MARSITECruise Report

2014 1st - 13th November - Leg 2

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MRS-HY-01	CTD/ Rosette
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MRS-DV-01-BC-03	Blade core
MRS-DV-01-PG-02	Pegaz
MRS-DV-01	ROV dive 1
MRS-DV-01-TI-07	Titanium bottle
MRS-DV-01-RA-15	Raman

Ex : MRS-DV-02-PC-03

MRS = MARsite
DV-02 = second ROV dive
PC-03 = third push core of the dive

1. General context

1.1. Background

1.1.1. Earthquake history in Europe and the Marmara region

Earthquakes continue to cause destruction around the world, including in the European region. In only the last fifteen years, substantial damage and casualties were produced in 1999 in Izmit (Turkey), 1999 in Athens (Greece) and 2009 in L'Aquila (Italy) due to damaging earthquake occurrence. Fortunately none of these events was as catastrophic as earthquakes in, for example, Istanbul in 1509 and 1766, Izmir in 1688, Eastern Sicily in 1693 and 1908 and Lisbon in 1755. Earthquakes in Turkey are caused by the activity of the North Anatolian Fault (NAF), which crosses the country along an east-west axis. For more than two millennia the Marmara region has been the crossroads between east and west. Being a continuously populated region and having as its centre Istanbul, the capital of both Eastern Roman and Ottoman empires, the historical seismicity record is continuous and relatively complete. Earthquake records spanning two millennia indicate that, on average, at least one medium intensity (Io=VII-VIII) earthquake has affected Istanbul in every 50 years. The average return period for high intensity (Io=VIII-IX) events has been about 250-300 years, the last one was in 1766.

Thus, this type of catastrophic event is now expected in the Marmara region. This region is considered by the scientific community as a unique natural laboratory for the study of earthquake-related science. This tectonically-diverse stretch plate-boundary contains a network of small faults organized around the right-lateral North Anatolian Fault. The geographic dimensions are well-suited to system-level earthquake studies: big enough to contain large (M > 7.4) events, which set the system's outer scale, but small enough for detailed surveys of seismicity and fault activity. Many of the faults in the region are seismically active, making the region one of the most data-rich and hazardous in Europe. Thus, research on fundamental problems in this well-instrumented natural laboratory keeps progressing.

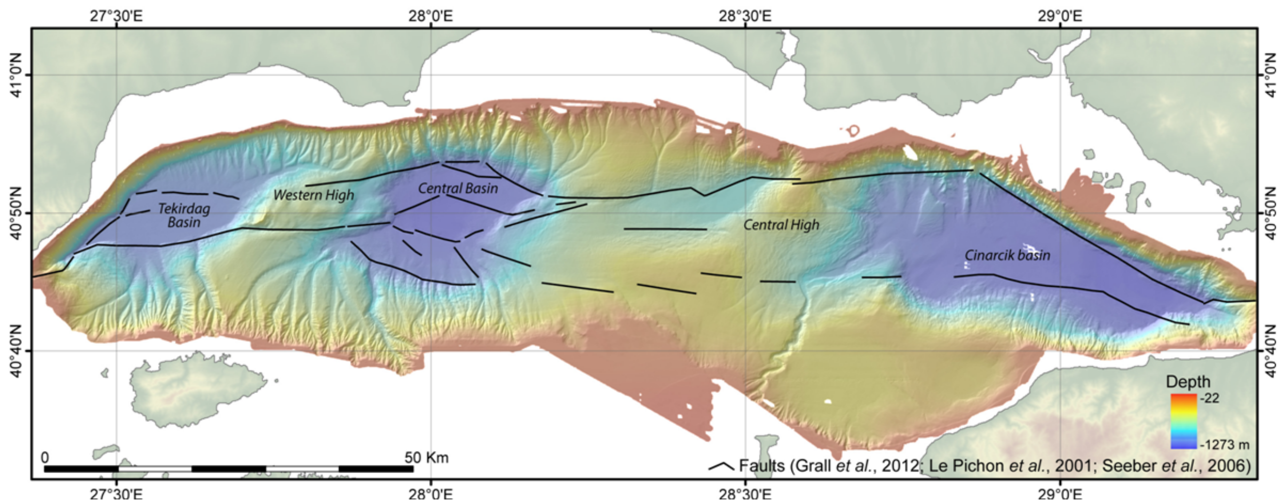


Figure 1 : Map of fault network in the sea of Marmara

1.1.2. MARSITE PROGRAMME

Owing to the aforementioned regional context, the heavily populated (> 15 M inhabitants) Marmara region has been identified at the EU level as a ‘Supersite’ in Europe for the monitoring and mitigation of natural hazards. As a result, the MARsite programme was funded in June 2012, for an amount of 7 M€ by the EC, under the call ENV.2012.6.4-2. Coordinated by KOERI, MARsite gathers 21 partners from Turkey, Italy, France, Germany, UK, Netherland and Switzerland.

