



This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No [308417]".



New Directions in Seismic Hazard Assessment through Focused Earth Observation in the Marmara Supersite

Grant Agreement Number: 308417

co-funded by the European Commission within the Seventh Framework Programme

THEME [ENV.2012.6.4-2]

[Long-term monitoring experiment in geologically active regions of Europe prone to natural hazards: the Supersite concept]

D8.1

Report on repeated deployments of autonomous instruments

Project Start Date	1 November 2012
Project Duration	36 months
Project Coordinator /Organization	Nurcan Meral Özel / KOERI
Work Package Number	WP-8
Deliverable Name/ Number	D8.1 Report on repeated deployments of autonomous instruments
Due Date Of Deliverable	31 st December 2014
Actual Submission Date	6 th February 2015
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Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission)	
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NATIONAL RESEARCH COUNCIL OF ITALY
INSTITUTE OF MARINE SCIENCES (BOLOGNA) – INGV -
ITU-EMCOL (ISTANBUL) – IFREMER

**TECHNICAL REPORT ON THE MORPHOBATHYMETRIC,
GEOPHYSICAL, CORING AND OCEANOGRAPHICAL ACTIVITIES
DURING MARM13 CRUISE, SEA OF MARMARA**

R/V URANIA CRUISE REPORT (2013-09-19 – 2013-10-14)

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MARM13 R/V URANIA - ISMAR Bologna CRUISE REPORT
Bologna, November 2013

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ISMAR-CNR Cataloging-In-Publication data: MARM13 R/V URANIA - ISMAR Bologna CRUISE REPORT

TECHNICAL REPORT ON THE MORPHOBATHYMETRIC, GEOPHYSICAL, CORING AND OCEANOGRAPHICAL ACTIVITIES DURING MARM13 CRUISE, SEA OF MARMARA. R/V URANIA CRUISE REPORT (2013-09-19 – 2013-10-14)

by Gasperini L., Marinaro G., Çağatay N., Bortoluzzi G., Dal Passo E., Savelli F., Gallerani A., Priore F., Lamperti S., Di Blasi F., Embriaco D., Giovannetti G., D'Anna G., Passafiume L., Can A., Ari Z., Albut G., Yalmaz B., Acar D., Ogretmen N., Roudaut M., Apprioual R., Diakonov A., Grazzini A., Raspagliosi M.

Includes bibliographical reference and index.

1. tectonics 2. active faults 3. paleoseismology 4. seismology 5. Sea of Marmara

Abstract - A marine geological cruise, MARM13, was carried out in the Sea of Marmara with main objective of assessing and mitigating seismic hazards in the region close to Istanbul. Geological/geophysical surveys were carried out along the submerged track of the North Anatolian Fault and equipments were deployed for seafloor monitoring. We collected multibeam bathymetry, chirp sub-bottom, ADCP and multichannel seismic data, together with carefully positioned core samples. INGV GEOSTAR family (SN-4 station) was deployed together with four INGVs OBS and two IFREMERs piezometers.

Sommario Vengono presentati le metodologie e linsieme dei risultati ottenuti durante la campagna MARM13 di rilievi geofisici, geologici e oceanografici nel Mar di Marmara. E stata utilizzata la nave da ricerca R/V Urania del CNR. Sono stati raccolti dati di multibeam, CHIRP SBP, ADCP e sismica a riflessione multicanale. Durante la campagna sono stati deposti un osservatorio (SN-4) e quattro OBS dell INGV, insieme a due piezometri dell IFREMER.

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Production Notes - The document was edited with standard text editors, typeset with L.Lamport's L^AT_EX, translated to PostScript with dvips and printed with an A4 laser printer. The full production was done on a Linux box with GNU-GPL software. Converted to HTML by N.Drakos's L^AT_EX2HTML and to PDF by Alladin Ghostscript's ps2pdf. Most of the maps included were produced by Wessel and Smith's GMT package. convert.

ACRONYM	DESCRIPTION	URL-email
CNR ISMAR IFREMER INGV ITU EMCOL UNIBO UNIPR UNIMIB SO.PRO.MAR.	Consiglio Nazionale Delle Ricerche Istituto di Scienze Marine Institute Franc.Exploit. Mer Istituto naz. geofisica e Vulcanologia Istanbul Technical University Eastern Mediterranean Center for Oceanography and Limnology University of Bologna University of Parma University of Milano-Bicocca Societa' Promozione lavori Marittimi Fiumicino (Italy)	www.cnr.it www.bo.ismar.cnr.it www.ifremer.fr www.ingv.it www.itu.edu.tr www.mines.itu.edu.tr/emcol/ https://www.unibo.it https://www.unipr.it http://www.unimib.it www.sopromar.it b
SEG XTF GPS-DGPS-RTK DTM SRTM	Soc. of Exploration Geophysicists Extended Triton Format Global Positioning System Digital Terrain Model Shuttle Radar Topogr.Mission	www.seg.org www.tritonelics.com samadhi.jpl.nasa.gov en.wikipedia.org www2.jpl.nasa.gov/srtm
MBES SBP SSS PSU UTM UTC WGS84 NMEA	MULTIBEAM ECHOSOUNDER SYSTEM Sub Bottom Profiling Side Scan Sonar Practical Salinity Scale Universal Transverse Mercator Universal Time Coordinated World Geodetic System 1984 National Marine Electronics Association	ioc.unesco.org www.nmea.org
SBE BENTHOS SIS KONGSBERG GEOMETRICS COMM-TECH GEO-RESOURCES	Sea Bird Electronics Teledyne Benthos Sea Floor Inf. System Kongsberg Maritime Geometrics Communication Technology www.geo-resources.com	www.seabird.com www.benthos.com www.kongsberg.com www.kongsberg.com www.geometrics.com www.comm-tec.com
MB-SYSTEM GMT	MB-SYSTEM Generic Mapping Tool	www.ldgo.columbia.edu/MB-System gmt.soest.hawaii.edu/gmt

Table 1: Acronyms of Organizations, Manufacturers and Products

ACKNOWLEDGMENTS

Many people contributed to the success of the research cruise (MARM13 *R/V Urania*). We are particularly indebted to the Captain Vincenzo Lubrano Lavadera, the officers and crew members of *R/V Urania* for their professionalism and efforts in assuring the success of the cruise. We thank also Dr. Del Sette of So.Pro.Mar. for help and assistance. The project was funded by Italian CNR and European Community (Project MARSITE).

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1. INTRODUCTION AND BACKGROUNDS

After the 1999 disastrous Kocaeli earthquake, the international community is attempting to produce reliable maps of active faults distribution in the Sea of Marmara. As a follow-up of this effort, within a framework of increasing knowledge of the North Anatolian Fault (NAF) system, a number of scientists is starting to realize that the Sea of Marmara constitute an unique opportunity to study seismogenic behavior of an active fault for several reasons, including the relatively high strain rates observed, and the presence of clear stratigraphic markers at the time scale of several thousand years. Another important point for studying the NAF system below the Sea of Marmara is that here the active fault segments lay close to a highly populated region and will be probably the site of large earthquakes in the next decades. We believe that an integrated approach involving the acquisition and analysis of geophysical (multibeam, chirp, multichannel reflection seismic), geological (cores) and seismological data, would represent an innovative strategy in the emerging field of submarine earthquake geology to assess the seismic hazard in the Marmara region. On the other hand, results from recent marine geological cruises that analyzed the almost systematic association of cold seeps (emission of gas and fluids from the seafloor) and active faults in the Marmara Sea highlighted the importance of gathering long term time series to study correlation between fluid vents and seismicity. For this reason, the project includes a geological/geophysical survey in key areas of the Sea of Marmara as well as the deployment of a submarine observatory to monitor the behavior of the fault over a 1 year period. Diverse earthquake scenarios can be envisioned that would fill the strain gap in the Sea of Marmara between the 1912 and 1999 ruptures, to the western and eastern bounds, respectively. The implications of each scenario for the hazard facing Istanbul (population over 12 millions) and elsewhere around Marmara vary widely, and their likelihood needs to be evaluated. These evaluations can only be as reliable as the seismologic, geophysical and geological parameters on which they are based. Major issues that can be addressed with reliable information on structure and rupture history are:

1. Is the Marmara Sea gap going to be filled by a single large rupture or by a sequence of smaller ruptures?
2. Is the plate motion through Marmara partitioned between distinct structures accommodating the trans-current and extensional components of motion?
3. Do faults with complementary roles in such partitioned systems rupture in repeatable sequences?
4. How much close to rupture are seismogenic faults in the Marmara Sea as a result of the Coulomb stress effect of the 1999 sequence and what is the tsunamigenic potential of these structures?
5. Are fluid and gas emissions observed during previous studies related to seismicity and could they possibly be used as earthquake precursors to mitigate hazards?

The survey carried out during MARM13 combined multibeam, chirp sub-bottom profiles and multichannel seismic reflection with carefully positioned core samples to resolve the shallow geometry and kinematics of portions of the fault system in the north eastern Marmara Sea.

Our purpose was to resolve fault geometry and kinematics and to date their most recent ruptures at the same scale as typical paleoseismological studies on land. We were guided by previous and ongoing projects studying larger scale and deeper characteristics of the fault array in the Marmara Sea. Our strategy was to juxtapose morphology and structures along the inferred rupture of the 1999 Izmit earthquake with other faults that may have ruptured in previous historic earthquakes near Istanbul, such as the very large and destructive earthquakes centered in the eastern Marmara sea in 1509 and 1766. Particularly important was to identify features characteristic of submarine ruptures of transcurrent faults which may be subtle in reflection profiles.

The main part of the cruise was devoted to the deployment of submarine observatory (SN-4, OBS and piezometers) that are intended to remain submerged along the NAF for periods of several months, depending on the instrument purpose. An extensive seabed sampling and mapping were performed.

MARM13 was carried out in the frame of MARSITE project, co-funded by the European Community as part of the Long-term monitoring experiment in geologically active regions of Europe prone to natural hazards: the Supersite concept program. Such cooperation aims to collect, share and integrate multidisciplinary data (seismologic, geochemical, surveying, satellite etc.) in order to carry out assessment, mitigation and management of seismic risk in the region of the Sea of Marmara. The purpose

for the MARM13 cruise was to test the hypothesis that the physical and geochemical properties of the fluids change within the fault throughout an earthquake cycle and that these changes can be recorded at the seafloor. The collection of data series by bottom observatories was the main objective of the cruise. This implied a site survey prior deployment that included geophysical observations carried out directly on board of Urania.

Specific tasks carried out during MARM13 cruise were:

1. Deployment of INGVs SN-4 and OBSs
2. Deployment of IFREMERs piezometers
3. Collect multibeam, Chirp SBP and multichannel seismic reflection data all along the Marmara Sea
4. Collect cores (piston and water/sediment cores) at several sites in the Marmara Sea

Main partners were: ITU-EMCOL and MTA from Turkey, ISMAR and INGV from Italy and IFREMER from France.

Relevant previous or future research cruises

The present project is based on many previous research cruises carried out using R/V Odin Finder and R/V Urania and also on cruises of R/V Le Suroit and R/V L'Atalante within the framework of an Italy,France,USA and Turkey collaborative programme. The key areas have been identified through the interpretation of the previously collected geophysical and geological data along the NAF strands and cruise work was designed in order to map active structures and features likely useful to understand fault kinematics. For details about some of these cruises see:

- Odin Finder 2000, http://www.ismar.cnr.it/products/reports-campagne/2000-2009/MARM05_REP
- Urania 2001, http://www.ismar.cnr.it/products/reports-campagne/2000-2009/MARM2001_REP
- Urania 2005, http://www.ismar.cnr.it/products/reports-campagne/2000-2009/MARM05_REP
- Urania 2009, http://www.ismar.cnr.it/products/reports-campagne/2000-2009/MARM09_REP
- Yunus 2010, http://www.ismar.cnr.it/products/reports-campagne/2010-2019/MARM10_01_REP
- Urania 2010, http://www.ismar.cnr.it/products/reports-campagne/2010-2010/MARM10_02_REP http://www.ismar.cnr.it/products/reports-campagne/2010-2010/MARM11_REP

The references in bibliography cover broad aspects of the scientific problems and issues relating to the NAF in the Sea of Marmara, among the many others, tectonics, seismology, geochemical and sedimentary processes (Şengör, 1979; Barka, 1992; Çağatay et al., 1998; Hubert-Ferrari et al., 2002; Şengör et al., 2004, 1985; Armijo et al., 1999; McClusky et al., 2002; Armijo et al., 2002; Le Pichon et al., 2001, 2003; Aksu et al., 2000; Imren et al., 2001; Gokasan et al., 2001; Kuşcu et al., 2009; Alpar and Yalıtırak, 2002; Demirbag et al., 2003; Barka and Kadinsky-Cade, 1988; Barka, 1992; Stein et al., 1997; Okay et al., 2000; Parke et al., 2002; Flerit et al., 2003; Polonia et al., 2004; Meade et al., 2002; Ambraseys and Finkel, 1991; Provost et al., 2003; Shindler, 1997; Okay et al., 2004; Polonia et al., 2002).

Moreover, in recent years a lot of effort was also devoted to the study of cold seeps, gas and fluid emissions. Geli et al. (2008) presents the results of geophysical investigations and of submersible dives during cruises MARMARA (R/V Le Suroit, September 2000) and MARNAUT (R/V L'Atalante, May-June 2007), pointing to clearcut evidence of gas and fluid emissions and active tectonics in the Dea of Marmara, particularly in the Çınarcık Basin. Çağatay et al. (2009) discusses the late Pleistocene-Holocene stratigraphy of the northern shelf of the Sea of Marmara extending back to isotope stage 6. This study reports the discovery of two new sapropel units deposited during isotope stage 5 highstand and discusses water exchange between the Black Sea and Mediterranean through the Sea of Marmara during various isotopic stages, based on seismic stratigraphic and core analyses.

Two recent publications (Gasparini et al., 2011a,b) discuss the problem of the geological slip rates in the Marmara region.

More recent publications discuss in greater detail all the above items (Gasparini et al., 2012a; Çağatay et al., 2012; Zitter et al., 2012; Ruffine et al., 2012; Gasparini et al., 2012b; Tary et al., 2011; Eris et al., 2011; Tryon et al., 2010).

2. CRUISE SUMMARY

SHIP: *R/V Urania* Flag: Italy [IT] Call Sign: IQSU IMO: 9013220, MMSI: 247498000 START: 2013-09-19 PORT: Messina

END: 2013-10-14 PORT: Messina

SEA/OCEAN: Sea of Marmara, Ionian Sea

LIMITS: NORTH 40:50.0 SOUTH: 36:50.0 WEST: 15:30.0 EAST: 27:00

OBJECTIVE: Active Faults and historical earthquakes in the Marmara Region

COORDINATING BODIES: ISMAR-Bologna BOLOGNA (ITALY)

CHIEF OF EXPEDITION: Luca Gasperini (ISMAR-CNR)

CONTACT: Luca.Gasperini@ismar.cnr.it

DISCIPLINES: MARINE GEOLOGY, MARINE GEOPHYSICS, MORPHOBATHYMETRY, PHYSICAL OCEANOGRAPHY

WORK DONE: ~ 4900 KM MULTIBEAM, ~4900KM CHIRP SBP TOTAL, ~2800 KM CHIRP SBP SEA OF MARMARA, SPARKER

4 OBS DEPLOYMENTS, 2 PIEZOMETER DEPLOYMENTS, 1 SN-4 DEPLOYMENT, 12 PISTON CORES, 2 SW INTERFACE CORES, 28 CTD CASTS, 2 ROV DIVES

LOCALIZATION:

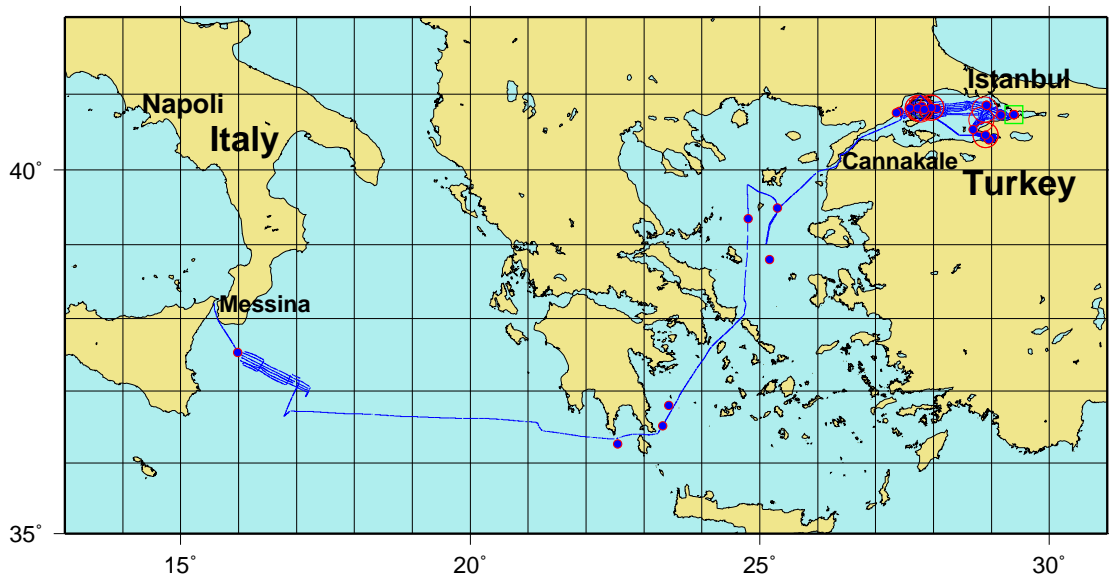


Figure 1: General ship tracks during Cruise MARM13, including transits from and to Messina.

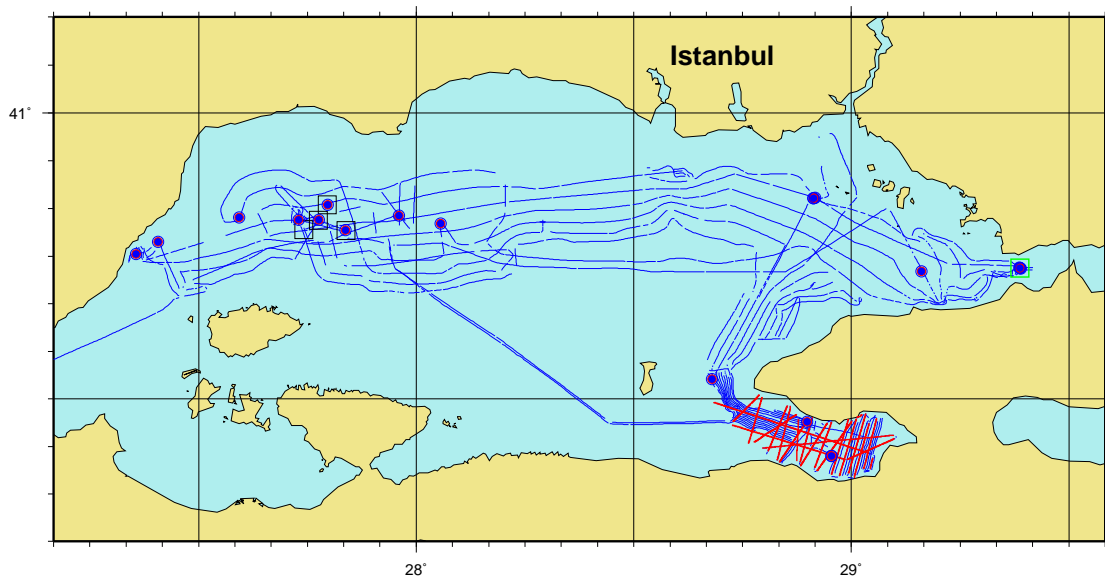


Figure 2: Ship tracks during cruise MARM13, Sea of Marmara. Red and blue circles and squares are coring locations. Red hollow circles are CTD and water sampling locations.

Table 2: CTD Stations. Cruise MARM13 with R/V *Urania*.

LON LAT	STATION NAME	DATA-NMEA	DATA-UPLOAD	FILE
ddmm.xxx		UTC		FILE
1559.200 3732.080	MARM13-01	2013-00-20T18:41:55	2013-00-20T18:43:00	MARM13-01.hex
2319.150 3630.940	MARM13-02	2013-00-24T08:52:15	2013-00-24T08:53:28	MARM13-02.hex
2447.950 3921.100	MARM13-03	2013-00-25T05:05:03	2013-00-25T05:05:30	MARM13-03.hex
2518.350 3929.710	MARM-13-4	2013-00-25T13:11:49	2013-00-25T13:12:11	MARM13-04.hex
2724.430 4046.510	MARM13-05	2013-00-26T15:16:52	2013-00-26T15:18:17	MARM13-05.hex
2721.370 4045.220	MARM-13-6	2013-00-26T20:08:34	2013-00-26T20:09:06	MARM13-06.hex
2909.680 4043.420	MARM13-07	2013-00-27T06:47:51	2013-00-27T06:48:18	MARM13-07.hex
2923.220 4043.740	MARM13-08	2013-00-27T16:07:07	2013-00-27T16:07:44	MARM13-08.hex
2855.020 4051.120	MARM13-09	2013-00-27T18:52:10	2013-00-27T18:53:38	MARM13-09.hex
2923.170 4043.810	MARM13-10	2013-00-28T13:19:22	2013-00-28T13:19:39	MARM13-10.hex
2923.360 4043.700	MARM13-11	2013-00-28T15:53:10	2013-00-28T15:55:49	MARM13-11.hex
2803.390 4048.430	MARM13-12	2013-00-29T09:15:51	2013-00-29T09:16:50	MARM13-12.hex
2923.230 4043.740	MARM13-13	2013-00-29T17:54:12	2013-00-29T17:54:20	MARM13-13.hex
2735.600 4049.050	MARM13-14	2013-00-30T06:35:05	2013-00-30T06:36:18	MARM13-14.hex
2840.770 4032.080	MARM13-15	2013-00-30T19:28:06	2013-00-30T19:29:48	MARM13-15.hex
2857.290 4024.020	MARM13-17	2013-00-02T19:46:40	2013-00-02T19:47:34	MARM13-17.hex
2854.810 4051.080	MARM13-18	2013-00-03T18:21:20	2013-00-03T18:22:18	MARM13-18.hex
2854.730 4051.080	MARM13-18-2	2013-00-03T18:51:42	2013-00-03T18:52:18	MARM13-18-2.hex
2857.250 4023.980	MARM13-19	2013-00-04T00:04:17	2013-00-04T00:04:57	MARM13-19.hex
2746.570 4048.830	MARM13-20	2013-00-04T14:43:19	2013-00-04T14:44:41	MARM13-20.hex
2747.820 4050.390	MARM13-20	2013-00-04T21:01:43	2013-00-04T21:02:48	MARM13-21.hex
2757.600 4049.250	MARM13-22	2013-00-05T19:22:49	2013-00-05T19:23:56	MARM13-22.hex
2743.810 4048.830	MARM13-23	2013-00-06T14:53:38	2013-00-06T14:54:59	MARM13-23.hex
2853.930 4027.590	MARM13-24	2013-00-07T14:15:14	2013-00-07T14:16:24	MARM13-24.hex
2750.250 4047.750	MARM13-25	2013-00-08T11:37:19	2013-00-08T11:37:58	MARM13-25.hex
2510.300 3848.120	MARM13-26	2013-00-09T21:28:51	2013-00-09T21:30:38	MARM13-26.hex
2325.450 3648.210	MARM13-27	2013-00-10T14:08:52	2013-00-10T14:10:05	MARM13-27.hex
2232.800 3615.930	MARM13-28	2013-00-11T07:22:50	2013-00-11T07:23:19	MARM13-28.hex

OPERATION	POSITION SHIP HDG OFFSET	POSITION TRUE	DATE	COMMENT
SN-4	2923.230 4043.742 260 STERN	2923.251 4043.745	2013-09-28T15:17:47	SN-4 INGV
SW01	2852.580 4025.675 330 CORER	2852.586 4025.674	2013-10-02T14:58:43	SWCorer ITU
PZN	2746.652 4048.934 001 CORER	2746.656 4048.931	2013-10-04T16:09:33	Piezometer IFREMER
OBS1	2746.494 4048.791 026 CORER	2746.496 4048.787	2013-10-04T18:41:42	OBS INGV
PZS-BENT	2746.656 4048.831 025 CORER	2746.658 4048.827	2013-10-04T19:28:29	Piezometer IFREMER
OBS2	2747.759 4050.381 039 CORER	2747.760 4050.376	2013-10-04T20:53:41	OBS INGV
M13-01-IT	2757.695 4049.259 171 CORER	2757.690 4049.262	2013-10-05T13:00:47	PistonCorer ISMAR 8.00m
M13-01-TR	2757.681 4049.259 283 CORER	2757.686 4049.261	2013-10-05T16:20:31	PistonCorer ISMAR 8.00m
M13-02-IT	2757.693 4049.262 123 CORER	2757.687 4049.261	2013-10-05T17:28:59	SWCorer ITU
M13-02-TR	2757.704 4049.266 075 CORER	2757.701 4049.262	2013-10-05T18:57:18	SWCorer ITU
OBS4	2744.536 4047.812 018 CORER	2744.539 4047.808	2013-10-05T21:22:50	OBS INGV
M13-03-IT	2746.297 4048.775 285 CORER	2746.302 4048.777	2013-10-06T07:30:03	PistonCorer ISMAR 9.20m
M13-03-TR	2746.321 4047.784 128 CORER	2746.315 4047.783	2013-10-06T11:18:18	PistonCorer ISMAR 9.21m
PZSV	2746.319 4048.770 143 STERN	2746.306 4048.783	2013-10-06T12:28:19	Piezometer IFREMER
OBS3	2750.350 4047.708 124 CORER	2750.344 4047.707	2013-10-06T13:15:34	OBS INGV
M13-04-IT	2743.796 4048.822 085 CORER	2743.792 4048.818	2013-10-06T14:23:50	PistonCorer ISMAR 9.00m
M13-04-TR	2743.779 4048.808 202 CORER	2743.777 4048.812	2013-10-06T17:34:29	PistonCorer ISMAR 8.60m
M13-05-IT	2849.556 4039.922 334 CORER	2849.562 4039.921	2013-10-07T06:59:54	PistonCorer ISMAR 9.40m
M13-06-TR	2852.715 4040.744 091 CORER	2852.711 4040.741	2013-10-07T10:37:32	PistonCorer ISMAR 8.73m
M13-07-IT	2853.657 4027.635 124 CORER	2853.651 4027.634	2013-10-07T13:50:21	PistonCorer ISMAR 8.63m
M13-08-TR	2853.722 4027.787 328 CORER	2853.728 4027.786	2013-10-07T16:59:57	PistonCorer ISMAR 7.40m

Table 3: Main Operations at Sea.

SCIENTIFIC AND TECHNICAL PARTIES

PARTICIPANTS	ORGANIZATION	EXPERTISE	tel & email & www
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Simone Lamperti	UNIBO		

Table 4: Scientific and technical parties

3. MATERIALS AND METHODS

The research cruise was carried out with the 61 meter *R/V Urania* (Fig.3), owned and operated by SO.PRO.MAR. and on long-term lease to CNR. The ship is normally used for geological, geophysical and oceanographical work in the Mediterranean Sea and adjoining waters, including but not limited to, the Atlantic Ocean, the Red Sea, and the Black Sea.

R/V Urania is equipped with DGPS and SEAPATH positioning system (satellite link by FUGRO), single-beam and multibeam bathymetry and integrated geophysical and oceanographical data acquisition systems, including ADCP, CHIRP SBP and other Sonar Equipment, other than water and sediment sampling. Additional equipment can be accommodated on the keel or towed.



Figure 3: *R/V Urania*.

3.1. NAVIGATION AND DATA ACQUISITION

The vessel was set-up for data acquisition and navigation with PDS-2000 software by RESON, interfacing by a multiserial and Ethernet link several instruments, among them the DGPS (Fugro), the Kongsberg EA60 single-beam echosounder, the SEAPATH MRU and the meteorological station. The position and depth data were also distributed to the CTD data acquisition console. A Kongsberg processor running the SIS software, collected the multibeam data, including the SEAPATH MRU, compass, and DGPS. The MBES were the 70kHz, 400 1x2°, 150° aperture EM-710 (2000 m range) and the EM302 (range 6000m) models by Kongsberg, with sonar heads positioned below the ship's keel using a dedicated blister. A Sound Velocity probe at the keel 1m above the Sonar Head is interfaced directly to the MBES processors, thus providing the necessary real-time data for the beam-forming. CTD casts were used for input of the sound velocity profile to the system. A MeteoFrance's BATOS Meteorological Station was also made available, at a rate of one measurement every 1 minutes.

POSITION	ACROSS	ALONG	HEIGHT
REFERENCE POINT	0.00	0.00	0.00
DGPS	1.64	14.30	14.18
MBEAM	0.00	14.36	-4.96
MAHRS	0.00	0.0	-3.40
ECHO SOUNDER 33	5.50	-1.85	-3.80
CHIRP	-1.0	11.80	-4.00
A-FRAME	6.5	-6.70	0.0
STERN	0.00	-30.60	0.00
SSS-TP	-3.0	-30.60	0.00
MAG	-3.0	-130.60	0.0

Table 5: Instrumental Offsets of PDS2000 on Ship Urania (PDS2000). The GPS antenna (primary positioning system) is located on point DGPS.

POSITION	ACROSS	ALONG	HEIGHT
REFERENCE POINT	0.00	0.00	0.00
SEAPATH_GPS	-4.039	0.163	-18.211
MRU	-0.341	-1.342	-1.596
MBEAM_TX	0.0936	10.2964	5.0623
MBEAM_RX	-0.0031	11.0144	5.0600
SEALEVEL	0	0	-0.0875

Table 6: Instrumental Offsets on Ship Urania (EM710). The DGPS antenna (primary positioning system) is located on point SEAPATH_GPS.

3.2. CHIRP SBP, MULTICHANNEL REFLECTION SEISMIC, MAGNETOMETRY, ROV, CTD

SBP data was acquired by the 16 transducers, hull mounted BENTHOS (DATASONICS) Mod.CAP-6600 CHIRP-II profiler, with operating frequencies ranging between 2 and 7 kHz. The pulse length ranged from 5 to 20 ms, while the trigger rates varied from 0.125 to 1-2 seconds according to water depth and morphology. Digital data acquired by the Communication Technology SWANPRO software were recorded in the XTF format on local disks and transferred on the network upon request. Backups were loaded on HD and DVD. The navigation data was made available to the system as lat/long by NMEA sentences of the DGPS receiver at a rate of approximately 1 Hz or by the PDS200's NMEA at 1Hz. The XTF data were then converted to SEG-Y by the ISMAR's XTF2SEGY routine (G.Stanghellini, personal communication) software. This latter data were then input to the ISMAR's SEISPHRO software (Gasparini and Stanghellini, 2009) for data processing and display.

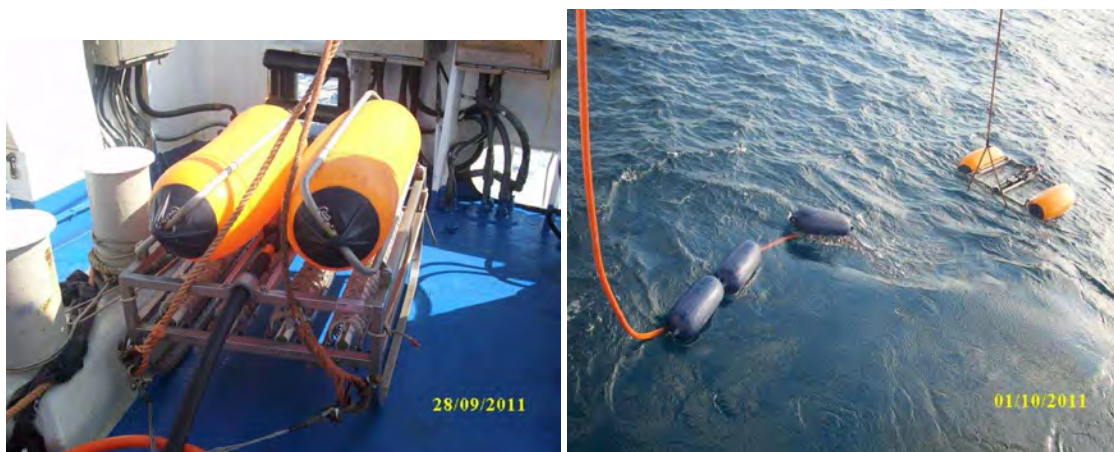


Figure 4: Geo-Resources GEO-SOURCE 1600 Sparker Source.

A 1.5 KJ Multi Tip sparker GEO-SOURCES by Geo-reources was towed astern on the starboard side (Fig.4). The power was generally set to 1.3 KJ. A 10 m long streamer was deployed on the port side by a 3m divergent and weights were set for towing at less than 0.5m water depth.

The seismic data were collected by a digital GEOMETRICS 8-channel streamer and recorded by the GEOMETRICS CNT-2 Marine Controller software. The group interval was of 3.125 m for a total active length of 25 m. The 70 m tow cable and a 10 m stretch section made up the streamer to a total length of ~150 m including tail buoys. The seismic source and the shot distance (6.25 m) was controlled by the PDS2000 at the speed of ~4 Kn, thus achieving a coverage of xxx%. The source was at surface, while the streamer was at 0.5-1m depth.

A Model G880 magnetometer by Geometrics was used and deployed from the stern's port side at a distance of 175m. The data were acquired by the Geometric's Maglog software.

CTD casts were taken throughout the surveyed areas, for oceanographical and sound velocity analysis, and were used for real-time MBES acquisition and post-processing. Data have been processed by the SBE Software, and bin-averaged ascii files were produced. The position of the CTD stations are reported in Table 2 and can be viewed in Fig.2, respectively.

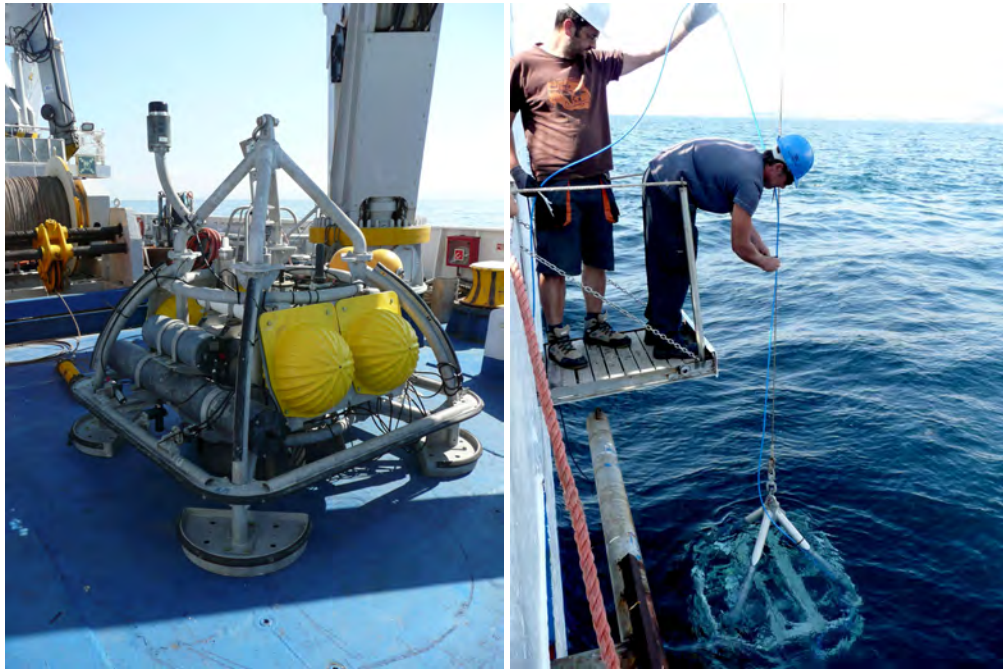


Figure 5: SN4 on deck (left) and MEDUSA deployed at sea.

3.3. SN-4 AND MEDUSA BOTTOM OBSERVATORIES

The SN-4 (Fig. 5) observatory was developed in the framework of ORION (Ocean Research by Integrated Observatory Networks) EC project and deployed as node of ASSEM (Array of Sensors for long-term SEabed Monitoring of geohazards) EC project during a joint experiment in the Corinth Gulf (Greece, 400 m w.d.) in 2004. In 2009 the upgraded version of the observatory was deployed in the Gulf of Izmit in Marmara Sea in the framework of the ESONET demo-mission.

All sensors installed on the observatory are managed by dedicated low-power electronics, able to perform the following tasks: management and acquisition from all scientific packages and status sensors; preparation and continuous update of hourly data messages; management of bidirectional communications via hydro-acoustic telemetry link; actuation of commands received (e.g., data request, system reconfiguration, restart) complete data back-up on internal memory. The SN-4 electronics can manage a wide set of data streams with quite different sampling rates tagging each datum according to a unique reference time set by a central high-precision clock. SN-4 is equipped with a 3-C broad-band seismometer, a 3-C current meter, two methane sensors, one oxygen sensor, one CTD and one turbidity meter with six months autonomous operation with the 12-V, 960-Ah lithium battery pack. With all these sensors SN-4 will be able to quantify the temporal relations between fluid expulsion, fluid chemistry and seismic

activity. To reduce disturbance of the frame and electronics, special devices were designed and implemented to install the seismometer. It is installed in a dedicated vessel integrated in a separate structure connected to the observatory via a special mechanical release. To guarantee a good coupling with the sea bottom, the structure is disconnected just after the observatory touch-down and kept linked to the frame by a slack rope. The validity of this method of seismometer installation is demonstrated by seismological data quality analysis made on data recorded during all the GEOSTAR-class observatory missions. The station has been deployed using a mechanical rope and an acoustic release, with the support of the ROV that controlled all the underwater operations. A recall buoy canister actuated by an acoustic release is installed on the observatory for the recovery operations. A secondary emergency recovery rope is installed on board of the SN4 frame; it can be easily used for a recovery procedure operated with the help of a ROV. The total weight in water is 1.5 kN thanks to the installation of 4 benthospheres on the frame.

The configuration for the MARM13 mission was as follows (Fig. 6, Tab. 7):

1. Communication with ship of opportunity by Sercel High Speed Acoustic Modem for data transfer and systems control
2. Deployment via winch and acoustic release and recovery via pop-up system (recall buoy canister) actuated by acoustic release
3. Endurance about 6 months; Power: 12V, 1920 Ah primary lithium pack; data storage 30GB HD
4. Dimensions: 2000x2000x2000 mm; Weight: 6.5 kN in air, 1.5 kN in water



Figure 6: SN4 drawing, cruise MARM13.

SENSOR	MODEL	SAMPLING RATE
Seismometer	Guralp CMG-40T	100Hz
Current meter	Nobsvka MAVS-3	5Hz
CTD	SBE-16 Plus	1 sample/10min
Turbidimeter	Wet Labs Echo-BBRTD	1 sample/10min
CH4 N.1	Franatech METS	1Hz
Oxygen	Aanderaa Oxygen Optode 3830	1Hz

Table 7: List of sensors installed on SN4

INGV MEDUSA (Fig. 5) is a towed inspection system that can be managed by a ship of opportunity, being deployed by a small winch delivering about 600 m of electrical and strength cable (Tab. 8). Once deployed in seawater, MEDUSA transmits in real-time to its Surface Control Unit all data collected by the installed payload consisting of (a) geochemical sensors measuring gas concentration (oxygen, methane), (b) water physical parameters (CTD), (c) system status and telemetry data and (d) images from an underwater camera.

MEDUSA is connected to the Surface Control Unit (SCU) through an umbilical cable. The SCU contains electronic equipment to control the underwater module, and all components are accommodated inside a transportable 14U industrial rack (230 VAC 50 Hz, 1.2 kW).

The sensors in Tab. 8 were installed for MARMARA2013 cruise

SENSOR	MODEL	MANUFACTURER
Oxygen sensor	Optode 3830	AANDERAA
Methane sensor	K-METS	Franatech
Methane sensor	HydroC	CONTROS
H2S electrode		
CTD	SBE-19plus	SeaBird
Turbidimeter	ECO-BBRTD	WET LABS
Echo sounder	PA500-6	TRITECH
TV Camera	Multi SeaCam 1060	DEEPSEA POWER&LIGHT

Table 8: List of sensors installed on MEDUSA

3.4. OBS

A number of 4 OBS, designed by INGV, were deployed (Fig. 7). Three of them were equipped with a 170Hz seismometer regulated by an auto-leveling base and a 15bit digitalizer. One of the OBS has been equipped with a 2Hz Differential Pressure Gauge (DPG), so as to reveal possible gaseous events connected to seismic shocks. The 14,4V, 350Ah lithium battery pack allows an autonomy up to 15 months. The OBS have both an electrolytic Burn-Wire release system that cuts the cable holding the frame to the weight and a classical acoustic release. A xenon flash lamp and a radiobeacon are installed on the OBS for recovery purpose.



Figure 7: Deployment of INGV OBS on Western High

3.5. PIEZOMETERS

The IFREMER piezometer (V2) is a device to measure the differential pressure and temperature at different levels in the sediment, for long term duration periods, after which system is recovered at surface by acoustic release (Fig. 8). Its applications are relative to geohazards including slope stability and relations between seismicity and fluids. The deployment duration can be up to 2 years (batteries and memory). The system is deployed on the bottom by the ship in station, and released upon satisfactory check of its attitude, principally verticality, to assure proper functioning during the mission.

Its main specifications are:

1. Up to 15 sensors, up to 15 m length
2. Water proofness of electronic and sensor (PBOF) up to 600 m
3. Clock synchronization (PPS input and DCF emulation input)
4. Pressure range ± 2000 mbar, accuracy 0.2%, resolution 1 mbar
5. Temperature range 0-40 °C, accuracy 0 to +25 °C ± 0.05 °C, resolution 0 to 25 °C < 0.015 °C at 10 °C

The operations on deck were performed by using the ships main winch for the deployment. After final checks of the selected sites by multibeam and CHIRP investigations, ship was put in station and the piezometers were: (a) put at 30-50 m above the seafloor for 10 minutes for stabilization, (b) deposited on the seafloor, (c) decoupled from ship by delivering the 30 m of cable and (d) released after interrogation by acoustic modem with acceptable response on instruments attitude and proper functioning. Two piezometers were deployed along the NAF, one on the northern side and the other on the southern.



Figure 8: Head of Ifremer piezometer prior to deployment

3.6. SEABED SAMPLING

The sea bottom samples were collected with 1.5 Ton piston corer, with 12m pipes, diameter 12cm, generally with trigger release, (Fig.9) and with a Sediment/water corer using 1.2 m liners, diameter 7cm. Cores recovered by the 1.5T corer were split on 1m long pieces. All cores have been taken in two copies for turkish and italian teams.

The sample locations are shown in Fig.2 and are reported on Tab.3



Figure 9: Deployment of gravity core

3.7. MISCELLANEOUS

The WGS84 datum, the UTM35N projection and UTC were chosen for navigation and display, and for data acquisition. The time zone was set to the UTC for the instrumental data acquisition. The positioning maps and bathymetric images were produced with GMT (Wessel and Smith, 1995) and Globalmapper.

The multibeam data were pre processed on board by the MB-SYSTEM, GMT software and ISMAR's routines and scripts, using the raw datafiles, after conversion to the ASCII format. Part of the data have been processed by the CARIS HIPS/SIPS package. ISMAR'S Bathymetric data were complemented by the IFREMER's DTM of Sea of Marmara (Le Pichon and et al., 2005). On-land SRTM topography data was used for mapping, structural analysis, after conversion to NETCDF GMT grid files.

4. DESCRIPTION OF DEPLOYMENTS AND OF DATA COLLECTED

Initial results are presented, in order to address the importance of the preliminary findings and processing sequence of the data acquired.

4.1. SN-4 OBSERVATORY DEPLOYMENT AND MEDUSA DIVES

The deployment of INGVs SN-4 at the entrance of the Gulf of Izmit was originally set to be on the 2013-09-27. Unfortunately, after an intense ROV recognition and multiple chirp and multibeam mapping searching for a flat-bottom area with gas phenomena, no suitable location was found. On the next day, 2013-09-28, a new survey was operated together with the MEDUSA observatory finally showing a suitable location for deployment very close to the NAF, on a flat bottom depth on the side of the steep E-W striking valley merging a few hundred m to the W with the Darica Canyon.

SN4 deployment operation started 2013-09-28 at 11:00 UTC after last check on SN4 status on board of URANIA. Deployment was monitored by ROV. The figures below show test performed with cable connection (before deployment, on deck) and with acoustic modem communication (during deployment at 50, 100,150 m depth and on the seafloor). After touch down on the sea floor at 15:17:47 UTC, SN4 tilt and orientation was checked to decide if the position was suitable for seismometer deployment (TiltX = 3 , TiltY = -4°, Heading = 304°from North).

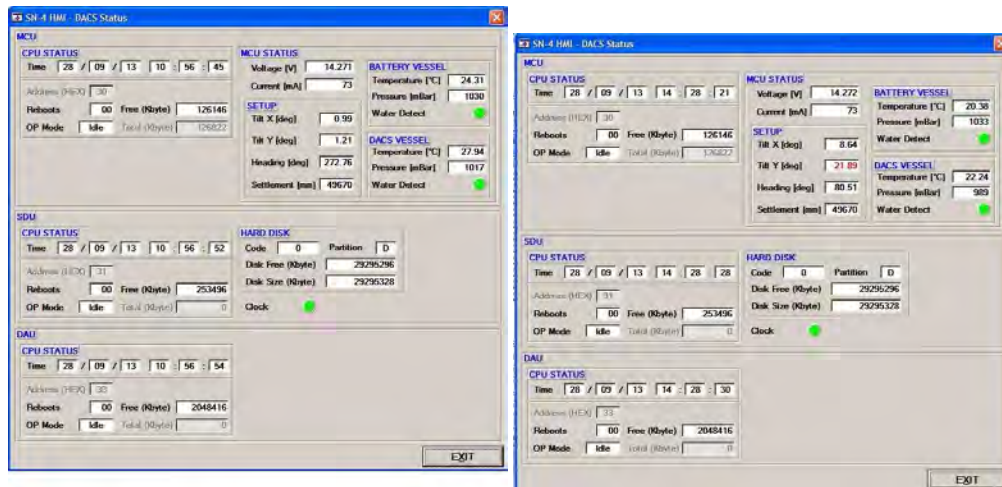


Figure 10: Screen display of SN4 parameters prior to deployment

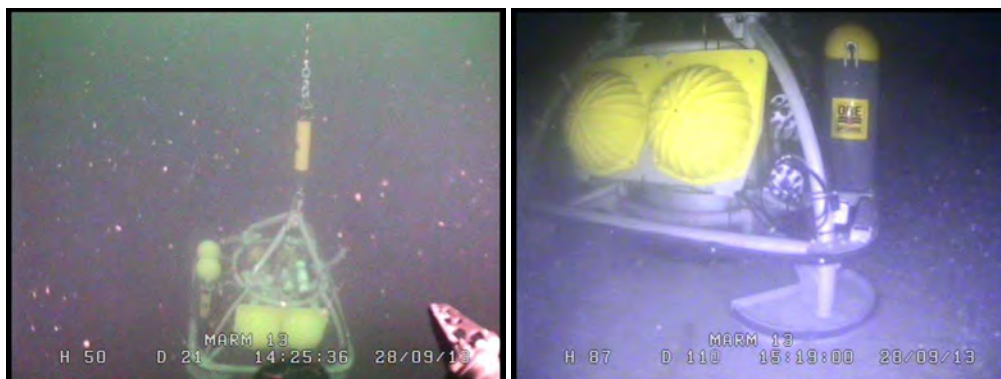


Figure 11: Photograph of SN4 on the seafloor



Figure 12: Photograph of GURALP sensor falling down

The OBS release command sent with acoustic was verified with real time video from ROV (Fig. 12). After verified the correct OBS release (dust release from the sea bottom due to touch down of the seismometer), the command GO Mission was sent to SN4 that started the acquisition of all sensors.

