428,00	487,82

ASSEM Associed activity													
Alarm seism (mW)	Alarm Seism Duty Cycle	Average Alarm Seism (mW)	Seism (mW)	Seism Duty Cycle	Average Seism (mW)	ASSEM Comm. (mW)	ASSEM Comm. Duty Cycle	Average ASSEM Comm. (mW)	DUMP (mW)	DUMP Duty Cycle	Average DUMP (mW)	Total 2 Digital power (mW)	Total Digital Power (mW)
1605,00	0,00463%	0,0743	1455,00	4,63%	67,36	1605,00	0,0023%	0,04	1455,00	0,01	13,47	80,9448	568,7635

Battery Life - 4Pack		1-Year Deployment		Battery Life - 12Pack		1-Year Deployment	
Digital Days per 4DD	Analog Days per 4DD	Number of Digital 4DD Battery Packs Required	Number of Analog 4DD Battery Packs Required	Digital Days per 12DD	Analog Days per 12DD	Number of Digital 12DD Battery Packs Required	Number of Analog 12DD Battery Packs Required
28,11	37,36	12,98	9,77	84,34	112,08	4,33	3,26

Exchange protocol between the combined station OBS/JPP and the Costof of the SEAMON WEST station:



The OBS/JPP combined station is connected to the SEAMON WEST station via a RS232 serial link.
Following is the serial link exchange description between the station OBS/JPP and the Costof:

Answers to the SEAMON commands set:

Limitations:

The exchanged data are in ASCII code in order to unease its reading through a simple terminal.
The dates exchanged in different commands follow a common format on 15 characters as follow:

type	Year	Month	Day	Hour	Minute	Second	10^{-3} s
Number of characters	2	2	2	2	2	2	3

In one year there is 365*24*60*60 = 31536000 seconds
With LTA = 4s the maximum number of seism is therefore 31536000/4 = 7884000.
So 7 characters will be used to code the number of seism.

OBS status request:

Request send by the SEAMON to the OBS :

ÿ..ÿÿ	'$'	'**D**'	FFh	Canal **1**	Size = 0	CheckSum	CR + LF
3-5 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes

Answer given by the OBS to SEAMON:

ÿÿÿ	'$'	'**d**'	FFh	Canal **1**	Size = 26	Data	CheckSum	CR + LF
3 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	26 bytes	2 bytes	2 bytes

Avec Data = 26 following bytes:

Date	separator	Number of blocks in the disk
15 bytes	'B'	10 bytes (characters ASCII)

Number of seism request.

Request send by the SEAMON to the OBS :

ÿ..ÿÿ	'$'	'**D**'	FFh	Canal **2**	Size = 0	Checksum	CR + LF
3-5 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes

Answer given by the OBS to SEAMON:

ÿÿÿ	'$'	'**d**'	FFh	Canal **2**	Size = 5	Number of seism	Checksum	CR + LF
3 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	7 bytes	2 bytes	2 bytes

Number of DUMP request.

Request send by the SEAMON to the OBS :

ÿ..ÿÿ	'$'	'**D**'	FFh	Canal **3**	Size = 0	CheckSum	CR + LF
3-5 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes

Answer given by the OBS to SEAMON:

ÿÿÿ	'$'	'**d**'	FFh	Canal **3**	Size = 4	Number of DUMP	CheckSum	CR + LF
3 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	4 bytes	2 bytes	2 bytes

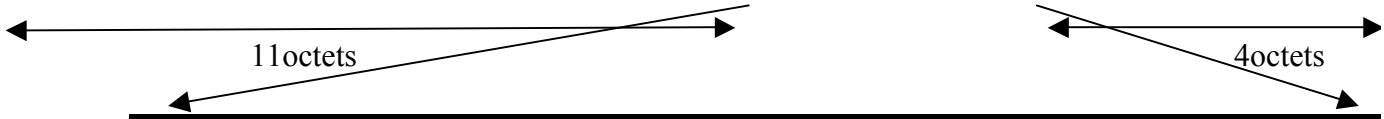
Date of the last seism since previous request.