A multibeam survey was done immediately after the deployment in order to locate the instrument on bottom. Figure 13 shows the bathymetry with the SN4 and deployment data.

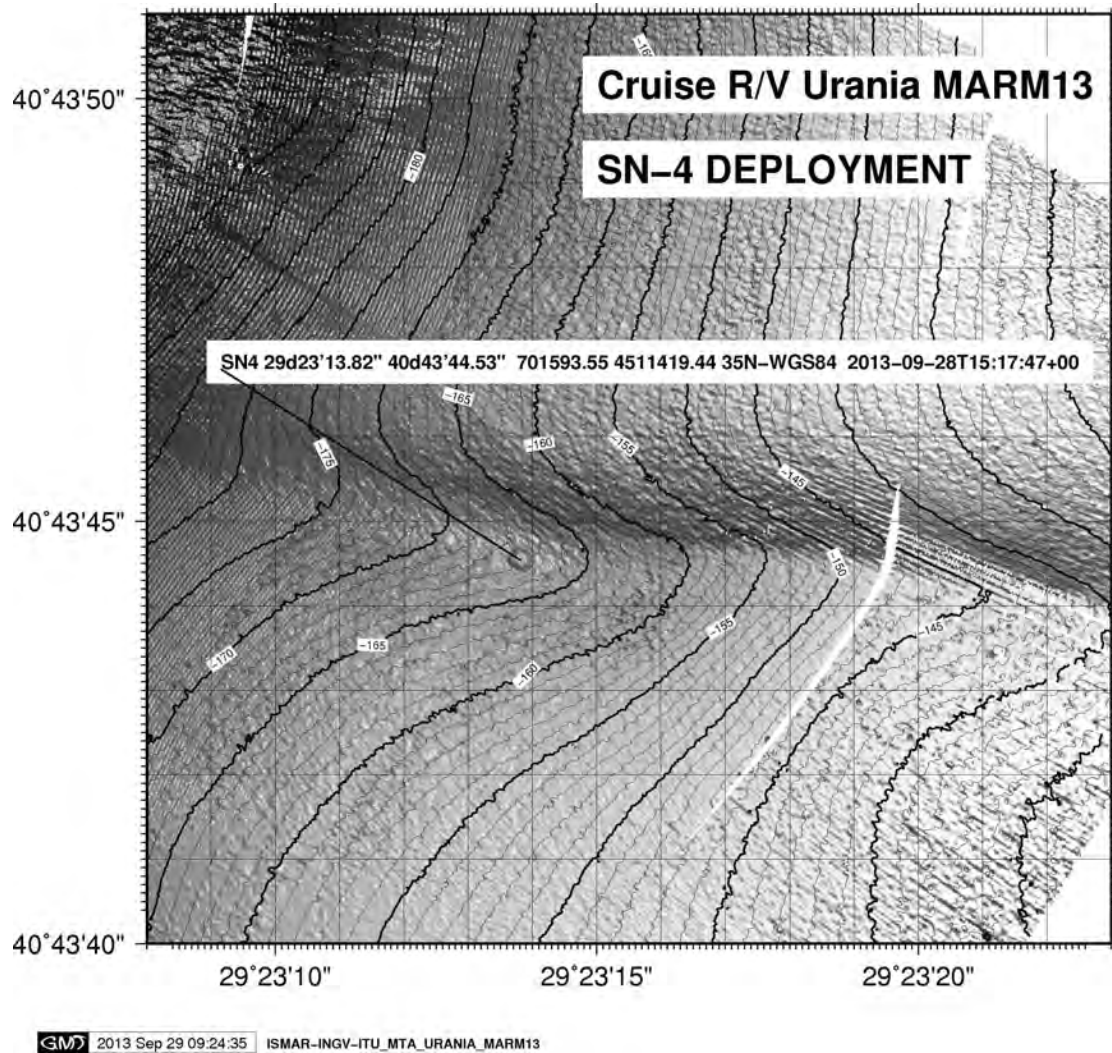


Figure 13: Bathymetry by EM710 multibeam of the deployment area of SN-4. The SN-4 position on bottom is indicated by the arrow.

A sea bottom survey was performed with MEDUSA on 27 September in the SN4 deployment area from 11:00 to 16:00 UTC

The figure below shows a rupture found on sea bottom;(North is toward the top of the figure).

4.2. OBS AND PIEZOMETERS DEPLOYMENT

The OBS were deployed on the 04 and 06-10-2013 after mapping by multibeam around the proposed sites, in order to identify most suitable areas. The following Table shows locations of deployment. The piezometers were deployed on the same days after CHIRP and multibeam investigation. The first one was deployed in the desired site, while the second one encountered a hard rock layer in the sub-bottom bending the steel pipe that contained the sensors. After repairing the pole, a second deployment was set in a different location which was a success. Following Table shows location of deployment, while the Figures provide an example of CHIRP images while investigating the deployment locations.

4.3. SEABED SAMPLING

Tables 3 and 9 show the positioning data and description of samples. Sampling by corers was successful even on hard grounds. Recovery ranged from 8.0 to 9.5 m.

4.4. MULTICHANNEL SEISMIC REFLECTION SURVEY

.. km of Multichannel lines were shot in the Gulf of Gemlik. All the lines underwent a preliminary quality check processing on board to obtain the neartrace.

4.5. BATHYMETRY

The grid of the multibeam lines acquired during the 25 days of operation in the study area are presented in Figures . A surface of approximately .. km² was covered in the surveyed areas during the cruise. Mapping on board was performed by using the PDS2000 production DTM, converted to ASCII, filtered by ISMAR's routine filter.bat, gridded by the nearneighbor GMT routine. The latter grids were used for navigation and structural analysis. Figures . Show examples of the acquired bathymetric data.

4.6. CHIRP

Several thousand Km of good quality CHIRP data have been collected in the Ionian Sea and in the Sea of Marmara.

4.7. MAGNETOMETRY

The magnetometer have been used mainly in the Ionian Sea.

SAMPLE	DESCRIPTION
--------	-------------

Table 9: Cruise MARM13: Sample description.

4.8. CTD AND SOUND VELOCITY DATA

Figure 14 shows the SV profiles, the TS diagram and location of the CTD casts collected on the MARM13cruise during the transits and in the Sea of Marmara. The data have been primarily used for the Speed of Sound data for the multibeams. Fig. 15 shows the Dissolved Oxygen data as well as Temperature and Salinity data, showing a well stratified water column with a pronounced halocline at ~20m depth (fresher waters from Black Sea and the Bosphorus). We must report about low oxygen, hypoxic water in the Sea of Marmara, generally at depths < 200m. Some casts have reported that the entire water column at depths below than ~ 190m m has to be considered anoxic, and this is true for the Eastern and Central Basins, and the entrance of the Izmit Gulf (Darica canyon). The Gemlik basin is filled with totally anoxic waters from the depth of ~ 80 m. The Western basin is filled by more oxygenated waters, although to be considered hypoxic toward the bottom, due to more pronounced exchanges with Mediterranean trough the Dardanelles. The presence of these large volumes of hypoxic and anoxic waters should be taken into considerations for the processes at the sediment waters interfaces, including the production of gas.

CRUISE MARM13 R/V URANIA

CTD DATA SBE911 Plus

DATE START: 2013-09-19

DATE END: 2013-10-14

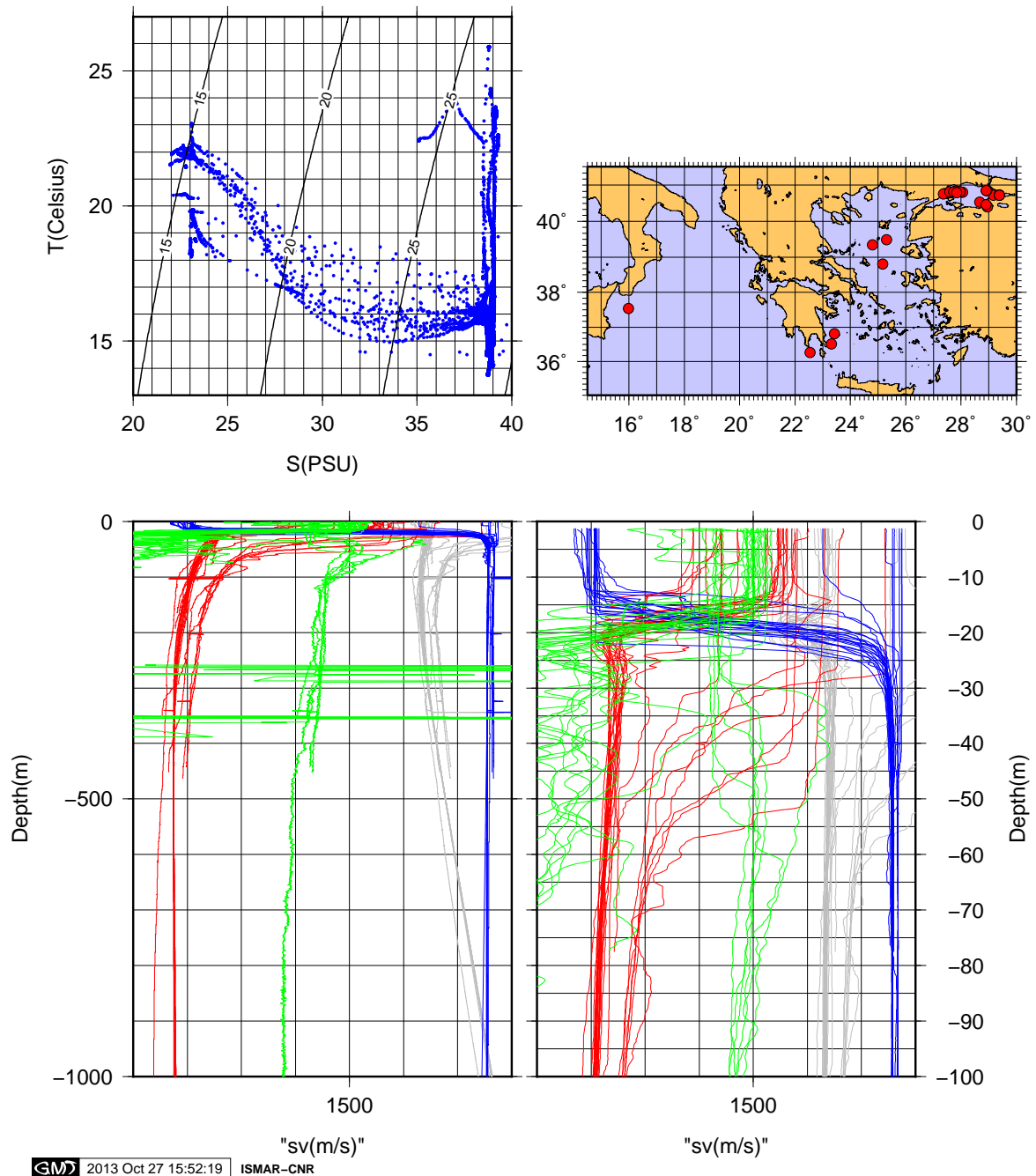


Figure 14: Cruise MARM13 CTD casts. Lower left: Sound Velocity(gray), T(red,13-28), S(blue, 37-39.25PSU). Upper left: TS diagram.

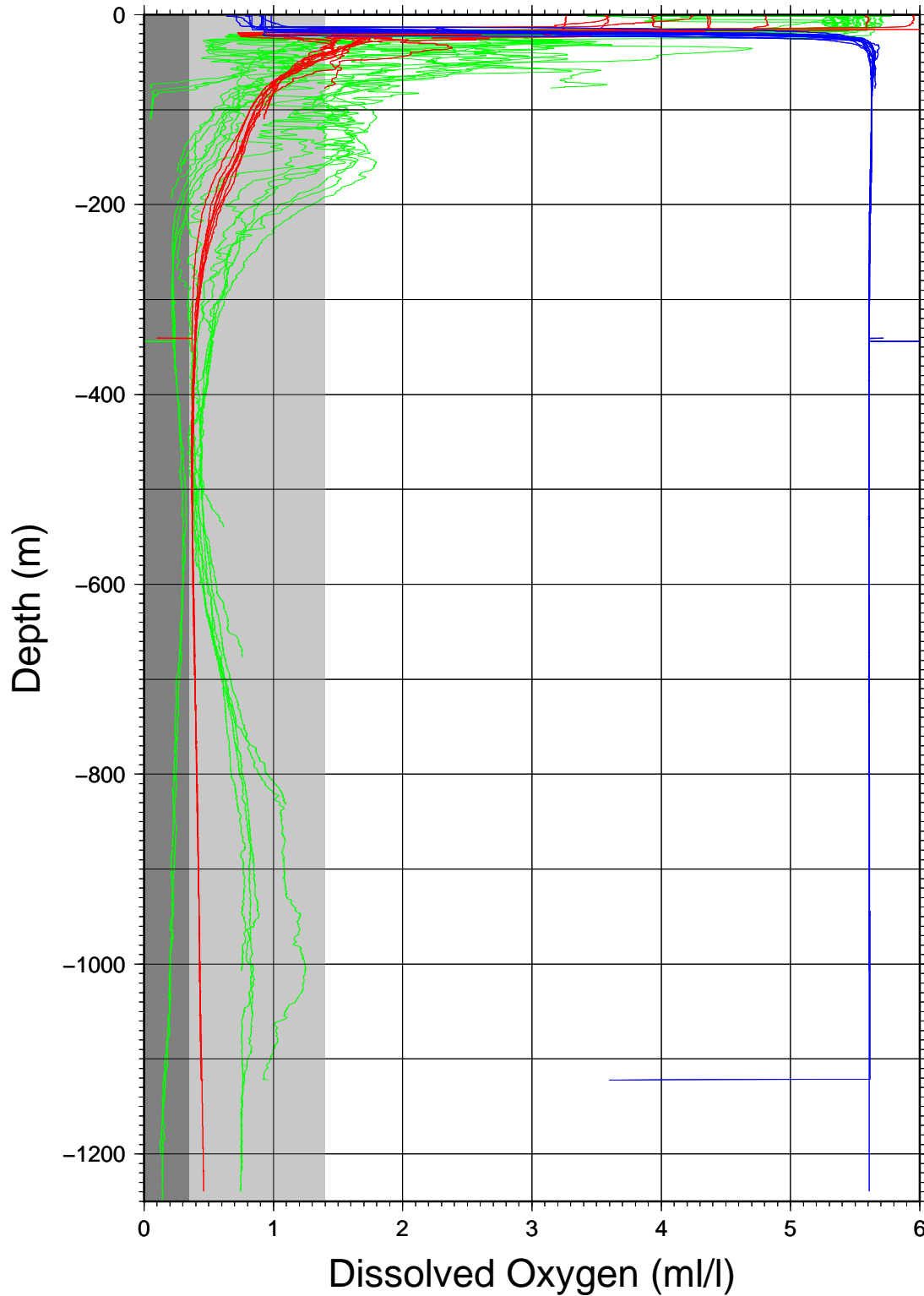


Figure 15: Cruise MARM13 CTD casts, Dissolved Oxygen (green lines). The gray bands indicate the values of Dissolved Oxygen for anoxic and hypoxic waters. Red line is Temperature (14 - 22 °C), blue line is Salinity (20 - 40 PSU).

5. CONCLUDING REMARKS AND FUTURE WORKS

Main targets of MARM13 cruise have been reached. A schematic list of first results is indicated.

- **Deployment of SN-4 observatory** Deployment of the SN-4 station in the Izmit Gulf was carried out after high resolution survey of the site using MBES and chirp-sonar and ROV and MEDUSA dives. The deployment of the station at the previous deployment site was discarded due to the presence of a numerous amount of bricks on the seafloor, rising the doubt of the station to be damaged after future discharges. Therefore, after a day-long survey a different location was spotted that could guarantee safety and long-lasting duration of the station, still remaining close enough to the fault segment intended to be surveyed. After deployment, several tests with acoustic transponder guaranteed the communication with the station verifying its functioning and attitude.
- **MEDUSA survey** The MEDUSA system was useful as to spot the suitable location for SN-4 deployment, other than providing CH4 emissions detection and water column analysis.
- **Deployment of OBS** The 4 OBSs were deployed correctly at their proposed stations, as verified by tests carried out soon after deployment.
- **Deployment of piezometers** The first piezometer was successfully deployed at the desired location. The second one, after a first problem with an overconsolidated rock layer that bent the iron pole, was successfully deployed after the necessary reparations. Tests with acoustic transponder assured their correct functioning.
- **Geophysical data** First results highlighted the high-resolution of the newly installed EM-302 and the Chirp system on board of Urania that perfectly fitted the requirements of accuracy in mapping the seafloor and the active faults in the Marmara Sea.
- **Sampling of the seabed** The seabed samples have been collected through the CP20 piston corer with a 10 m pipe by ISMAR and the Turkish sediment/water corer. All piston cores, for a total of 10 of them, recorded a consistent recovery in between 7.40 and 9.40 m, while the sediment/water cores were all satisfactory. Half of the cores were given to the Turkish team for further analysis, while the rest will be analyzed at ISMAR labs.
- **Multichannel reflection seismic** The survey was useful to test the newly acquired streamer which demonstrated its validity. It has also shown.

Analysis of the data collected during the expedition is under process and will continue during the forthcoming several months. No problems were encountered regarding neither the people nor the environment during the cruise.

References

- Aksu, A. E., Calon, T. J., Hiscott, R. N., Yasar, D., 2000. Anatomy of the North Anatolian fault zone in the Marmara sea, western Turkey: Extensional basins above a continental transform. *GSA Today* 6, 3–7.
- Alpar, B., Yaltirak, C., 2002. Characteristic features of the North Anatolian Fault in the eastern Marmara region and its tectonic evolution. *Marine Geology* 190, 329–350.
- Ambraseys, N. N., Finkel, C. F., 1991. Long term seismicity of the Istanbul and of the Marmara Sea region. *Terra Nova* 3, 527–539.
- Armijo, R., Meyer, B., Hubert, A., Barka, A., 1999. Westward propagation of the North Anatolian fault into the northern Aegean: timing and kinematics. *Geology* 27, 267–270.
- Armijo, R., Meyer, B., Navarro, S., King, G., Barka, A., 2002. Asymmetric slip partitioning in the Sea of marmara pull-apart: a clue to propagation processes of the North anatolian Fault? *Terra Nova* 14, 80–86.
- Barka, A., 1992. The North Anatolian fault zone. *Annales Tectonicae* 6, 164–195.
- Barka, A., Kadinsky-Cade, K., 1988. Strike-slip fault geometry in Turkey and its influence on earthquake activity. *Tectonics* 7, 663–684.
- Çağatay, M., Erel, L., Bellucci, L., Polonia, A., Gasperini, L., Eriş, K., Sancar, Ü., Biltekin, D., Uçarkuş, G., Ulgen, U., et al., 2012. Sedimentary earthquake records in the izmit gulf, sea of marmara, turkey. *Sedimentary Geology*.
- Çağatay, M. N., Eriş, K., Ryan, W. B. F., Sancar, U., Polonia, A., Akçer, S., Biltekin, D., Gasperini, L., Görür, N., Lericolais, G., Bard, E., 2009. Late Pleistocene–Holocene evolution of the northern shelf of the Sea of Marmara. *Marine Geology* 265, 87–100.
- Çağatay, M. N., Görür, N., Alpar, B., Saatçılar, R., Akkok, R., Sakiñç, M., Yuce, H., Yaltirak, C., Kuşcu, I., 1998. Geological evolution of the Gulf of Saros, NE Aegean Sea. *Geo-Marine Lett.* 18, 1–9.
- Demirbag, E., Rangin, C., Le Pichon, X., Sengor, A. M. C., 2003. Investigation of the tectonics of the Main Marmara Fault by means of deep-towed seismic data. *Tectonophysics* 361, 1–19.
- Eris, K. K., Cagatay, M., Akcer, S., Gasperini, L., Mart, Y., 2011. Late glacial to holocene sea-level changes in the sea of marmara: new evidence from high-resolution seismics and core studies. *GEO-MARINE LETTERS* 31 (1), 1–18.
- Flerit, F., Armijo, R., King, G. C. P., Meyer, B., A., A. B., 2003. Splip partitioning in the Sea of marmara pull-apart determined from GPS velocity vectors. *Geophys. J. Int.* 154, 1–7.
- Gasperini, L., Polonia, A., Bortoluzzi, G., Le Pichon, X., Tryon, M., Cagatay, N., Geli, L., 2011a. How far did the surface rupture of the 1999 Izmit earthquake reach in Sea of Marmara? *Tectonics* 30, TC1010, 11 pp.
- Gasperini, L., Polonia, A., Cagatay, M. N., Bortoluzzi, G., Ferrante, V., 2011b. Geological slip rates along the North Anatolian Fault in the Marmara region. *Tectonics* 30, TC6001.
- Gasperini, L., Polonia, A., Del Bianco, F., Etiopie, G., Marinario, G., Favali, P., Italiano, F., Çağatay, M., 2012a. Gas seepage and seismogenic structures along the north anatolian fault in the eastern sea of marmara. *Geochemistry, Geophysics, Geosystems* 13 (10).
- Gasperini, L., Polonia, A., Del Bianco, F., Favali, P., Marinario, G., Etiopie, G., et al., 2012b. Cold seeps, active faults and the earthquake cycle along the north anatolian fault system in the sea of marmara (nw turkey). *Bollettino di Geofisica Teorica ed Applicata*.
- Gasperini, L., Stanghellini, G., 2009. SEISPRHO: an interactive computer program for processing and interpretation of high-resolution seismic reflection profiles. *Comp. Geosci.* 37 (7), 1497–1507.
- Geli, L., Henry, P., Zitter, T., Dupre, S., Tryon, M., CAGATAY, M., Mercier de Lepinay, M., Le Pichon, X., SENGOR, A., GORUR, N., Natalin, B., UCARKUS, G., Ozeren, S., Volker, D., Gasperini, L., Burnard, P., Bourlange, S., Marnaut Scientific Party, T., 2008. Gas Emissions And Active Tectonics Within The Submerged Section Of The North Anatolian Fault Zone In The Sea Of Marmara. *Earth Planet. Sc. Lett.* 274, 34–39.
- Gokasan, E., Alpar, B., Gazioglu, C., Yucel, Z., Tok, B., Dogan, E., Guneyso, C., 2001. Active tectonics of the Izmit Gulf (NE Marmara Sea): from high resolution seismic and multi-beam bathymetry data. *Marine Geology* 175, 273–296.
- Hubert-Ferrari, A., Armijo, R., King, G., Meyer, B., A., B., 2002. Morphology, displacement, and slip rates along the North Anatolian Fault, Turkey. *J. Geophys. Res.* 107, 2235.
- Imren, C., Le Pichon, X., Rangin, C., Demirbag, E., Ecevitoglu, B., Gorur, N., 2001. The North Anatolian Fault within the Sea of marmara: a new interpretation based on multi-channel seismic and multibeam bathymetry data. *Earth Planet. Sc. Lett.* 186, 143–158.
- Kuşcu, I., Okamura, M., Matsuoka, H., Yamamori, K., Awata, Y., Ozalp, S., 2009. Recognition of active faults and stepover geometry in Gemlik Bay, Sea of Marmara. *Marine Geology* 260, 90–101.
- Le Pichon, X., Chamot-Rooke, N., Rangin, C., Sengor, A., 2003. The North anatolian Fault in the Sea of Marmara. *J. Geophys. Res.* 108, 2170–2179.
- Le Pichon, X., et al., 2005. MARMARA SURVEY, 11 Sep - 4 oct 2000, Multibeam Bathymetry, Le Suroit. Tech. Rep. Marine Atlas of the Sea of Marmara, Cruise Report Web site, IFREMER.
URL www.ifremer.fr/drogm_uk/marmara/accueil_1.htm
- Le Pichon, X., Şengör, A. M. C., Demirbag, E., Rangin, C., Imren, C., Armijo, R., Görür, N., Çağatay, N., de Lepinay, B. M., Meyer, B., Saatçılar, R., Tok, B., 2001. The active main Marmara fault. *Earth Planet. Sc. Lett.* 192, 595–616.
- McClusky, S., Bassalanian, S., Barka, A., Demir, C., Ergintav, S., Georgiev, I., Gurkan, O., Hamburger, M., Hurst, K., Hans-Gert, H. G., Karstens, K., Kekelidze, G., King, R., Kotzev, V., Lenk, O., Mahmoud, S., Mishin, A., Nadariya, M., Ouzounis, A., Paradissis, D., Peter, Y., Prilepin, M., Relinger, R., Sanli, I., Seeger, H., Tealeb, A., Toksaz, M. N., Veis, G., 2002. Global Positioning system constraints on plate kinematics and dynamics in the eastern Mediterranean and Caucasus. *J. Geophys. Res.* 105 (B3), 5695–5719.
- Meade, B. J., Hager, B., Reilinger, R., 2002. Estimates of seismic potential in the Marmara region from block models of secular deformation constrained by GPS measurements. *Bull. Seismol. Soc. Am.* 92, 208–215.
- Okay, A. I., Kaslılar-Ozcan, A., Imren, C., Boztepe-Guney, A., Demirbag, E., Kuscı, I., 2000. Active faults and evolving strike-slip basins in the Marmara Sea, northwest Turkey: a multichannel seismic reflection study. *Tectonophysics* 321, 189–218.
- Okay, A. I., Tuysuz, O., Kaya, S., 2004. From transpression to transension: changes in morphology and structure around a bend on the North Anatolian Fault in the Marmara region. *Tectonophysics* 391, 259–282.
- Parke, J. R., White, R. S., McKenzie, D., Minshull, T. A., Bull, J. M., Kuscu, I., Gorur, N., Sengor, C., 2002. Interaction between faulting and sedimentation in the Sea of Marmara, western Turkey. *J. Geophys. Res.* 107, 2286.
- Polonia, A., Cormier, M.-H., Cagatay, N., Bortoluzzi, G., Bonatti, E., Gasperini, L., Seeber, L., Gorur, N., Capotondi, L., McHugh,

- C., Ryan, W. B. F., Emre, O., Okay, N., Ligi, M., Tok, B., Blasi, A., Busetti, M., Eris, K., Fabretti, P., Fielding, E. J., Imren, C., Kurt, H., Magagnoli, A., Marozzi, G., Ozer, N., Penitenti, D., Serpi, G., Sarikavak, K., 2002. Exploring submarine earthquake geology in the Marmara Sea. *Eos Trans. AGU* 83 (21), 229.
- Polonia, A., Gasperini, L., Amorosi, A., Bonatti, E., Bortoluzzi, G., Çağatay, N., Capotondi, L., Cormier, M.-H., Görür, N., McHugh, C., Seeber, L., 2004. Holocene slip rate of the north anatolia fault in the marmara sea. *Earth Planet. Science Lett.* 227 (3–4).
- Provost, A. S., Chery, J., Hassani, R., 2003. 3D mechanical modeling of the GPS velocity field along the North Anatolian fault. *Earth Planet. Sc. Lett.* 209, 361–377.
- Ruffine, L., Fandino Torres, O., Etoubleau, J., Cheron, S., Donval, J.-P., Germain, Y., Ponzevera, E., Guyader, V., Dennielou, B., Etiope, G., et al., 2012. Geochemical dynamics of the natural-gas hydrate system in the sea of marmara, offshore turkey.
- Şengör, A. M. C., 1979. The North Anatolian transform fault: its age, offset and tectonic significance. *J. Geol. Soc. London* 136, 269–282.
- Şengör, A. M. C., Görür, N., Şaroğlu, F., 1985. Strike-slip faulting and related basin formation in zones of tectonic escape: Turkey as a case study. In: Biddle, K. D., Christie-Blick, N. (Eds.), *Strike-slip deformation, basin formation, and sedimentation*. Vol. 17 of *Spec. Publ. SEPM*, pp. 227–264.
- Şengör, A. M. C., Tuysuz, O., Imren, C., Sakiç, M., Eyidogan, H., Görür, N., Le Pichon, X., Rangin, C., 2004. The North Anatolian Fault. A new look. *Ann. Rev. Earth Planet. Sci.* 33, 1–75.
- Shindler, C., 1997. Geology of NW Turkey: Results of the Marmara poly-project. In: Shindler, C., Pfister, M. (Eds.), *Active Tectonics of Northwestern Anatolia: The Marmara Project*. Verlag der Fachvereine, Zurich, p. 582.
- Stein, R. S., Barka, A., Dieterich, J. H., 1997. Progressive failure on the North Anatolian Fault since 1989 by earthquake stress triggering. *Geophys. J. Int* 128, 594–604.
- Tary, J.-B., Géli, L., Henry, P., Natalin, B., Gasperini, L., Çomoğlu, M., Çağatay, N., Bardainne, T., 2011. Sea-bottom observations from the western escarpment of the sea of marmara. *Bulletin of the Seismological Society of America* 101 (2), 775–791.
- Tryon, M., Henry, P., Çağatay, M., Zitter, T., Geli, L., Gasperini, L., Burnard, P., Bourlange, S., Grall, C., 2010. Pore fluid chemistry of the north anatolian fault zone in the sea of marmara: A diversity of sources and processes. *Geochemistry, Geophysics, Geosystems* 11 (10).
- Wessel, P., Smith, W. H. F., 1995. New version of the Generic Mapping Tool released. *EOS Trans. AGU*, 329.
- Zitter, T., Grall, C., Henry, P., Özeren, M., Çağatay, M., Şengör, A., Gasperini, L., de Lépinay, B. M., Geli, L., 2012. Distribution, morphology and triggers of submarine mass wasting in the sea of marmara. *Marine Geology*.

6. APPENDIX

6.1. DIARY OF OPERATIONS

- 2013-09-19 Mobilization in Messina. Leave dock on 16:30 UTC, heading to Ionian Sea.
- 2013-09-20 CTD, multibeam, Chirp, magnetometry Ionian Sea.
- 2013-09-21 CTD, multibeam, Chirp, magnetometry Ionian Sea.
- 2013-09-21 CTD, multibeam, Chirp, magnetometry Ionian Sea.
- 2013-09-22 CTD, multibeam, Chirp, magnetometry Ionian Sea.
- 2013-09-23 Transit to Dardanelles
- 2013-09-24 Transit to Dardanelles
- 2013-09-25 Transit to Dardanelles
- 2013-09-26 Arrival 08:00 Canakkale, Dardanelles, transit to Sea of Marmara. Work in Ganos
- 2013-09-27 Arrival 07:00 Darica Canyon. CTD, chirp, multibeam and ROV and MEDUSA mapping for SN4 deployment
- 2013-09-28 SN4 Deployment
- 2013-09-29 CTD,Chirp, Multibeam mapping Sea of Marmara
- 2013-09-30 CTD,Chirp, Multibeam mapping Sea of Marmara
- 2013-10-01 CTD,Chirp, Multibeam, Multichannel Gemlik Gulf
- 2013-10-02 CTD,Chirp, Multibeam, Multichannel Gemlik Gulf
- 2011-10-03 At anchor In Istanbul. Disembark italian and turkish scientists, embark turkish, italian and french scientists. Transit to working area West Marmara.
- 2011-10-04 2 CTD castS, mbeam and chirp. Depoymento of 2 piezometers (one failed) and two OBS.
- 2011-10-05 1 CTD cast, mbeam and Chirp. 2 piston cores and 1 OBS deployed.
- 2011-10-06 1 CTD cast, mbeam, Chirp. Deployment of 1 piezometer and 1 OBS. 2 piston cores.
- 2011-10-07 1 CTD cast, Mbeam, chirp. 2 piston cores.
- 2011-10-08 Mbeam, chirp. Check of OBS due to Alarm Messages. Transit to Istanbul, Disembark french and turkish scientists.
- 2011-10-09 Transit to Italy.
- 2011-10-10 Transit to Italy.
- 2011-10-11 Transit to Italy.
- 2011-10-12 Transit to Italy, mbeam, chirp, magnetometry.
- 2011-10-13 Transit to Italy, mbeam, chirp, magnetometry. Docking in Messina 14:00 UTC.
- 2011-10-14 Disembark people, end of cruise 18:00 UTC.

6.2. POSITIONING MAPS OF MOST RELEVANT OPERATIONS AT SEA

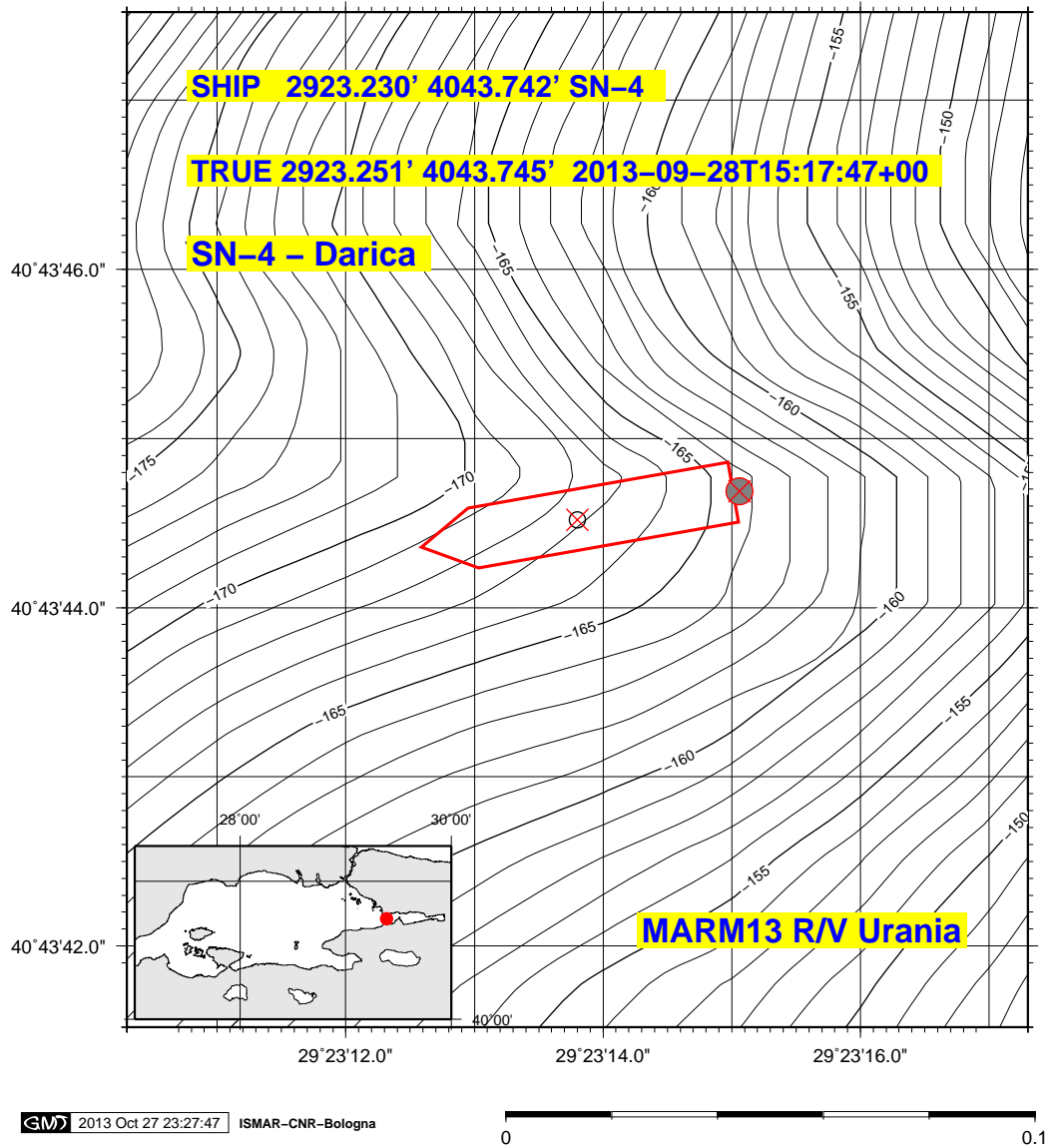


Figure 16: SN-4 positioning data.

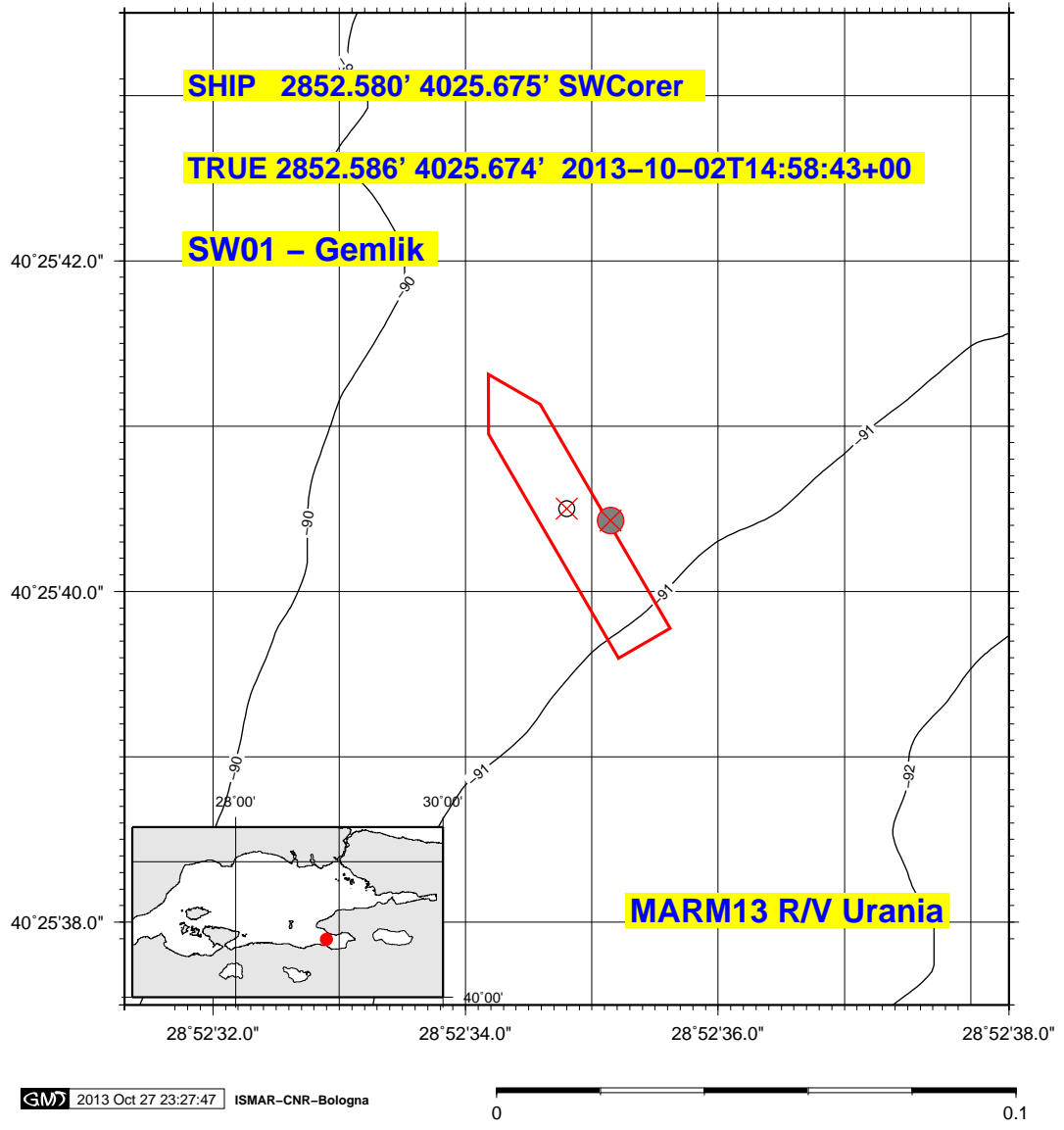


Figure 17: SW01 positioning data.

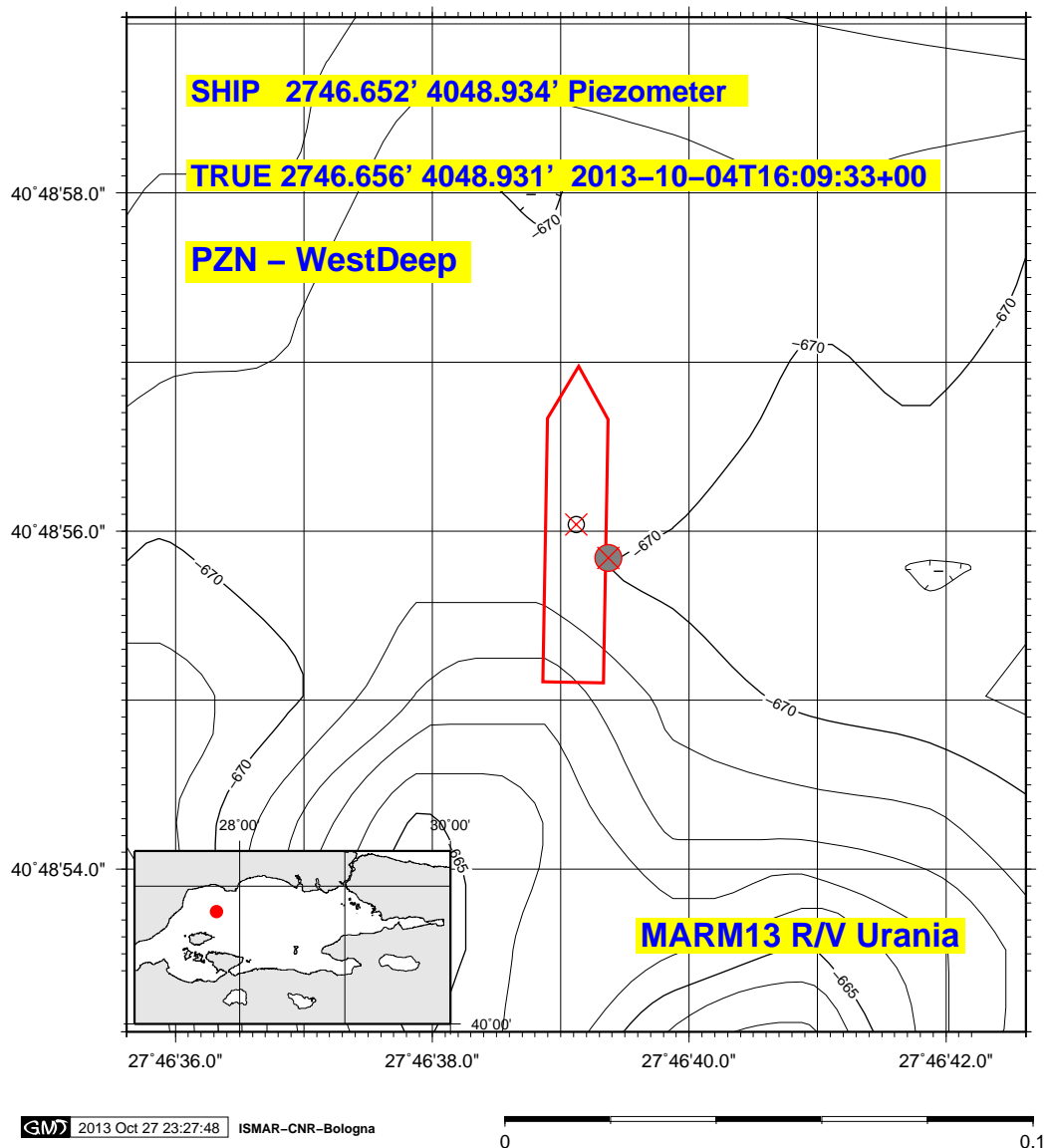


Figure 18: PZN positioning data.

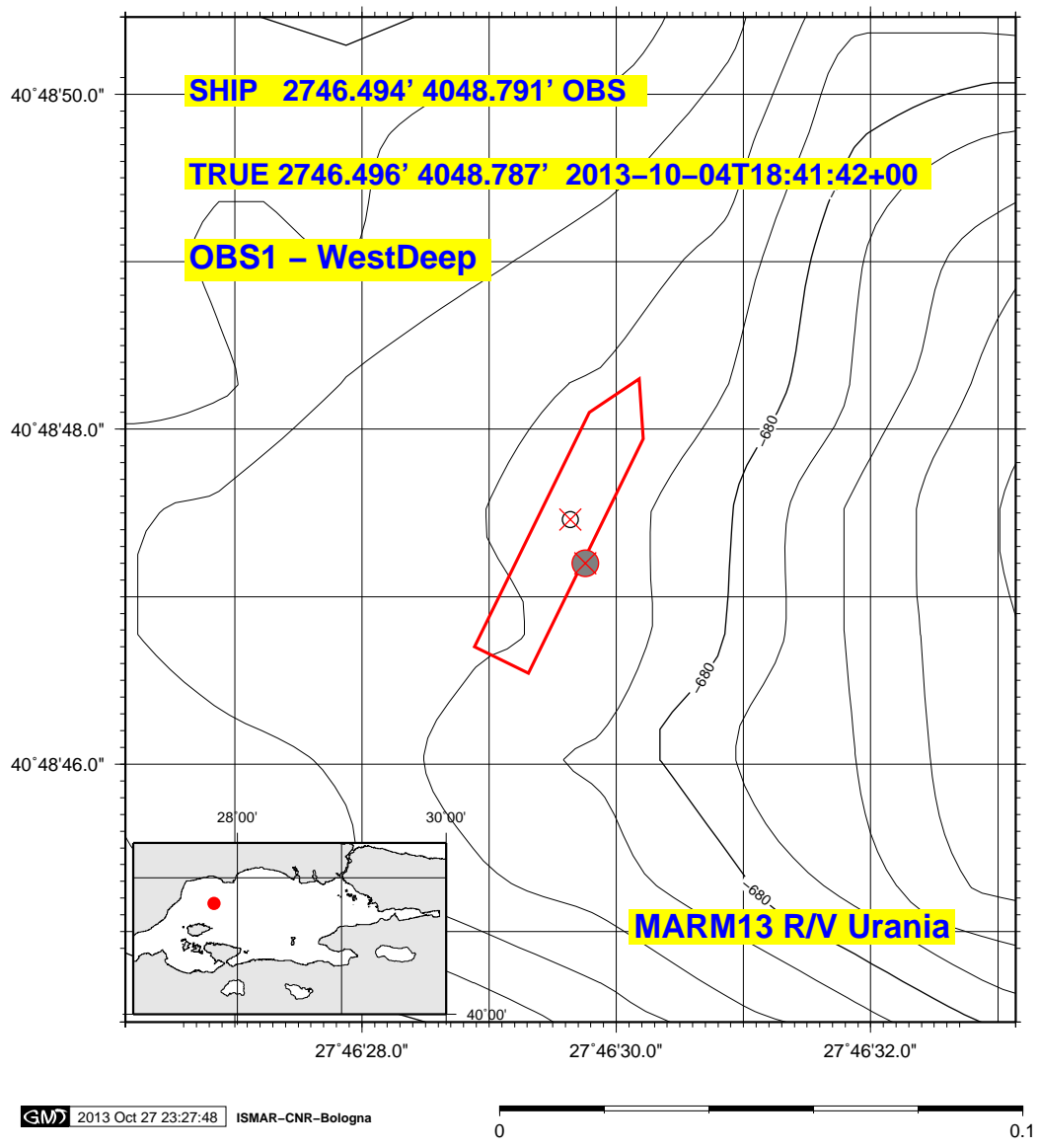


Figure 19: OBS1 positioning data.

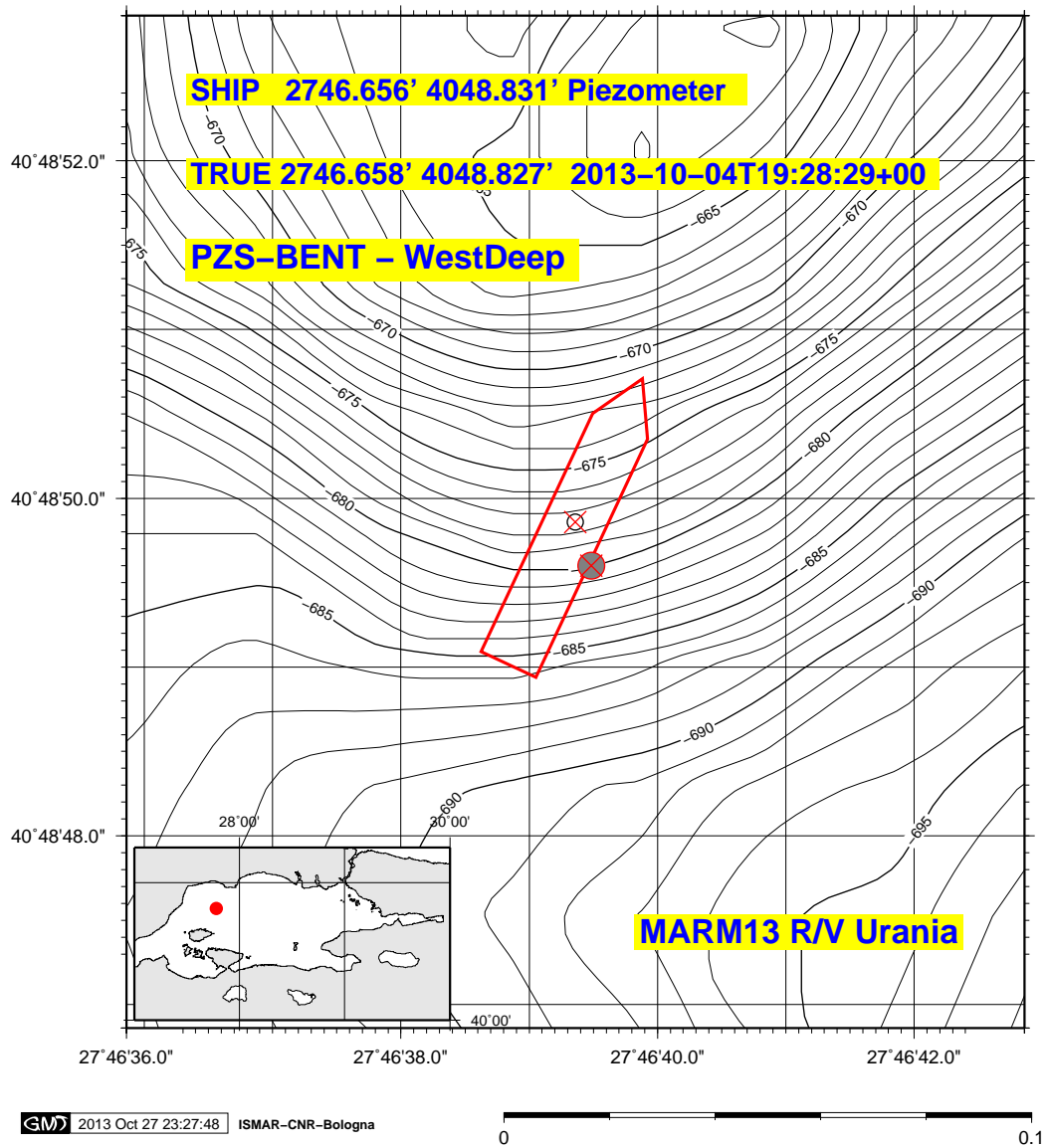


Figure 20: PZS-BENT positioning data.

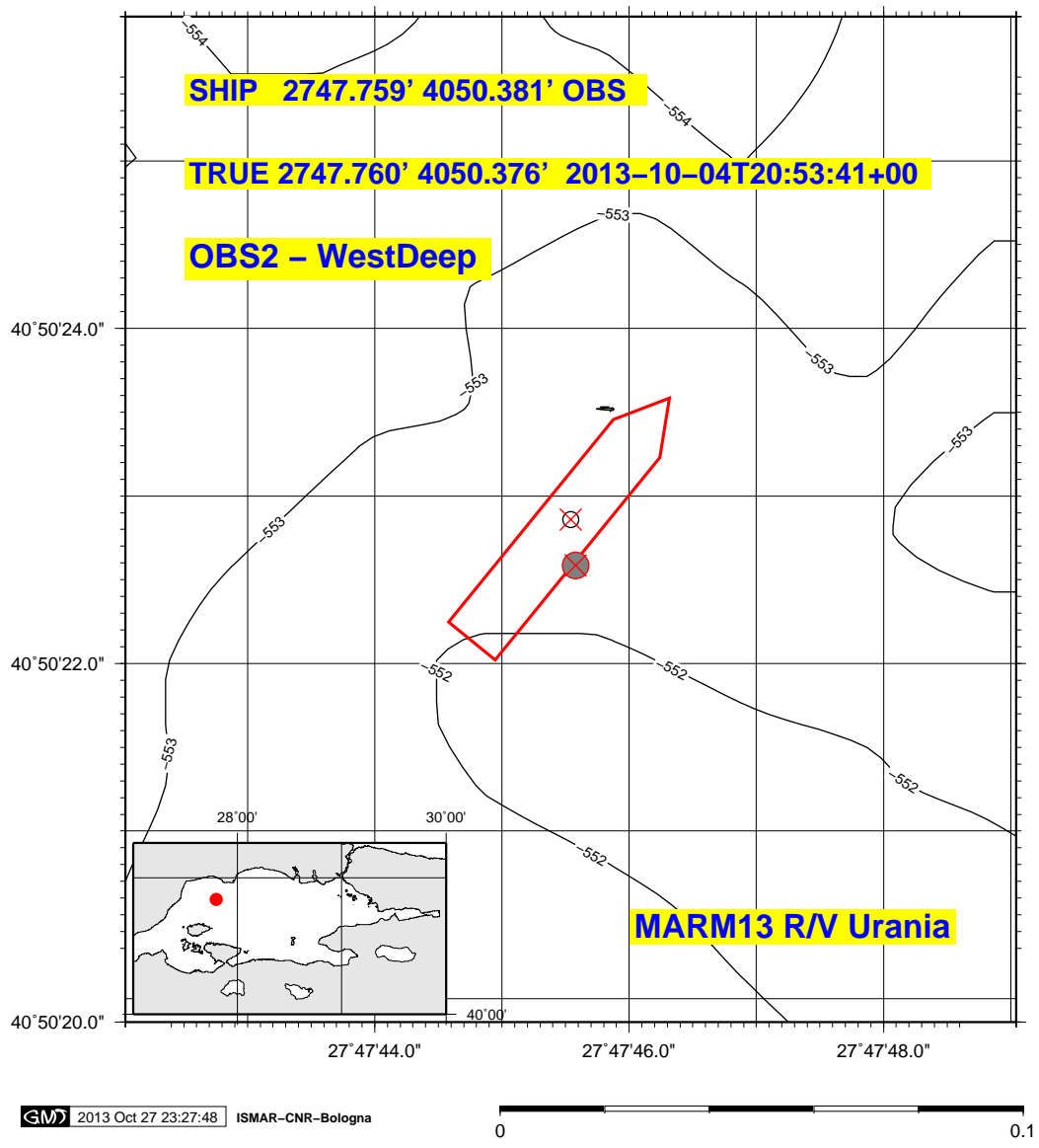


Figure 21: OBS2 positioning data.

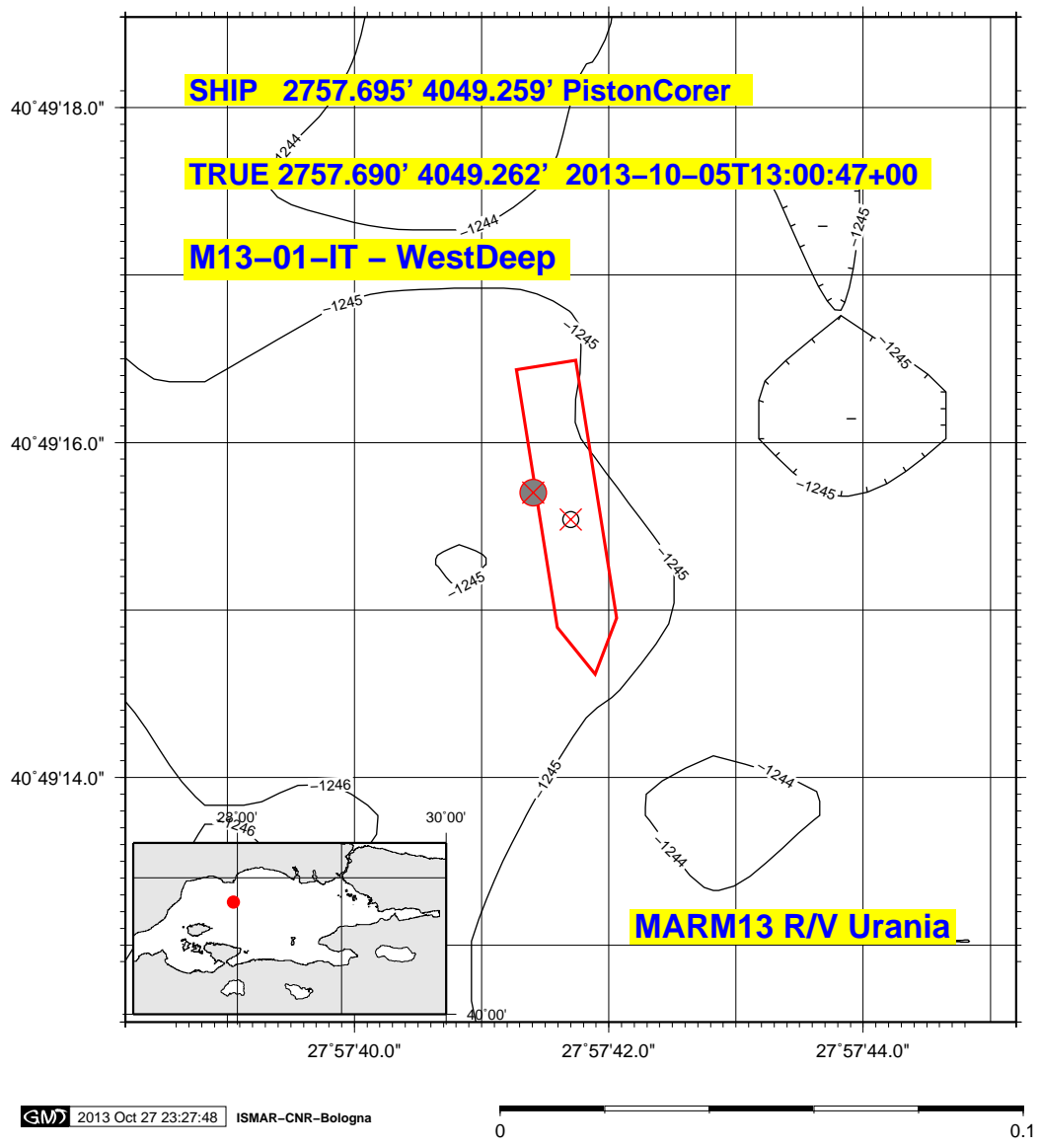


Figure 22: M13-01-IT positioning data.

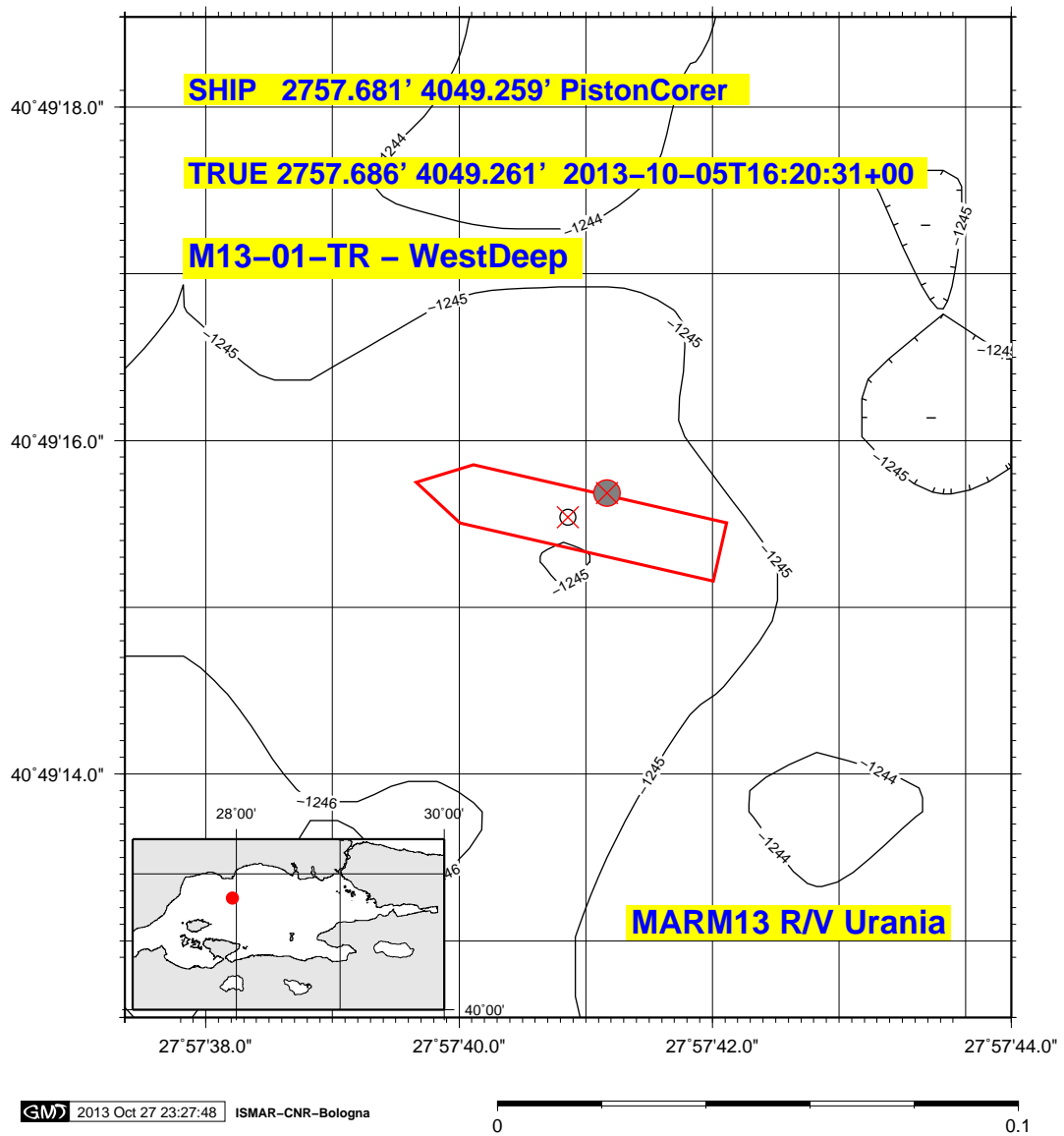


Figure 23: M13-01-TR positioning data.

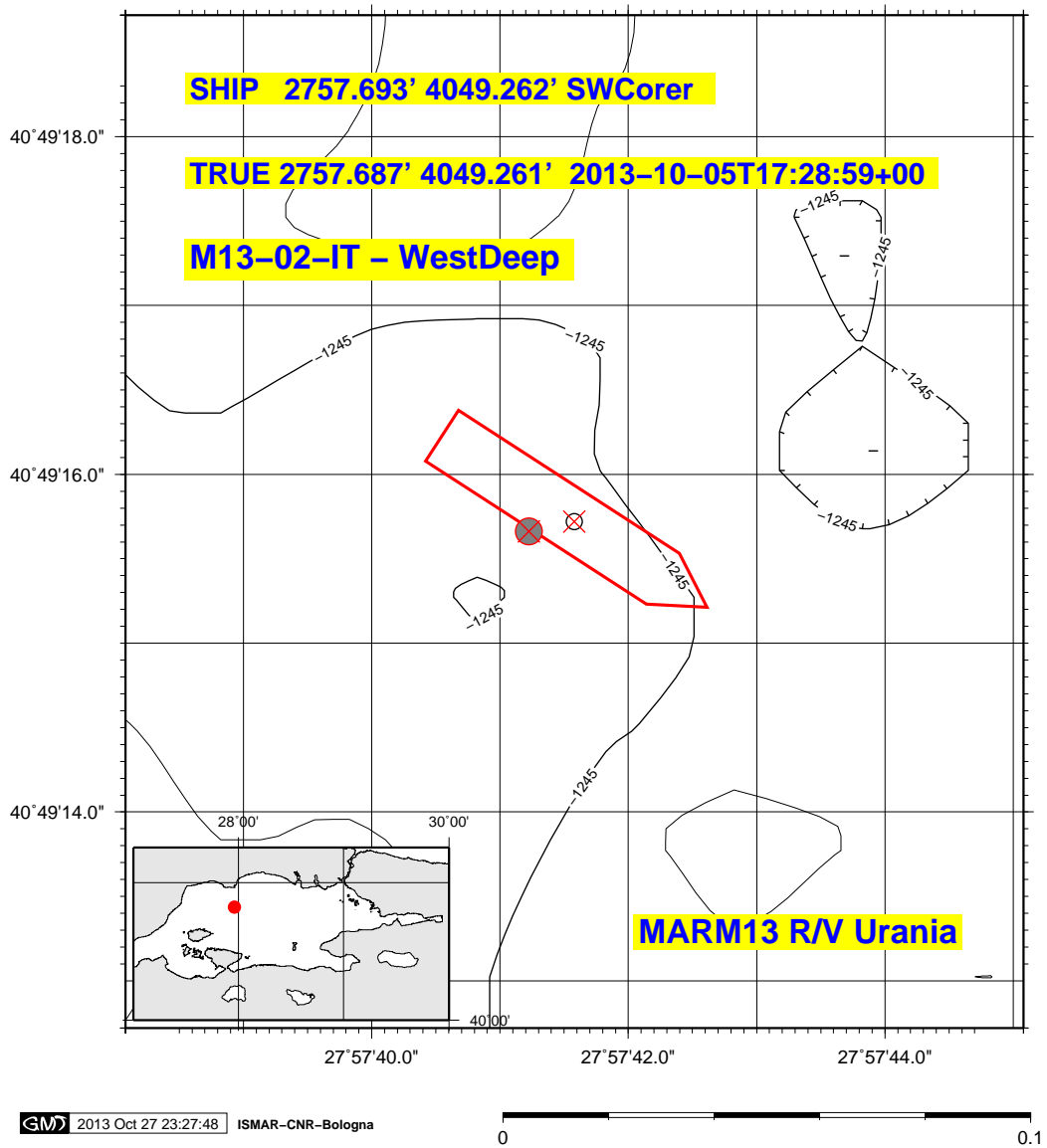


Figure 24: M13-02-IT positioning data.

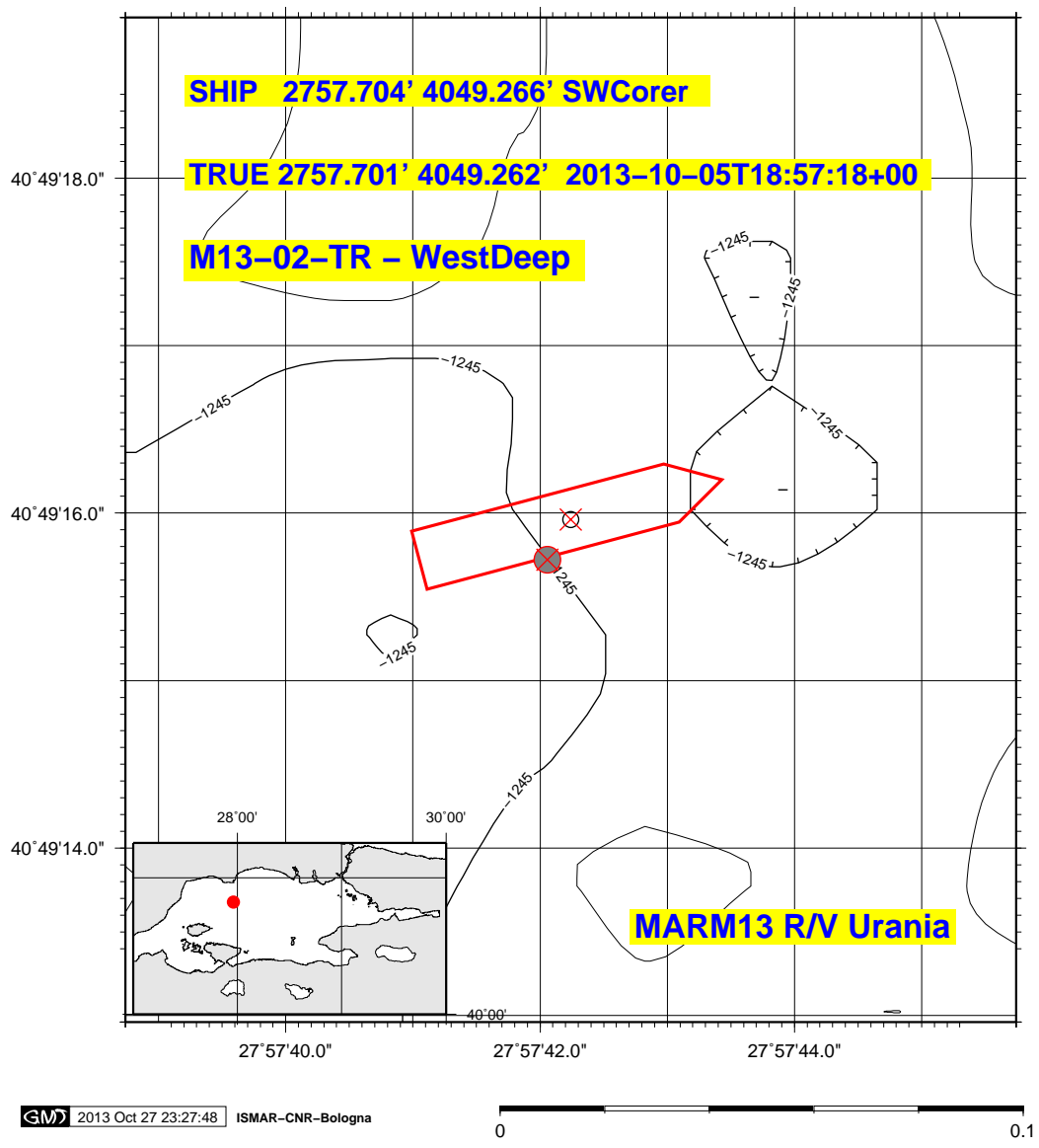


Figure 25: M13-02-TR positioning data.

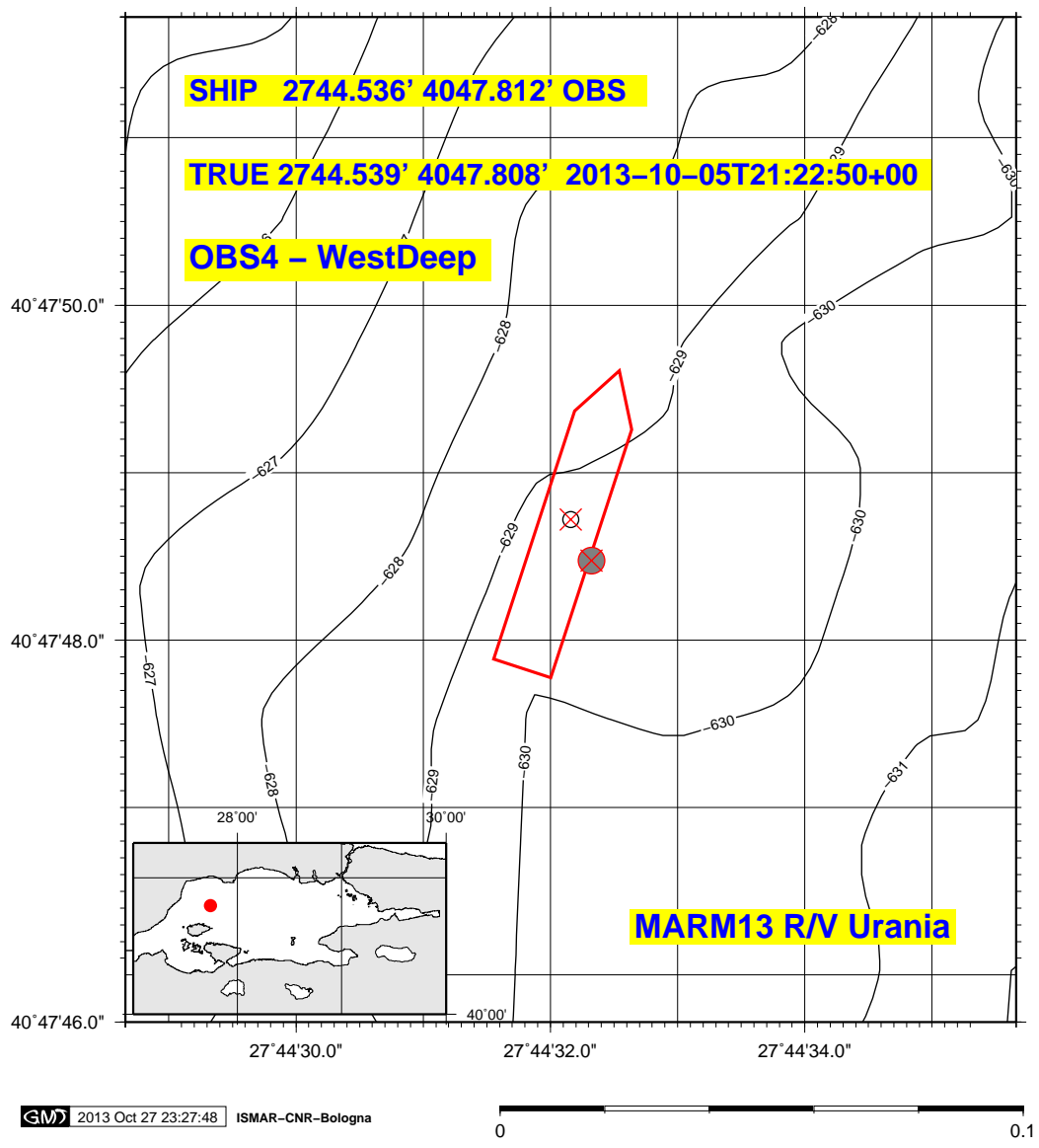


Figure 26: OBS4 positioning data.

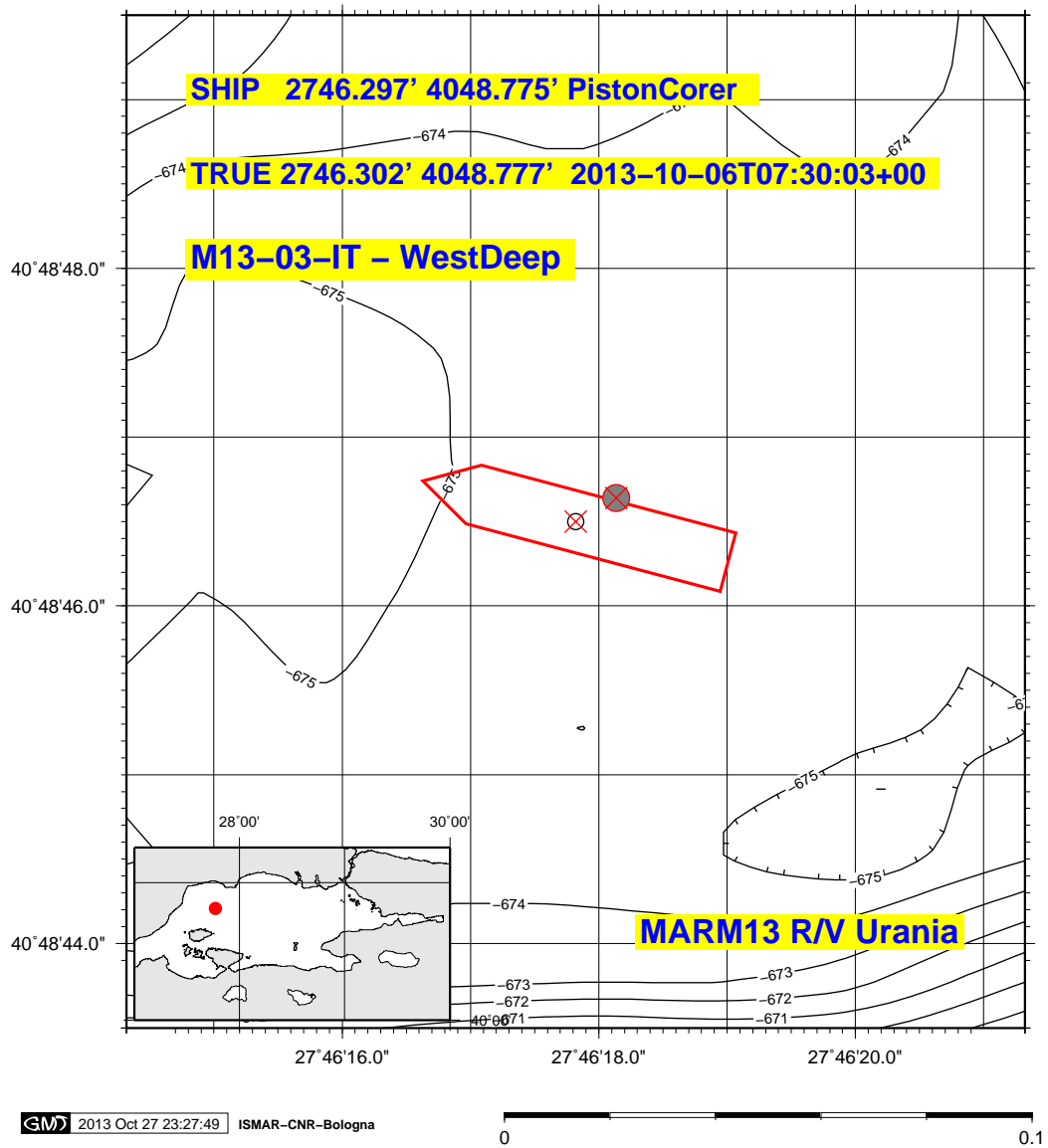


Figure 27: M13-03-IT positioning data.

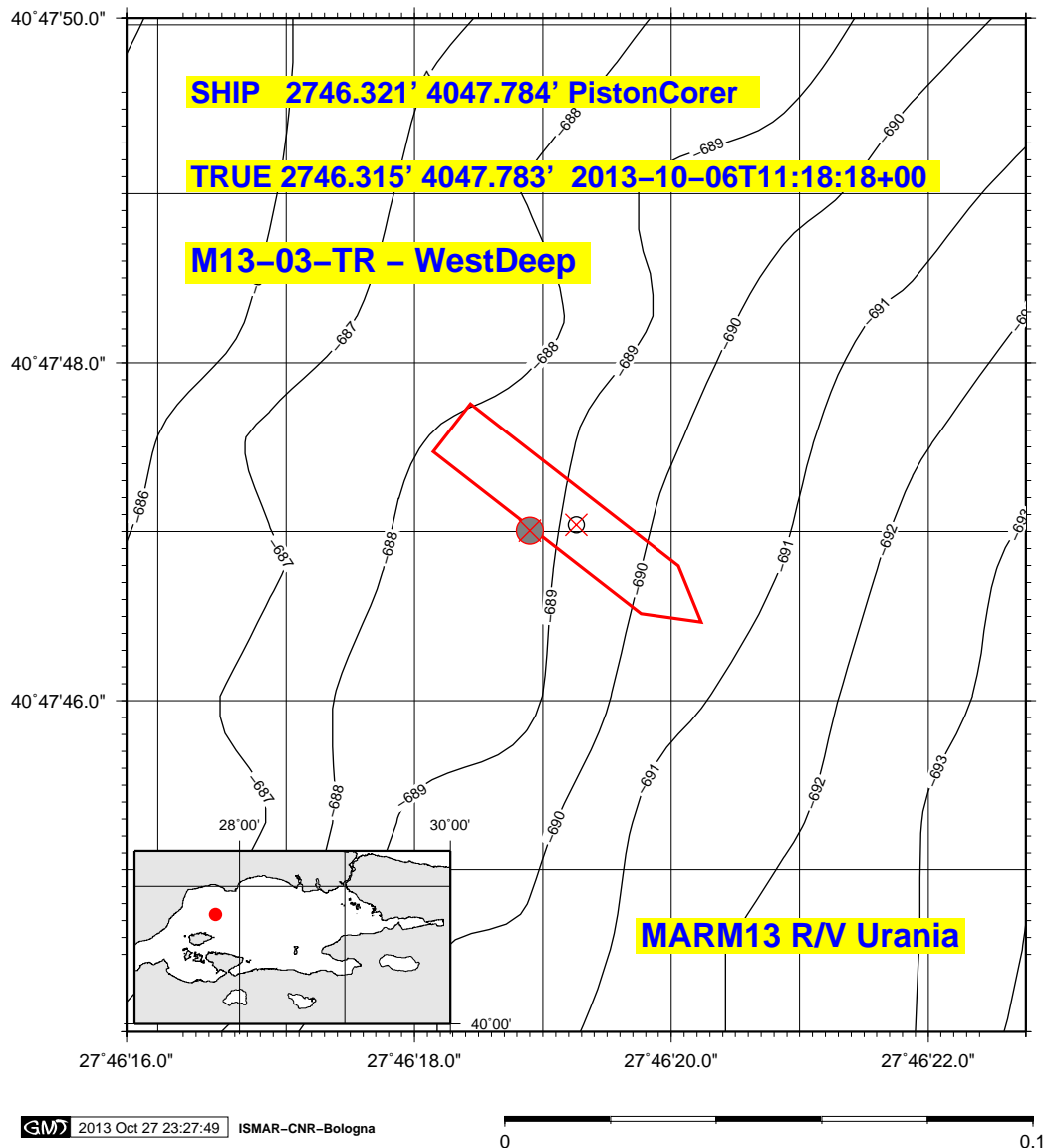


Figure 28: M13-03-TR positioning data.

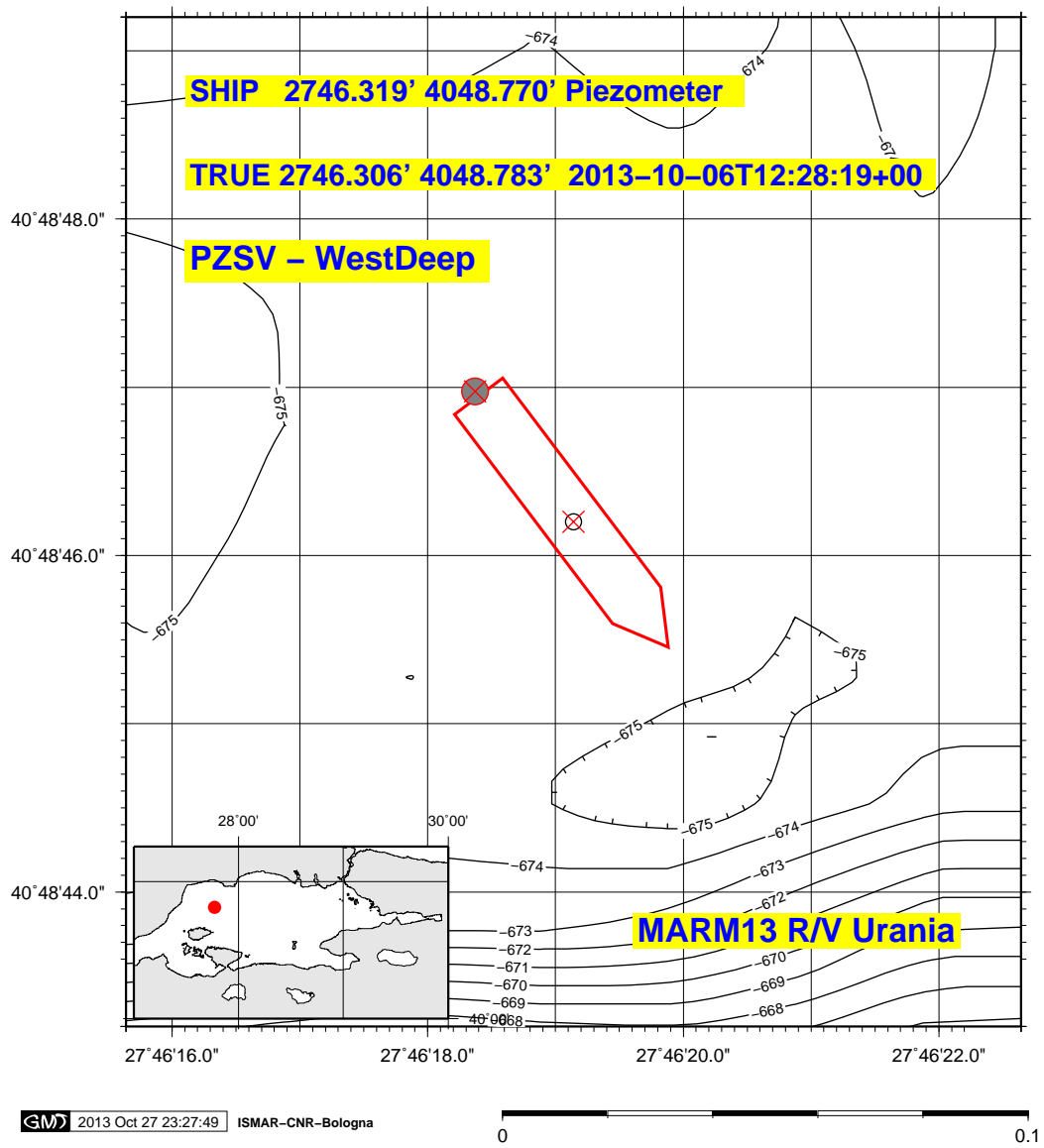


Figure 29: PZSV positioning data.

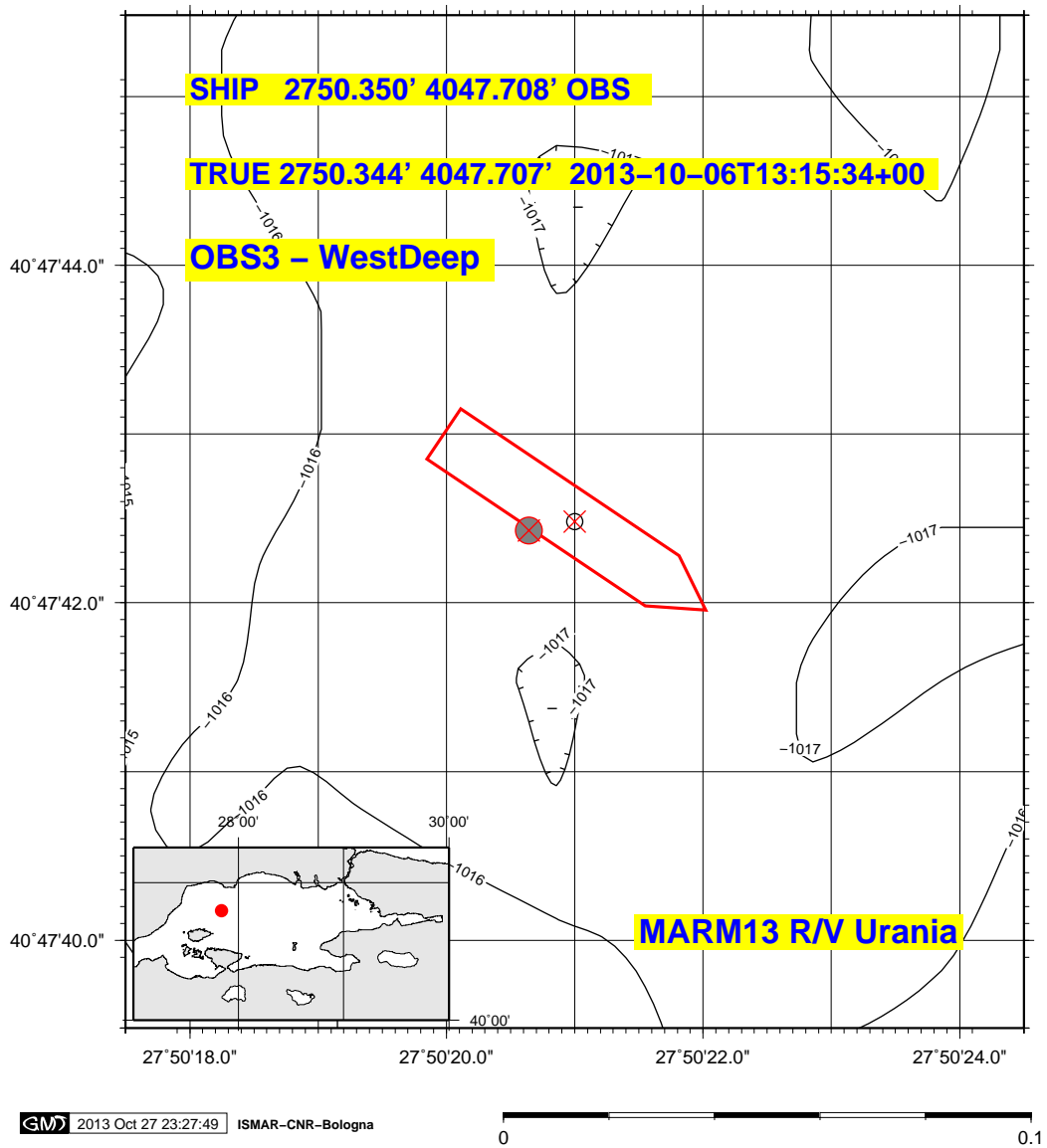


Figure 30: OBS3 positioning data.

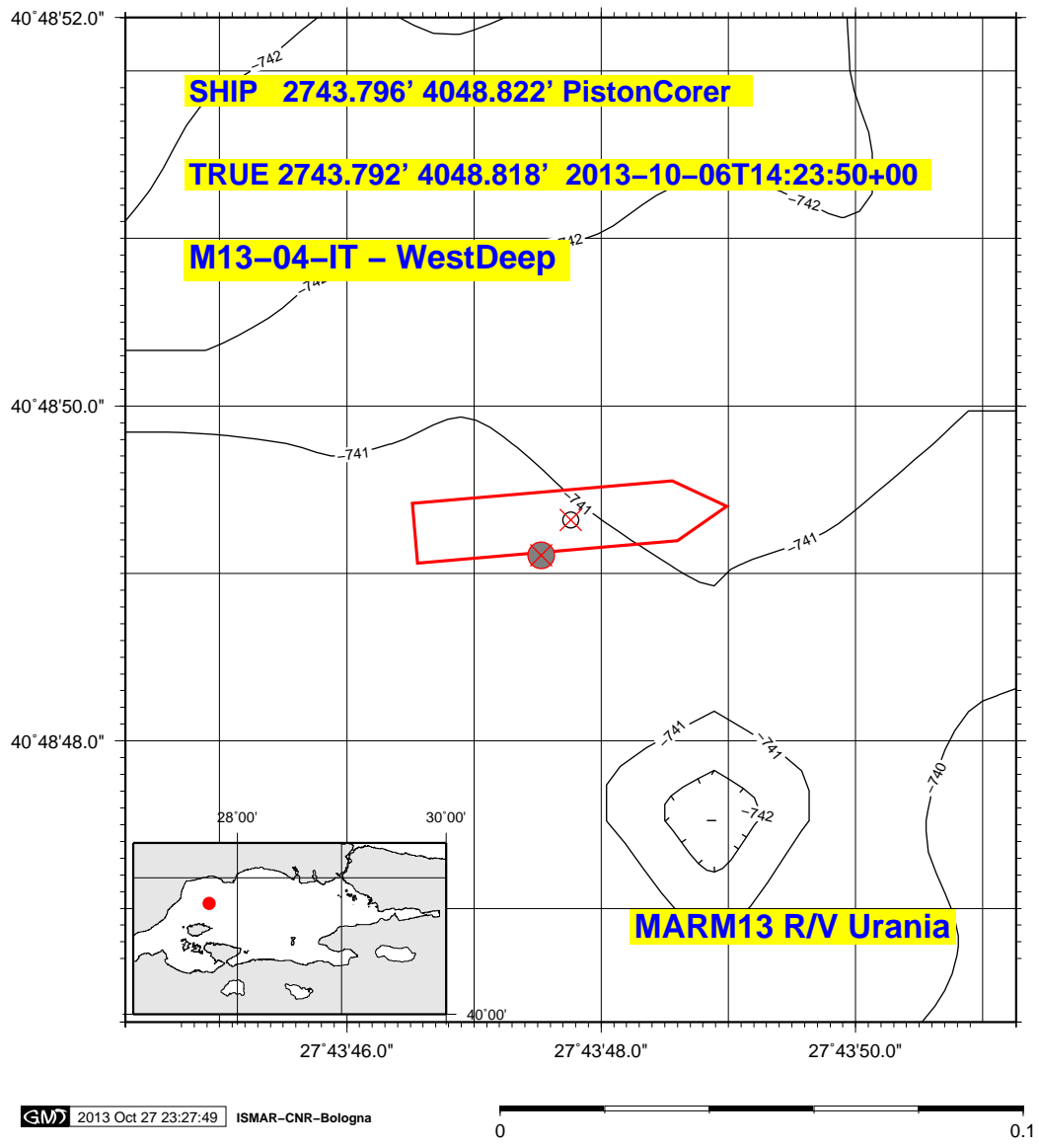


Figure 31: M13-04-IT positioning data.

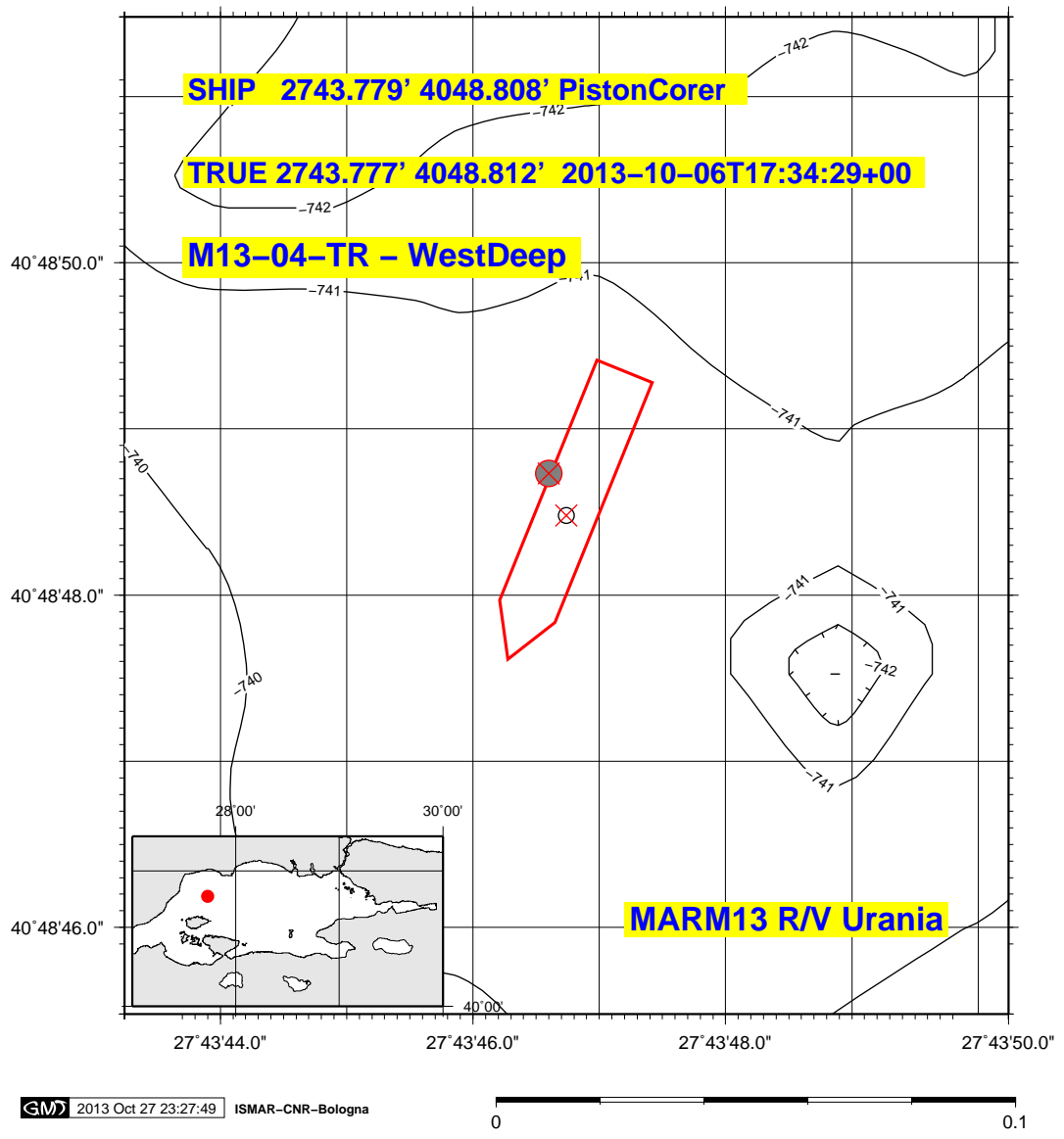


Figure 32: M13-04-TR positioning data.