Request send by the SEAMON to the OBS :

ÿ..ÿÿ	'$'	'**D**'	FFh	Canal **4**	Size = 0	CheckSum	CR + LF
3-5 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes

Answer given by the OBS to SEAMON:

Ÿÿÿ	'$'	'**d**'	FFh	Canal **4**	size = 2+16*N	answer (127max)	CheckSum	CR + LF
3 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 + 16*N bytes	2 bytes	2 bytes



Number of seism = N	seism 1 Date	Level1	seism 2 Date	Level2	…	Date seism N	level N
2 bytes	15 bytes	1 byte	15 bytes	1 byte	…	15 bytes	1 byt

Seismic alarm.

This alarm is send as soon as the current detected level is greater than the trigger level.
This can be dis-activated with the A command, or reactivated with the B command.

Message given by the OBS to SEAMON:

ÿÿÿ	'$'	'**g**'	FFh	Canal **1**	size = 16	seism Date	Level	CheckSum	CR + LF
3 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	15 bytes	1 bytes	2 bytes	2 bytes

Deactivation of the Seismic alarm.

Request send by the SEAMON to the OBS :

ÿ..ÿÿ	'$'	'**A**'	FFh	Canal **1**	Size = 0	CheckSum	CR + LF
3-5 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes

Answer given by the OBS to SEAMON:

ÿ..ÿÿ	'$'	'**a**'	FFh	Canal **1**	Size = 0	CheckSum	CR + LF
3-5 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes

Activation of the Seismic alarm.

Request send by the SEAMON to the OBS :

ÿ..ÿÿ	'$'	'**B**'	FFh	Canal **1**	Size = 0	CheckSum	CR + LF

3-5 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes

Answer given by the OBS to SEAMON:

ÿ..ÿÿ	'$'	'**b**'	FFh	Canal **1**	Size = 0	CheckSum	CR + LF
3-5 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes

Triggering level adjustment.

It is possible to remotely adjust the triggering level.
This level is initialized at 0 on startup.
Its max value is 7.
When a seism of this level or greater is detected, the alarm will be send.

Request send by the SEAMON to the OBS :

Ÿÿÿ	'$'	'**T**'	FFh	Canal **1**	size = 2	level	CheckSum	CR + LF
3 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes	2 bytes

Answer given by the OBS to SEAMON:

ÿ..ÿÿ	'$'	'**t**'	FFh	Canal **1**	Size = 0	CheckSum	CR + LF
3-5 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes

Seism counter reset.

Request send by the SEAMON to the OBS :

ÿ..ÿÿ	'$'	'**R**'	FFh	Canal **1**	Size = 0	CheckSum	CR + LF
3-5 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes

Answer given by the OBS to SEAMON:

ÿÿÿ	'$'	'**r**'	FFh	Canal **1**	Size = 0	CheckSum	CR + LF
3 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes

Dump counter reset.

Request send by the SEAMON to the OBS :

Ÿÿÿ	'$'	'**R**'	FFh	Canal **2**	Size = 0	CheckSum	CR + LF
3 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes

Answer given by the OBS to SEAMON:

ÿ..ÿÿ	'$'	'**r**'	FFh	Canal **2**	Size = 0	CheckSum	CR + LF
3-5 bytes	1 byte	1 byte	1 byte	1 byte	4 bytes	2 bytes	2 bytes

Transmitted data amount :

'Reduced data' transmission sumary :

Command	coding	Type : P AL NRTC	Measurement Period (MP)	Number of byte out	Number of byte in	weigh /day
OBS status request	'D'+Canal 1	P	1 jour	0	26	26
Number of seism request	'D'+Canal 2	P	1 jour	0	5	5
Number of DUMP request.	'D'+Canal 3	P	1 jour	0	4	4
Date of the last seism since previous request	'D'+Canal 4	P	1 jour	0	2 + 7*16 <122	?
Seismic alarm	'g'+Canal 1	AL	imprédictible	0	16	?
Deactivation of the Seismic alarm	'A'+Canal 1	NRTC	On user request	0	0	0
Activation of the Seismic alarm	'B'+Canal 1	NRTC	On user request	0	0	0
Triggering level adjustment	'T'+Canal 1	NRTC	On user request	1	0	?
Seism counter reset	'R'+Canal 1	NRTC	On user request	0	5	5
Dump counter reset	'R'+Canal 2	NRTC	On user request	0	0	0