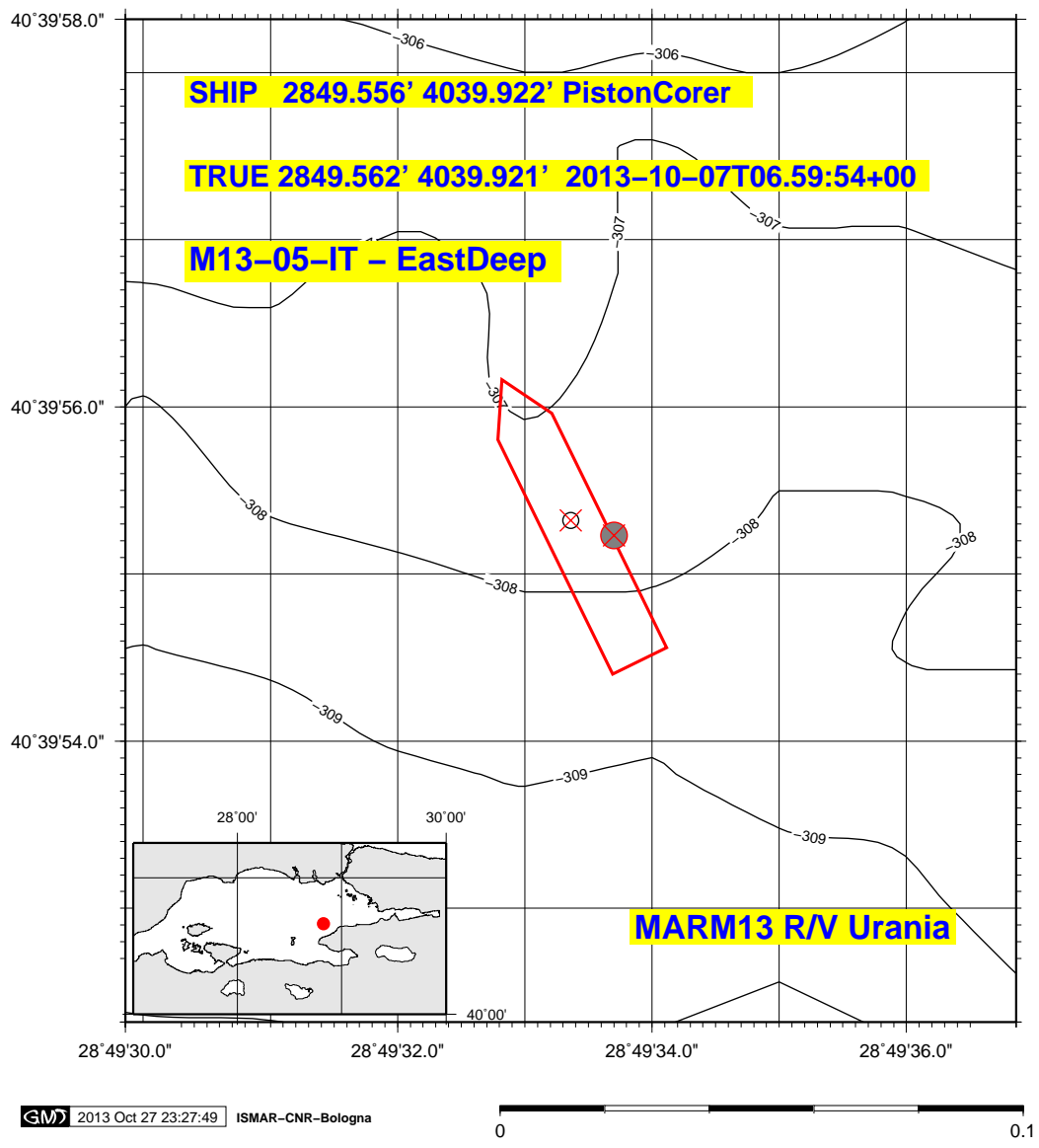


Figure 33: M13-05-IT positioning data.

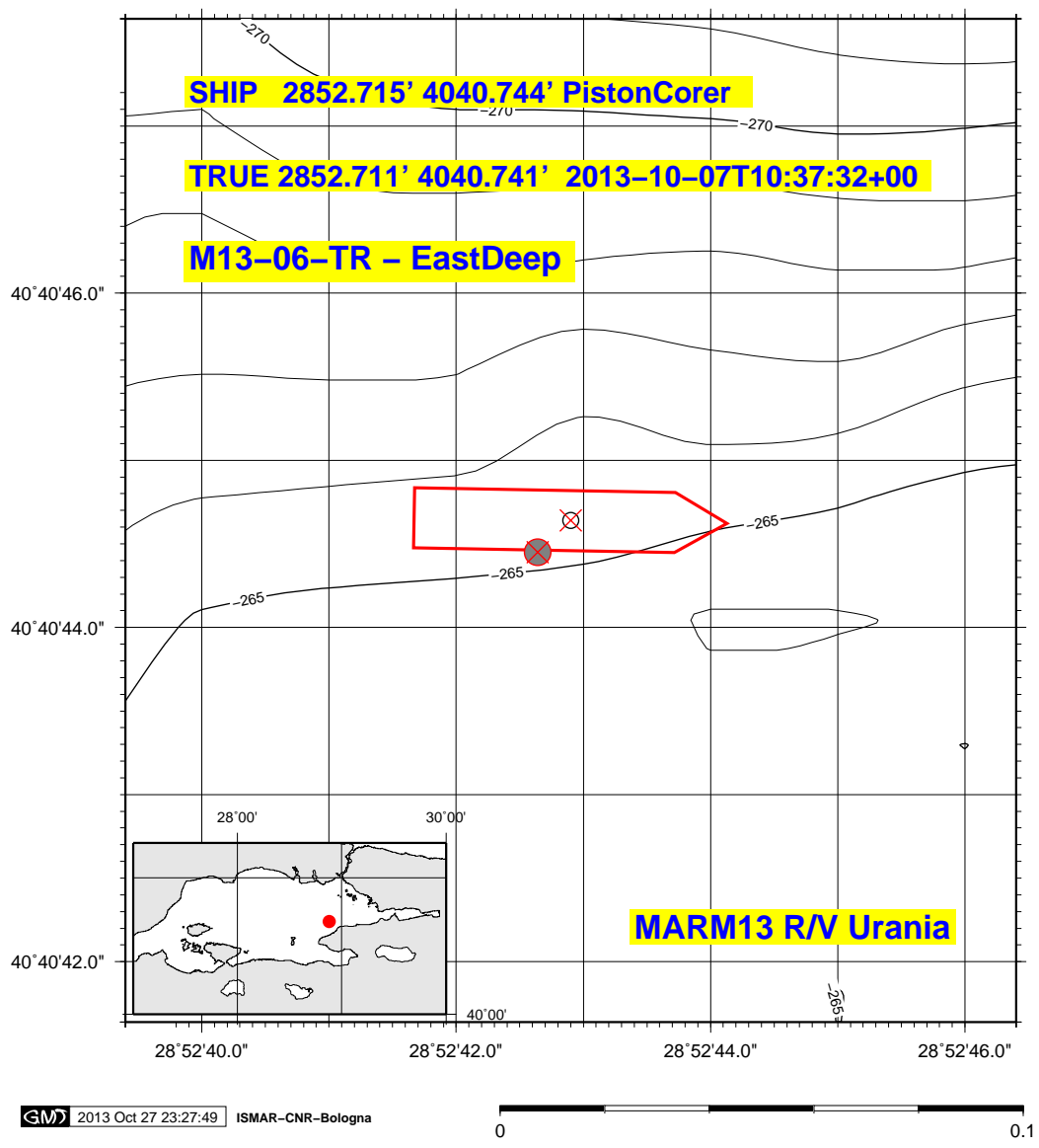


Figure 34: M13-06-TR positioning data.

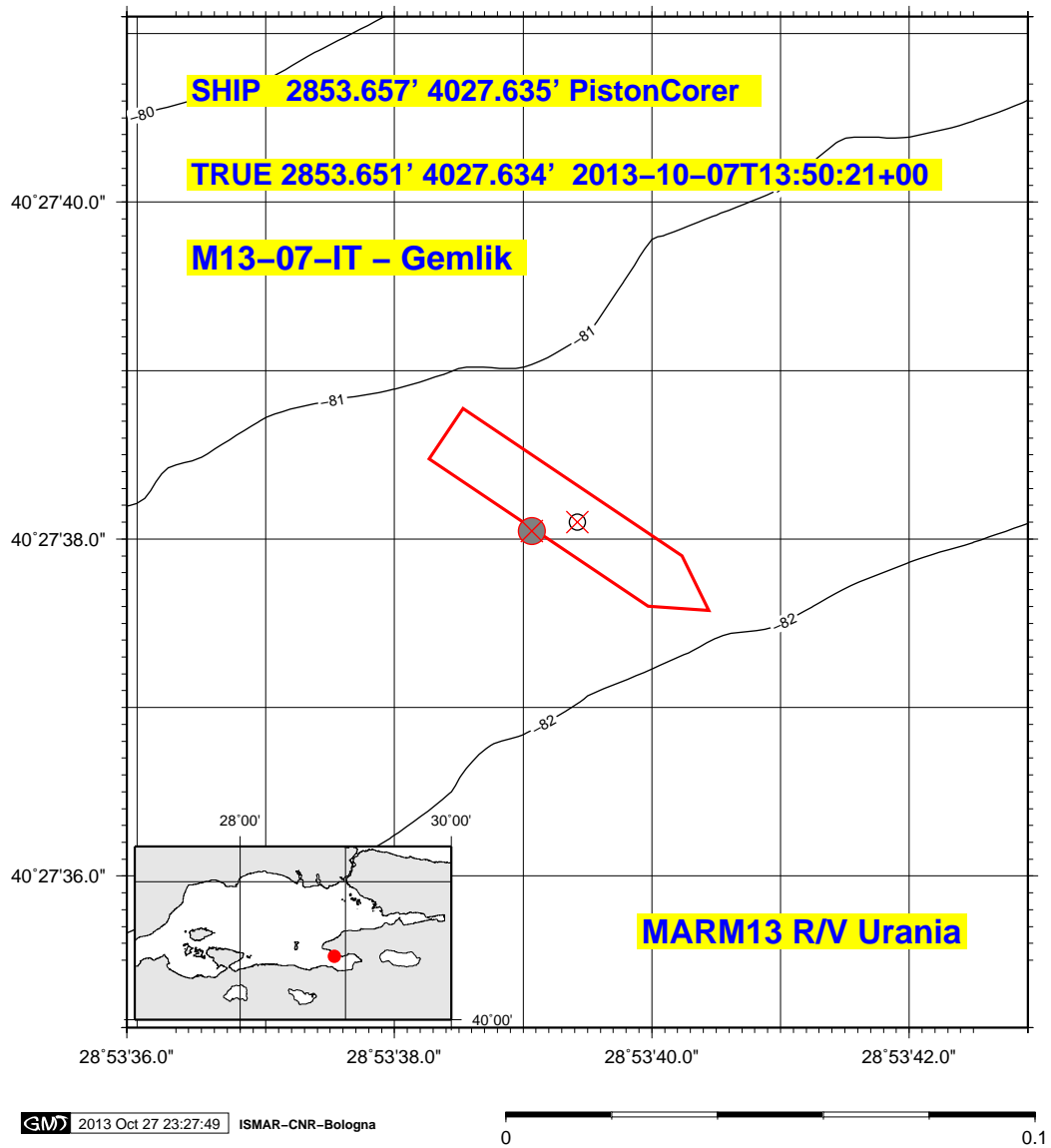


Figure 35: M13-07-IT positioning data.

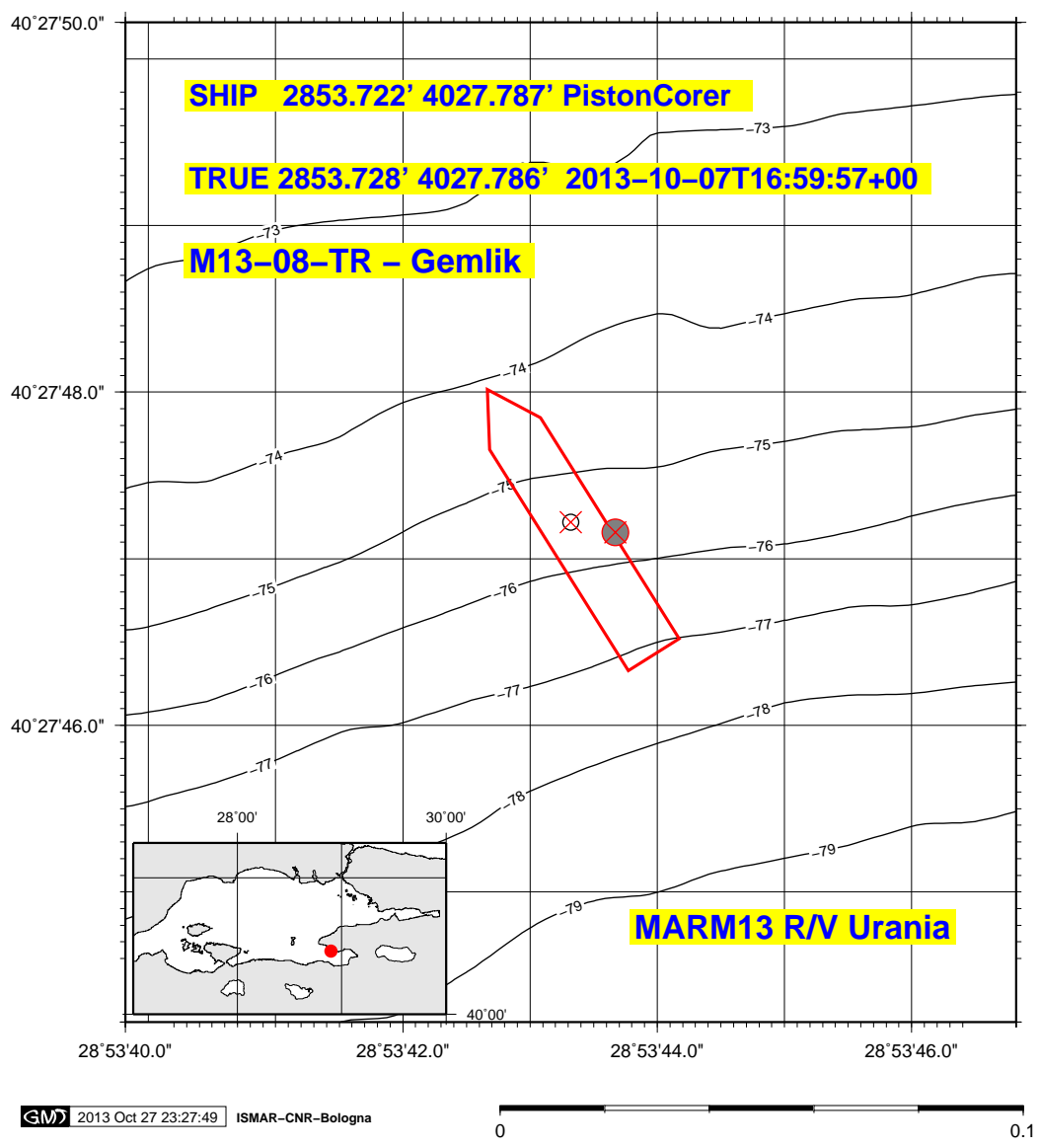


Figure 36: M13-08-TR positioning data.

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1) Presentation

To conduct the MARSITE programme, a campagne of LotOBS deployments was carried out from 15-19th September 2014 on-board R/V Yunus.

The LotOBS is a seabottom seismometer which records local seismic activity in submarine areas. It is the logical follow-up to the MicroOBS equipment developed at Ifremer and commercialized by Sercel. The LotOBS is developed to reply to scientific challenges of local seismicity.

LotOBS is naturally based on the electronic acquisition of the MicroOBS 2004 with 4 recordings sensors (components) : 1 hydrophone and 3 geophones. Adaptations are sometimes made including one to record measures made over several months to improve the coupling of geophones with the seabottom.

For the deployment, after programming, we add a "loseable" weight to the equipment, with 2 solutions for deployment :

- the equipment falls freely to the ocean floor,
- the obs is lowered by cable, for precise positioning on the bottom.

The LotOBS records over a period up to 4 months. From the surface, through an acoustic command, a release command, we give the LotOBS an order to release the weight and the equipment goes back up to the surface. This puts into action a VHF transmitter and a flash transmitter (gonio and visual) in order to locate it at the surface.



2) Cruise programme :

16/09/2014 –TRANSPORT BREST - ISTANBUL :

- Train Brest – Paris : TGV 6h45.
- Taxi Montparnasse – Orly south terminal
- Pegasus Airline 14h05 – Istanbul Sabiha Airport
- Transport Airport to hotel
- Evening in Istanbul : Away Suites

18/09/2014 – : DEPLOYMENT

- Departure 8:00 from the port of Marmara EREGLISI
- On the way to point OBS06 for deployments.
- Anchorages : OBS06, OBS05, OBS03, OBS07, OBS04, OBS02, OBS08, OBS09
- 13h (LT): Stopover in Tekirdag to sign administrative forms
- 13h35(LT) : Departure from Tekirdag
- Anchorage OBS01 then OBS10 (13h30 GMT)
- On the way to Istanbul
- Evening in Istanbul : Away Suites

19/09/2014 – : RETURN

- Evening in Istanbul : Away Suites
- Transport Hotel to Airport
- Pegasus Airline 14h05 – Istanbul Sabiha airport
- Train Paris – Brest



3) Deployment results

For deployment, the position of anchorages noted correspond to the position of the ship, the LotOBS free-falls to the bottom. List of deployment points :

OBS01 Date Lat Long Depth

Name	Date	Latitude	Longitude	Depth
OBS01	18/09/2014 12:51	N40° 55,006'	E27° 45,862'	443
OBS02	18/09/2014 08:30	N40° 48,917'	E27° 46,614'	661
OBS03	18/09/2014 07:23	N40° 42,775'	E27° 47,224'	481
OBS04	18/09/2014 08:27	N40° 48,760'	E27° 46,302'	665
OBS05	18/09/2014 06:50	N40° 46,764'	E27° 50,891'	918
OBS06	18/09/2014 06:13	N40° 49,886'	E27° 56,820'	1191
OBS07	18/09/2014 07:58	N40° 46,572'	E27° 42,511'	568
OBS08	18/09/2014 09:08	N40° 51,075'	E27° 42,480'	1024
OBS09	18/09/2014 09:42	N40° 49,186'	E27° 36,304'	1106
OBS10	18/09/2014 13:30	N40° 50,998'	E27° 50,731'	401



MARSITECRUISE

R/V POURQUOI PAS?
OCTOBER 28th – November 17th, 2014



One-Month Cruise Report

Chief scientists :
LEG I Louis Géli (Ifremer)
LEG II Livio Ruffine (Ifremer)
LEG III Pierre Henry (CEREGE)

MARSITECRUISE of R/V *Pourquoi pas ?*
ONE-MONTH REPORT

1

MARSite (GA 308417) D8.1 Report on repeated deployments of autonomous instruments



MARSITECRUISE
R/V POURQUOI PAS?
OCTOBER 28th – November 17th, 2014

One-Month Cruise Report

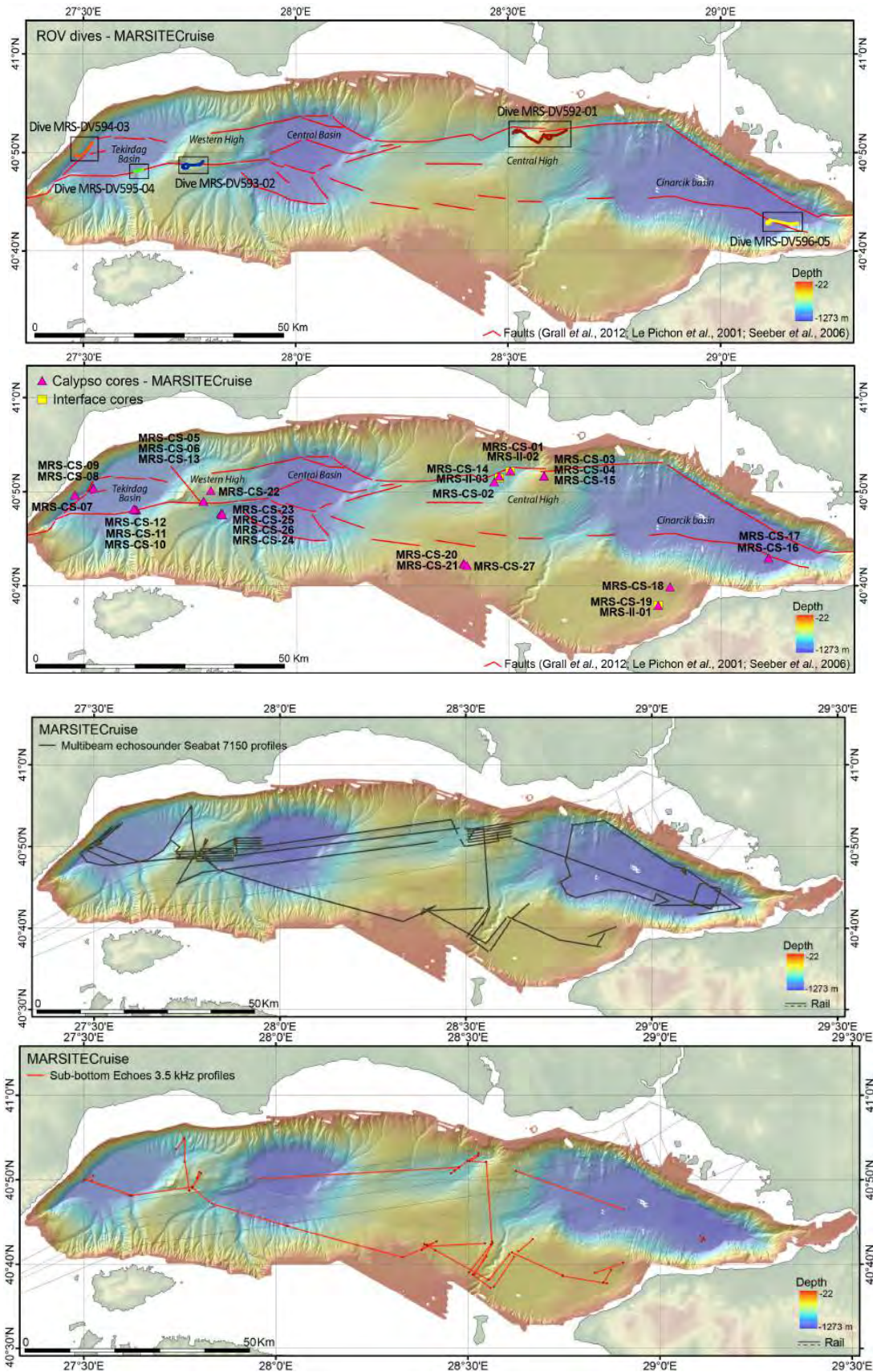
With special thanks to Captain Thierry Alix and Crew of *R/V Pourquoi pas?*

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GENERAL MAPS of the Sea of Marmara bathymetry with ROV Dives, Core locations, profiles with multibeam echo-sounder in water column mode, lines with sub-bottom profiler (3.5 kHz)

Extended summary

The scientific cruise MARSITECRUISE of *R/V Pourquoi pas?* took place from 28 October to 17 November 2014 within the frame of the MARSITE programme supported by the European Union. Its aim was to better understand the behaviour of the North Anatolian fault in the Marmara sea in view of improving the assessment of the seismic hazard weighing on the Istanbul region. Coordinated by the Observatory of the University of Kandilli (KOERI, based in Istanbul), MARSITE groups 23 partners and includes different components : land, spatial and marine. The marine operations of the programme were coordinated by Ifremer and conducted using Italian (*R/V Urania*) and French (*R/V Pourquoi pas?*) naval means.

During the first part of the cruise (28/10 to 1/11), 10 geodetic acoustic stations were deployed on the seafloor to measure directly the relative plate motion along the submerged part of the North Anatolian Fault. Four stations were implemented by the "LDO : Laboratoire Domaines Océaniques" from Brest ; the six others by Geomar. The stations have been designed to remain 3 years on the seafloor. Visits are programmed every six months, using Turkish naval means, to check their functioning and to collect data.

During the second part of the cruise (2/11 to 13/11), the ROV VICTOR 6000 was deployed in order to collect *in situ* samples and measurements (interstitial waters, gas, brines, oil) to understand the migration of fluids along the faults. During Leg 2, 5 ROV dives were conducted (for a total of 148.4 hours) resulting in 18 gas samples, 28 Raman measurements and 41 measurements of gas flow, 35 interface corers and 2 blade corers for geomicrobiology, 7 Titanium seringues to study rare gases. A total of 12 long Calypso sediment cores were made to analyse deep interstitial fluids and 8 CTD associated with the evaluation of 2 methane captors for the geochemical evaluation of plumes observed during acoustic surveys of the water column. The success of *in situ* Raman spectroscopic measurements is novel at Ifremer ; this is the second only success of such an experiment on a world scale and opens doors to a new *in situ* gas sampling strategy.

Finally, a unique experiment, initially programmed for Leg1, was accomplished. An acoustic bubble detector (BOB) and two seabed seismographs were deployed by the TOV to study the phenomena of natural degassing of methane on the seafloor.

The third part of the cruise (13-16 November) had a double objective : i) acquire sediment cores in key sites for paleoseismic studies aiming to specify the recurrence rate of earthquakes in the Marmara sea ; ii) recover INGV and Ifremer instruments deployed during previous operations within the frame of the MARSITE programme.

Despite a technical breakdown of the ROV during Leg1, the operational objectives (data acquisition, deployment of equipment) of MARSITECRUISE were reached, thanks to the reactivity of the teams on-board who adapted to a new and completely modified programme. The scientific results will not be known until analysis (one to three years will be necessary).

The MARSITECRUISE is the result of collaboration between 15 partners: Ifremer; 7 CNRS laboratories (IUEM-Brest, CEREGE-Aix-en-Provence, ITER-Grenoble, LOCEAN-Paris, CRPG-Nancy, MNHN-Paris, LIENSs); INGV (Italy); Geomar (Kiel); ITU (Istanbul); KOERI (Istanbul); MTA (Ankara); Peking University (China) and the University of Munster (Germany).

Further to the cruise, a press conference organized by the French Embassy took place at the Palais de France in Istanbul. Collaboration with the services of the Embassy were extremely fruitful, our collaboration with Turkey are consequently strengthened. We particularly thank Mrs Maria Bonnafous-Boucher deputy consellor for Cultural Affairs at the French embassy in Ankara for her action and Mrs Nurcan Özel, Deputy Director of KOERI for her support.

I. Leg 1

I.1 Geodetic experiment on the Central High

I.1.1 Background/specific objectives

Whether or not the Istanbul-Silivri segment actually ruptured in 1766 is **still an open question** because historical reports, which are known to be hampered by great uncertainties, cannot be considered as definite proofs indicating the exact location of past ruptures. In addition, detailed, high-resolution bathymetric investigations using Autonomous Unmanned Vehicles conducted in 2009 [Géli et al, 2010] did not provide any evidence for fresh scarps along the *Istanbul-Silivri segment*, possibly due to the draping of sediment deposits during the last 2 centuries. In addition, while intense bubbling is observed on a structural high, 1 km south of the main fault trace, no evidence of fluid expulsion has been found on the fault itself [Géli et al, 2008].

The **goal** of this experiment is to determine if the *Istanbul-Silivri* segment of the North-Anatolian Fault within the Sea of Marmara is locked or creeping. This fundamental question is here addressed by combining underwater, geophysical methods including seafloor telemetry and passive seismology using OBSs. The geodetic experiment (GEODEX) was implemented on the eastern part of the segment, e.g. on the Central High where the fault trace on the seafloor of the Main Marmara Fault is visible besides the sediment draping (Fig. I.1.1 & I.1.x).

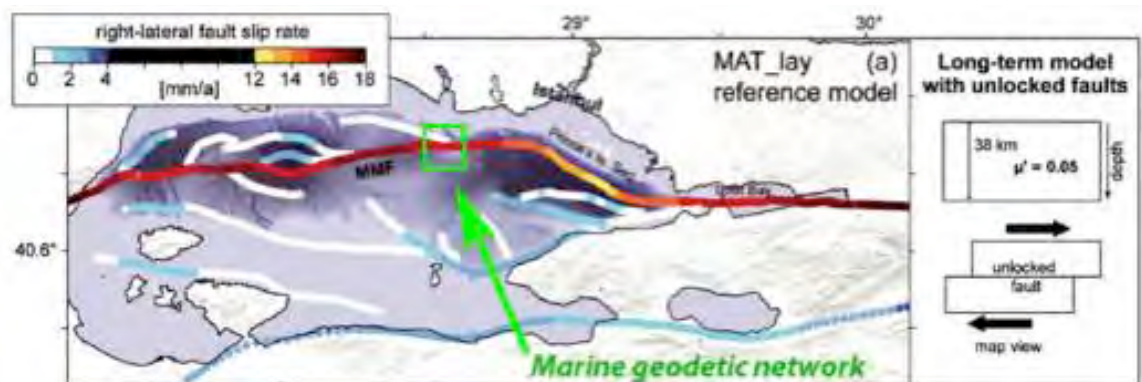


Fig. I.1.1 Map indicating the location of the Main Marmara Fault (brown, thick line) and the distribution of slip-rates along the submerged fault system within the Sea of Marmara. The green square indicates the location of the Geodetic experiment. Modified after Hergert et al [2011].

I.1.2 Deployment of geodetic instruments

The following geodetic equipment were deployed for an expected duration > 3 years:

- 4 acoustic ranging stations working at 20 kHz, from “Laboratoire Domaines Océaniques” of IUEM (Institut Universitaire Européen de la Mer), called “French stations”, named F01 to F04.
- 6 acoustic ranging stations working at 23 kHz, from Geomar, called “German stations”, named G01 to G06.

FRENCH (IUEM/LDO) GEODETIC STATIONS				
Emplacement	Station Id	Latitude	Longitude	Water depth
F1	2001	40°52.24879'N	28°31.11901'E	811
F2	2002	40°52.0931'N	28°31.4136'E	804
F3	2004	40°52.2268'N	28°31.7193'E	805
F4	2003	40°52.0859'N	28°30.7950'E	825

GERMAN (GEOMAR) GEODETIC STATIONS				
Emplacement	Station Id	Latitude	Longitude	Water Depth
G1	2304	40°52.24551'N	28°31.07442'E	813
G2	2305	40°52.0955'N	28°31.3542'E	804
G4	2307	40°52.08827'N	28°30.73863'E	827
G3	2302	40°52.24284'N	28°31.66376'E	805
G5	2303	40°52.09708'N	28°31.96168'E	779
G6	2301	40°52.28916'N	28°31.3149'E	807

Table I.1: Locations of geodetic stations

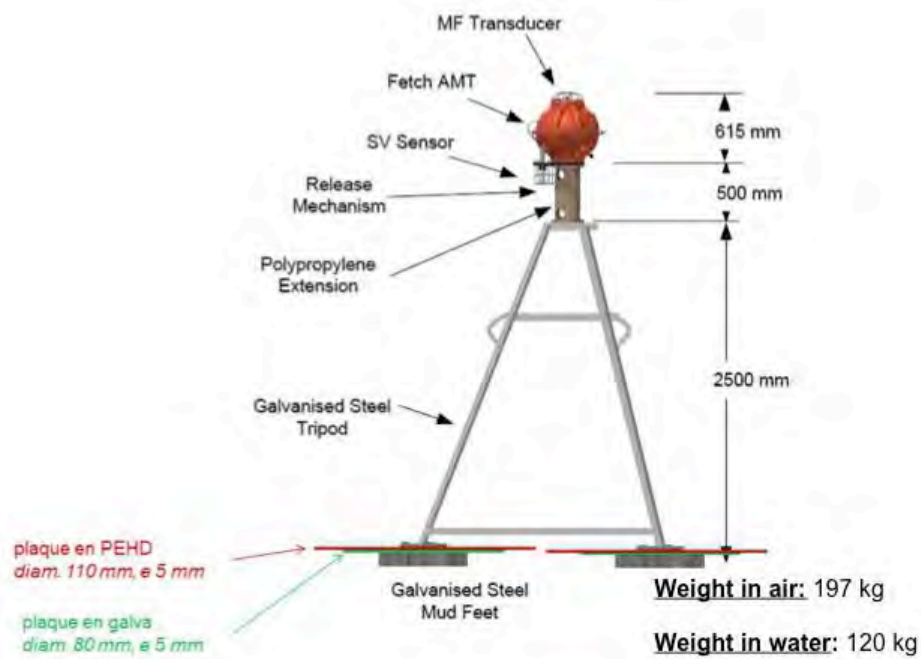


Fig. I.1.2 : Equipment dimensions for French geodetic station

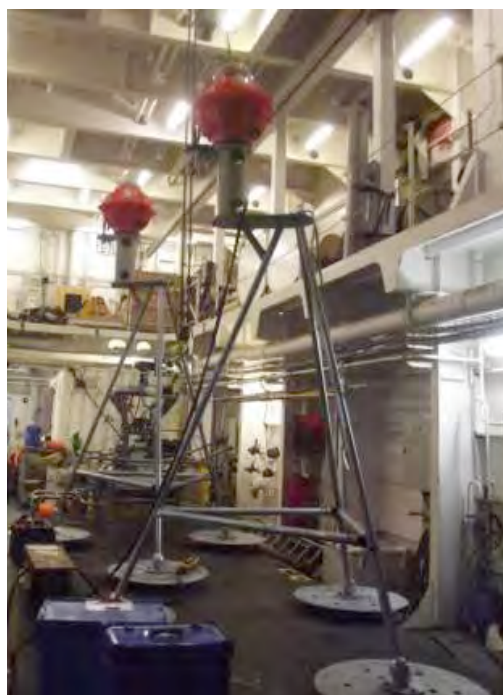


Fig. I.1.3: French geodetic stations on deck on board R/V Pourquoi pas? during Marsite Cruise.

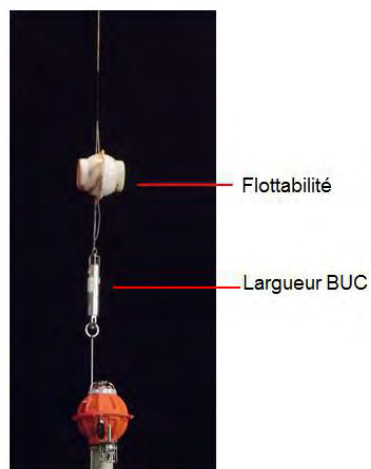


Fig I.1.4: Deployment of French geodetic station from R/V Pourquoi pas? during Leg 1 of Marsite Cruise.

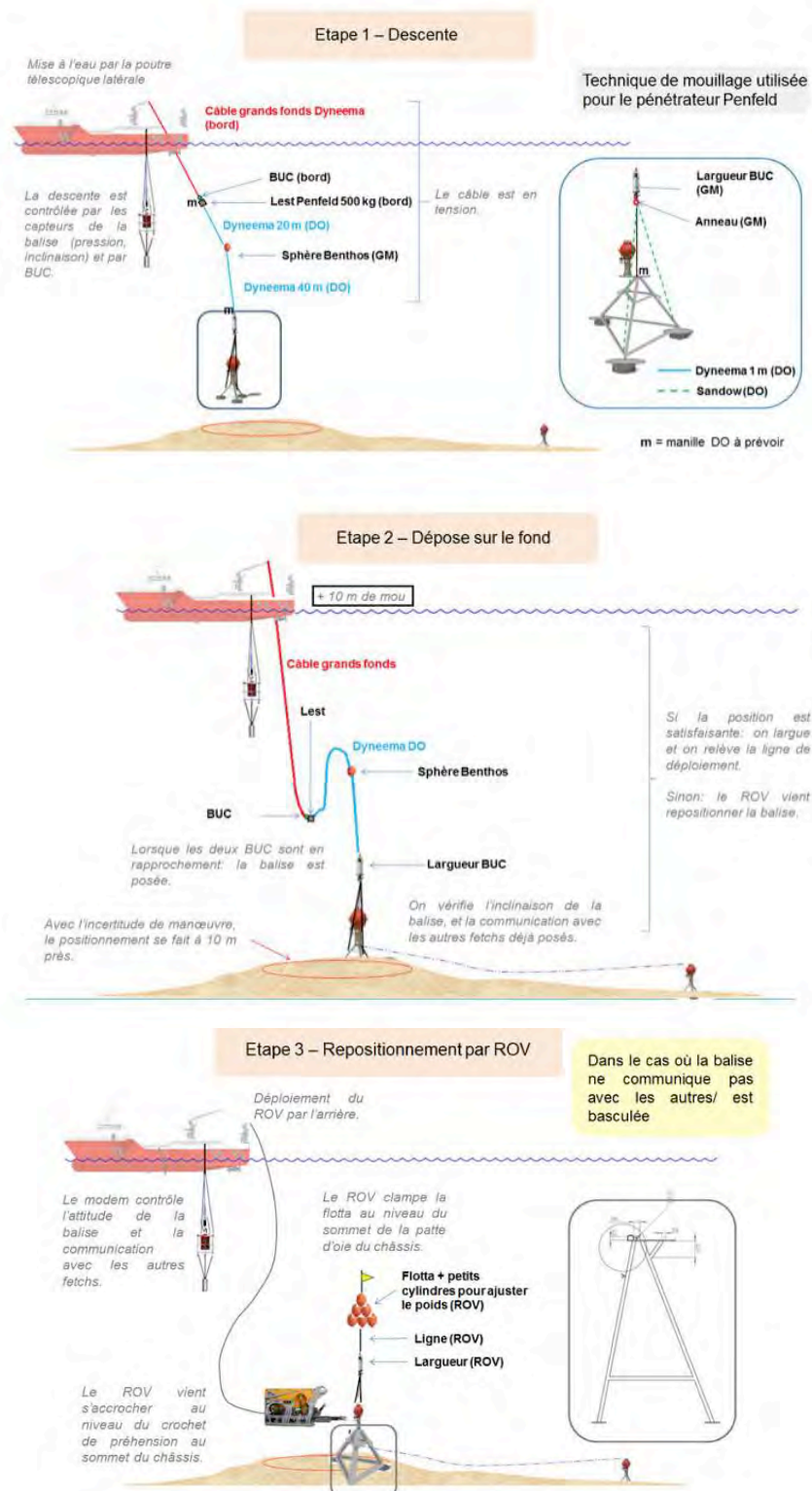


Figure I.1.5: Details of the deployment protocol. In Phase 1 (top), the modem is deployed first. Then the station is lowered down with a cable equipped with a weight and an Ultra Short Baseline. In Phase 2, the equipment is released after a good position has been found on the seafloor. In Phase 3, the ROV is used in case of problems. The use of ROV Victor was not necessary during the Marsite Cruise.

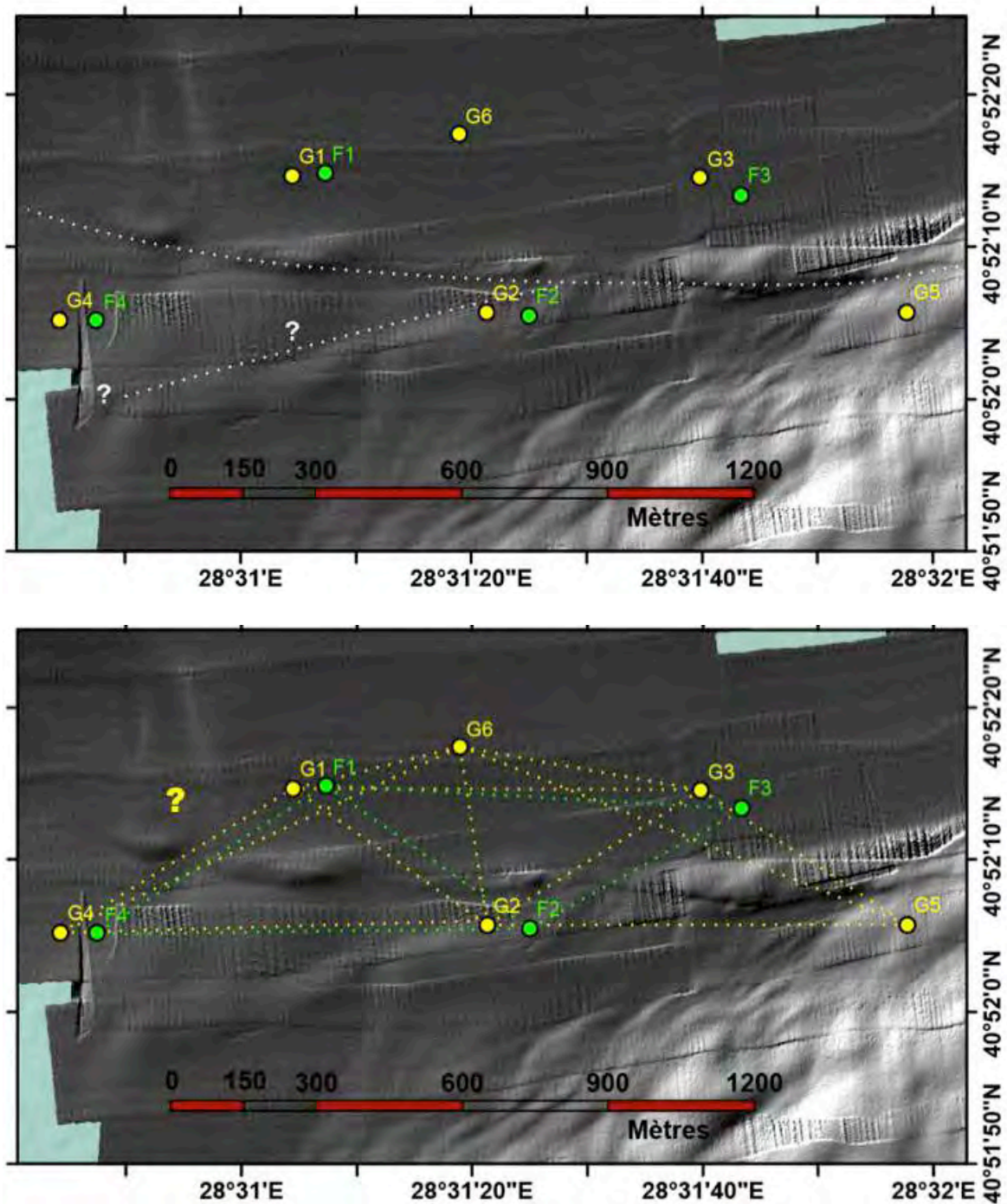


Figure II.1.6 Top figure shows the experimental lay-out, on both sides of the fault. Lower panel indicates the geometry of the ray paths between the different pairs of sensors. Redundant sensors from the German and from the french networks have been installed at each node, in order to consolidate results. French stations use 20 kHz transponders emitting every hour, while the frequency used for the German stations is 23 kHz emitting every two hours.

The geodetic stations are all equipped with AMT-FETCH acoustic transponders manufactured by SONARDYNE inc (UK), allowing reception from -and emission to- all other stations. French and german stations do not emit at the same frequency (20 kHz and 23 kHz, respectively), hence the two networks (from LDO and GEOMAR) work independently :

- french station emit 20 kHz signals very hour
- german stations emit 23 kHz signals every two hours.

The coordinates are listed in Table I.1 and the network configuration is shown in Figure II.1.6. The geodetic instruments measure the local sound speed, temperature and inclination and pressure. The distance measured from one beacon to the next (“baselines”) is done by the sound travel time measurement between the geodetic stations. From the speed of sound (measured at the endpoints of the baselines) and the travel time of signals between the instruments, the distances that separate them are estimated. In general the installation of the geodetic stations worked without any problem:

- All stations could be deployed in the target location of about 10x10 m and we received in real-time, thanks to the communication with the acoustic modem deployed over the ship side, the baselines which we expected according to the visibility studies done before the experience.
- All instruments work as expected and measure locally all associated parameters (celerity, temperature, pressure, inclination).
- For the german network, it is to be noted that intercommunication between the baselines worked for 12 of the 15 possible baselines (Figure II.1.6). The geodetic stations G2303 and G2307 have no line of sight and baselines longer than 1 km were not recorded due to station settings. During leg3, station G2303 was reconfigured in order to obtain longer baselines, by adding one-directional measurements for the baselines G2303-G2307 and G2303-G2304. This will result in the measurement of 14 from 15 possible baselines, there from 12 baselines with bidirectional distance estimate. Although after leg1 only few baseline measurements are available the first result suggest that the precision of the distance estimate is smaller than 5 mm.

All stations were visited with ROV VICTOR, during the first dive (DIVE01) of Leg 2, on November 2nd, 2014 (Table I.2). All stations were found to be correctly installed on the seafloor, with the three feet firmly coupled to the sediments. All equipments were laying horizontally on the seafloor, except for station G5, which was known to be tilted by an angle of 10°, based on shipboard acoustic interrogations made by the group from GEOMAR. Visual observations with ROV confirmed the inclination.

Station	Hour (TU)	Observations
G4	02/11/14 01:49	OK - Feet completely buried in sediments - stable
F4	02/11/14 02:02	OK - horizontal - Feet laying on top of sediments - stable
G1	02/11/14 02:42	OK - horizontal - Feet slightly buried - stable
F1	02/11/14 02:54	OK - horizontal - Feet buried - stable
G6	02/11/14 03:43	OK - horizontal - Feet buried - stable
G2	02/11/14 04:02	OK - horizontal - Feet buried - stable
F2	02/11/14 04:20	OK - horizontal - Feet buried - stable
G3	02/11/14 04:58	OK - horizontal - Feet buried - stable
F3	02/11/14 05:08	OK - horizontal - Feet buried - stable
G5	02/11/14 06:15	Feet completely buried in sediments – Tilt ~10°

Table I.2: Dates of visual visits of the Geodetic stations on the seafloor using ROV Victor.



Figure I.1.7 Photograph of geodetic station F4 taken on November, 2, 2014, at 02:02 GMT with ROV Victor.



Figure I.1.8 Photograph of acoustic transponder installed on geodetic station G6 taken on November, 2, 2014, at 03:45 GMT with ROV Victor.

I.1.3 OBS deployment

The Istanbul-Siliviri segment is known to be anomalously “silent” compared to the other segments within the Sea of Marmara. The initial plan was to deploy 8 OBSs in order to monitor the low-level micro-seismicity in the Geodetic Experiment area. Due to unexplained, technical failures, only 6 were eventually deployed. These instruments will be recovered by GEOMAR using R/V METEOR in April 2015.

COORDINATES OBS GEOMAR						
LATITUDE		LONGITUDE		Water	GEOMAR	Geographical Site
Deg	Min	Deg	Min	depth (m)	Identification Number	(Number given during cruise)
40	52,1722	28	33,7472	549	OBS8	OBS-GEOMAR4
40	52,1761	28	32,8038	663	OBS7	OBS-GEOMAR2
40	53,04728	28	31,54003	682	OBS6	OBS GEOMAR 7
40	53,06452	28	29,42369	658	OBS5	OBS GEOMAR 6
40	51,26572	28	29,38985	823	OBS4	OBS GEOMAR 3
40	51,26976	28	31,49927	689	OBS3	OBS GEOMAR 1

Table I.2 Coordinates of GEOMAR OBSs deployed during the Marsite Cruise



Figure I.1.9 Photograph of GEOMAR OBS deployed during Leg1 of Marsite Cruise.

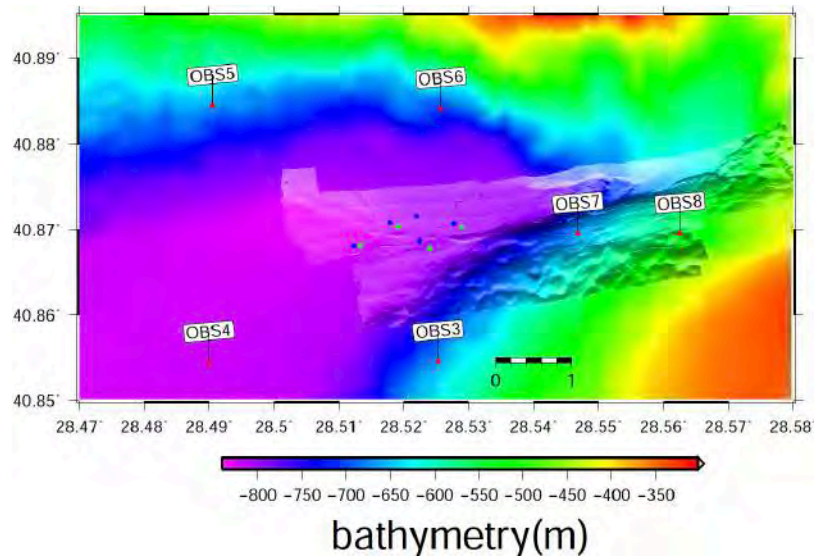


Fig. I.10 : Map showing the location (red points) of the GEOMAR OBS stations labelled with station IDs. The geodetic stations are shown with blue (GEOMAR) and green (LDO) points. Bathymetry from echosounder data. In the region of the geodetic network high resolution bathymetry from AUV mapping is shown. In order to enhance the fault structure the AUV bathymetry was illuminated from the South.

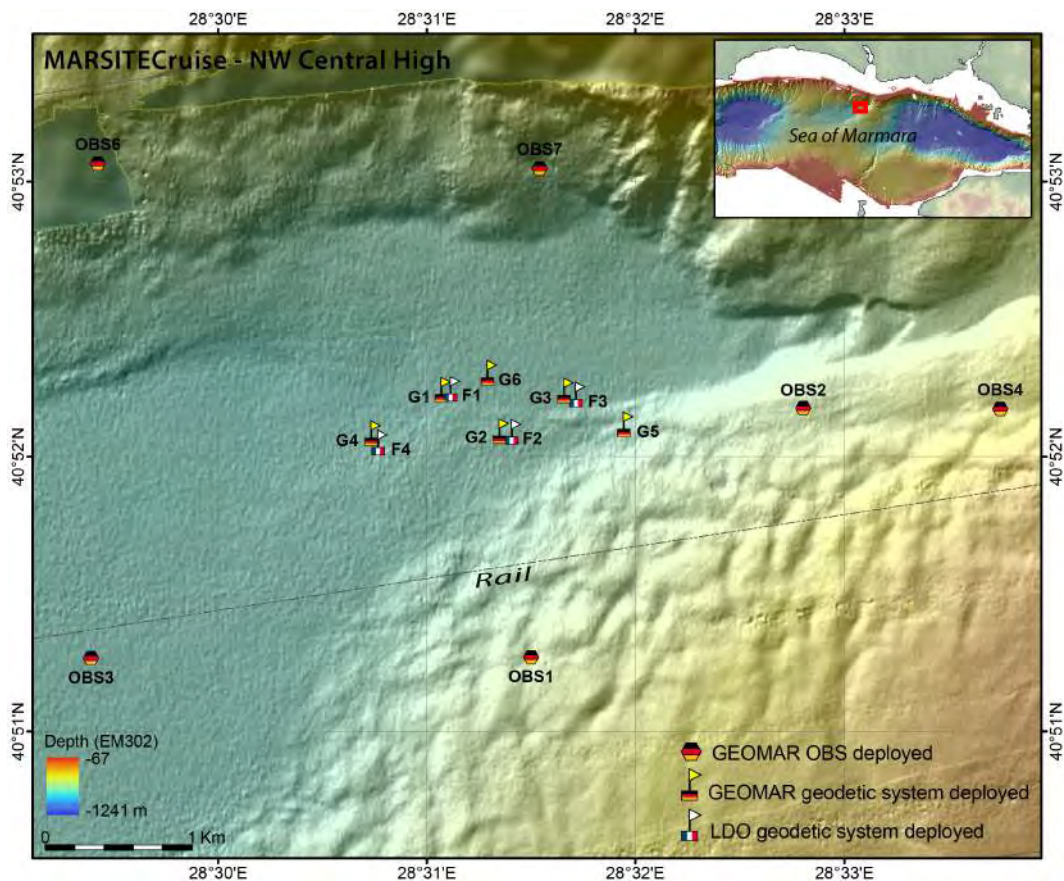


Fig. I.10 : Map showing the location (red points) of the GEOMAR OBS stations labelled with site number (see correspondance between Station ID and Site ID in Table I.2. The geodetic stations are shown with german (GEOMAR) and french (LDO) flags.

I.2 Core sampling

Two ROV dives were initially planned during Leg 1, for respectively, checking the installation of the geodetic stations and 2) for deploying the instruments devoted to the BOB experiment on top of the Western High. Unfortunately, the cable of the ROV was damaged and repaired only after 4 days. This obliged us to completely reconsider our plans. The ROV operations were transferred from Leg 1 to Leg 2. Instead, core samplings and acoustic surveys were carried out during Leg 1.

Date	Heure	Latitude	Longitude	CORE ID	Core length (m)
31/10/2014	05:53:00	N 40° 52,28862'	E 28° 30,20471'	CS01	23,5
31/10/2014	17:14:25	N 40° 51,08721'	E 28° 27,93654'	CS02	24

Table I.3: List of cores taken during Leg 1 (Kumburgaz Basin).

I.3 En-route profiles with multibeam echo-sounder in water column mode

PROFIL	Date	DEBUT			FIN		
		Heure TU	Latitude N	Longitud E	Heure TU	Latitude N	Longitud E
PR1	29-oct	08:38	40° 53,110'	28° 40,062'	09:10	40° 52,145'	28° 33,655'
PR2	29-oct	09:25	40° 52,074'	28° 33,633'	09:32	40° 52,163'	28° 32,825'
PR3	30-oct	07:25	40° 52,057'	28° 30,226'	08:05	40° 52,953'	28° 37,175'
PR4	30-oct	08:11	40° 52,566'	28° 37,051'	08:50	40° 51,816'	28° 30,343'
PR5	30-oct	08:56	40° 51,511'	28° 30,364'	09:35	40° 52,296'	28° 37,224'
PR6	30-oct	09:42	40° 51,959'	28° 37,25'	10:22	40° 51,174'	28° 30,407'
PR7	30-oct	10:28	40° 50,833'	28° 30,332'	11:07	40° 51,662'	28° 37,331'
PR8	30-oct	11:16	40° 51,211'	28° 37,322'	11:45	40° 50,729'	28° 32,279'
PR9	30-oct	12:00	40° 50,823'	28° 30,428'	12:15	40° 51,980'	28° 31,369'
PR10	31-oct	03:56	40° 50,757'	28° 27,327'	04:27	40° 53,150'	28° 31,715'
PR10a	31-oct	04:31	40° 52,795'	28° 31,618'	04:48	40° 52,178'	28° 30,279'
PR11	31-oct	22:27	40° 52,123'	28° 32,801'	22:56	40° 52,20'	28° 29,978'
PR12	31-oct	23:05	40° 52,251'	28° 28,936'	02:03	40° 48,890'	27° 52,571'
PR13	01-nov	02:06	40° 48,878'	27° 52,245'	03:14	40° 48,718'	27° 43,363'
PR14	01-nov	03:24	40° 49,403'	27° 43,367'	04:34	40° 49,451'	27° 52,563'
PR15	01-nov	04:43	40° 48,586'	27° 52,548'	05:53	40° 48,442'	27° 43,274'
PR16	01-nov	06:03	40° 49,044'	27° 43,428'	07:16	40° 49,194'	27° 53,073'
PR18	01-nov	08:17	40° 48,439'	27° 46,371'	08:33	40° 49,640'	27° 47,321'
PR19	01-nov	08:36	40° 49,706'	27° 47,572'	09:13	40° 49,805'	27° 52,460'
PR20	01-nov	09:27	40° 49,249'	27° 53,049'	09:27	40° 50,994'	40° 50,994'
PR21	01-nov	09:46	40° 50,991'	27° 52,842'	10:37	40° 48,728'	27° 46,247'

Table I.4 : List of Multibeam Echo-Sounder profiles (RESON SeaBat 7150). See map and complete list in Appendix 7 for Legs 1, 2 and 3

II. Leg 2

II.1 Background/specific objectives

The specific objective of Leg 2 is to construct a versatile geochemical database on fluids (free and dissolved gases, hydrates, brines and pore waters) physicochemical properties in order to generate accurate knowledge on the relationships between fluid migration and faulting. The integration of all data would further our understanding on the hydrogeologic system of the SoM.

The geochemical analysis of free gas samples collected in 2007 during the MarNaut cruise on R/V L'Atalante has provided evidence that thermogenic gas is emitted from seabed seeps in the proximity of the North Anatolian Fault within the western part of Sea of Marmara. High-resolution 3D seismic data from where the North Anatolian Fault cuts a gas / oil system from the Thrace Basin province show a diapiric feature that pierces the crest of an anticline, within less than 1 km off the fault zone. The feature provides structures that convey gas to seeps on the seafloor. The gas follows migration pathways away from the fault zone, which at greater depth must interact with the source of the gas. Based on new heat flow data and on published geochemical information, the gas prone layer is located at depths greater than ~ 2 km below seafloor, well into the seismogenic zone. Hence, the physical properties and the chemistry of the fluids within the conduit of the mud volcano are likely to change systematically with the state of stress and strain in the fault zone throughout the earthquake cycle. Some of these changes, or their consequential effects, such as variations in gas emissions, could be recorded at the seafloor, in the search for transients.

Due to its broad regional occurrences, gas ventings play an important role in the evolution of the SoM; and undoubtedly their migration pathway are influenced by the dynamics of the fault networks, especially the NAF. Thus, the birth, intensity and/ or lifetime of these gas seepages may also be influenced by earthquake occurrences (Cormier et al., 2006; Kuscu et al., 2005; Kuscu et al., 2008). Previous studies (Bourry et al., 2009; Ruffine et al., 2012) based on samples collected during MarNaut, showed that the gases are either of biogenic or thermogenic origin, or are a mixture of both at different levels of mixing. Whatever their origin these gases, in particular the methane, constitute the cornerstone of several geochemical processes occurring within the sediment column.

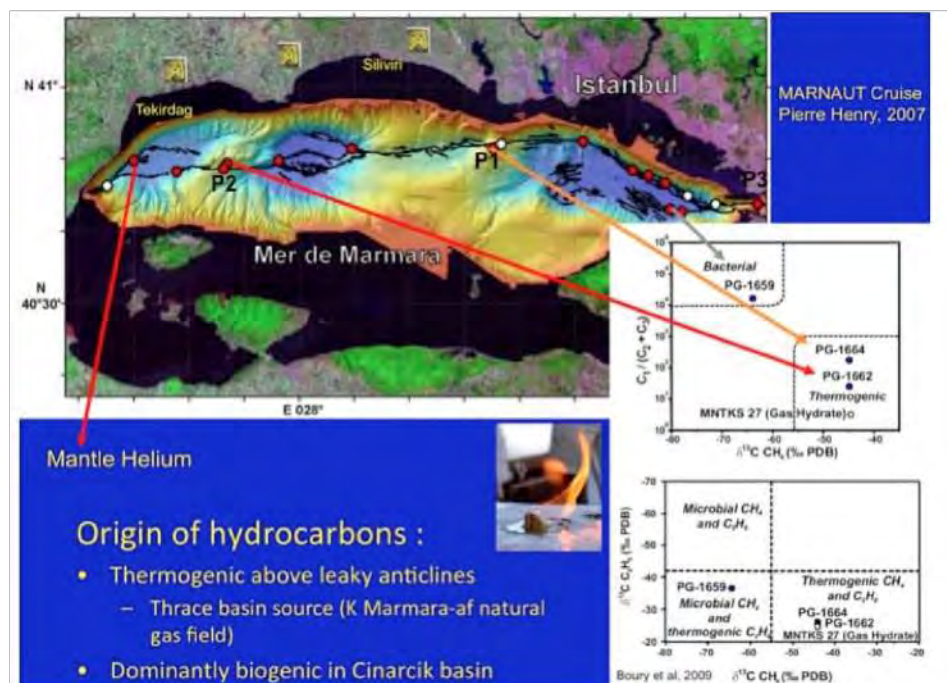


Figure II.1: Summary of main results obtained during the MarNaut Cruise (PI Pierre Henry) based on the geochemical analysis of gas sampled in-situ with Nautile submersible [e.g. Bourry et al, 2009]. The geochemical data indicate that the North Anatolian Fault cross-cuts a gas reservoir in the SoM.

The objective of Leg-2 is to go a step beyond MarNaut, by proposing an integrated geochemical programme which aims at characterizing gas expulsion sites in several strategic areas in the SoM by working on four different types of sampling: the gases expelled, the gas hydrates accumulated in the shallow sediments, the pore fluid migrating through the sediment in the vicinity of the venting, and the sediment, the geological matrix in which the fluid migration takes place. The use of ROV- Victor has allowed direct *in situ* sampling of gas bubbles, a critical issue for tracking hydrocarbon's sources, and drawing its circulation pattern. Direct visual observations, gas sampling camera monitoring with ROV-Victor and acoustic mapping of gas seeps have been highly valuable to characterize the gas bubbles and to calibrate the onboard acoustic systems. The specific actions were:

1. In-situ gas sampling was performed map at key seismogenic locations in the SoM in order to better constraint the hydrocarbon sources, the interconnection between sources and the role of the fault network on fluid circulation. The collected gases were transferred into appropriate high-pressure vessel.
2. Coring operations were performed in the near-vicinity of gas ventings, and also away to get reference cores, in order to identify the process that affect the geochemistry of the migrating fluids. Based on previous investigations (*Tryon et al, 2010*), fluids come from either seawater or deep hydrocarbon reservoirs. They can also be the products of moderate to high-temperature geochemical processes occurring at depth like illitization. When arriving to the shallow sediment, other geochemical processes take over (e.g. Anaerobic Oxidation of Methane- AOM, authigenic carbonate precipitation, barite precipitation) and may further modify the fluid chemistry. The long cores (of about 25 m length) that were collected should provide the opportunity of sampling fluids at their lowermost end which has not been polluted by seawater infiltration. Therefore, their composition would be representative of the source composition, or very close. On board, after recovered, the cores were sampled for pore fluid using the Rhyzon moisture sampler at appropriate depth resolution, then the collected samples were immediately analysed for alkalinity, chloride and sulphate contents. On shore, concentrations of the others majors and minors elements (alkaline earth elements, manganese, lithium, iron, boron) will be measured, along with strontium, lithium and boron isotopes.
3. Methane sensors (attached on the CTD-Rosette) were tested in the surrounding of gas vents. Two methane sensors were tested: i) an off-the-shelf sensor from Framatec which allows the measurements of dissolved methane concentrations in the range of 10- 50 000 $\mu\text{mol/L}$; ii) an in-house sensor under development at Ifremer.
4. To carry out sediment sampling and analyses on the recovered cores. Though, investigations on the geology of the SoM has a long history, a quantitative description of the bulk chemical composition and the mineralogy of the sediments as well as the consequences of their interactions with migrating fluids are still poorly understood.
6. Sea water samples were taken using titanium bottle gas samplers (as used for NarNaut) in order to analyze the **He isotopic composition of the fluids**. The samples were treated on board the ship (freeing up the Ti bottle samplers for the following dive), and the gases extracted were stored in copper 'pinch-off tubes' (a standard sampling method for He isotope determinations) and returned to Nancy for analysis in the noble gas laboratory at CRPG.

The geochemical datasets acquired during Leg 2 will lead to:

1. The geochemical mapping and characterization of gas expulsion sites in seismogenic areas in the SoM, especially along the Istanbul-Siliviri fault segment.
2. The drafting of a conceptual model describing the hydrogeology of all studied areas put together. The resulting set of analyses will also give us the possibility of taking into consideration the influences of deep-seated fluids and deep geochemical reactions within the conceptual model.
3. The evaluation of the active lifetime of the mud volcano located on the Western High.
4. The release of some technological lockings which are linked to the development of reliable methane sensors for oceanic investigations.
5. The mapping of the mantle-derived fluids and its relations with the fault system.

II.2 Operations with ROV/Victor

II.2.1 ROV

ROV/Victor 6000 is a Remotely Operated Vehicle (named Victor 6000) that can be deployed at water depth up to 6000 m. Its main purposes are to explore the deep-sea by visual inspection, together with sampling geochemical, micro-biological materials. ROV/Victor can operate up to 72 hours with a dedicated crew of 9 people working in 3 shifts to ensure a 24 hours/day service.

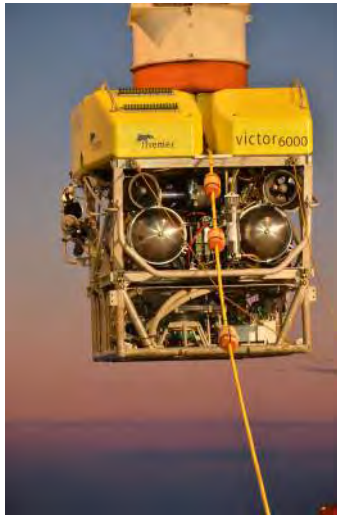


Fig. II.3 Deployment of ROV-Victor during Leg 2 of Marsitecruise

II.2.2 In-situ sampling tools used with ROV

II.2.4.1 PEGAZ gas sampling system (Tool Code PE)

The PEGAZ sampler allows the in-situ sampling of gases emanating from the seafloor. Gases were further conditioned in pressurized contained on-board *R/V Pourquoi pas?* for analysis in the lab.



Figure II.4 : Gas sampling by ROV using a blade core.

II.2.4.2 Titane syringe system (Tool code : TI)

The titanium syringe allows the sampling of pressurized fluids, especially liquid, emanating from the seafloor. Fluids were collected into a titanium bottle and reconditioned onboard.

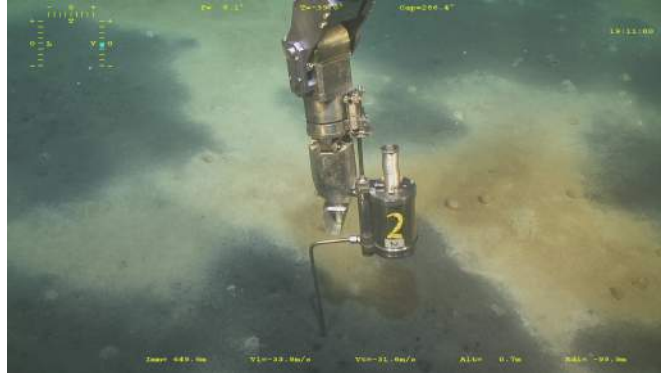


Figure II.5 : Fluid sampling by ROV using a Titanium Syringe and Bottle.

II.2.4.3 Raman Spectrometry system (Tool Code : RA)

The *in situ* Raman spectrometer allows an estimation of the major chemical components present in the gas bubbles : CO₂, CH₄, C₂H₆, C₃H₈, etc.



Figure II.6 : Chemical analysis of gas bubbles using a Raman spectrometer.

II.2.4.4 Flow meter (Tool Code : FLO).

Flow meters are graduated, transparent cyclinders allowing the measurement of gas flow at seeps. Measurements are made visually using ROV observations : flow is the time required to fill the volume of the cyclinder.



Figure II.7 : Flow measurement on a gas seep.

II.2.4.5 Push-Corer sampling (Tool Code : PC)

The “push corer” allows delicate, non-destructive sampling of the 30 cm of sediments using the ROV arm to smoothly push the corer into the sediments. Such system is particularly suitable to sample sediment associated with bacterial mats.



Figure II.8: Sediment sampling by ROV using a push corer.

II.2.4.6 Blade corer sampling (Tool Code BC)

The blade corer allows the delicate, non-destructive sampling of the first 30 cm depth of sediment over a surface of around 600 cm³ using the ROV-arm. Such a system is suitable for sample sediment associated with living communities (microbial mat, mega fauna, etc).

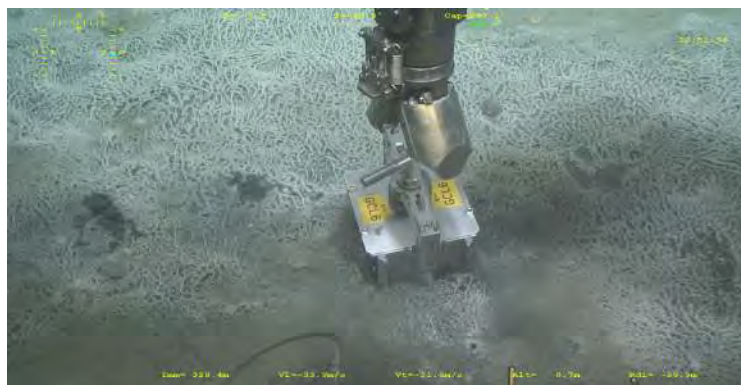


Figure II.9: Sediment sampling by ROV using a blade corer.

II.2.3 ROV Dives

A total of 5 dives were performed during Leg 2, as shown in Figure II.2 below.

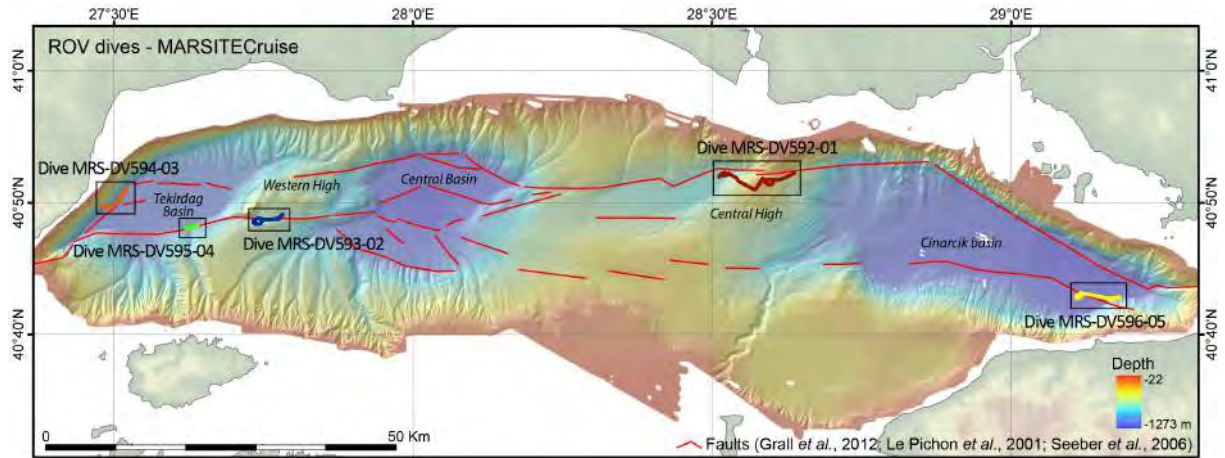


Fig. II.10 In total, 5 dives of ROV/Victor were performed during Leg II.

DIVE ID MRS-DV	592-01	593-02	594-03	595-04	595-05
Zone	Central High	Central High	South Tekirdag	South Tekirdag	Cinarcik
Central Point	N40.862° E28.583°	N40.78893, E27.74580	N40.858000 E27.530000	N40.8032 E27.6296	N40.711 E29.139
Lat min	40.843988°	40.770918°	40°50.3993'N	40.785188°	40.692945°
Long min	28.559278°	27.722104°	27°30.3768'E	27.605899°	29.115276°
Lat max	40.880007°	40.806937°	40°52.5604'N	40.821207°	40.729050°
Long max	28.606722°	27.769496°	27°33.2232'E	27.653301°	29.162724°
Start from desk	02/11/2014 00:09	04/11/2014 08:56	06/11/2014 05:29	08/11/2014 01:07	10/11/2014 12:34
Arrival on desk	03/11/2014 15:38	05/11/2014 15:33	07/11/2014 14:38	08/11/2014 19:33	11/11/2014 15:22
Under water	02/11/2014 00:28	04/11/2014 09:16	06/11/2014 05:49	08/11/2014 01:23	10/11/2014 13:02
Surface arrival	03/11/2014 15:05	05/11/2014 15:02	07/11/2014 14:13	08/11/2014 19:00	11/11/2014 14:57
Arrival on bottom	02/11/2014 01:17	04/11/2014 10:06	06/11/2014 06:40	08/11/2014 02:22	10/11/2014 14:12
Depart. from bottom	03/11/2014 14:25	05/11/2014 14:29	07/11/2014 13:10	08/11/2014 17:55	11/11/2014 13:37
Hours under water	39h29'	30h37'	32h24'	18h26'	25h55'
Hours on bottom	38h37'	28h23'	30h20'	17h37'	23h25'
Distance on bottom (km)	23	16	16,59	5,25	12,8

Table II.1: Summary of ROV/Victor dive characteristics

II.2.3.1 Dive 1 (MRS-DV592-01)

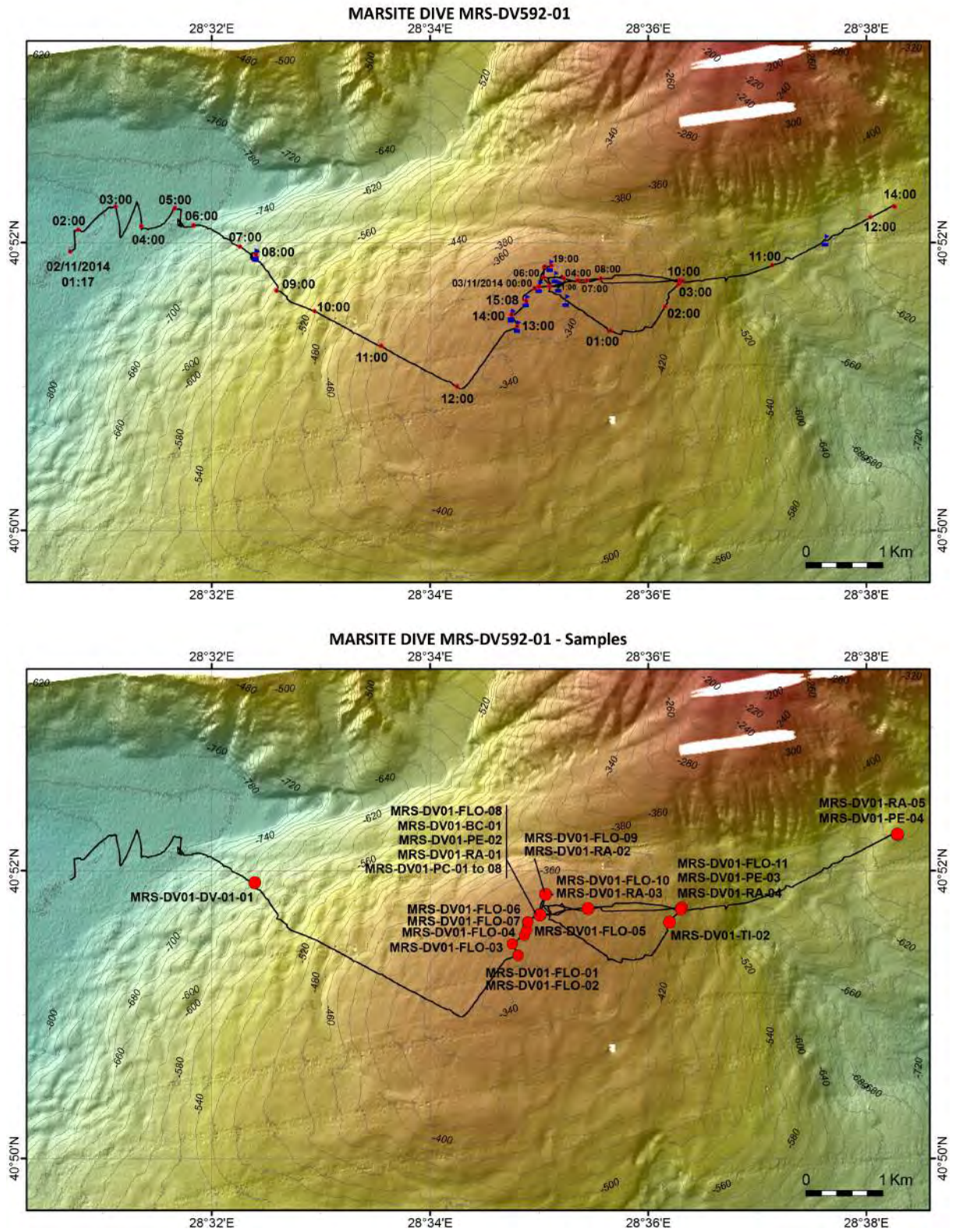


Figure II.11 Upper panel indicates navigation of ROV/Victor during Dive MRS-DV-592-01. Lower panel shows the location of samples collected with ROV/VICTOR.

MARSITE - DIVE 01 - Central High



07h49 Carbonates and bivalves (?)

08H10 Bivalves on black patches

13H59 Flowmeter on bacterial mat



14H39 Bivalves shells

16H22 Flowmeter measurement
on bacterial mat

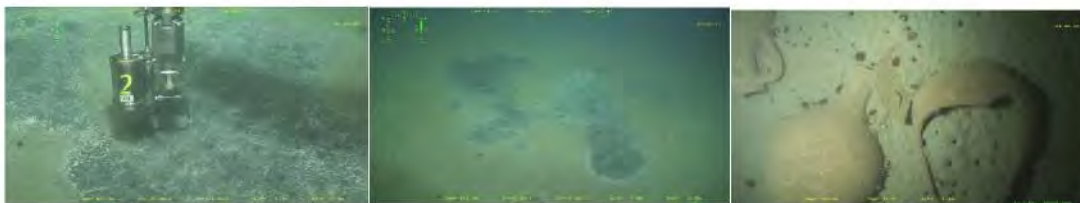
16H50 Pegaz 02 sample



17H00 Raman measurement

20H05 Push cores 01, 02, 03 (et 04)

22H51 Blade core in bacterial mat



02H31 Titane bottle on black patch

03H02 Black patches with bacterial mat

04H45 Amphora



13H16 Pegaz 04 sampling

Figure II.12 Selection of photographs taken during Dive 01 (MRS-DV-592-01). Note that archeological assets were discovered during the dive. This discovery was immediately reported by email to our contact at SHOD, for transmission to the relevant Turkish authorities (see Appendix 1).

DATE	HOUR	DEPTH (m)	Sample ID	TOOL	LATITUDE	LONGITUDE
02/11/2014	13:09:00	333	MRS-DV01-FLO-01	Flowmeter	40.856964	28.580073
02/11/2014	13:12:00	333	MRS-DV01-FLO-02	Flowmeter	40.856966	28.580072
02/11/2014	13:52:00	331	MRS-DV01-FLO-03	Flowmeter	40.858323	28.579152
02/11/2014	14:19:00	329	MRS-DV01-FLO-04	Flowmeter	40.859288	28.580996
02/11/2014	14:51:00	328	MRS-DV01-FLO-05	Flowmeter	40.859906	28.581373
02/11/2014	15:42:00	328	MRS-DV01-FLO-06	Flowmeter	40.860827	28.581527
02/11/2014	15:48:00	328	MRS-DV01-FLO-07	Flowmeter	40.860845	28.581565
02/11/2014	16:21:00	328	MRS-DV01-FLO-08	Flowmeter	40.861569	28.583340
02/11/2014	16:49:00	328.5	MRS-DV01-PE-02	Pegaz	40.861564	28.583343
02/11/2014	17:06:00	328.5	MRS-DV01-RA-01	Raman	40.861561	28.583345
02/11/2014	17:55:00	671	MRS-DV01-FLO-09	Flowmeter	40.863917	28.584146
02/11/2014	18:18:00	334.2	MRS-DV01-RA-02	Raman	40.863914	28.584184
02/11/2014	19:52:00	328.5	MRS-DV01-PC-04	Push core	40.861525	28.583352
02/11/2014	19:58:00	328.5	MRS-DV01-PC-02	Push core	40.861522	28.583355
02/11/2014	20:03:00	328.5	MRS-DV01-PC-01	Push core	40.861518	28.583362
02/11/2014	20:10:00	328.5	MRS-DV01-PC-03	Push core	40.86152	28.583366
02/11/2014	21:58:00	328.4	MRS-DV01-PC-06	Push core	40.861517	28.583361
02/11/2014	22:13:00	328.5	MRS-DV01-PC-07	Push core	40.861511	28.583362
02/11/2014	22:32:00	328.5	MRS-DV01-PC-05	Push core	40.861517	28.583358
02/11/2014	22:41:00	328.5	MRS-DV01-PC-08	Push core	40.861514	28.583363
02/11/2014	22:50:00	334	MRS-DV01-BC-01	Blade core	40.861515	28.583352
03/11/2014	02:31:00	402.2	MRS-DV01-TI-02	Titanium bottle	40.860721	28.603077
03/11/2014	06:57:07	342	MRS-DV01-FLO-10	Flowmeter	40.8622905	28.5906387
03/11/2014	07:03:00	342	MRS-DV01-RA-03	Raman	40.862291	28.590646
03/11/2014	09:03:30	413.8	MRS-DV01-FLO-11	Flowmeter	40.8623086	28.6048958
03/11/2014	09:16:00	413.8	MRS-DV01-RA-04	Raman	40.862306	28.604887
03/11/2014	09:31:00	413.8	MRS-DV01-PE-03	Pegaz	40.862307	28.60489
03/11/2014	12:46:00	527	MRS-DV01-PE-04	Pegaz	40.870822	28.637693
03/11/2014	13:26:00	527	MRS-DV01-RA-05	Raman	40.870846	28.637692

Table II.2 : List of samples collected during Marsite ROV dive MRS-DV-592-01

II.2.3.2 Dive 2 MRS-DV-593-02

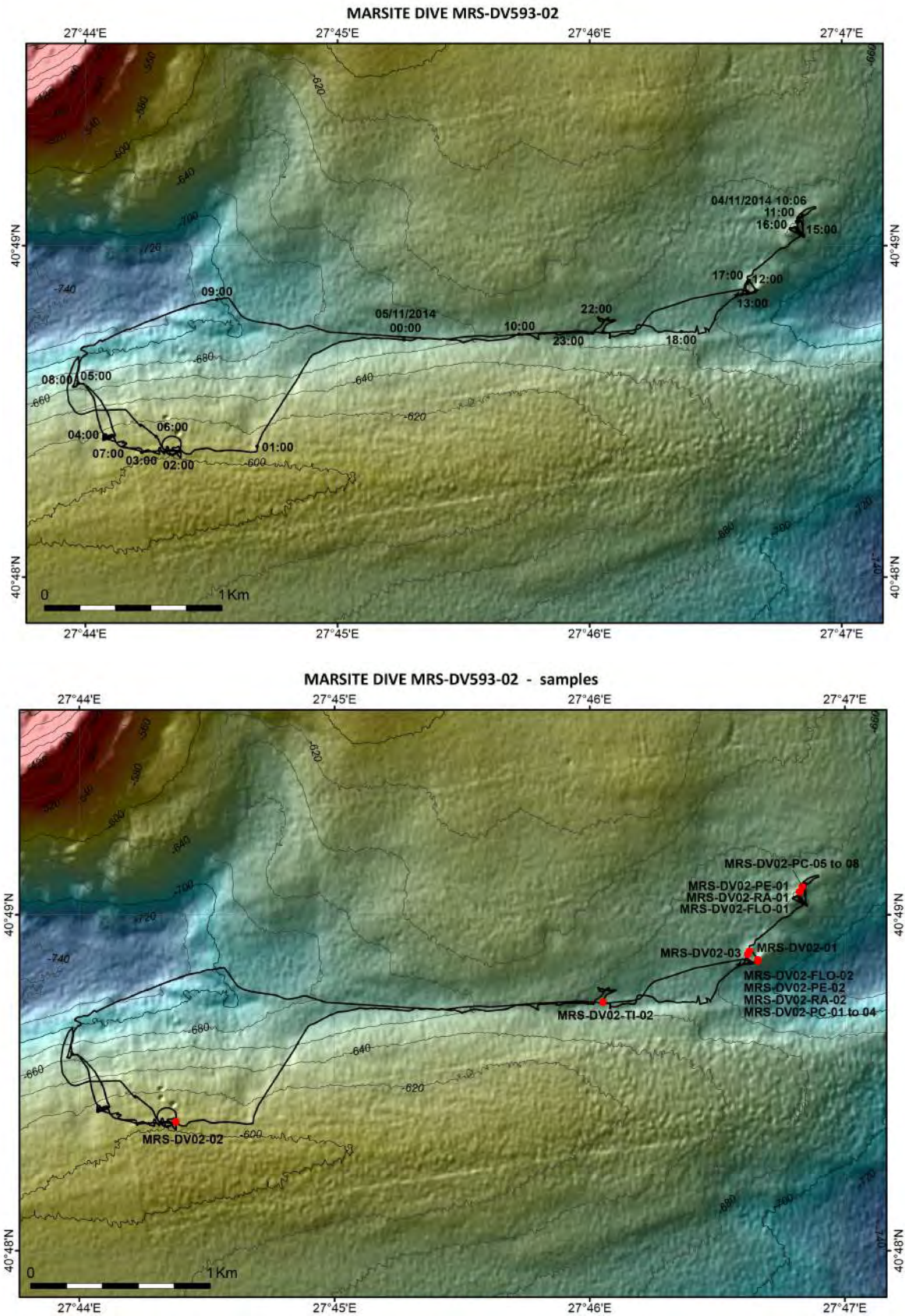


Figure II.13 Upper panel indicates navigation of ROV/Victor during Dive MRS-DV-593-02. Lower panel shows the location of samples collected with ROV/VICTOR.

MARSITE - DV02 - Western High

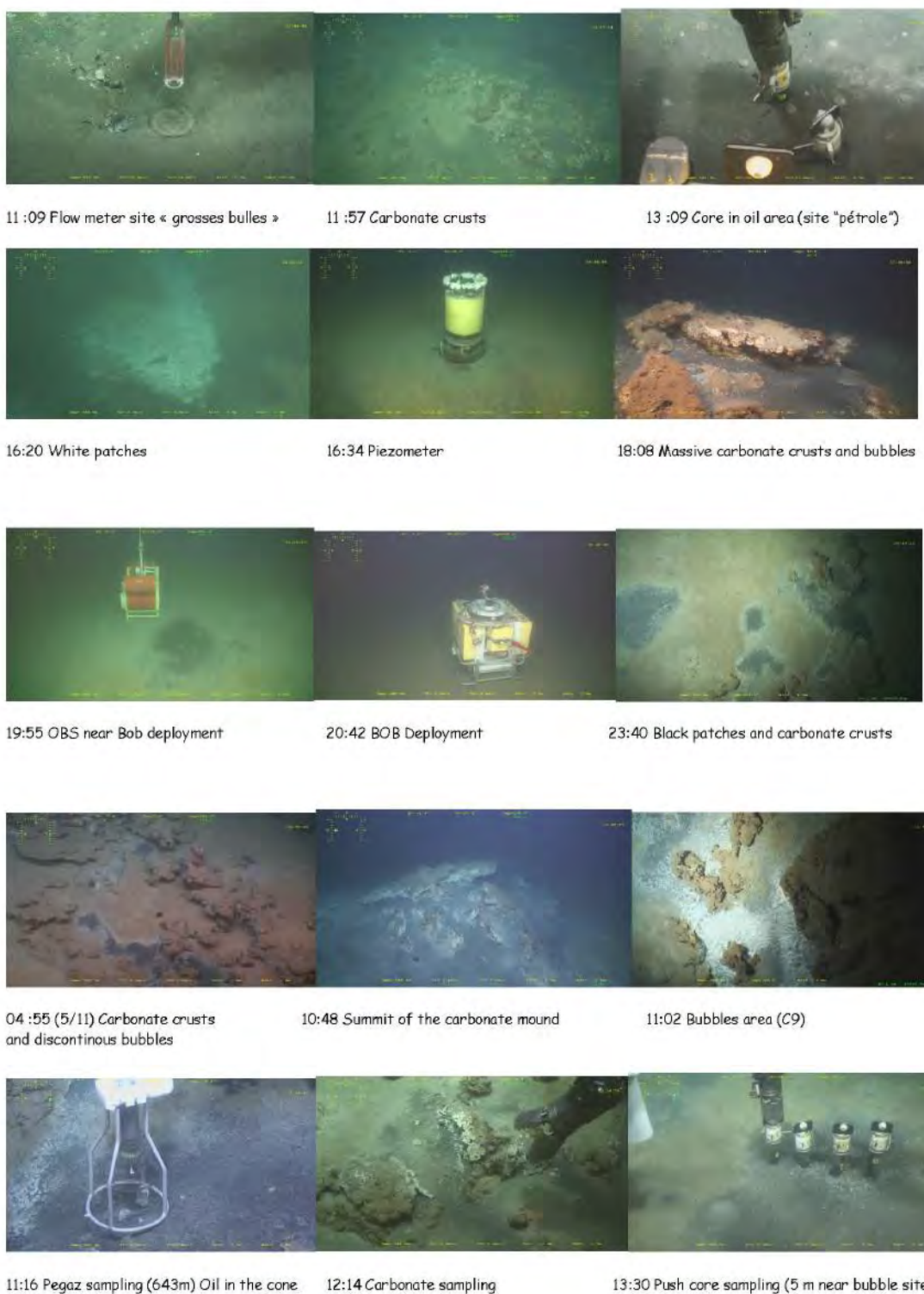


Figure II.14 Selection of photographs taken during Dive 02 (MRS-DV-593-02).

DATE	HOUR	Depth (m)	SAMPLE ID	TOOL	LATITUDE	LONGITUDE
04/11/2014	11:08:24	0	MRS-DV02-FLO-01	Flowmeter	40.81780	27.78040
04/11/2014	11:20:00	640	MRS-DV02-PE-01	Pegaz	40.81780	27.78041
04/11/2014	11:27:00	0	MRS-DV02-RA-01	Raman	40.81780	27.78041
04/11/2014	12:59:00	0	MRS-DV02-PC-08	Push core	40.81804	27.78058
04/11/2014	13:09:00	0	MRS-DV02-PC-06	Push core	40.81804	27.78058
04/11/2014	13:12:00	0	MRS-DV02-PC-05	Push core	40.81804	27.78058
04/11/2014	13:17:00	0	MRS-DV02-PC-07	Push core	40.81804	27.78057
04/11/2014	16:49:00	0	MRS-DV02-01	Basket	40.81484	27.77711
04/11/2014	18:43:00	0	MRS-DV02-TI-02	Ti bottle	40.81231	27.76755
05/11/2014	01:47:00	586	MRS-DV02-02	Basket	40.80639	27.73963
05/11/2014	11:10:00	643	MRS-DV02-FLO-02	Flowmeter	40.81436	27.77769
05/11/2014	11:15:00	643	MRS-DV02-PE-02	Pegaz	40.81436	27.77768
05/11/2014	11:38:00	643	MRS-DV02-RA-02	Raman	40.81435	27.77766
05/11/2014	12:15:00	646	MRS-DV02-03	Basket	40.81469	27.77702
05/11/2014	13:17:00	643	MRS-DV02-PC-04	Push core	40.81440	27.77767
05/11/2014	13:21:00	643	MRS-DV02-PC-02	Push core	40.81441	27.77768
05/11/2014	13:24:00	643	MRS-DV02-PC-01	Push core	40.81441	27.77768
05/11/2014	13:30:00	643	MRS-DV02-PC-03	Push core	40.81441	27.77768

Table II.3 : List of samples collected during Marsite ROV dive MRS-DV-593-02

II.2.3.3 Dive MRS-DV-594-03

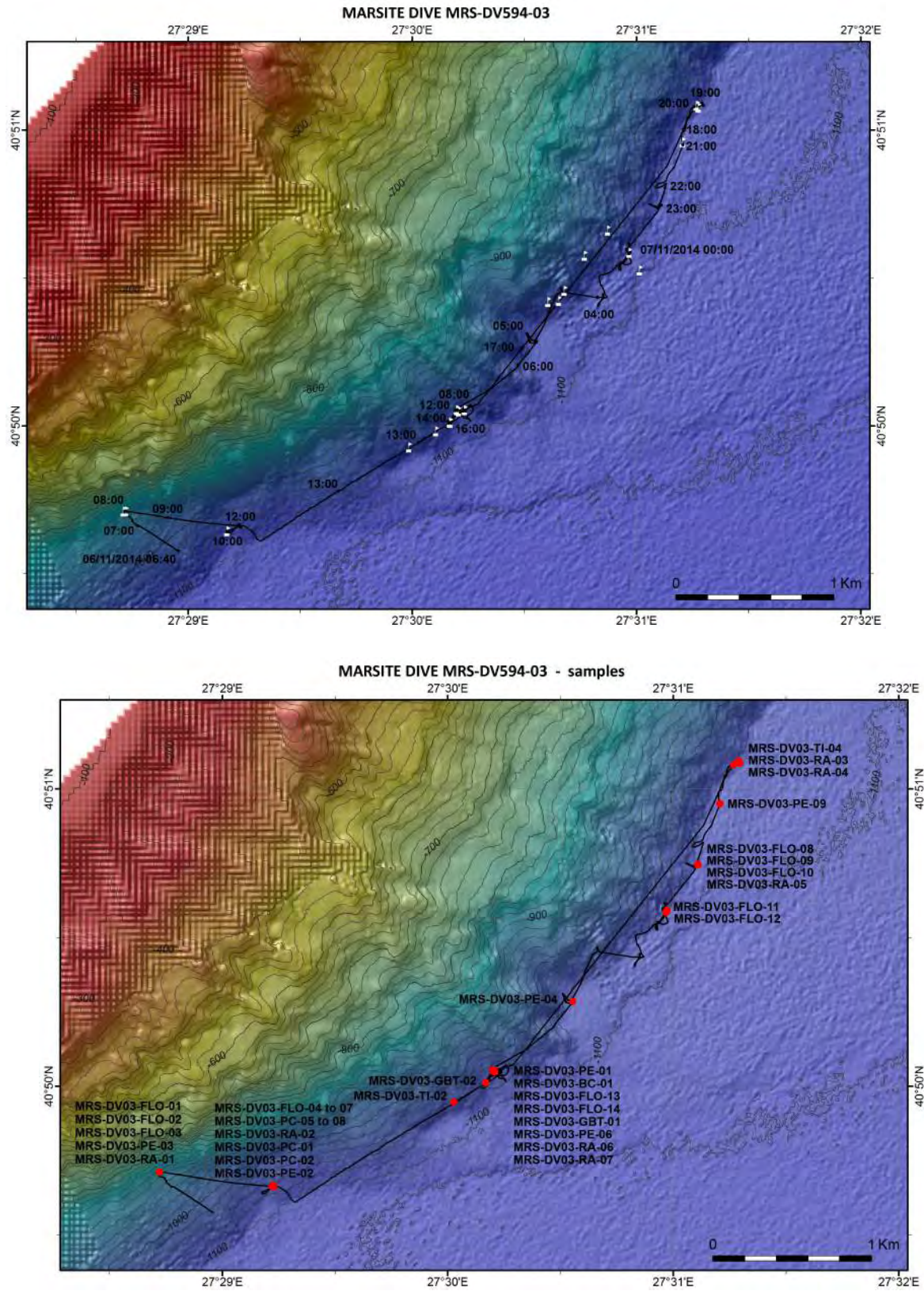
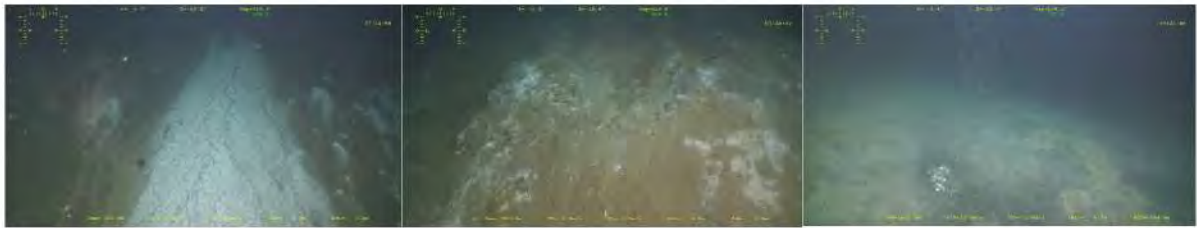


Figure II.15 Upper panel indicates navigation of ROV/Victor during Dive MRS-DV-594-03. Lower panel shows the location of samples collected with ROV/VICTOR.

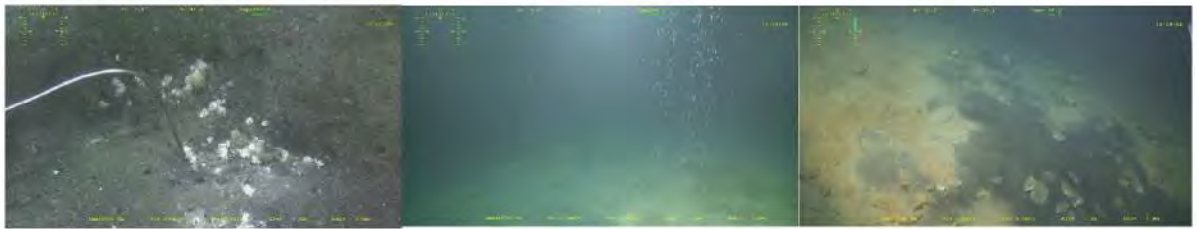
MARSITE - DIVE 03 - TEKIRDAG



07:14 Massive bacterial flow

07:28 Bubbles on summit of flow

09:21 Bubbles (middle of black patch)



12:11 Temperature on bubbles (14.7°C)

12:14 View on rising bubbles

14:18 Black patch between Mussel and Boris



15:25 Site Boubouns

16:10 Mussels on sedimentary rocks

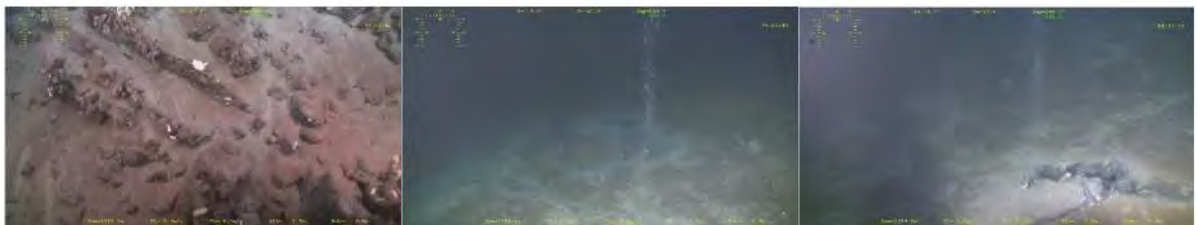
19:39 Temperature on shimmering fluids



20:09 Black patches with oil visible at the surface

20:29 Oil seeping out on black patch

00:17 Oil rising (site Dallas)



06:01 View on sedimentary rocks

06:22 Arrival on Boris site

06:51 Site Boubouns

Figure II.16 Selection of photographs taken during Dive 03 (MRS-DV-594-03).

DATE/	HOUR	DEPTH	SAMPLE ID	TOOL	LATITUDE	LONGITUDE
06/11/2014	07:51:00	895	MRS-DV03-PE-03	Pegaz	40.82852	27.47871
06/11/2014	08:12:00	895	MRS-DV03-RA-01	Raman	40.82850	27.47871
06/11/2014	08:25:00	895	MRS-DV03-FLO-01	Flowmeter	40.82852	27.47870
06/11/2014	08:28:00	895	MRS-DV03-FLO-02	Flowmeter	40.82851	27.47871
06/11/2014	08:40:00	895	MRS-DV03-FLO-03	Flowmeter	40.82850	27.47871
06/11/2014	09:26:00	1070	MRS-DV03-PE-02	Pegaz	40.82768	27.48708
06/11/2014	09:32:00	1070	MRS-DV03-RA-02	Raman	40.82769	27.48705
06/11/2014	09:38:00	1070	MRS-DV03-FLO-04	Flowmeter	40.82769	27.48707
06/11/2014	09:42:00	1070	MRS-DV03-FLO-05	Flowmeter	40.82769	27.48706
06/11/2014	09:44:00	1070	MRS-DV03-FLO-06	Flowmeter	40.82769	27.48706
06/11/2014	09:48:00	1070	MRS-DV03-FLO-07	Flowmeter	40.82770	27.48706
06/11/2014	10:22:00	1070	MRS-DV03-PC-05	Push core	40.82771	27.48715
06/11/2014	10:26:00	1070	MRS-DV03-PC-06	Push core	40.82770	27.48714
06/11/2014	10:27:00	1070	MRS-DV03-PC-07	Push core	40.82769	27.48718
06/11/2014	10:30:00	1070	MRS-DV03-PC-08	Push core	40.82767	27.48714
06/11/2014	11:59:00	1070	MRS-DV03-PC-01	Push core	40.82774	27.48710
06/11/2014	12:03:00	1070	MRS-DV03-PC-02	Push core	40.82775	27.48712
06/11/2014	18:38:00	1085	MRS-DV03-RA-03	Raman	40.85144	27.52163
06/11/2014	19:25:00	1085	MRS-DV03-TI-04	Titanium bottle	40.85156	27.52153
06/11/2014	19:48:00	1085	MRS-DV03-RA-04	Raman	40.85136	27.52114
06/11/2014	20:53:00	1085	MRS-DV03-PE-09	Pegaz	40.84916	27.52013
06/11/2014	22:43:00	1092	MRS-DV03-FLO-08	Flowmeter	40.84576	27.51852
06/11/2014	23:04:00	1092	MRS-DV03-RA-05	Raman	40.84575	27.51850
06/11/2014	23:10:00	1092	MRS-DV03-FLO-09	Flowmeter	40.84574	27.51851
06/11/2014	23:31:00	1092	MRS-DV03-FLO-10	Flowmeter	40.84574	27.51851
07/11/2014	00:47:00	1092	MRS-DV03-FLO-11	Flowmeter	40.84319	27.51624
07/11/2014	01:40:38	1090	MRS-DV03-FLO-12	Flowmeter	40.84305	27.51615
07/11/2014	05:45:00	1090	MRS-DV03-PE-04	Pegaz	40.83807	27.50928
07/11/2014	08:09:00	1055	MRS-DV03-PE-06	Pegaz	40.83422	27.50334
07/11/2014	08:12:00	1055	MRS-DV03-RA-06	Raman	40.83423	27.50335
07/11/2014	08:18:00	1055	MRS-DV03-FLO-13	Flowmeter	40.83422	27.50335
07/11/2014	08:27:00	1059	MRS-DV03-FLO-14	Flowmeter	40.83414	27.50347
07/11/2014	08:40:00	1059	MRS-DV03-RA-07	Raman	40.83412	27.50346
07/11/2014	08:36:00	1059	MRS-DV03-PE-01	Pegaz	40.83412	27.50347
07/11/2014	09:29:00	1055	MRS-DV03-BC-01	Blade core	40.83421	27.50333
07/11/2014	09:55:00	1054	MRS-DV03-GBT-01	Big Bio Box	40.83422	27.50344
07/11/2014	10:51:00	1073	MRS-DV03-GBT-02	Big Bio Box	40.83353	27.50283
07/11/2014	13:02:00	1071	MRS-DV03-TI-02	Ti bottle	40.83241	27.50047

Table II.4 : List of samples collected during Marsite ROV dive MRS-DV-594-03

II.2.3.4 MRS-DV-595-04

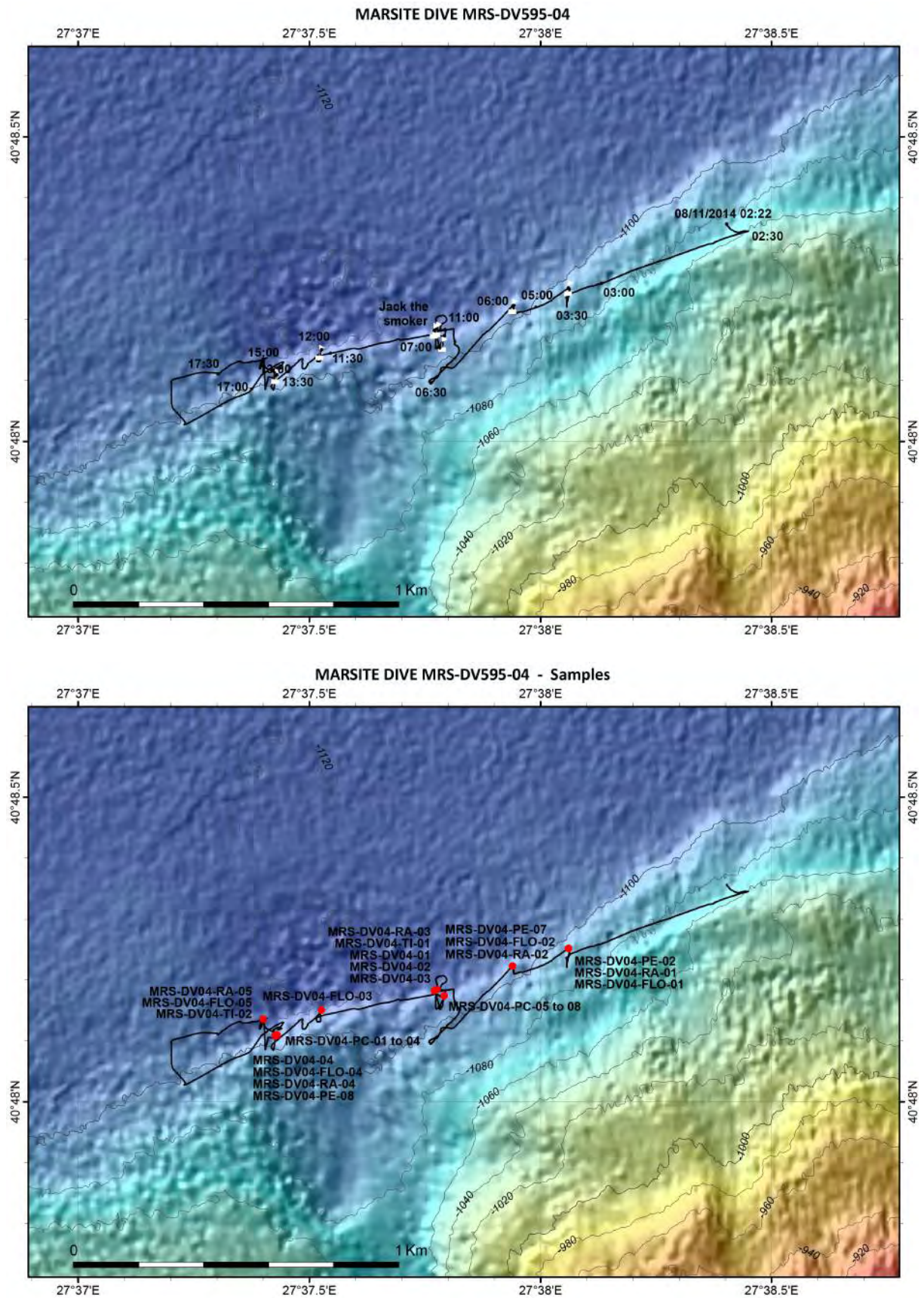


Figure II.17 Upper panel indicates navigation of ROV/Victor during Dive MRS-DV-595-04. Lower panel shows the location of samples collected with ROV/VICTOR.

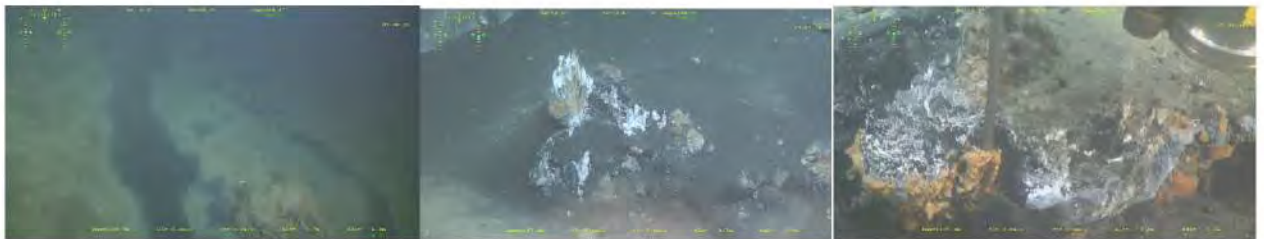
MARSITE - DIVE 04 - SOUTH TEKIRDAG



03:17 Strong gas bubbling on black patch

03:22 Gas bubbling on black patch

06:29 Carbonate crust



07:00 Black patch elongated N80

07:07 Jack the smoker

07:50 Titanium bottle on Jack



08:05 Crust sampling

09:04 PC on black patch near Jack

10:40 General view of Jack



11:16 Carbonate pavement

12:45 Flowmeter on bubbles (site Carla)

13:19 Crust sampling



13:29 Coral and anemone on crust

14:18 Push core on site Carla

15:55 Titanium bottle

Fig. II.18 Selection of photographs taken during Dive 04 (MRS-DV-595-04).

DATE	HOUR	PROF	SAMPLE ID	TOOL	LATITUDE	LONGITUDE
08/11/2014	03:37:00	895	MRS-DV04-PE-02	Pegaz	40.804185	27.634338
08/11/2014	04:13:00	1083	MRS-DV04-FLO-01	Flowmeter	40.804195	27.634346
08/11/2014	05:33:00	1098	MRS-DV04-FLO-02	Flowmeter	40.803706	27.632333
08/11/2014	05:44:00	1098	MRS-DV04-RA-02	Raman	40.803703	27.632335
08/11/2014	06:02:00	1098	MRS-DV04-PE-07	Pegaz	40.803704	27.632346
08/11/2014	07:31:00	1107	MRS-DV04-RA-03	Raman	40.803025	27.629514
08/11/2014	07:50:00	1107	MRS-DV04-TI-01	Titanium bottle	40.803034	27.629524
08/11/2014	08:06:00	1107	MRS-DV04-01	Basket	40.803041	27.629529
08/11/2014	09:31:00	1103	MRS-DV04-PC-06	Push core	40.802899	27.629871
08/11/2014	09:34:00	1103	MRS-DV04-PC-05	Push core	40.802894	27.629880
08/11/2014	09:42:00	1103	MRS-DV04-PC-07	Push core	40.802896	27.629878
08/11/2014	09:46:00	1103	MRS-DV04-PC-08	Push core	40.802890	27.629874
08/11/2014	10:47:00	1107	MRS-DV04-02	Basket	40.803055	27.629575
08/11/2014	11:01:00	1107	MRS-DV04-03	Basket	40.803067	27.629614
08/11/2014	12:01:00	1112	MRS-DV04-FLO-03	Flowmeter	40.802509	27.625455
08/11/2014	12:47:00	1099	MRS-DV04-FLO-04	Flowmeter	40.801790	27.623784
08/11/2014	13:00:00	1099	MRS-DV04-RA-04	Raman	40.801793	27.623771
08/11/2014	13:18:00	1099	MRS-DV04-04	Basket	40.801790	27.623779
08/11/2014	13:40:00	1100	MRS-DV04-PC-03	Push core	40.801811	27.623839
08/11/2014	13:52:00	1100	MRS-DV04-PC-04	Push core	40.801814	27.623846
08/11/2014	14:01:00	1100	MRS-DV04-PC-02	Push core	40.801818	27.623846
08/11/2014	14:09:00	1100	MRS-DV04-PC-01	Push core	40.801823	27.623838
08/11/2014	15:56:00	1112	MRS-DV04-TI-02	Titanium bottle	40.802252	27.623350
08/11/2014	04:40:00		MRS-DV04-RA-01	Raman	40.804187	27.634349
08/11/2014	13:06:00	1099	MRS-DV04-PE-08	Pegaz	40.801796	27.623779
08/11/2014	15:38:00		MRS-DV04-RA-05	Raman	40.802251	27.623345
08/11/2014	15:05:00		MRS-DV04-FLO-05	Flowmeter	40.802246	27.623352

Table II.5 : List of samples collected during Marsite ROV dive MRS-DV-595-04

II.2.3.5 Dive 05 (MRS-DV-596-05)

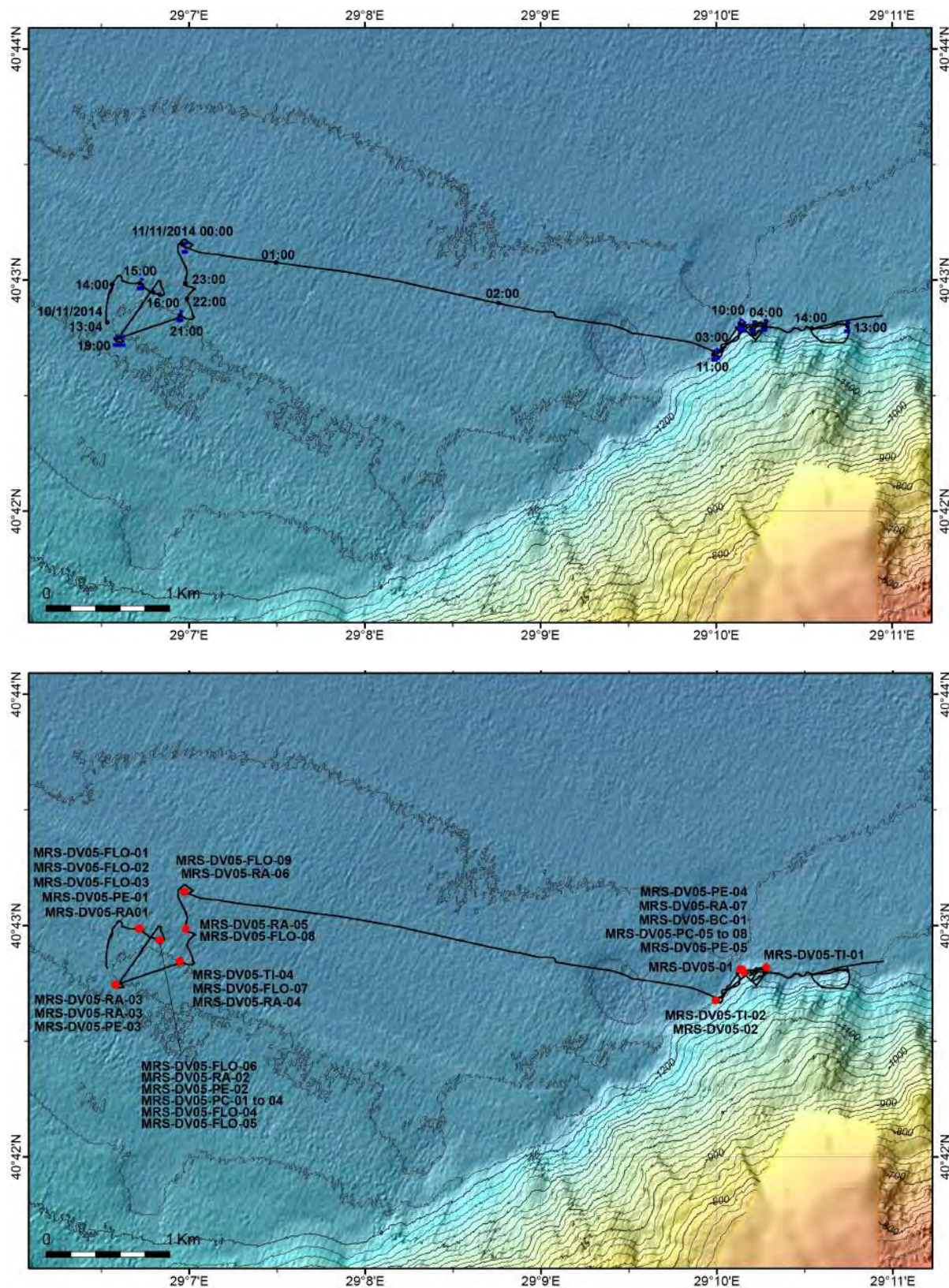


Figure II.19 Upper panel indicates navigation of ROV/Victor during Dive MRS-DV-596-05. Lower panel shows the location of samples collected with ROV/VICTOR.

DATE	HEURE	PROF	SAMPLE ID	TOOL	LATITUDE	LONGITUDE
10/11/2014	14:49:50	1238	MRS-DV05-FLO-01	Flowmeter	40.716429	29.111955
10/11/2014	15:00:33	1238	MRS-DV05-FLO-02	Flowmeter	40.716438	29.111959
10/11/2014	15:13:00	1238	MRS-DV05-RA01	Raman	40.716429	29.111966
10/11/2014	15:22:00	1238	MRS-DV05-PE-01	Pegaz	40.716438	29.111922
10/11/2014	15:25:00	1238	MRS-DV05-FLO-03	Flowmeter	40.716438	29.111916
10/11/2014	16:14:00	1238	MRS-DV05-RA-02	Raman	40.71558	29.113852
10/11/2014	16:33:00	1238	MRS-DV05-PE-02	Pegaz	40.715577	29.113881
10/11/2014	16:50:00	1238	MRS-DV05-FLO-04	Flowmeter	40.715596	29.113895
10/11/2014	16:59:00	1238	MRS-DV05-FLO-05	Flowmeter	40.715591	29.113895
10/11/2014	17:03:00	1238	MRS-DV05-FLO-06	Flowmeter	40.715602	29.113887
10/11/2014	17:13:00	1238	MRS-DV05-PC-04	Push core	40.715587	29.113882
10/11/2014	17:21:00	1238	MRS-DV05-PC-01	Push core	40.715585	29.113873
10/11/2014	17:41:00	1238	MRS-DV05-PC-02	Push core	40.715568	29.113893
10/11/2014	17:47:00	1238	MRS-DV05-PC-03	Push core	40.715573	29.113894
10/11/2014	19:46:00	1231	MRS-DV05-RA-03	Raman	40.712388	29.109691
10/11/2014	19:55:00	1231	MRS-DV05-PE-03	Pegaz	40.712394	29.109688
10/11/2014	20:42:00	1236	MRS-DV05-FLO-07	Flowmeter	40.714068	29.115759
10/11/2014	20:59:00		MRS-DV05-RA-04	Raman	40.714104	29.115818
10/11/2014	21:10:00		MRS-DV05-TI-04	Ti bottle	40.714107	29.115806
10/11/2014	22:44:00	1244	MRS-DV05-FLO-08	Flowmeter	40.716431	29.11633
10/11/2014	22:51:00	1242	MRS-DV05-RA-05	Raman	40.716421	29.116331
11/11/2014	00:09:00	1246	MRS-DV05-FLO-09	Flowmeter	40.719075	29.116222
11/11/2014	00:18:00	1246	MRS-DV05-RA-06	Raman	40.719066	29.116233
11/11/2014	06:30:00	1232	MRS-DV05-TI-01	Ti bottle	40.713657	29.171393
11/11/2014	07:57:00	1237	MRS-DV05-01	Basket	40.713297	29.169253
11/11/2014	08:35:00	1250	MRS-DV05-PE-05	Pegaz	40.713494	29.168906
11/11/2014	08:49:00		MRS-DV05-PE-04	Pegaz	40.713492	29.16892
11/11/2014	09:10:00	1250	MRS-DV05-RA-07	Raman	40.713497	29.16891
11/11/2014	09:34:00	1247	MRS-DV05-PC-08	Push core	40.713456	29.168946
11/11/2014	09:38:00	1247	MRS-DV05-PC-07	Push core	40.713468	29.169003
11/11/2014	09:45:00	1247	MRS-DV05-PC-06	Push core	40.713465	29.168997
11/11/2014	09:53:00	1247	MRS-DV05-PC-05	Push core	40.713467	29.169001
11/11/2014	10:17:00	1247	MRS-DV05-BC-01	Blade core	40.713515	29.16905
11/11/2014	11:35:00	1233	MRS-DV05-TI-02	Ti bottle	40.711266	29.166554
11/11/2014	11:53:00	1230	MRS-DV05-02	Basket	40.711259	29.166564

Table II.6 : List of samples collected during Marsite ROV dive MRS-DV-596-05

II.2.4 List of samples taken with ROV/Victor

II.2.4.1 List of gas sampling (PEGAZ)

Dive	Day	Hour	w. depth (m)	Sample ID	Lat (N)	Long (E)
MRS-DV592-01	02/11/2014	16:49:00	329	MRS-DV01-PE-02	40,86156	28,58334
MRS-DV592-01	03/11/2014	09:31:00	414	MRS-DV01-PE-03	40,86231	28,60489
MRS-DV592-01	03/11/2014	12:46:00	527	MRS-DV01-PE-04	40,87082	28,63769
MRS-DV593-02	04/11/2014	11:20:00	640	MRS-DV02-PE-01	40,81780	27,78041
MRS-DV593-02	05/11/2014	11:15:00	643	MRS-DV02-PE-02	40,81436	27,77768
MRS-DV594-03	06/11/2014	07:51:00	895	MRS-DV03-PE-03	40,82852	27,47871
MRS-DV594-03	06/11/2014	09:26:00	1070	MRS-DV03-PE-02	40,82768	27,48708
MRS-DV594-03	06/11/2014	20:53:00	1085	MRS-DV03-PE-09	40,84916	27,52013
MRS-DV594-03	07/11/2014	05:45:00	1090	MRS-DV03-PE-04	40,83807	27,50928
MRS-DV594-03	07/11/2014	08:09:00	1055	MRS-DV03-PE-06	40,83422	27,50334
MRS-DV594-03	07/11/2014	08:36:00	1059	MRS-DV03-PE-01	40,83412	27,50347
MRS-DV595-04	08/11/2014	03:37:00	895	MRS-DV04-PE-02	40,80419	27,63434
MRS-DV595-04	08/11/2014	06:02:00	1098	MRS-DV04-PE-07	40,80370	27,63235
MRS-DV595-04	08/11/2014	13:06:00	1099	MRS-DV04-PE-08	40,80180	27,62378
MRS-DV596-05	10/11/2014	15:22:00	1238	MRS-DV05-PE-01	40,71644	29,11192
MRS-DV596-05	10/11/2014	16:33:00	1238	MRS-DV05-PE-02	40,71558	29,11388
MRS-DV596-05	10/11/2014	19:55:00	1231	MRS-DV05-PE-03	40,71239	29,10969
MRS-DV596-05	11/11/2014	08:35:00	1250	MRS-DV05-PE-05	40,71349	29,16891
MRS-DV596-05	11/11/2014	08:49:00		MRS-DV05-PE-04	40,71349	29,16892

Table II.7 : List of PEGAZ samples collected during Marsite Leg 2.

II.2.4.2 List of Titane bottles samples (TI)

Dive	Day	Hour	w. depth (m)	Sample ID	Lat (N)	Long (E)
MRS-DV592-01	03/11/2014	02:31:00	402	MRS-DV01-TI-02	40,86072	28,60308
MRS-DV593-02	04/11/2014	18:43:00		MRS-DV02-TI-02	40,81231	27,76755
MRS-DV594-03	06/11/2014	19:25:00	1085	MRS-DV03-TI-04	40,85156	27,52153
MRS-DV594-03	07/11/2014	13:02:00	1071	MRS-DV03-TI-02	40,83241	27,50047
MRS-DV595-04	08/11/2014	07:50:00	1107	MRS-DV04-TI-01	40,80303	27,62952
MRS-DV595-04	08/11/2014	15:56:00	1112	MRS-DV04-TI-02	40,80225	27,62335
MRS-DV596-05	10/11/2014	21:10:00		MRS-DV05-TI-04	40,71411	29,11581
MRS-DV596-05	11/11/2014	06:30:00	1232	MRS-DV05-TI-01	40,71366	29,17139
MRS-DV596-05	11/11/2014	11:35:00	1233	MRS-DV05-TI-02	40,71127	29,16655

Table II.8 : List of Titanium syringe samples collected during Marsite Leg 2.

II.2.4.3 List of Raman Spectrometry measurements (RA)

Dive	Day	Hour	w. depth (m)	Sample ID	Lat (N)	Long (E)
MRS-DV592-01	02/11/2014	17:06:00	329	MRS-DV01-RA-01	40,86156	28,58335
MRS-DV592-01	02/11/2014	18:18:00	334	MRS-DV01-RA-02	40,86391	28,58418
MRS-DV592-01	03/11/2014	07:03:00	342	MRS-DV01-RA-03	40,86229	28,59065
MRS-DV592-01	03/11/2014	09:16:00	414	MRS-DV01-RA-04	40,86231	28,60489
MRS-DV592-01	03/11/2014	13:26:00	527	MRS-DV01-RA-05	40,87085	28,63769
MRS-DV593-02	04/11/2014	11:27:00		MRS-DV02-RA-01	40,81780	27,78041
MRS-DV593-02	05/11/2014	11:38:00	643	MRS-DV02-RA-02	40,81435	27,77766
MRS-DV594-03	06/11/2014	08:12:00	895	MRS-DV03-RA-01	40,82850	27,47871
MRS-DV594-03	06/11/2014	09:32:00	1070	MRS-DV03-RA-02	40,82769	27,48705
MRS-DV594-03	06/11/2014	18:38:00	1085	MRS-DV03-RA-03	40,85144	27,52163
MRS-DV594-03	06/11/2014	19:48:00	1085	MRS-DV03-RA-04	40,85136	27,52114
MRS-DV594-03	06/11/2014	23:04:00	1092	MRS-DV03-RA-05	40,84575	27,51850
MRS-DV594-03	07/11/2014	08:12:00	1055	MRS-DV03-RA-06	40,83423	27,50335
MRS-DV594-03	07/11/2014	08:40:00	1059	MRS-DV03-RA-07	40,83412	27,50346
MRS-DV595-04	08/11/2014	05:44:00	1098	MRS-DV04-RA-02	40,80370	27,63234
MRS-DV595-04	08/11/2014	07:31:00	1107	MRS-DV04-RA-03	40,80303	27,62951
MRS-DV595-04	08/11/2014	13:00:00	1099	MRS-DV04-RA-04	40,80179	27,62377
MRS-DV595-04	08/11/2014	04:40:00		MRS-DV04-RA-01	40,80419	27,63435
MRS-DV595-04	08/11/2014	15:38:00		MRS-DV04-RA-05	40,80225	27,62335
MRS-DV596-05	10/11/2014	15:13:00	1238	MRS-DV05-RA01	40,71643	29,11197
MRS-DV596-05	10/11/2014	16:14:00	1238	MRS-DV05-RA-02	40,71558	29,11385
MRS-DV596-05	10/11/2014	19:46:00	1231	MRS-DV05-RA-03	40,71239	29,10969
MRS-DV596-05	10/11/2014	20:49:00	1236	MRS-DV05-RA-04	40,71409	29,11582
MRS-DV596-05	10/11/2014	22:51:00	1242	MRS-DV05-RA-05	40,71642	29,11633
MRS-DV596-05	11/11/2014	00:18:00	1246	MRS-DV05-RA-06	40,71907	29,11623
MRS-DV596-05	11/11/2014	09:10:00	1250	MRS-DV05-RA-07	40,71350	29,16891

Table II.9 : List of Raman Spectrometry measurements during Marsite Leg 2.

II.2.4.4 List of flow measurements (FLO)

Dive	Day	Hour	w. depth (m)	Sample ID	Lat (N)	Long (E)
MRS-DV592-01	02/11/2014	13:09:00	333	MRS-DV01-FLO-01	40,85696	28,58007
MRS-DV592-01	02/11/2014	13:12:00	333	MRS-DV01-FLO-02	40,85697	28,58007
MRS-DV592-01	02/11/2014	13:52:00	331	MRS-DV01-FLO-03	40,85832	28,57915
MRS-DV592-01	02/11/2014	14:19:00	329	MRS-DV01-FLO-04	40,85929	28,58100
MRS-DV592-01	02/11/2014	14:51:00	328	MRS-DV01-FLO-05	40,85991	28,58137
MRS-DV592-01	02/11/2014	15:42:00	328	MRS-DV01-FLO-06	40,86083	28,58153
MRS-DV592-01	02/11/2014	15:48:00	328	MRS-DV01-FLO-07	40,86085	28,58157
MRS-DV592-01	02/11/2014	16:21:00	328	MRS-DV01-FLO-08	40,86157	28,58334
MRS-DV592-01	02/11/2014	17:55:00	671	MRS-DV01-FLO-09	40,86392	28,58415
MRS-DV592-01	02/11/2014	06:57:07	342	MRS-DV01-FLO-10	40,86229	28,59064
MRS-DV592-01	02/11/2014	09:03:30	414	MRS-DV01-FLO-11	40,86231	28,60490
MRS-DV593-02	04/11/2014	11:08:24		MRS-DV02-FLO-01	40,81780	27,78040
MRS-DV593-02	05/11/2014	11:10:00	643	MRS-DV02-FLO-02	40,81436	27,77769
MRS-DV594-03	06/11/2014	08:25:00	895	MRS-DV03-FLO-01	40,82852	27,47870
MRS-DV594-03	06/11/2014	08:28:00	895	MRS-DV03-FLO-02	40,82851	27,47871
MRS-DV594-03	06/11/2014	08:40:00	895	MRS-DV03-FLO-03	40,82850	27,47871
MRS-DV594-03	06/11/2014	09:38:00	1070	MRS-DV03-FLO-04	40,82769	27,48707
MRS-DV594-03	06/11/2014	09:42:00	1070	MRS-DV03-FLO-05	40,82769	27,48706
MRS-DV594-03	06/11/2014	09:44:00	1070	MRS-DV03-FLO-06	40,82769	27,48706
MRS-DV594-03	06/11/2014	09:48:00	1070	MRS-DV03-FLO-07	40,82770	27,48706
MRS-DV594-03	06/11/2014	22:43:00	1092	MRS-DV03-FLO-08	40,84576	27,51852
MRS-DV594-03	06/11/2014	23:10:00	1092	MRS-DV03-FLO-09	40,84574	27,51851
MRS-DV594-03	06/11/2014	23:31:00	1092	MRS-DV03-FLO-10	40,84574	27,51851
MRS-DV594-03	07/11/2014	00:47:00	1092	MRS-DV03-FLO-11	40,84319	27,51624
MRS-DV594-03	07/11/2014	01:40:38	1090	MRS-DV03-FLO-12	40,84305	27,51615
MRS-DV594-03	07/11/2014	08:18:00	1055	MRS-DV03-FLO-13	40,83422	27,50335
MRS-DV594-03	07/11/2014	08:27:00	1059	MRS-DV03-FLO-14	40,83414	27,50347
MRS-DV595-04	08/11/2014	04:13:00	1083	MRS-DV04-FLO-01	40,80420	27,63435
MRS-DV595-04	08/11/2014	05:33:00	1098	MRS-DV04-FLO-02	40,80371	27,63233
MRS-DV595-04	08/11/2014	12:01:00	1112	MRS-DV04-FLO-03	40,80251	27,62546
MRS-DV595-04	08/11/2014	12:47:00	1099	MRS-DV04-FLO-04	40,80179	27,62378
MRS-DV595-04	08/11/2014	15:05:00		MRS-DV04-FLO-05	40,80225	27,62335
MRS-DV596-05	10/11/2014	14:49:50	1238	MRS-DV05-FLO-01	40,71643	29,11196
MRS-DV596-05	10/11/2014	15:00:33	1238	MRS-DV05-FLO-02	40,71644	29,11196
MRS-DV596-05	10/11/2014	15:25:00	1238	MRS-DV05-FLO-03	40,71644	29,11192
MRS-DV596-05	10/11/2014	16:50:00	1238	MRS-DV05-FLO-04	40,71560	29,11390
MRS-DV596-05	10/11/2014	16:59:00	1238	MRS-DV05-FLO-05	40,71559	29,11390
MRS-DV596-05	10/11/2014	17:03:00	1238	MRS-DV05-FLO-06	40,71560	29,11389
MRS-DV596-05	10/11/2014	20:42:00	1236	MRS-DV05-FLO-07	40,71407	29,11576
MRS-DV596-05	10/11/2014	22:44:00	1244	MRS-DV05-FLO-08	40,71643	29,11633
MRS-DV596-05	11/11/2014	00:09:00	1246	MRS-DV05-FLO-09	40,71908	29,11622

Table II.10 : List of flow measurements collected during Marsite Leg 2

II.2.4.5 Push-Corer samples (PC)

Dive	Day	Hour	w. depth (m)	Sample ID	Lat (N)	Long (E)
MRS-DV592-01	02/11/2014	19:52:00	329	MRS-DV01-PC-04	40,86153	28,58335
MRS-DV592-01	02/11/2014	19:58:00	329	MRS-DV01-PC-02	40,86152	28,58336
MRS-DV592-01	02/11/2014	20:03:00	329	MRS-DV01-PC-01	40,86152	28,58336
MRS-DV592-01	02/11/2014	20:10:00	328	MRS-DV01-PC-03	40,86152	28,58337
MRS-DV592-01	02/11/2014	21:58:00	328	MRS-DV01-PC-06	40,86152	28,58336
MRS-DV592-01	02/11/2014	22:13:00	329	MRS-DV01-PC-07	40,86151	28,58336
MRS-DV592-01	02/11/2014	22:32:00	329	MRS-DV01-PC-05	40,86152	28,58336
MRS-DV592-01	02/11/2014	22:41:00	329	MRS-DV01-PC-08	40,86151	28,58336
MRS-DV593-02	04/11/2014	12:59:00		MRS-DV02-PC-08	40,81804	27,78058
MRS-DV593-02	04/11/2014	13:09:00		MRS-DV02-PC-06	40,81804	27,78058
MRS-DV593-02	04/11/2014	13:12:00		MRS-DV02-PC-05	40,81804	27,78058
MRS-DV593-02	04/11/2014	13:17:00		MRS-DV02-PC-07	40,81804	27,78057
MRS-DV593-02	05/11/2014	13:17:00	643	MRS-DV02-PC-04	40,81440	27,77767
MRS-DV593-02	05/11/2014	13:21:00	643	MRS-DV02-PC-02	40,81441	27,77768
MRS-DV593-02	05/11/2014	13:24:00	643	MRS-DV02-PC-01	40,81441	27,77768
MRS-DV593-02	05/11/2014	13:30:00	643	MRS-DV02-PC-03	40,81441	27,77768
MRS-DV594-03	06/11/2014	10:22:00	1070	MRS-DV03-PC-05	40,82771	27,48715
MRS-DV594-03	06/11/2014	10:26:00	1070	MRS-DV03-PC-06	40,82770	27,48714
MRS-DV594-03	06/11/2014	10:27:00	1070	MRS-DV03-PC-07	40,82769	27,48718
MRS-DV594-03	06/11/2014	10:30:00	1070	MRS-DV03-PC-08	40,82767	27,48714
MRS-DV594-03	06/11/2014	11:59:00	1070	MRS-DV03-PC-01	40,82774	27,48710
MRS-DV594-03	06/11/2014	12:03:00	1070	MRS-DV03-PC-02	40,82775	27,48712
MRS-DV595-04	08/11/2014	09:31:00	1103	MRS-DV04-PC-06	40,80290	27,62987
MRS-DV595-04	08/11/2014	09:34:00	1103	MRS-DV04-PC-05	40,80289	27,62988
MRS-DV595-04	08/11/2014	09:42:00	1103	MRS-DV04-PC-07	40,80290	27,62988
MRS-DV595-04	08/11/2014	09:46:00	1103	MRS-DV04-PC-08	40,80289	27,62987
MRS-DV595-04	08/11/2014	13:40:00	1100	MRS-DV04-PC-03	40,80181	27,62384
MRS-DV595-04	08/11/2014	13:52:00	1100	MRS-DV04-PC-04	40,80181	27,62385
MRS-DV595-04	08/11/2014	14:01:00	1100	MRS-DV04-PC-02	40,80182	27,62385
MRS-DV595-04	08/11/2014	14:09:00	1100	MRS-DV04-PC-01	40,80182	27,62384
MRS-DV596-05	10/11/2014	17:13:00	1238	MRS-DV05-PC-04	40,71559	29,11388
MRS-DV596-05	10/11/2014	17:21:00	1238	MRS-DV05-PC-01	40,71559	29,11387
MRS-DV596-05	10/11/2014	17:41:00	1238	MRS-DV05-PC-02	40,71557	29,11389
MRS-DV596-05	10/11/2014	17:47:00	1238	MRS-DV05-PC-03	40,71557	29,11389
MRS-DV596-05	11/11/2014	09:34:00	1247	MRS-DV05-PC-08	40,71346	29,16895
MRS-DV596-05	11/11/2014	09:38:00	1247	MRS-DV05-PC-07	40,71347	29,16900
MRS-DV596-05	11/11/2014	09:45:00	1247	MRS-DV05-PC-06	40,71347	29,16900
MRS-DV596-05	11/11/2014	09:53:00	1247	MRS-DV05-PC-05	40,71347	29,16900

Table II.11 : List of push cores collected during Marsite Leg 2

II.2.4.6 List of Blade corer sampling (BC)

DIVE ID	DATE	HOUR	DEPTH (m)	SAMPLE NAME	LATITUDE	LONGITUDE
MRS-DV592-01	02/11/2014	22:50:00	334	MRS-DV01-BC-01	40,86152	28,58335
MRS-DV594-03	07/11/2014	09:29:00	1055	MRS-DV03-BC-01	40,83421	27,50333
MRS-DV596-05	11/11/2014	10:17:00	1247	MRS-DV05-BC-01	40,71352	29,16905

Table II.12 : List of blade cores collected during Marsite Leg 2

II.4 CTD-Rosette Hydrocasts

The CTD- Hydrocast system allows the measurements the physical properties of the water column (Conductivity, Temperature and Depth), and the sampling of seawater. During Leg 2, two methane sensors were installed on the frame of the CTD and tested *in situ*. The first one is an off-the-shelf sensor from Framatec which allows the measurements of dissolved methane concentrations in the range of 10- 50 000 $\mu\text{mol/L}$. The second one is an in-house sensor under development at Ifremer, designed to be more robust and more reliable than the commercially available one. Both sensors were connected to the CTD-Rosette system and deployed on several gas expulsion sites, in order to gain insight into the response of both sensors as a function of:

- The nature of the gases. What is the influence of other gases such as CO_2 , heavier hydrocarbons, H_2S , O_2 on the sensor response?
- Temperature and pressure. Do temperature and pressure strongly affect the measurement?
- The intensity of the plume which is close to the measurement points. Does the plume disturb significantly the sensor response?

A total of 8 hydrocasts were collected at key sites characterized by an intense seeping of methane (see Figure I.21 for locations).

DATE	HOUR	HYDROCAST	DEPTH (m)	LATITUDE	LONGITUDE
04/11/2014	00:03:31	MRS-HY-01	327	40,861693	28,583308
05/11/2014	18:29:31	MRS-HY-02	656	40,817229	27,781068
06/11/2014	04:21:27	MRS-HY-03	1022	40,833982	27,503309
07/11/2014	15:49:00	MRS-HY-04	807	40,828156	27,478648
08/11/2014	20:55:58	MRS-HY-05	1090	40,801677	27,623496
09/11/2014	07:01:00	MRS-HY-06	994	40,834174	27,503215
09/11/2014	16:08:39	MRS-HY-07	655	40,818269	27,780996
11/11/2014	17:15:44	MRS-HY-08	1238	40,716401	29,111470

Table II.12 : List of hydro-cass collected during Marsite Leg 2



Figure II.20 : CTD- Hydrocast system equipped with methane sensors

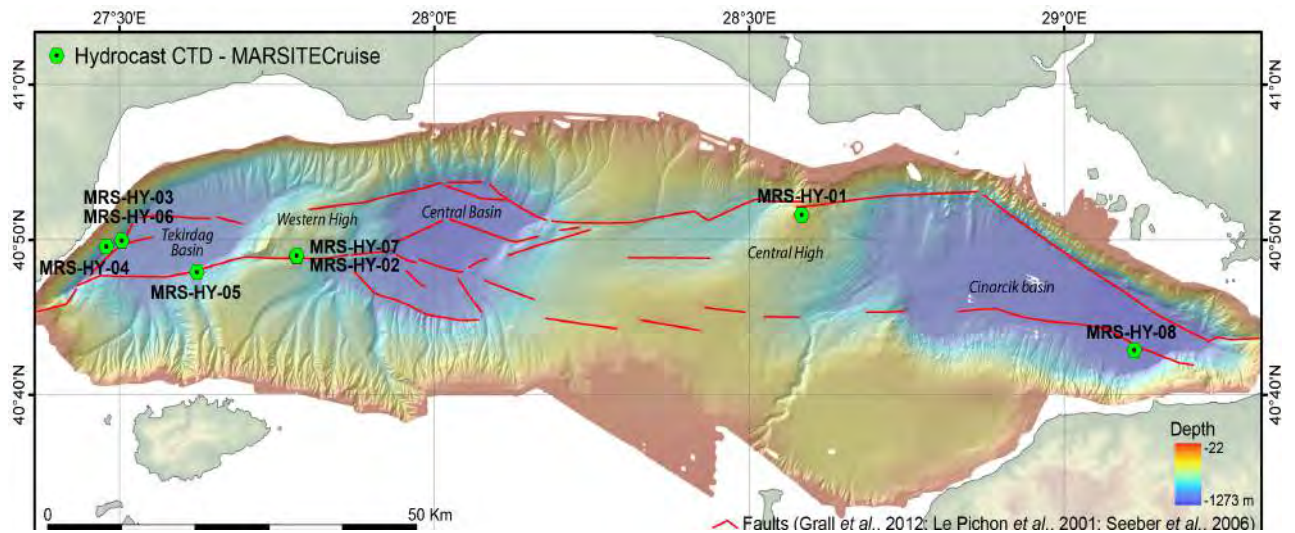


Fig. II.21 Map of CTD hydrocasts performed during Leg 2

II.5 Core sampling for geochemical analysis

During Leg 2, long piston cores were taken for geochemical analysis at the same locations than the gas samplings. An additional core was also be taken away from the western high active zone. After retrieval on-board, the cores were cut into 1-m segments on deck and then transferred to a shipboard chemical laboratory for pore-fluid extraction using Rhyzon soil moisture samplers. This consists on a capillary-driven system with a hydrophilic, porous polymer tube of 2.5 mm in diameter and 50 mm length as main part. The latter is introduced into the sediment and the fluid is collected in a 10-mL syringe connected to the other end of the capillary. Samplings were performed with appropriate resolution, depending on the core length.

Immediately after sampling, 1-mL aliquot of fluid were withdrawn for total alkalinity measurement using a titrator, and 0.2 mL for chloride and sulphate measurements by ionic chromatography. This will give us an idea about the hydrocarbon (especially the methane) distribution depth in the shallow sediment and will be correlated to both seismic surveys and gas vent distribution. The remaining sample was stored in 6-mL pre-evacuated vial and frozen for further analyses onshore.



Figure II.22 : Pore fluid sampling using the rhyzon moisture sampler.

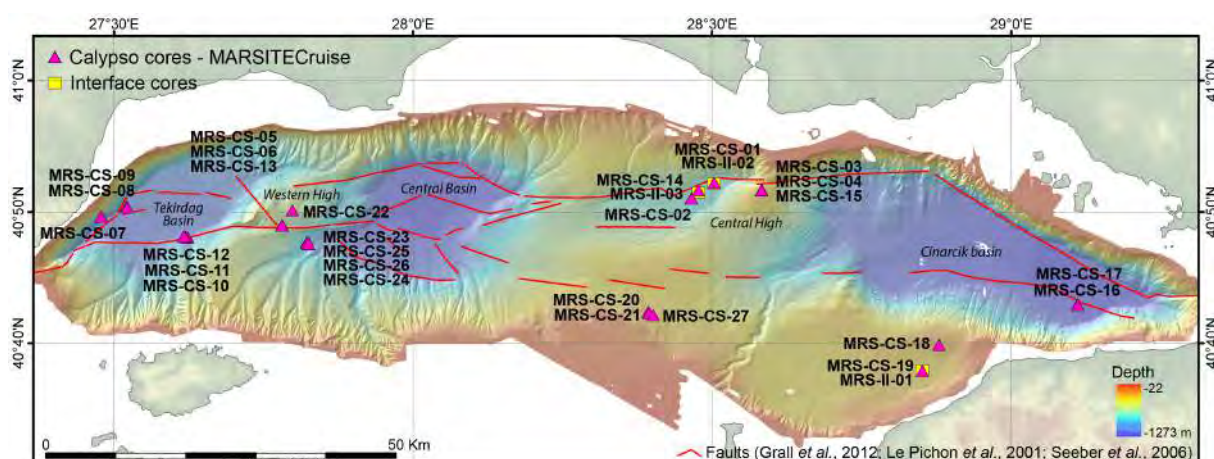


Figure II.23 : Cores MRS-CS-03 to MRS-CS-17 were taken during Leg 2. The coordinates of the coring sites are indicated in Appendix A6.

II.6 Multibeam “water column profiles”

Acoustic surveys were conducted using the shipboard multibeam system RESON 7150 of *R/V Pourquoi pas?* In order to detect active gas emissions sites from the seafloor. The location map and the list of profiles are indicated in Appendix A7.

II.7 BOB Experiment (BOBEX) on the Western High

OBSs deployed in the Marmara seafloor commonly record non-seismic microevents, characterized by short durations of less than 0.8 s, by frequencies ranging between 4 and 30 Hz, and by highly variable amplitudes. The presence of gas in superficial sediments, together with analogies with laboratory experiments, suggest the hypothesis that gas migration followed by the collapse of fluid-filled cavities or conduits could be the source of the observed microevents.

During the Marsitecruise, we have thus carried out a specific experiment to test this hypothesis. The challenge is important because, if true, this hypothesis could imply that OBSs may provide valuable information to improve our understanding of natural degassing processes from the seafloor. First, a site of gas emissions was carefully selected on the Western High. This site is characterized by flat seafloor and by the existence of 3 aligned gas sources. Then BOB was deployed in the close vicinity (< 70 m) and in the alignment of the gas sources, along with an ADCP moored in the water column, for the 3D measurement of the deep-bottom current.

The experiment is fully described in Appendix A5.

III. Leg 3

III.1 Background/specific objectives

Leg 3 was dedicated to core sampling and to the recovery of geophysical instrumentation.

The general objective of core analysis will be to ground truth interpretations of high-resolution seismic data and to identify and date sedimentary events related to earthquakes. The background and specific objectives are described hereafter:

- Fault slip rates (vertical and horizontal) have been estimated from seismic data based on reflector sequence ages based on assumed 100 kyr cyclicity and correlation with low-stand deltas (Sorlien et al., 2012; Grall et al., 2012, 2013). Only very shallow horizons have been dated directly (Beck et al., 2007). One goal will be to ground truth the assumed horizon ages with long Calypso cores taken on structural highs and at fault outcrops. The originality of the approach is the use of multi-proxy data acquisition (magnetic susceptibility and artificial magnetizations, gamma-densimetry, XRF scanning, biomarkers, tephra) to correlate cores that sampled overlapping time intervals. Chronology will be established by tying local environmental changes (i.e. marine-lacustrine transitions and paleoclimate proxies) to climatic and eustatic cycles. Nannofossil assemblages during marine high stands and tephra will provide additional control points.
- Turbidites-Homogenites (TH) were sampled in cores for the Sea of Marmara basin and correlations with historic events have been attempted (Sarı and Çağatay, 2006; Çağatay et al., 2012; McHugh et al., 2014), but the TH record could not be established in Kumburgaz basin, in part because of difficulties distinguishing TH attributable to earthquake events from other turbidites (McHugh et al., 2006). A new method based on anisotropy of magnetic susceptibility (Campos et al., 2013) will be combined with more classical methods (grain size analysis, X-ray scanning) to distinguish turbidites of different origin. The knowledge of the thickness of instantaneous deposits is crucial in order to establish consistent age/depth models.
- Assessing the synchronicity of turbidite events observed at different locations and their association with historical earthquakes requires taking into account uncertainties in dating methods (e.g. radiocarbon, tephra) as well as in correlations between cores. In order to provide a reliable basis for hypothesis testing, Age models construction will include the estimation of uncertainties from multiple sources (dating and tie-point correlation) using Gaussian processes (Heaton et al., 2013). We will re-examine the Sea of Marmara dataset with this method and re-evaluate their interpretation in term of segmentation and earthquake recurrence. We will use ash layers as additional control points and sedimentary records of the last events will be dated using short lifetime radionuclides (^{137}Cs and ^{210}Pb) methods.
- Fault scarps in high-resolution bathymetric maps obtained with Automated Underwater Vehicles (AUV) display very different character on the western high and central high in the Sea of Marmara although the sedimentation rates are in the same range. We will adapt the concept of scarp degradation (Avouac and Peltzer, 1993) in the marine context, interpreting quantitatively the scarp morphologies and bringing additional constraints on past seafloor rupture history.

III.2 Sediment cores (Calypos cores and interface cores)

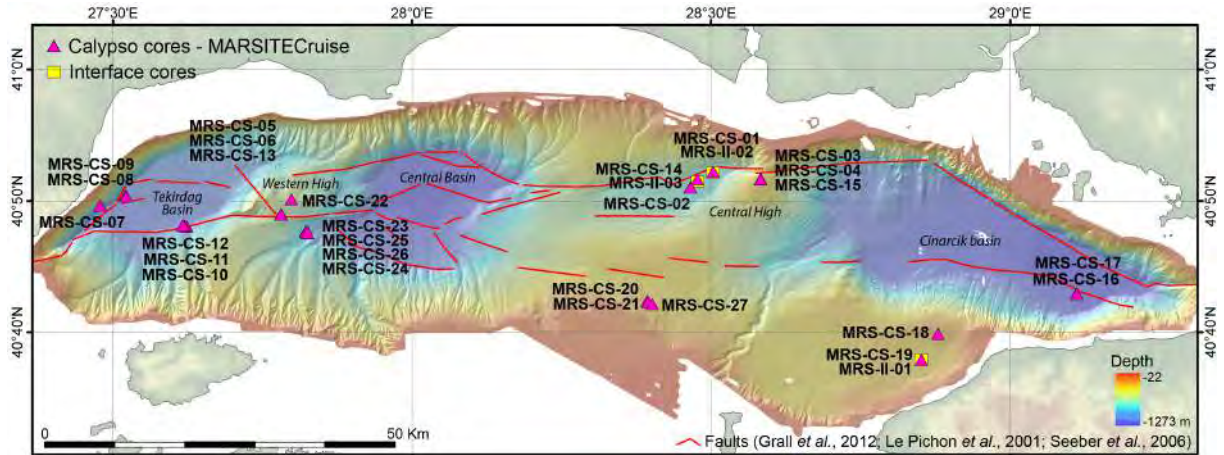


Figure III.1a: Cores MRS-CS-19 to MRS-CS-27 were taken during Leg 3. The coordinates of the coring sites are indicated in Appendix A6.

A total of 9 long cores were taken during Leg 3, along with 3 interface cores with the ITU system. The cores were distributed between ITU and CEREGE as indicated in Table III.0 here below.

Core (MRS-CS-)	Destination
19	ITU
20	ITU
21	ITU
22	CEREGE
23	CEREGE
24	CEREGE
25	CEREGE
26	CEREGE
27	ITU

III.3 Selected examples of sub-bottom profiles and core locations

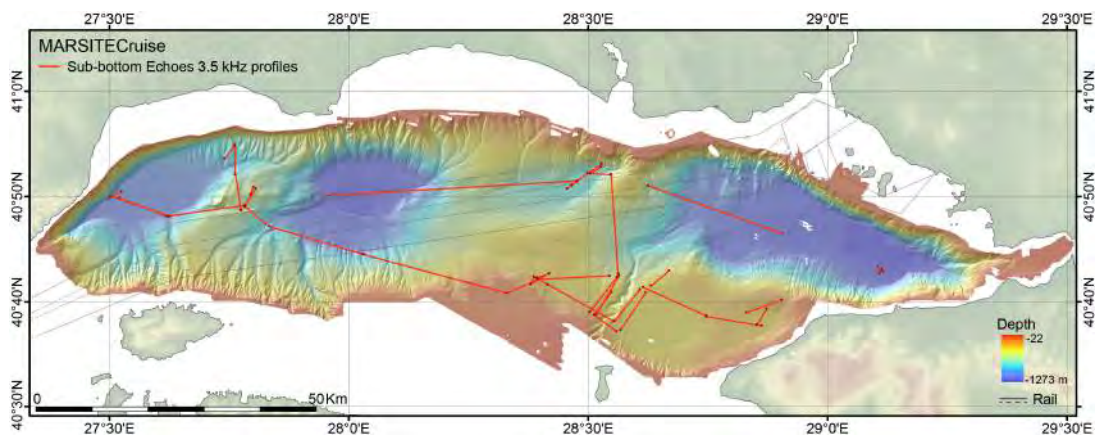


Fig. III.1b Location of sub-bottom profiler lines collected during the Marsitecruise. Selected examples of profiles are gives n in Fig III.2 to Fig III.5.

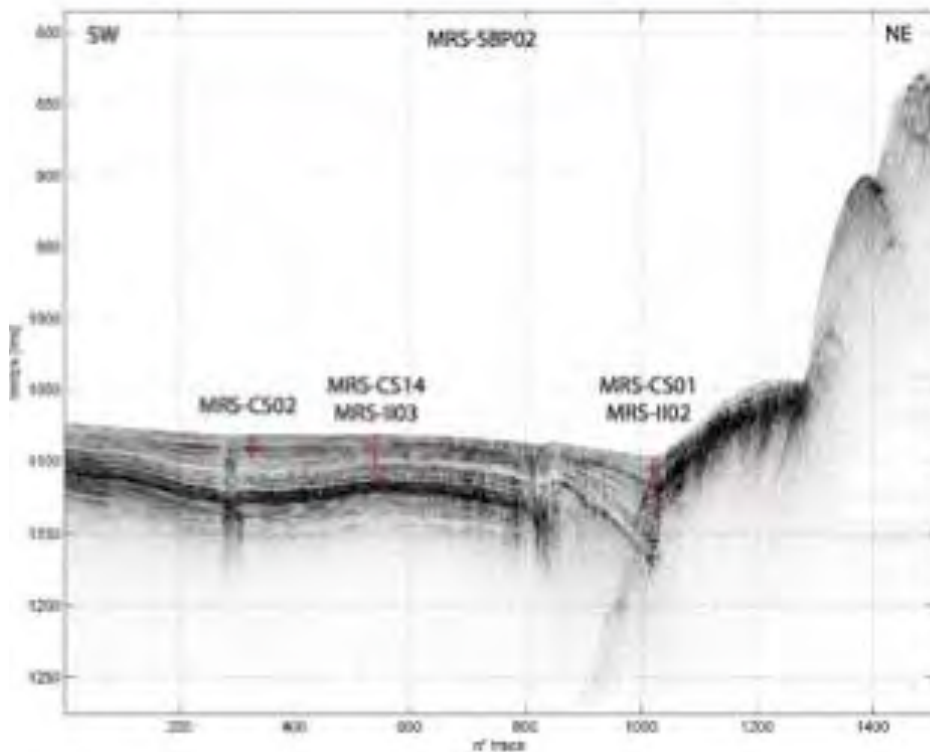
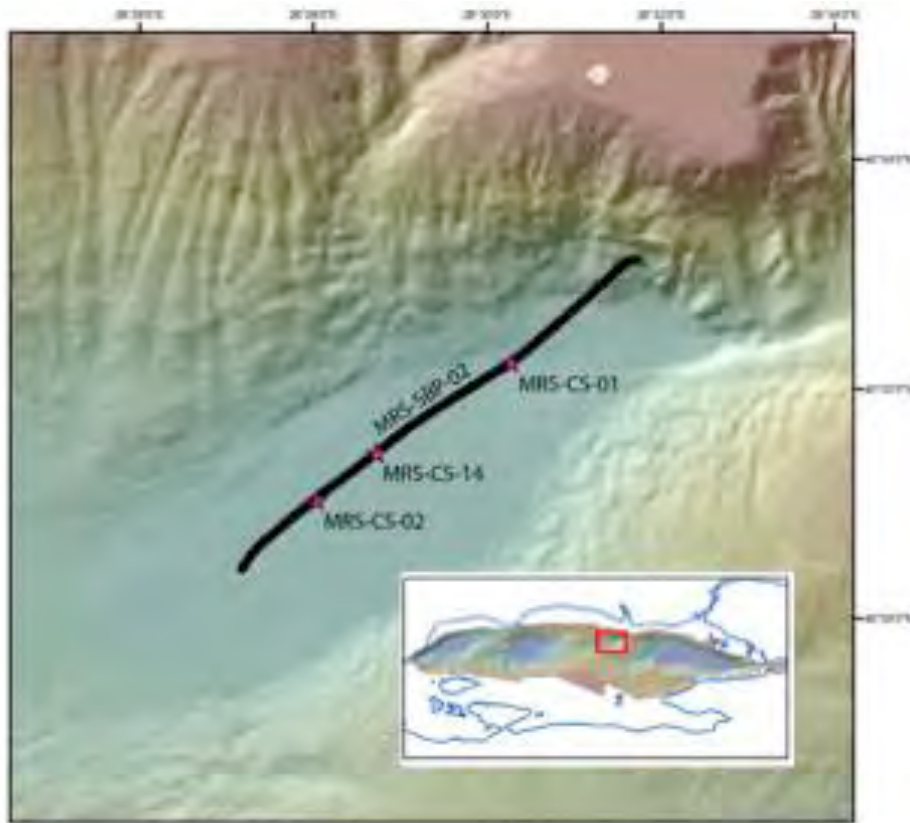


Figure III.2 Sub-bottom (Chirp) profile MRS-SBP02 shot in the Kumburgaz Basin along with indications on the location of Cores MRS-CS-01, MR-CS02, MRS-CS-14.

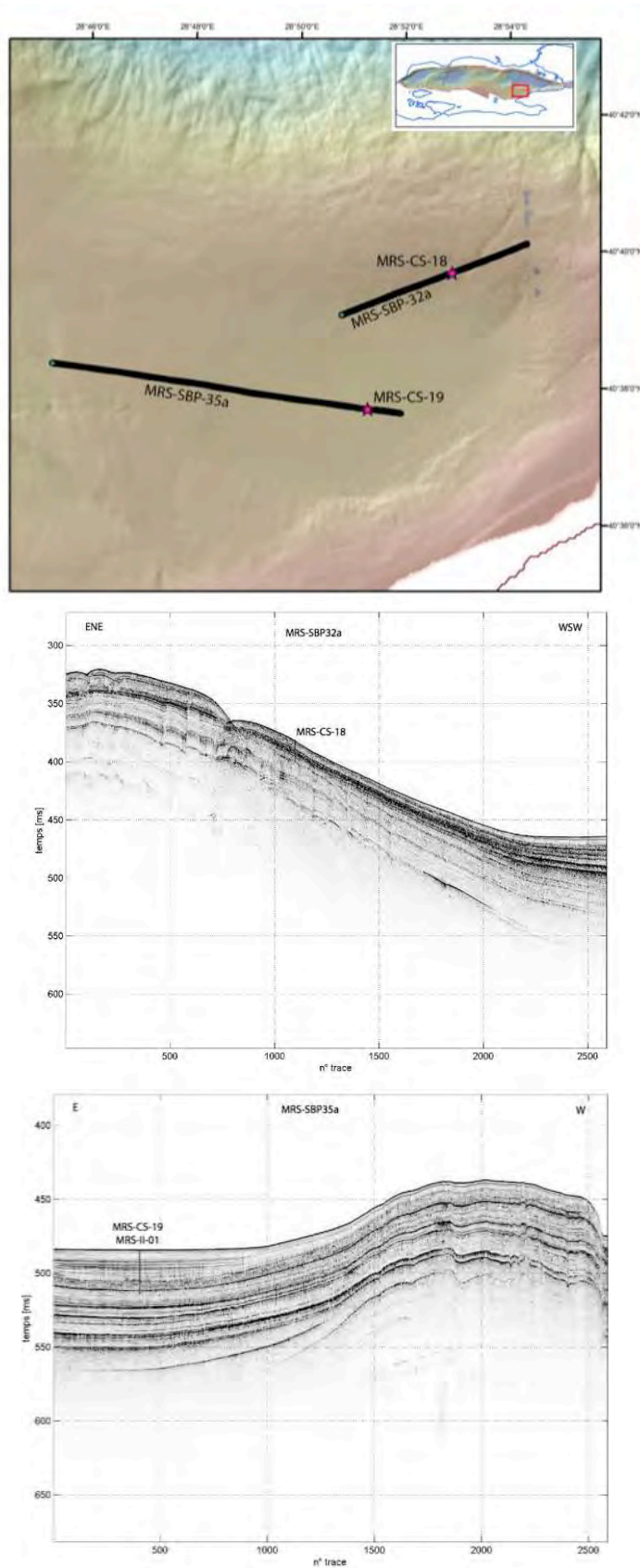


Figure III.3 Sub-bottom (Chirp) profile MRS-SBP32a & MRS-SBP35A shot in the Imrali Basin along with indications on the location of Cores MRS-CS-18 & MRS-CS-19.

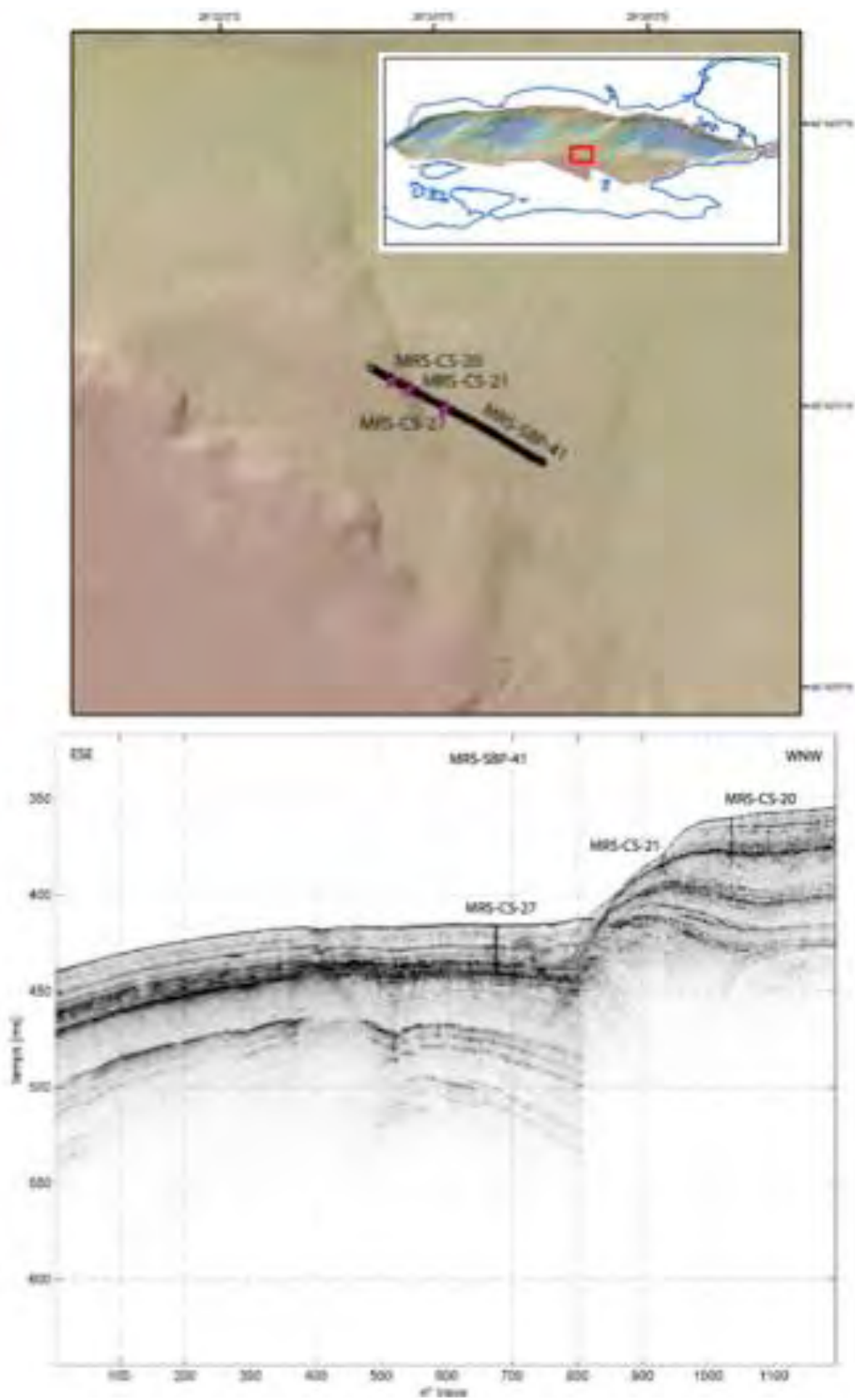


Figure III.4 Sub-bottom (Chirp) profile MRS-SBP41 shot along with indications on the location of Cores MRS-CS-20, MRS-CS-21 & MRS-CS-27

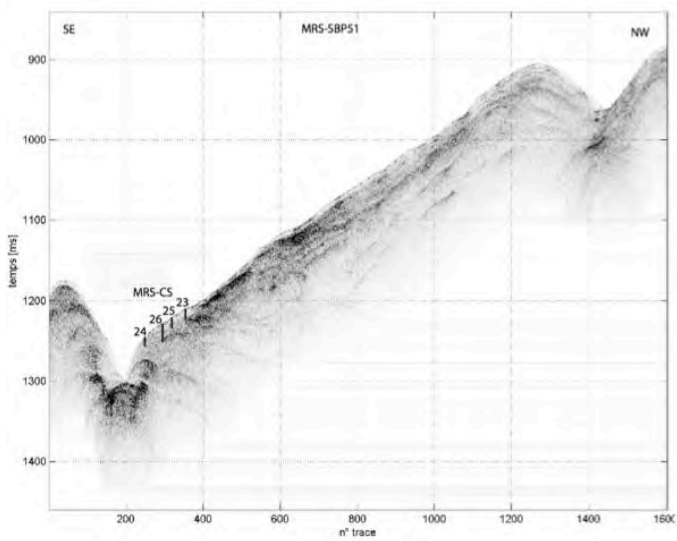
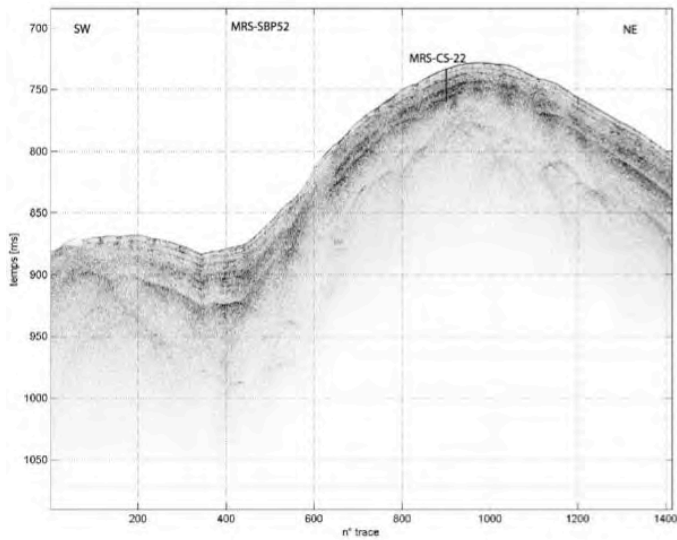
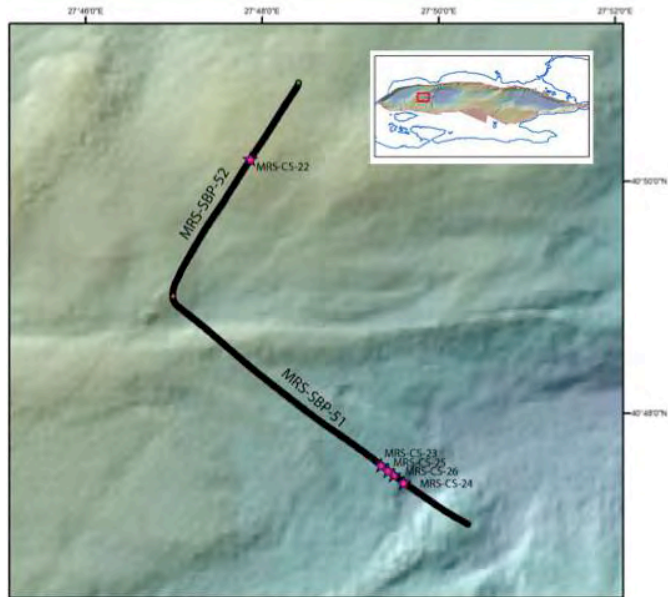


Figure III.5 Sub-bottom (Chirp) profile MRS-SBP32a & MRS-SBP35a shot in the Western High along with indications on the location of Cores MRS-CS-18 & MRS-CS-19

III.5 Instrument recovery operations

The instruments that were deployed during Leg 1 for the BOBEX experiment were recovered at the end of Leg 3:

- 2 OLDOBS
- 1 BOB (bubble acoustic detector)
- 1 ANITRA mooring equipped with an ADCP for measuring sea-bottom currents in the water column.

In addition, the following instruments were recovered during MarsiteCruise, Leg 3 :

- 3 broad-band OBSs of INGV. **Note:** 4 OBS were deployed in October 2013 with R/V Urania; 1 out of 4 popped up to the surface in June 2014 and was recovered by a fisherman. This OBS was then uploaded onboard R/V *Pourquoi pas?* and shipped back to Toulon.
- 8 LOTOBSs of Ifremer. **Note:** 10 LOTOBSs were deployed with R/V Yunuz in September 2014; LOTOBS3 and LOTOBS6 were not recovered by R/V *Pourquoi pas?*, likely due to technical failures in the release system. LOTOBS6 was eventually found floating at the surface by a fisherman.
- 2 piezometers of Ifremer. **Note:** these two piezometers were deployed with R/V Urania in October 2013.

Operation	Instrument ID	N	Lat	E	Lon	date	time (UTC)	Observations
Recover IFREMER OBS	YUN_2014_10	40°	50,998'	27°	50,731'	14/11	12:21	
Attempt to recover IFREMER OBS	YUN_2014_06	40°	49,886'	27°	56,820'	14/11	12:49	No release after 3 trials
Recover IFREMER OBS	YUN_2014_05	40°	46,764'	27°	50,891'	14/11	16:02	
Recover INGV OBS	INGV OBS-3	40°	47,707'	27°	50,344'	14/11	17:11	
Recover INGV OBS	INGV OBS-4	40°	47,812'	27°	44,536'	14/11	18:41	
Recover IFREMER OBS	YUN_2014_07	40°	46,572'	27°	42,511'	14/11	19:39	
Recover BOB	BOB 0	40°	48,780'	27°	46,037'	15/11	8:10	on board
Recover IFREMER LOTOBS	MRS-LOTOBS-1	40°	48,777'	27°	46,080'	15/11	8:42	on board
Recover IFREMER LOTOBS	MRS-LOTOBS-2	40°	48,781'	27°	46,071'	15/11	9:16	no dog
Recover ADCP	ANITRA3	40°	48,775'	27°	46,103'	15/11	9:46	on board
Recover IFREMER OBS	YUN_2014_04	40°	48,760'	27°	46,302'	15/11	10:20	on board
Recover IFREMER piezometer	PZS	40°	48,783'	27°	46,306'	15/11	11:01	on board
Recover INGV OBS	INGV OBS-1	40°	48,787'	27°	46,496'	15/11	12:05	on board
Recover IFREMER piezometer	PZN	40°	48,931'	27°	46,656'	15/11	12:50	on board
Recover IFREMER OBS	YUN_2014_02	40°	48,917'	27°	46,614'	15/11	13:21	on board
Recover IFREMER OBS	YUN_2014_01	40°	55,006'	27°	45,862'	15/11	15:15	on board
Recover IFREMER OBS	YUN_2014_08	40°	51,075'	27°	42,480'	15/11	16:33	on board
Attempt to recover IFREMER OBS	YUN_2014_09	40°	49,186'	27°	36,304'	15/11	19:06	No release after 3 trials
Recover IFREMER OBS	YUN_2014_03	40°	42,775'	27°	47,224'	15/11	20:35	on board
2nd Attempt to recover IFREMER OBS	YUN_2014_06	40°	49,886'	27°	56,820'	15/11		No release after 3 trials. LOTOBS YUN_2014_06 was eventually found 15 days after the cruise by a fisherman

Table III.1: List of operations related to instrument recovery during Leg 1.

IV. Conclusion

Despite a technical breakdown of the ROV, the operational objectives (data acquisition & deployment of equipment) of MARSITECRUISE successfully achieved, thanks to the reactivity of the teams on-board who adapted to a new and completely modified programme.

During Leg1 (28/10 to 1/11), 10 geodetic acoustic stations were deployed by LDO (Brest) and GEOMAR (Kiel) on the Marmara seafloor to measure directly the relative plate motion along the submerged part of the North Anatolian Fault. The stations will be visited every six months, using Turkish naval means, to check their functioning and to collect data.

During Leg 2 (2/11 to 13/11), five dives of ROV/VICTOR resulted in 18 gas samples, 28 Raman measurements and 41 measurements of gas flow, 35 interface corers and 2 blade corers for geo-microbiology, 7 Titanium syringes to study rare gases. A total of 8 CTDs were acquired and 12 long Calypso sediment cores were made. The geochemical dataset will be used to develop new proxies for studying the paleo-seismicity of the Sea of Marmara. Attempts will be made to identify locked segments from seepages and clay transformations and to try to decipher relationships between sulphate profiles and seismicity. Geo-thermometers will also be applied to the Marmara region to estimate reservoir depths across the fault zone. An acoustic bubble detector (BOB) and two seabed seismographs were also deployed during Leg 2 with ROV/VICTOR to study the phenomena of natural degassing of methane on the seafloor.

During Leg 3 (13-16 November), sediment cores were acquired in key sites for paleoseismic studies in order to specify the recurrence rate of earthquakes in the Marmara sea. In addition, the INGV and Ifremer instruments that were deployed during previous operations within the frame of the MARSITE programme were recovered.

MARSITECRUISE R/V Pourquoi pas ?

APPENDIX 1

DISCOVERY OF ARCHEOLOGICAL ASSETS¹

¹This report was emailed by the Captain of *R/V Pourquoi pas ?* to Captain Erhan Gezgin, SHOD (egezgin@shodb.gov.tr) on november 3rd, 2014, for transmission to the Turkish Authorities.

Appendix 1-1
MARSITECRUISE – One-Month Report

On november 3rd, 2014, the following items were discovered with Research Vessel (R/V) « Pourquoi pas ? » using ROV/Victor of Ifremer :

Date	Hour (UT)	Latitude	Longitude	Water Depth	Description
03/11/2014	04:44:49	40°51.7609'N	28°35.1380'E	330	Field of Amphora
03/11/2014	05:12:54	40°51.6961'N	28°35.1780'E	325	Ship Wreck
03/11/2014	11:30:43	40°52.0169'N	28°37.6303'E	566	Amphora

1. Field of Amphora :



Fig. 1 : Photographs of the field of amphora found on november 3rd, 2014, at 04 :44
Coordinates : 40°51.7609'N, 28°35.1380'E, Depth 330 m

2. Ship Wreck :

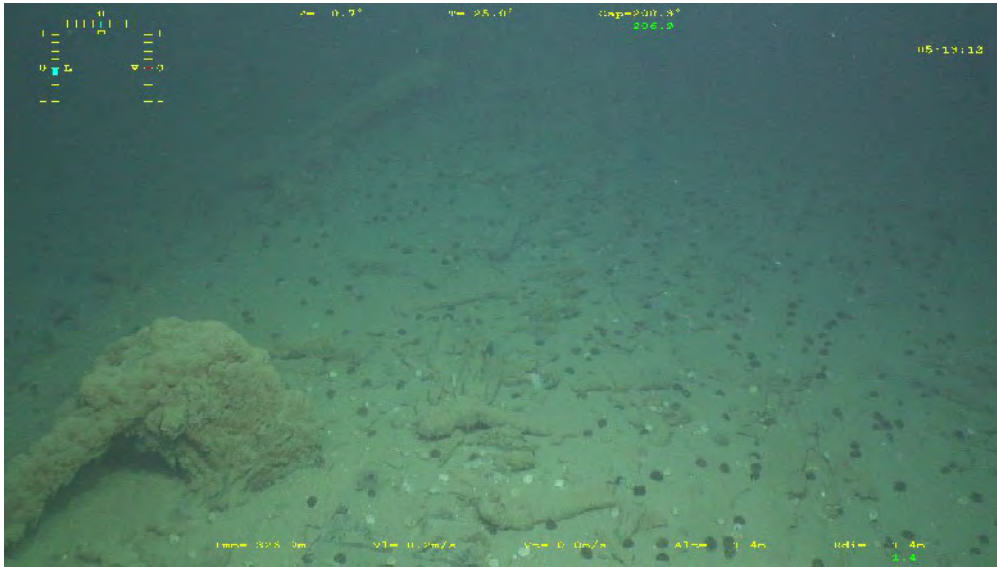


Fig. 2 : The above, half-buried ship wreck was discovered at 05 :12 TU, on november 3rd, 2014, near the field of amphora, at 05 :12, by 325 m water depth, at coordinates 40°51.6961'N, 28°35.1780'E

3. Isolated amphora



Fig. 3 : The above amphora was discovered at 11:30 TU, on november 3rd, 2014, by 330 m water depth, at coordinates 40°52.0169'N, 28°37.6303'E

**MARSITECRUISE
R/V Pourquoiipas ?**

APPENDIX 2

**Acknowledgement of receipt of data by
ITU and KOERI**



Istanbul, 17th november 2014

FOR WHOM IT MAY CONCERN

I, undersigned, Burak Yalmaz, acknowledge receipt of the numerical dataset collected during the MARSITE cruise with *R/V Pourquoi pas ?* in the Sea of Marmara from October 28th to November 16th, 2014.

The data are copied on three 2-Terabytes disks:

ITÜ_MARSITECRUISE_DISK01 contains all numerical data from DIVE 01 and DIVE03 of ROV/VICTOR, e.g.:

- the video files, readable VLC-type software
- all complementary data : ROV navigation, photographs, environmental parameters, etc.
- the environmental data (temperature, wind, salinity, ADCP)


ITÜ_MARSITECRUISE_DISK02 contains all numerical data from DIVE 02, DIVE04 and DIVE05 of ROV/VICTOR, e.g.:

- the video files, readable VLC-type software
- all complementary data : ROV navigation, photographs, environmental parameters, etc.
- the environmental data (temperature, wind, salinity, ADCP)

ITÜ_MARSITE_DISK03 contains the following 4 directories:

- SHIP_SENSORS : all data produced by the sensors of *R/V Pourquoi Pas?* :
 - Multibeam bathymetry from echosounder RESON 7150
 - Multibeam water column acoustic data from echosounder RESON 7150
 - Sub-Bottom Profilers
 - Environmental parameters
 - Electronic LOG BOOK Casino

- OBS: All RAW data recorded with the IFREMER OBS that were deployed in September 2014 with R/V YUNUZ
- Directory PIEZOMETERS : All RAW data collected with the 2 piezometers that were deployed on the Western High on october 2013
- Directory MARSITE_BOB_ANITRAA contains : All raw data collected by the instruments deployed during Leg2 and recovered during Leg 3 to monitor bubbles on the Western High, namely :
 - BOB_DATA : raw data from the Bubble Acoustic Recorder BOB.
 - DATA_ANITRA3_ADCP : raw data from the Acoustic Doppler Current Profiler
 - DATA_SP2T_Probe : raw data from SP2 Temperature Probe

Yalamaz Burak ITU	Louis Géli Head of Marine Geosciences Research Unit, Ifremer
	



Ifremer



Istanbul, 17th november 2014

FOR WHOM IT MAY CONCERN

According to the ongoing Memorandum of Understanding between KOERI and Ifremer, I, undersigned, Nurcan Özel, deputy director of KOERI and coordinator of MARSITE Programme, acknowledge receipt of the numerical dataset collected during the MARSITE cruise with *R/V Pourquoi pas ?* in the Sea of Marmara from October 28th to November 16th, 2014.

The data are copied on three 2-Terabytes. The disks are delivered with a specific dock which allows connexion to any USB3-Port:

KOERI_MARSITECRUISE_DISK01 contains all numerical data from DIVE 01 and DIVE03 of ROV/VICTOR, e.g.:

- the video files, readable VLC-type software
- all complementary data : ROV navigation, photographs, environmental parameters, etc.
- the environmental data (temperature, wind, salinity, ADCP)


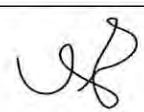
KOERI_MARSITECRUISE_DISK02 contains all numerical data from DIVE 02, DIVE04 and DIVE05 of ROV/VICTOR, e.g.:

- the video files, readable VLC-type software
- all complementary data : ROV navigation, photographs, environmental parameters, etc.
- the environmental data (temperature, wind, salinity, ADCP)

KOERI_MARSITE_DISK03 contains the following 4 directories:

- SHIP_SENSORS : all data produced by the sensors of *R/V Pourquoi Pas?* :
 - Multibeam bathymetry from echosounder RESON 7150
 - Multibeam waer column acoustic data from echosounder RESON 7150
 - Sub-Bottom Profilers
 - Environmental parameters
 - Electronic LOG BOOK Casino

- OBS: All RAW data recorded with the IFREMER OBS that were deployed in September 2014 with R/V YUNUZ
- Directory PIEZOMETERS : All RAW data collected with the 2 piezometers that were deployed on the Western High on october 2013
- Directory MARSITE_BOB_ANITRAA contains : All raw data collected by the instruments deployed during Leg2 and recovered during Leg 3 to monitor bubbles on the Western High, namely :
 - BOB_DATA : raw data from the Bubble Acoustic Recorder BOB.
 - DATA_ANITRA3_ADCP : raw data from the Acoustic Doppler Current Profiler
 - DATA_SP2T_Probe : raw data from SP2 Temperature Probe

<p>Nurcan Meral Özel Deputy director of KOERI MARSITE Coordinator</p>	<p>Louis Géli Head of Marine Geosciences Research Unit, Ifremer</p>
	



Ifremer



MARSITECRUISE

R/V Pourquoiipas ?

APPENDIX 3

**FULL LOG OF
OPERATIONS**

Legs 1, 2, 3

LOG OF OPERATIONS – LEG 1

Day of operation beginning	Hour of operation beginning (SHIP	Operation	Remarks	Reference Point
29/10/14	8:40	Departs from Istanbul - Transit to point F1- ADCP OS 38 kHz en route		
29/10/14	11:15	Deployment OBS-GEOMAR 4		OBS-GEOMAR 4
29/10/14	11:15	Water column survey		
29/10/14	11:36	Deployment OBS-GEOMAR 2		OBS-GEOMAR 2
29/10/14	11:15	Station au point F1		F1
29/10/14	11:15	Station ADCP OS 38 kHz	Ship stationary, no change in course	
29/10/14	11:15	Profile XCTD	Speed of descent 0.5 m/s.Hydro winch	
29/10/14	11:15	Deployment modem DO.		
29/10/14	13:00	Deployment geodetic structure DO #F1.	Announce of ROV breakdown. Cable stuck in a slipway panel during F1	
29/10/14	12:55	Weight and Ultra Short Baseline F1 on-board, transit to F2		
29/10/14		Circular survey around F2		
29/10/14	17:34:00	Deployment geodetic structure DO #F2.		F2
29/10/14	19:10	Weight and Ultra Short Baseline F2 on-board Transit to F3		
29/10/14	20:15	Deployment geodetic structure DO #F3.		F3
29/10/14	22:18	Weight & Ultra Short Baseline F3 on-board, Transit to F4		
29/10/14	23:19	Deployment geodetic structure DO #F4.		F4
30/10/14	1:09	Weight & Ultra Short Baseline F4 on board, reel-in Modem DO, Transit to G4		

30/10/14	4:05	Deployment of geodetic structure Geomar #G4.		G4
30/10/14	5:49	Weight & Ultra Short Baseline G4 on-board ; Transit to point G1 (80 metres west of		
30/10/14	6:32	Déploiement structure géodésique Geomar #G1.		G1
30/10/14	9:11	Weight & Ultra Short Baseline G1 on-board ;		
30/10/14	9:25	Start survey, Bathymetry, water column, chirp - 8 knots (duration : 6 h)		
30/10/14	13:56	End survey - Transit to G2		
30/10/14	14:44	1st check of French Geodetic Stations		
30/10/14	15:48	Deploy Geodetic Station Geomar #G2.		G2
30/10/14	18:46	Weight and Ultra Short Baseline G2 on board ; Transit to point G3		
30/10/14	19:18	Deploy Geodetic Station Geomar #G3.		G3
30/10/14	20:55	Weight and Ultra Short Baseline G3 on board ; Transit to point G5		
30/10/14	21:32	Deploy at Geomargeodetic station #G5		G5
30/10/14	23:10	Weight and Ultra Short Baseline G5 on board ; Transit to point G6		
30/10/14	23:49	Deploy Geodetic station Geomar #6.		G6
30/10/14	30/10/14 02:18	Weight and Ultra Short Baseline G6 on board ; Modem onboard		
	31/10/14 3:06	Deploy OBS GEOMAR 7		OBS-GEOMAR 7
	31/10/14 3:40	Deploy OBS GEOMAR 6		OBS-GEOMAR 6
	31/10/14 4:18	Deploy OBS GEOMAR 3		OBS-GEOMAR 3
	31/10/14 4:47	Deploy OBS GEOMAR 1		OBS-GEOMAR 1

	31/10/14 5:56	Profils CHIRP WP7-WP3 (end : 6:27)		
	31/10/14 7:25	Coring MRS-CS01 in Kumburgas basin at point WP4		MRS-CS01 : 40°52,28862' N
	31/10/14 13:04	2nd data retrieval at French Geodetic Station		
	31/10/14 15:16	Data retrieval at GEOMAR at geodetic stations		
	31/10/14 19:14	Coring MRS-CS02 in Kumburgas basin at point WP6		MRS-CS02 : 40°51,08721' N
	31/10/14 20:10	Transit to meeting point with Alain Christophe		
	1/1/14 22:30	Collect Alain Christophe.		
	1/1/14 23:00	Transit to Point DEB	DEB 40° 52,18°N - 28° 32,81' E - END 40°52,21'N - 28°40,003' E	
	1/1/14 0:27	Bathymetric profile from DEB to END		
	1/1/14 0:56	TRANSIT to MUD VOLCANO BOX - MB ON - CHIRP ON		
	1/1/14 4:06	Start survey, Bathymetry, water colum , chirp - 5 knots		
	1/1/14 8:37	End of survey SMF, Search deployment site for 2 OBS + ADCP mooring		
	1/1/14 13:25	Deploy IFREMER – MARSITE-OLDOBS 1		MARSITE-OLDOBS 1 40°48,86873'27°46,064 86'
	1/1/14 14:35	Deploy IFREMER – MARSITE-OLDOBS 2		MARSITE-OLDOBS 2 40°48,77327'27°46,057 63'
	1/1/14 15:54	Test weight and lead of ROV –	Aniitra ADCP not deployed, lack of time	
	1/1/14 17:00	Transit to Istanbul Area		
	1/1/14 22:45	Exchange of Personnel – END LEG 1		

LOG OF OPERATIONS – LEG 2

Date (start)	Local Time (start)	OPERATION	Working Area
2/11/2014	2:09	Start of ROV Dive 1 (Checking Geodetic deployments + geochemical sampling from PEGAZ, push cores and Raman analyses)	Central High
3/11/2014	17:39	End ROV-Dive 1	Central High
3/11/2014	18:39	Coring on the Central High at point	Central High
3/11/2014	22:39	Transit close to Istanbul area for 2 nd personnel exchange	Istanbul
4/11/2014	10:57	Start of ROV-Dive 2 on Western High (Deployment of BoB and ADCP + geochemical sampling from PEGAZ, push cores and Raman)	Western High
5/11/2014	17:18	End of ROV-Dive 2 on Western High - Recovery	Western High
5/11/2014	19:18	CTD-Hydrocast on the Western High	Western High
5/11/2014	21:18	Core on the Western High	Western High
6/11/2014	2:18	Transit to Tekirdag basin with multibeam water column on Western high and Tekirdag	Western High and Tekirdag
6/11/2014	7:30	Start of ROV- Dive 3 on the Tekirdag basin Edge (Geochemical sampling from PEGAZ, push cores and Raman analyses)	Tekirdag
7/11/2014	16:30	End of ROV- Dive 3 on the Edge basin - Recovery	Tekirdag
7/11/2014	18:30	CTD-Hydrocast at Tekirdag	Tekirdag
7/11/2014	22:30	Core in Tekirdag basin	Tekirdag
8/11/2014	3:12	Start of ROV- Dive 4 on the Southern Tekirdag basin (Geochemical sampling from PEGAZ, push cores and Raman analyses)	Western High
8/11/2014	21:39	End of ROV- Dive 3 on the Eastern Tekirdag basin	Western High

8/11/2014	23:39	CTD-Hydrocast on Eastern Tekirdag basin	Western High
9/11/2014	1:39	Core on Eastern Tekirdag basin	Western High
9/11/2014	7:39	Core on Western High (Hydrate Mount)	
9/11/2014	9:39	CTD-Hydrocast on Western High (Black bubble site)	
9/11/2014	11:39	Transit to Kumburgaz basin	
9/11/2014	18:39	Coring in Kumburgaz basin	
9/11/2014	21:39	CTD-Hydrocast in Kumburgaz basin	
10/11/2014	2:39	Transit to Cinarcik basin with multibeamon Cinarcik segment	Cinarcik basin
10/11/2014	14:39	Start of ROV- Dive 5 in Cinarcik basin (Geochemical sampling froL PEGAZ, push cores and Raman analyses)	Cinarcik basin
11/11/2014	17:18	End of ROV- Dive 3 in in Cinarcik basin	Cinarcik basin
11/11/2014	19:18	CTD-Hydrocast in Cinarcik basin	Cinarcik basin
11/11/2014	21:18	Core in Cinarcik basin	Cinarcik basin
11/11/2014	23:18	Core in Cinarcik basin	Cinarcik basin
12/11/2014	2:18	Core processing- Fluid extraction- CTD-Hydrocast- Acoustic survey of the water column	
13/11/2014	8:18	End of Operations for Leg 2- Transit to Istanbul Area	
13/11/2014	8:18	Exchange of personnel -End Leg 2	
13/11/2014	8:18	Start of Leg 3	

LOG OF OPERATIONS – LEG 3

date	time (UTC)	Operation	Observations	Reference Point
13/11	8:00	Leave Istanbul and transit to East Imrali basin, Sub-bottom profiler (SBP) and multibeam on		
13/11	9:08	SBP Profile on CS18	along Piri Reis profile TAMAM 58	
13/11	9:52	End of profile, leave sounders on		
13/11	11:08	Take 24 m calypso core (for ITU)	core on deck 12:26, recovery 14.25 m	CS18
13/11	12:52	SBP Profile		
13/11	13:27	End of profile, leave sounders on		
13/11	14:00	Take ITU interface core (for ITU)	core on deck 14:28, recovery 0.89 cm	II01
13/11	15:25	Take 24 m calypso core (for ITU)	core on deck 16:10, recovery 22,64 m	CS19
13/11	16:50	Sub-bottom profiler (SBP) and multibeam on transit to W Imrali basin		
13/11		on coring site CS19		CS19
13/11	18:18	SBP profile E of Imrali canyon	Parallel to Imrali canyon	
13/11		turn	turn on request from coast guards	
13/11		SBP Profile on CS20, CS 21	along Piri Reis profile TAMAM 52	
13/11		End of profile, leave sounders on		
13/11		SBP Profile (cross line on CS21)	Profile perpendicular to scarp	
13/11		End of profile, leave sounders on		
13/11	21:02	Take 24 m calypso core (for ITU)	core on deck 22:20, recovery: 18,90 m	CS20
14/11	0:05	Take 24 m calypso core (for ITU)	core on deck 03:41, bent, recovery 8;88 m	CS21
14/11	3:48	Sub-bottom profiler (SBP) on		
14/11	4:38	SBP profile W of Imrali canyon	Parallel to Imrali canyon	
14/11	5:10	end profile, return to coring site		
14/11	5:52	Transit to Western high with SBP and multibeam on		

14/11	9:05	SBP profile on core sites CS23 to 26	along Piri Reis profile a2b10	
14/11		End of profile, leave sounders on		
14/11		SBP profile on core CS22 site	along Piri Reis profile a2b10	
14/11		End of profile, leave sounders on		
14/11	10:08	Take 24 m calypso core (for CEREGE)	core on deck 11:40 , recovery 20,42 m	CS22
14/11	12:21	Recover IFREMER OBS		YUN_2014_10
14/11	12:49	Attempt to recover IFREMER OBS	No release after 3 trials	YUN_2014_06
14/11	16:02	Recover IFREMER OBS		YUN_2014_05
14/11	17:11	Recover INGV OBS		INGV OBS-3
14/11	18:41	Recover INGV OBS		INGV OBS-4
14/11	19:39	Recover IFREMER OBS		YUN_2014_07
14/11	21:00	Take 12 m calypso core (for CEREGE)	core on deck 22:08 , recovery 10,32 m	CS23
14/11	23:08	Take 12 m calypso core (for CEREGE)	core on deck 15/11 01:00 , recovery 8.90 m	CS24
15/11	2:11	Take 12 m calypso core (for CEREGE)	core on deck 03:30 , recovery 10,65 m	CS25
15/11	4:55	Take 24 m calypso core (for CEREGE)	core on deck 06:30 , recovery 17.59 m	CS26
15/11	6:52	Mutibeam Reson 7150		
15/11	7:13	end of profile		
15/11	8:10	Recover BOB	on board	BOB 0
15/11	8:42	Recover IFREMER LOTOBS	on board	MRS-LOTOBS-1
15/11	9:16	Recover IFREMER LOTOBS	no dog	MRS-LOTOBS-2
15/11	9:46	Recover ADCP	on board	ANITRA3
15/11	10:20	Recover IFREMER OBS	on board	YUN_2014_04
15/11	11:01	Recover IFREMER piezometer	on board	PZS
15/11	12:05	Recover INGV OBS	on board	INGV OBS-1
15/11	12:50	Recover IFREMER piezometer	on board	PZN
15/11	13:21	Recover IFREMER OBS	on board	YUN_2014_02
15/11	15:15	Recover IFREMER OBS	on board	YUN_2014_01

15/11	16:33	Recover IFREMER OBS	on board	YUN_2014_08
15/11	19:06	Attempt to recover IFREMER OBS	No release after 3 trials	YUN_2014_09
15/11	20:35	Recover IFREMER OBS	on board	YUN_2014_03
15/11		2nd Attempt to recover IFREMER OBS		YUN_2014_06
16/11		Transit to W Imrali Basin		
16/11	1:13	Take 24 m calypso core (for ITU)	core on deck 02:20 , recovery 20,65 m	CS27
16/11	2:20	Transit to Kumburgaz Basin with multibeam and SBP on		
16/11	3:07	SBP profile and RESON 7150	Parallel to Imrali canyon	
16/11	3:38	end profile		
16/11	4:46	SBP profile and RESON 7150		
16/11	5:08	end profile		
16/11	5:23	Interrogation of géodetic acoustic beacons, data download	begin interrogation	F1
16/11	9:30	Reprogramming of beacon G5, transit to coring site	begin transit	G5
16/11	10:06	Take interface core II02 (for ITU)	core on deck 10:50, recovery 1.14 m	CS01/II02
16/11	11:27	Take interface core II03 (for ITU)	core on deck 12:03, recovery 0.95 m	CS14/II03
16/11	12:03	Transit to W Imrali Basin with multibeam and SBP on		
16/11	13:00	SBP profile and RESON 7150	Parallel to Imrali canyon	
16/11	13:23	End of profile, leave sounders on		
16/11	13:40	SBP profile and RESON 7150	Parallel to Imrali canyon	
16/11	14:05	End of profile, leave sounders on		
16/11	19:30	Arrival Istanbul – END OF CRUISE	On Dock	IST

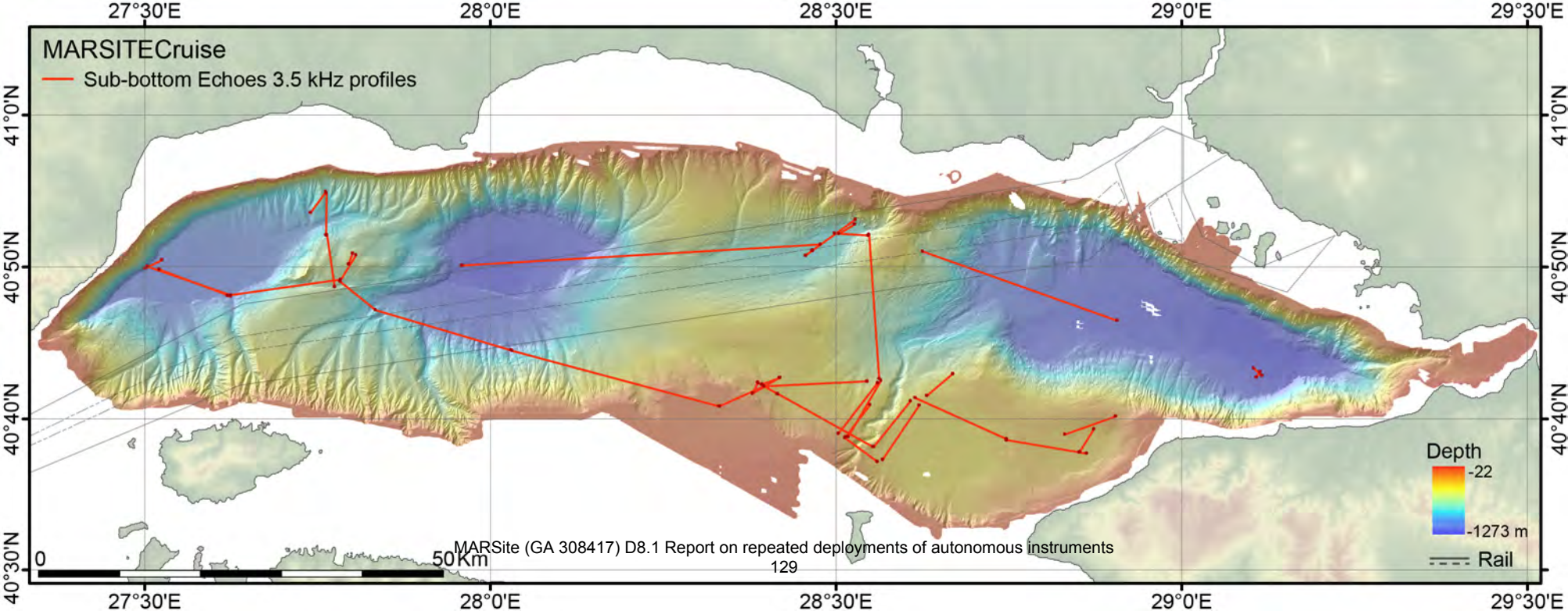
MARSITECRUISE

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APPENDIX 4

MARSITE Cores

Nom opération* (32C)	Date (JJ/MM/AAAA hh:mm:ss)	Latitude en Deg. Dec. (9,7)	Longitude en Deg. Dec. (10,7)	Hauteur eau en m. (8,2)	Longueur tube en m. (7,2)	Diamètre en m. (6,2)	Poids lest en kg. (9,2)	Chute libre en m. (5,2)	Boucle en m. (5,2)	Arrachement en kg. (9,2)	Longueur récup. en m. (7,2)	Pénétration en m. (7,2)	Nb. tronçons (3)	Commentaires point (400C)	Desc. base (200C)
MRS-CS01	31/10/2014 05:52:00	40,8714770	28,5034120	834,00	23,35	0,11	3360	1,55	3,87	2,5	2105	23,5	22		
MRS-CS02	31/10/2014 17:14:00	40,8514530	28,4656090	819,00	23,35	0,11	3360	1,55	3,87	1,8	1350	24	14		
MRS-CS03	03/11/2014 20:20:00	40,8617300	28,5833990	326,00	13,4	0,11	3360	1,63	3,63	4,6	975	12	10		Argile compacte avec odeur de gaz
MRS-CS04	03/11/2014 22:55:00	40,8616800	28,5832960	327,00	13,4	0,11	3360	1,63	3,63	3	638	8	7		Argile compacte
MRS-CS05	05/11/2014 16:46:00	40,8172600	27,7810420	657,00	13,4	0,11	3360	1,63	3,63	2	907	13	11		Hydrates
MRS-CS06	05/11/2014 20:23:00	40,8171520	27,7811130	658,00	13,4	0,11	3360	1,63	3,63	2,5	875	13	10		
MRS-CS07	07/11/2014 17:45:00	40,8283770	27,4784590	872,00	13,4	0,11	3360	2,89	5,39	1,5	497	4	5		Petits galets dans l'ogive
MRS-CS08	07/11/2014 19:47:00	40,8400820	27,5212500	1091,00	13,4	0,11	3360	2,16	5,36	3,4	1167	13,4	12		Argile très compacte
MRS-CS09	07/11/2014 23:09:00	40,8400070	27,5215280	1090,00	13,4	0,11	3360	2,98	5,38	2,5	1107	13,4	12		Argile dense
MRS-CS10	09/11/2014 22:56:00	40,8016930	27,6235080	1090,00	13,4	0,11	3360	2,98	5,38	0	0	4	0	Craotte flambée	Petits galets dans l'ogive
MRS-CS11	09/11/2014 10:17:00	40,8026280	27,6196300	1108,00	11,9	0,11	3360	2,2	5,15	2,5	0	12	0	Carottier vide	Sédiment fluide
MRS-CS12	09/11/2014 12:43:00	40,8034860	27,6165840	1110,00	11,9	0,11	3360	2,2	5,15	2	0	12	0	Carottier vide	Sédiment fluide
MRS-CS13	09/11/2014 17:58:00	40,8171190	27,7811410	663,00	11,9	0,11	3360	3,4	5,13	1,8	1180	12	12		Hydrate dans l'ogive et argile à la base
MRS-CS14	10/11/2014 03:27:00	40,8587520	28,4772910	820,00	24,5	0,11	3360	1,55	3,95	0,9	2095	24	21		Argile compacte
MRS-CS15	10/11/2014 06:15:00	40,8618160	28,5831550	330,00	11,9	0,11	3360	1	1,86	5,5	958	8	10		Argile compacte
MRS-CS16	11/11/2014 19:26:00	40,7164560	29,1117640	1237,00	11,9	0,11	3360	3,7	6,88	2,3	1013	12	11		
MRS-CS17	11/11/2014 22:01:00	40,7164730	29,1117720	1237,00	11,9	0,11	3360	3,7	6,88	3	1060	12	11		
MRS-CS18	13/11/2014 11:33:00	40,6620630	28,8795850	291,00	24,5	0,11	3360	1	1,32	2,8	1425	18	16	Carotte pistonée	
MRS-CS19	13/11/2014 15:55:00	40,6297060	28,8518730	365,00	24,5	0,11	3360	1	1,32	1,8	2264	25	23		
MRS-CS20	13/11/2014 21:32:00	40,7040210	28,3927970	285,00	24,5	0,11	3360	1,1	1,86	3	1890	24,5	19		
MRS-CS21	14/11/2014 00:19:00	40,7029710	28,3953170	305,00	24,5	0,11	3360	1,1	1,86	2,8	888	18	9	Carotte flambée	
MRS-CS22	14/11/2014 10:51:00	40,8371780	27,7975450	553,00	23,4	0,11	3360	1,55	2,99	2,6	2042		21		
MRS-CS23	14/11/2014 21:28:00	40,7929830	27,8216170	919,00	11,9	0,11	3360	2,49	4,39	2,5	1032		11		
MRS-CS24	14/11/2014 00:06:00	40,7903280	27,8259030	942,00	11,9	0,11	3360	2,49	4,39	1,6	890		9		
MRS-CS25	15/11/2014 02:52:00	40,7922090	27,8229210	326,00	11,9	0,11	3360	2,49	4,39	2,4	1065	12	11		
MRS-CS26	15/11/2014 05:34:00	40,7915990	27,8239910	928,00	23,4	0,11	3360	2,05	4,75	2,5	1759	19,5	18		
MRS-CS27	16/11/2014 01:44:00	40,7006370	28,4007790	314,00	23,4	0,11	3360	1	1,84	1,2	2063	23,4	21		



MARSITECRUISE

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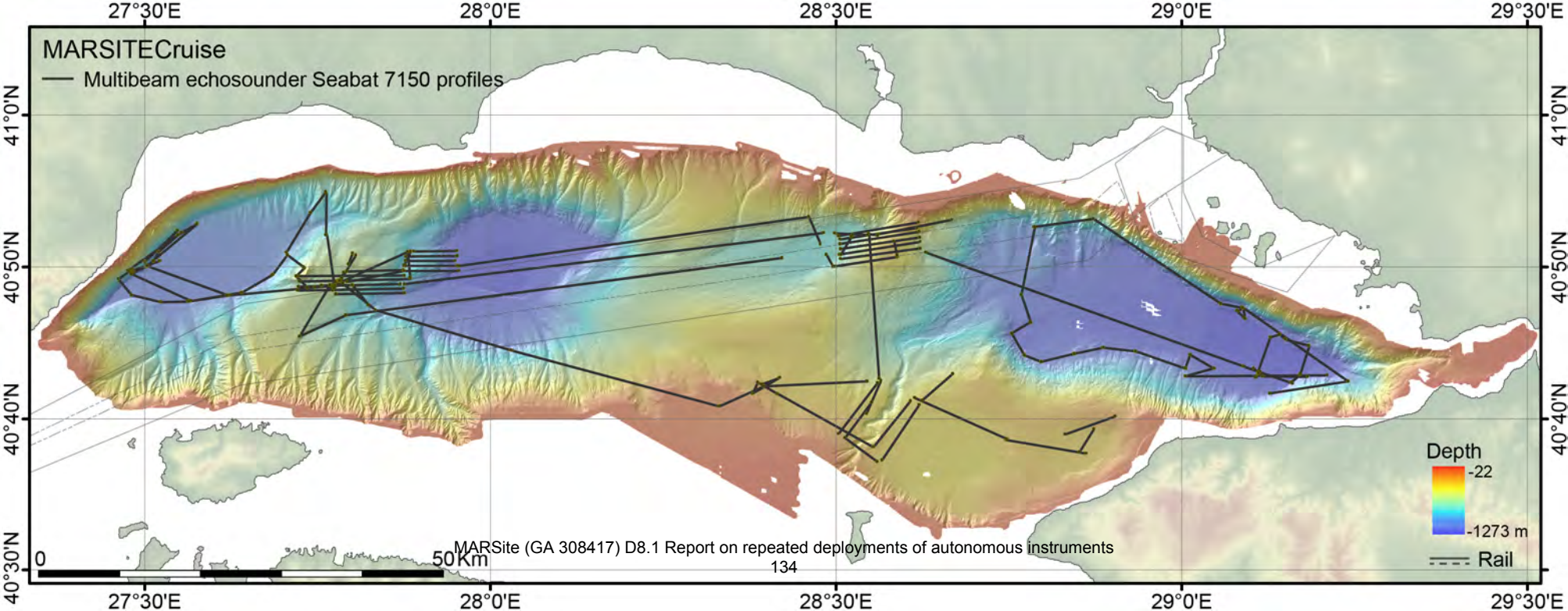
APPENDIX 5

**List of multibeam (walter column) profiles
for legs 1, 2, 3**

	DEBUT				FIN			
	Date	Heure	Latitude (N)	Longitude (E)	Date	Heure	Latitude (N)	Longitude (E)
PR_1	29/10/2014	08:38:47	40° 53,11024'	28° 40,0628'	29/10/2014	09:10:44	40° 52,14298'	28° 33,64799'
PR_2	29/10/2014	09:25:01	40° 52,07459'	28° 33,63304'	29/10/2014	10:06:10	40° 52,2626'	28° 31,12095'
PR_3	29/10/2014	14:16:27	40° 52,11721'	28° 31,41339'	29/10/2014	15:01:35	40° 52,0212'	28° 31,58821'
PR_4	29/10/2014	15:17:55	40° 52,07434'	28° 31,44989'	29/10/2014	16:52:03	40° 52,11629'	28° 31,42521'
PR_5	30/10/2014	07:25:22	40° 52,05721'	28° 30,22617'	30/10/2014	08:05:33	40° 52,95307'	28° 37,17478'
PR_6	30/10/2014	08:11:59	40° 52,56647'	28° 37,05136'	30/10/2014	08:50:22	40° 51,8159'	28° 30,34316'
PR_7	30/10/2014	08:56:45	40° 51,51091'	28° 30,36368'	30/10/2014	09:35:53	40° 52,29668'	28° 37,22459'
PR_8	30/10/2014	09:42:44	40° 51,95943'	28° 37,2506'	30/10/2014	10:22:57	40° 51,17403'	28° 30,40788'
PR_9	30/10/2014	10:28:22	40° 50,83315'	28° 30,33284'	30/10/2014	11:07:53	40° 51,66169'	28° 37,33061'
PR_10	30/10/2014	11:16:08	40° 51,21129'	28° 37,32243'	30/10/2014	11:56:16	40° 50,51779'	28° 30,41431'
PR_11	30/10/2014	12:00:18	40° 50,82298'	28° 30,42857'	30/10/2014	12:15:02	40° 51,98075'	28° 31,36971'
PR_12	31/10/2014	22:27:39	40° 52,1231'	28° 32,80106'	31/10/2014	22:56:43	40° 52,2043'	28° 29,97839'
PR_13	31/10/2014	23:05:41	40° 52,25182'	28° 28,93644'	01/11/2014	02:03:47	40° 48,89061'	27° 52,57172'
PR_14	01/11/2014	02:06:02	40° 48,8779'	27° 52,24493'	01/11/2014	03:14:24	40° 48,71831'	27° 43,36261'
PR_15	01/11/2014	03:24:49	40° 49,40395'	27° 43,36696'	01/11/2014	04:34:36	40° 49,45103'	27° 52,56312'
PR_16	01/11/2014	04:43:45	40° 48,58646'	27° 52,54804'	01/11/2014	05:53:13	40° 48,4419'	27° 43,27485'
PR_17	01/11/2014	06:03:54	40° 49,0442'	27° 43,42837'	01/11/2014	07:16:51	40° 49,19446'	27° 53,0735'
PR_18	01/11/2014	07:27:20	40° 48,28067'	27° 52,57283'	01/11/2014	08:12:05	40° 48,20792'	27° 46,62835'
PR_19	01/11/2014	08:17:18	40° 48,43959'	27° 46,37122'	01/11/2014	08:33:55	40° 49,64033'	27° 47,32087'
PR_20	01/11/2014	08:36:34	40° 49,70634'	27° 47,57172'	01/11/2014	09:13:55	40° 49,80571'	27° 52,46044'
PR_21	01/11/2014	09:27:59	40° 49,29344'	27° 53,05476'	01/11/2014	09:46:06	40° 50,99153'	27° 52,84214'
PR_22	01/11/2014	09:46:06	40° 50,99153'	27° 52,84214'	01/11/2014	10:37:45	40° 48,72874'	27° 46,24735'
PR_23	04/11/2014	01:14:58	40° 50,59798'	28° 25,30718'	04/11/2014	03:47:00	40° 46,83334'	27° 47,49346'
PR_24	04/11/2014	03:47:10	40° 46,83334'	27° 47,49346'	04/11/2014	04:15:05	40° 45,44371'	27° 43,49146'
PR_25	04/11/2014	04:15:21	40° 45,42037'	27° 43,4217'	04/11/2014	05:00:00	40° 48,81908'	27° 46,08541'
PR_26	04/11/2014	05:00:46	40° 48,80618'	27° 46,08328'	04/11/2014	08:55:22	40° 48,9855'	27° 46,60539'
PR_27	05/11/2014	21:25:09	40° 49,25934'	27° 47,12716'	05/11/2014	21:32:20	40° 48,76211'	27° 46,41796'
PR_28	05/11/2014	21:32:25	40° 48,75836'	27° 46,40551'	05/11/2014	21:43:49	40° 48,66755'	27° 44,80877'
PR_29	05/11/2014	21:43:57	40° 48,66664'	27° 44,79072'	05/11/2014	21:49:01	40° 48,64387'	27° 44,11804'
PR_30	05/11/2014	21:49:03	40° 48,64387'	27° 44,11804'	05/11/2014	21:59:52	40° 49,38281'	27° 43,18571'
PR_31	05/11/2014	22:00:02	40° 49,39767'	27° 43,17277'	05/11/2014	22:24:30	40° 49,93073'	27° 43,88565'
PR_32	05/11/2014	22:25:37	40° 49,98392'	27° 43,78616'	05/11/2014	22:48:08	40° 50,80922'	27° 42,3837'
PR_33	05/11/2014	22:48:09	40° 50,80922'	27° 42,3837'	05/11/2014	23:04:17	40° 49,48896'	27° 41,11755'
PR_34	05/11/2014	23:04:26	40° 49,47893'	27° 41,10433'	05/11/2014	23:28:27	40° 48,33158'	27° 38,43455'
PR_35	05/11/2014	23:28:40	40° 48,3277'	27° 38,40736'	06/11/2014	00:03:00	40° 47,75906'	27° 34,03476'
PR_36	06/11/2014	00:03:03	40° 47,75906'	27° 34,03476'	06/11/2014	00:36:05	40° 49,52804'	27° 28,8875'
PR_37	06/11/2014	00:36:14	40° 49,53503'	27° 28,86901'	06/11/2014	01:05:23	40° 50,37941'	27° 30,77085'
PR_38	06/11/2014	01:05:32	40° 50,39054'	27° 30,78184'	06/11/2014	01:12:49	40° 51,00103'	27° 31,22498'
PR_39	06/11/2014	01:12:55	40° 51,00692'	27° 31,23503'	06/11/2014	01:29:34	40° 52,11796'	27° 32,92863'
PR_40	06/11/2014	01:29:39	40° 52,12333'	27° 32,9375'	06/11/2014	01:50:33	40° 52,87946'	27° 34,61005'
PR_41	06/11/2014	01:51:58	40° 52,82034'	27° 34,51511'	06/11/2014	02:40:22	40° 50,07046'	27° 30,18341'
PR_42	06/11/2014	02:41:30	40° 50,06058'	27° 30,1792'	06/11/2014	05:09:33	40° 50,03795'	27° 30,19838'
PR_43	06/11/2014	05:09:35	40° 50,03795'	27° 30,19838'	06/11/2014	05:29:08	40° 49,66687'	27° 29,0582'
PR_44	07/11/2014	15:18:38	40° 49,69336'	27° 28,71671'	07/11/2014	18:58:13	40° 49,75871'	27° 28,94501'
PR_45	07/11/2014	18:58:32	40° 49,76562'	27° 28,95559'	07/11/2014	19:33:07	40° 50,41197'	27° 31,3064'
PR_46	07/11/2014	19:33:19	40° 50,41005'	27° 31,30532'	07/11/2014	21:08:24	40° 50,39972'	27° 31,29042'
PR_47	09/11/2014	02:01:26	40° 48,13604'	27° 37,45274'	09/11/2014	02:50:41	40° 47,72333'	27° 33,79466'
PR_48	09/11/2014	02:50:47	40° 47,72262'	27° 33,78127'	09/11/2014	03:08:23	40° 47,67791'	27° 31,42045'
PR_49	09/11/2014	03:08:29	40° 47,67885'	27° 31,40716'	09/11/2014	03:28:00	40° 48,14569'	27° 28,891'
PR_50	09/11/2014	03:28:11	40° 48,15486'	27° 28,87034'	09/11/2014	03:41:31	40° 49,18414'	27° 27,75811'

	DEBUT				FIN			
	Date	Heure	Latitude (N)	Longitude (E)	Date	Heure	Latitude (N)	Longitude (E)
PR_51	09/11/2014	03:50:51	40° 49,19694'	27° 27,74423'	09/11/2014	04:01:03	40° 49,84308'	27° 28,93856'
PR_52	09/11/2014	04:11:53	40° 49,77305'	27° 28,58745'	09/11/2014	04:57:05	40° 52,28631'	27° 33,21072'
PR_53	09/11/2014	05:08:24	40° 52,42027'	27° 32,86756'	09/11/2014	05:38:06	40° 50,36489'	27° 30,05609'
PR_54	09/11/2014	05:38:31	40° 50,3274'	27° 30,01195'	09/11/2014	05:44:39	40° 50,04046'	27° 30,18091'
PR_55	09/11/2014	05:45:02	40° 50,03813'	27° 30,19216'	09/11/2014	06:03:59	40° 50,05042'	27° 30,19403'
PR_56	09/11/2014	07:59:37	40° 50,051'	27° 30,2356'	09/11/2014	09:19:39	40° 48,15967'	27° 37,17364'
PR_57	09/11/2014	13:51:59	40° 48,10459'	27° 37,21775'				
PR_58					09/11/2014	15:03:18	40° 48,78607'	27° 46,53281'
PR_59	09/11/2014	15:03:23	40° 48,78988'	27° 46,54046'	09/11/2014	15:08:56	40° 49,1173'	27° 46,9972'
PR_60	09/11/2014	15:09:02	40° 49,12199'	27° 47,00262'	09/11/2014	15:21:56	40° 49,10969'	27° 46,85025'
PR_61	09/11/2014	15:22:00	40° 49,10939'	27° 46,8503'	09/11/2014	17:16:16	40° 49,0961'	27° 46,86072'
PR_62	09/11/2014	17:16:43	40° 49,09465'	27° 46,86125'	09/11/2014	17:34:37	40° 49,0271'	27° 46,86845'
PR_63	09/11/2014	17:36:40	40° 49,02707'	27° 46,86842'	09/11/2014	18:04:12	40° 49,02818'	27° 46,87089'
PR_64	09/11/2014	18:04:19	40° 49,02815'	27° 46,87091'	09/11/2014	18:48:54	40° 48,94629'	27° 47,25983'
PR_65	09/11/2014	18:50:48	40° 48,99595'	27° 47,58248'	09/11/2014	19:13:57	40° 49,72609'	27° 52,50353'
PR_66	09/11/2014	19:14:45	40° 49,72752'	27° 52,57695'	09/11/2014	19:49:50	40° 49,75209'	27° 57,26248'
PR_67	09/11/2014	19:59:58	40° 50,4091'	27° 56,98397'	09/11/2014	20:31:39	40° 50,38631'	27° 52,67539'
PR_68	09/11/2014	20:39:58	40° 50,69956'	27° 52,71331'	09/11/2014	21:14:00	40° 50,71473'	27° 57,11922'
PR_69	09/11/2014	21:20:47	40° 51,05296'	27° 57,08851'	09/11/2014	21:48:33	40° 51,02188'	27° 53,34773'
PR_70	09/11/2014	21:50:32	40° 51,0286'	27° 53,08743'	09/11/2014	22:05:30	40° 50,08724'	27° 52,51284'
PR_71	09/11/2014	22:07:11	40° 50,05345'	27° 52,68892'	09/11/2014	22:41:25	40° 50,0711'	27° 57,13502'
PR_72	09/11/2014	22:42:19	40° 50,07562'	27° 57,25981'	10/11/2014	01:15:00	40° 53,30974'	28° 27,64876'
PR_73	10/11/2014	01:15:05	40° 53,30504'	28° 27,66199'	10/11/2014	01:32:26	40° 51,51953'	28° 28,65596'
PR_74	10/11/2014	04:34:13	40° 50,81222'	28° 29,19321'	10/11/2014	04:43:21	40° 50,03652'	28° 29,74732'
PR_75	10/11/2014	04:44:29	40° 50,03195'	28° 29,86665'	10/11/2014	05:25:50	40° 50,67499'	28° 35,29828'
PR_76	10/11/2014	05:26:58	40° 50,74719'	28° 35,31224'	10/11/2014	05:41:18	40° 51,68522'	28° 35,03094'
PR_77	10/11/2014	07:08:28	40° 50,94637'	28° 37,80582'	10/11/2014	09:35:02	40° 43,45686'	29° 5,33728'
PR_78	10/11/2014	09:35:14	40° 43,42838'	29° 5,42575'	10/11/2014	10:06:59	40° 42,34091'	29° 9,61768'
PR_79	10/11/2014	10:17:17	40° 42,38336'	29° 9,53297'	10/11/2014	10:24:58	40° 42,88885'	29° 10,25583'
PR_80	10/11/2014	10:25:45	40° 42,95889'	29° 10,29796'	10/11/2014	10:45:37	40° 44,81098'	29° 11,11081'
PR_81	10/11/2014	10:55:23	40° 44,82353'	29° 11,04379'	10/11/2014	11:10:55	40° 45,22426'	29° 9,03814'
PR_82	10/11/2014	11:11:01	40° 45,22924'	29° 9,02683'	10/11/2014	11:15:58	40° 45,53416'	29° 8,51037'
PR_83	10/11/2014	11:16:09	40° 45,53845'	29° 8,48627'	10/11/2014	11:22:26	40° 45,37824'	29° 7,71857'
PR_84	10/11/2014	11:22:41	40° 45,36011'	29° 7,69564'	10/11/2014	11:47:02	40° 43,05072'	29° 6,595'
PR_85	11/11/2014	15:35:41	40° 42,76529'	29° 10,94773'	11/11/2014	15:53:33	40° 42,8042'	29° 7,01675'
PR_86	11/11/2014	15:53:38	40° 42,80627'	29° 7,00499'	11/11/2014	16:01:20	40° 43,31452'	29° 6,25304'
PR_87	11/11/2014	16:10:12	40° 43,10011'	29° 6,83021'	11/11/2014	16:14:54	40° 42,72074'	29° 6,44831'
PR_88	11/11/2014	16:15:05	40° 42,70908'	29° 6,43715'	11/11/2014	16:31:38	40° 42,97413'	29° 6,65069'
PR_89	11/11/2014	16:32:09	40° 42,97477'	29° 6,65453'	11/11/2014	16:49:41	40° 42,98521'	29° 6,70054'
PR_90	12/11/2014	04:07:12	40° 41,66278'	29° 7,65615'	12/11/2014	05:04:24	40° 42,45683'	29° 14,45096'
PR_91	12/11/2014	05:04:29	40° 42,45721'	29° 14,46018'	12/11/2014	06:42:18	40° 47,37125'	29° 5,27294'
PR_92	12/11/2014	06:50:48	40° 47,26594'	29° 5,3354'	12/11/2014	06:57:38	40° 46,5719'	29° 5,51138'
PR_93	12/11/2014	07:05:45	40° 46,64632'	29° 5,44706'	12/11/2014	07:12:11	40° 47,1269'	29° 4,78798'
PR_94	12/11/2014	07:18:20	40° 47,08684'	29° 4,91107'	12/11/2014	07:30:08	40° 47,30555'	29° 5,32916'
PR_95	12/11/2014	07:30:13	40° 47,30399'	29° 5,3184'	12/11/2014	07:53:25	40° 47,60531'	29° 3,41125'
PR_96	12/11/2014	07:53:30	40° 47,6'	29° 3,39975'	12/11/2014	09:34:44	40° 53,1844'	28° 52,37008'
PR_97	12/11/2014	09:49:05	40° 52,57483'	28° 51,6936'	12/11/2014	10:23:32	40° 52,62908'	28° 47,18701'
PR_98	12/11/2014	10:30:24	40° 52,63456'	28° 47,26327'	12/11/2014	11:16:27	40° 48,19478'	28° 46,09529'
PR_99	12/11/2014	11:16:33	40° 48,18515'	28° 46,09681'	12/11/2014	11:35:54	40° 46,33396'	28° 46,90214'
PR_100	12/11/2014	11:41:52	40° 46,35704'	28° 46,8859'	12/11/2014	11:56:27	40° 45,62339'	28° 45,25578'

	DEBUT				FIN			
	Date	Heure	Latitude (N)	Longitude (E)	Date	Heure	Latitude (N)	Longitude (E)
PR_101	12/11/2014	12:14:03	40° 45,60525'	28° 45,25615'	12/11/2014	12:29:57	40° 44,18371'	28° 46,35256'
PR_102	12/11/2014	12:30:08	40° 44,17951'	28° 46,3564'	12/11/2014	12:41:27	40° 43,76082'	28° 47,80579'
PR_103	12/11/2014	12:41:37	40° 43,76118'	28° 47,8282'	12/11/2014	13:03:50	40° 44,29591'	28° 50,67904'
PR_104	12/11/2014	13:03:57	40° 44,29876'	28° 50,69342'	12/11/2014	13:23:30	40° 44,67362'	28° 53,12621'
PR_105	12/11/2014	13:24:25	40° 44,68032'	28° 53,24147'	12/11/2014	13:46:02	40° 44,45084'	28° 55,94748'
PR_106	12/11/2014	13:46:29	40° 44,44231'	28° 56,00501'	12/11/2014	14:21:18	40° 43,29427'	29° 0,3775'
PR_107	12/11/2014	14:29:11	40° 43,33429'	29° 0,3247'	12/11/2014	14:38:21	40° 44,22354'	29° 0,72562'
PR_108	12/11/2014	14:38:21	40° 44,22354'	29° 0,72562'	12/11/2014	15:07:00	40° 43,28982'	29° 2,84797'
PR_109	12/11/2014	15:13:53	40° 43,3186'	29° 2,77731'	12/11/2014	15:33:32	40° 42,79778'	29° 0,3136'
PR_110	12/11/2014	15:40:56	40° 42,80224'	29° 0,37307'	12/11/2014	17:59:26	40° 42,85408'	29° 12,67705'
PR_111	13/11/2014	09:09:45	40° 40,13232'	28° 54,21146'	13/11/2014	09:51:23	40° 38,94907'	28° 49,86734'
PR_112	13/11/2014	12:56:21	40° 39,31902'	28° 52,41121'	13/11/2014	13:41:30	40° 37,79118'	28° 51,13397'
PR_113	13/11/2014	16:51:25	40° 37,70605'	28° 51,68915'	13/11/2014	17:26:53	40° 38,5751'	28° 44,79013'
PR_114	13/11/2014	17:37:49	40° 38,65158'	28° 44,85352'	13/11/2014	18:18:16	40° 41,37982'	28° 36,85452'
PR_115	13/11/2014	18:20:31	40° 41,16772'	28° 36,48722'	13/11/2014	18:45:54	40° 38,12587'	28° 33,25118'
PR_116	13/11/2014	18:46:00	40° 38,1326'	28° 33,23445'	13/11/2014	19:30:29	40° 41,62087'	28° 24,97525'
PR_117	13/11/2014	19:31:04	40° 41,64786'	28° 24,90329'	13/11/2014	19:47:37	40° 42,37119'	28° 23,26063'
PR_118	13/11/2014	19:47:55	40° 42,38615'	28° 23,23322'	13/11/2014	20:01:04	40° 41,65318'	28° 22,79235'
PR_119	13/11/2014	20:01:23	40° 41,65318'	28° 22,79235'	13/11/2014	20:29:39	40° 42,68168'	28° 25,07421'
PR_120	13/11/2014	20:30:05	40° 42,69722'	28° 25,11772'	13/11/2014	20:50:00	40° 42,25729'	28° 23,56864'
PR_121	14/11/2014	04:51:04	40° 40,34308'	28° 32,65895'	14/11/2014	05:10:01	40° 42,53801'	28° 33,90697'
PR_122	14/11/2014	05:14:58	40° 42,45534'	28° 32,68408'	14/11/2014	05:52:01	40° 42,13474'	28° 23,76296'
PR_123	14/11/2014	05:52:02	40° 42,13474'	28° 23,76296'	14/11/2014	06:11:00	40° 40,79247'	28° 19,88701'
PR_124	14/11/2014	06:11:01	40° 40,79247'	28° 19,88701'	14/11/2014	07:34:06	40° 44,4808'	28° 1,90106'
PR_125	14/11/2014	07:34:35	40° 44,50307'	28° 1,79876'	14/11/2014	08:30:01	40° 47,14588'	27° 50,06398'
PR_126	14/11/2014	08:30:04	40° 47,14588'	27° 50,06398'	14/11/2014	09:05:40	40° 49,04773'	27° 46,94867'
PR_127	14/11/2014	09:06:01	40° 49,06912'	27° 46,95174'	14/11/2014	09:30:17	40° 50,78362'	27° 48,33421'
PR_128	14/11/2014	09:35:30	40° 50,90122'	27° 48,04225'	14/11/2014	09:56:07	40° 50,20211'	27° 47,69437'
PR_129	15/11/2014	06:37:27	40° 47,49595'	27° 49,44032'	15/11/2014	06:53:08	40° 48,82243'	27° 48,03588'
PR_130	15/11/2014	06:53:14	40° 48,82088'	27° 48,02375'	15/11/2014	07:13:39	40° 48,76982'	27° 45,38912'
PR_131	15/11/2014	07:13:53	40° 48,76989'	27° 45,35876'	15/11/2014	12:06:47	40° 48,59227'	27° 46,42106'
PR_132	15/11/2014	13:27:18	40° 48,70966'	27° 46,47759'	15/11/2014	14:14:19	40° 52,1104'	27° 45,83821'
PR_133	15/11/2014	14:17:22	40° 52,12006'	27° 45,74494'	15/11/2014	14:41:45	40° 54,86043'	27° 45,80115'
PR_134	15/11/2014	15:15:05	40° 54,95483'	27° 45,72344'	15/11/2014	15:38:26	40° 53,55754'	27° 44,37965'
PR_135	15/11/2014	15:38:26	40° 53,55754'	27° 44,37965'	15/11/2014	16:18:15	40° 50,94522'	27° 42,31247'
PR_136	16/11/2014	03:06:24	40° 38,97607'	28° 30,21184'	16/11/2014	03:38:30	40° 42,3527'	28° 33,61223'
PR_137	16/11/2014	03:40:43	40° 42,61529'	28° 33,73436'	16/11/2014	04:38:41	40° 52,17612'	28° 32,89359'
PR_138	16/11/2014	04:46:32	40° 52,0968'	28° 32,76221'	16/11/2014	05:08:00	40° 52,21593'	28° 29,86418'
PR_139	16/11/2014	13:07:26	40° 41,05895'	28° 33,11437'	16/11/2014	13:23:59	40° 38,72851'	28° 30,7994'
PR_140	16/11/2014	13:24:15	40° 38,72851'	28° 30,7994'	16/11/2014	13:38:34	40° 37,1576'	28° 33,55741'
PR_141	16/11/2014	13:41:11	40° 37,26689'	28° 34,02749'	16/11/2014	14:05:58	40° 40,90738'	28° 37,23734'
PR_142	16/11/2014	14:08:09	40° 41,21054'	28° 37,49159'	16/11/2014	14:23:00	40° 42,95485'	28° 40,13078'



MARSITECRUISE

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APPENDIX 6

Sub-bottom profiles (CHIRP)

SUB-BOTTOM PROFILES (CHIRP)

LEG 1

Profile name	start		end	
	Lat	Lon	Lat	Lon
MRS-SBP-02	40.8420889	28.4512194	40.8857694	28.5287306
MRS-SBP-03	40.8809306	28.5281222	40.8699278	28.5046694

LEG 3

Profile name	start		end	
	Lat	Lon	Lat	Lon
MRS-SBP-32a	40.6688972	28.9036111	40.6525972	28.8441167
MRS-SBP-32b	40.6525917	28.8440917	40.6480472	28.8288167
MRS-SBP-33	40.6600722	28.8774833	40.6310444	28.8520611
MRS-SBP-35	40.6283000	28.8621833	40.6423833	28.7514083
MRS-SBP-37a	40.6439306	28.7481639	40.6835639	28.6349389
MRS-SBP-37b	40.6835806	28.6348944	40.6896889	28.6149806
MRS-SBP-39	40.6851694	28.6073861	40.6354694	28.5541667
MRS-SBP-40a	40.6355722	28.5539056	40.6819083	28.4447639
MRS-SBP-40b	40.6819583	28.4446417	40.6937694	28.4160639
MRS-SBP-41	40.6938361	28.4158917	40.7054333	28.3892139
MRS-SBP-43	40.6945639	28.3791444	40.7120056	28.4207972
MRS-SBP-46a	40.7030444	28.3957389	40.6572806	28.4906583
MRS-SBP-46b	40.6572583	28.4907028	40.6859167	28.5581611
MRS-SBP-46c	40.6859472	28.5581889	40.7095167	28.5705583
MRS-SBP-47a	40.7095167	28.5702389	40.7033056	28.4189194
MRS-SBP-47b	40.7033028	28.4188639	40.7020639	28.3933056
MRS-SBP-48	40.7020306	28.3930556	40.6802667	28.3292306
MRS-SBP-49a	40.6803222	28.3289556	40.7065444	28.2019278
MRS-SBP-49b	40.7065556	28.2018806	40.7093167	28.1875722
MRS-SBP-49c	40.7286639	28.0927472	40.7413972	28.0314389
MRS-SBP-50a	40.7415472	28.0307417	40.7721861	27.8918944
MRS-SBP-50b	40.7722056	27.8918000	40.7840722	27.8383028
MRS-SBP-51	40.7842417	27.8379083	40.8173694	27.7826139
MRS-SBP-52	40.8174861	27.7826139	40.8479000	27.8067389
MRS-SBP-53	40.8487778	27.8013944	40.8394750	27.7908056
MRS-SBP-55	40.8119556	27.7746833	40.8245361	27.7727972
MRS-SBP-56	40.8253444	27.7726500	40.8687611	27.7640833
MRS-SBP-57	40.8689083	27.7624889	40.9138194	27.7635389
MRS-SBP-58	40.9091000	27.7566861	40.8928167	27.7394667
MRS-SBP-59	40.8904056	27.7330889	40.8495528	27.7058222
MRS-SBP-60	40.6490806	28.5033278	40.7060583	28.5603806
MRS-SBP-61a	40.7097778	28.5623139	40.8401083	28.5492167
MRS-SBP-61b	40.8401500	28.5492139	40.8700500	28.5483194
MRS-SBP-62	40.8681944	28.5479000	40.8702056	28.4975583
MRS-SBP-63	40.6998861	28.5669917	40.6446861	28.5135028
MRS-SBP-64	40.6429222	28.5149139	40.6185611	28.5619778
MRS-SBP-65	40.6204611	28.5662417	40.6885028	28.6265806
MRS-SBP-66	40.6886139	28.6267278	40.7172389	28.6707389

MARSITECRUISE

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APPENDIX 7

Marsite Cruise participants

Participants	Institution	email address	LEG 1	LEG 2	LEG 3	Country	Work on board
André Ogor	Ifremer	andre.ogor@ifremer.fr	1		1	FRANCE	
Livio Ruffine	Ifremer	livio.ruffine@ifremer.fr	1	1	1	FRANCE	Chief scientist Leg 2
Jean-Pierre Donval	Ifremer	jean.pierre.donval@ifremer.fr	1	1		FRANCE	Gas bubbles: molecular analysis
Yoan Germain	Ifremer	yoan.germain@ifremer.fr		1		FRANCE	Fluid alkalinity
Hélène Ondréas	Ifremer	helene.ondreas@ifremer.fr	1	1		FRANCE	Geology/ Mosaic picture
Anne-Sophie Alix	Ifremer	anne.sophie.alix@ifremer.fr		1		FRANCE	GIS
Ludovic Legoix	Ifremer	ludovic.legoix@ifremer.fr		1		FRANCE	Gas bubbles: C1 $\delta^{13}\text{C}$ analysis/ High-pressure Hydrate analysis
Emmanuel Ponzevera	Ifremer	emmanuel.ponzevera@ifremer.fr		1	1	FRANCE	Fluid extraction for metal isotopes (Sr, Li, B)
Claire Croguennec	Ifremer	claire.croguennec@ifremer.fr		1	1	FRANCE	Fluid extraction for minor element analysis/ pore fluids: C1 and CO2 $\delta^{13}\text{C}$ analyses
Joel Etoubleau	Ifremer	joel.etableau@ifremer.fr		1		FRANCE	<i>Sediment</i> : XRF analysis
Françoise Lesongeur	Ifremer	francoise.lesongeur@ifremer.fr		1		FRANCE	Deep Sea Environment
Dominique Birot	Ifremer	dominique.birot@ifremer.fr		1		FRANCE	CTD/ methane capteur
Jonathan Perchoc	Ifremer	jonathan.perchoc@ifremer.fr		1		FRANCE	CTD/ methane capteur
Christian Podeur	Ifremer	christian.podeur@ifremer.fr		1		FRANCE	Push core/ methane capteur
Joel Knoery	Ifremer	joel.knoery@ifremer.fr		1		FRANCE	Gas and pore fluids: Hg analysis
Bastien Thomas	Ifremer	bastien.thomas@ifremer.fr		1		FRANCE	Gas and pore fluids: Hg analysis
Emmanuel Rinnert	Ifremer	emmanuel.rinnert@ifremer.fr		1		FRANCE	Raman: Gas bubble/ dissolved HAP analyses
Louis Géli	Ifremer	louis.geli@ifremer.fr	1	1	1	FRANCE	Project leader, Chief scientist Leg 1
Laurent Bignon	Ifremer	laurent.bignon@ifremer.fr	1	1	1	FRANCE	PEGAZ deployment/maintenance
Carla Scalabrin	Ifremer	carla.scalabrin@ifremer.fr	1	1	1	FRANCE	Acoustic: water column survey
Angélique Roubi	Ifremer	angelique.roubi@ifremer.fr		1	1	FRANCE	Core : MSCL
Ronan Apprioual	Ifremer	ronan.apprioual@ifremer.fr	1			FRANCE	Mechanics
Pelleau Pascal	Ifremer	pascal.pelleau@ifremer.fr			1	FRANCE	Electronics
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