A specific work package (WP8) including all marine operations was approved and implemented within MARsite Programme for «monitoring seismicity and fluid activity near the fault using existing cabled and autonomous multiparameter seafloor instrumentation ». This has involved a specific cruise, MARSITECruise, for the deployment of instrumentations, combined with a scientific program to investigate the seep activity in the Sea of Marmara (SoM).

The MARSITECruise was organized in 3 separated legs:

- Leg-1 (4 working days at sea; October, 28th to November, 1st) was specifically devoted to the deployment of 6 OBSs to collect long time series of geophysical data on the relations between fluids and seismicity, and 10 geodetic transponders to characterize and quantify strain along the Istanbul-Silivri fault segment. The latter instruments will be maintained after 6 months and recovered after at least five years.

- Leg-2 (12 working days at sea; November, 1st to November, 13th) was devoted to the geochemical investigation of cold seeps characterized by vigorous gas emissions. Operations carried out in the frame of this leg consist of: Acoustic surveys using both Multibeam Echo-Sounder RESON SeaBat 7150 and the Ixsea Echoes 3.5 sediment penetrator, dives with Ifremer’s ROV Victor 6000 for seafloor inspection, long sediment cores for pore-fluid, gas hydrates and solid phases extractions, *in situ* gas sampling using the PEGAZ system and hydrocasts using a CTD-Rosette coupled with methane sensors. The generated database, together with the analyses of the collected samples aims at providing accurate knowledge on the relationships between fluid migration and faulting. It will further our understanding on the hydrogeologic system of the SoM. In addition, an acoustic bubble recorder (BOB) was deployed on the Western High to monitor the time evolution of bubble emissions on a gas seep field.

- Leg-3 (4 working days at sea, November, 13th to November, 16th) was devoted to sedimentology sampling: 13 sediment cores of more than 12m length were collected for seismistratigraphy investigation.

The present report details the operations of Leg-2. It has involved 10 partners: Ifremer (Brest and Nantes), 3 labs within CNRS (LOCEAN-Paris, MNHN-Paris, CRPG-Nancy), ITU (Istanbul), TUBITAK (Istanbul), MTA (Ankara), Peking University- China and University of Müenster-Germany.

1.2. **Objectives of Leg-2**

The Sea of Marmara has a highly faulted seafloor as it is crossed east- west by the North Anatolian Fault (NAF), and is characterized by an extensive secondary-fault networks. This whole fault system acts as preferential conduits for fluid (gases, brine, and brackish water) migration (Tryon et al., 2010). The occurrence of multiple seeps emitting gases at the seafloor gives rise to a large number of plumes in the water column (Géli et al., 2008; Zitter et al., 2008, Dupré et al.).

The scientific expedition, Marnaut (http://p.f.henry.free.fr/marmara/), conducted in 2007 on the *R/V* Atalante with the Nautile submersible, has enabled the identification of tens of gas-seep sites (Burnard et al., 2012; Dupré et al., 2012; Géli et al., 2008). Three of them have been sampled. They were characterized by the presence of bacterial mats, macro, mega- and meiofauna (Ritt et al.). The geochemical analyses revealed that the gases result from mixture of several source of different origin (Bourry et al., 2009; Ruffine et al., 2012): At the western part of the SoM, the gases are of thermogenic origin and mainly come from the Thrace basin, the more important hydrocarbon-producing province of Turkey. Methane represents ~90% of their molar composition. Mantle-derived helium are found at the very western part of the sea (Burnard et al., 2012). Thermogenic gases have also been collected in the central part. However, methane is overwhelmingly present (more than 98 %-mol), and the isotopic analyses revealed that these gases have undergone a biodegradation at the reservoir level or during secondary migration, followed by methanogenesis at depth. The eastern part of the sea is mainly characterized by biogenic gases resulting from CO_2-reduction at low temperature.

Gas hydrates have also been collected on the western part of the sea and were characterized by a large amount of heavy hydrocarbons (> 20%-mol), more important than for the associated gas seeps (Bourry et al., 2009; Ruffine et al., 2012).

The Marmesonet cruise in 2009, on board the *R/V* Le Suroit, was primarily devoted to (1) the mapping of gas plumes over the entire SoM by AUV-driven acoustic surveys, and (2) the characterization of the system plumbing by 3D seismic. After processing, the seismic data show a diapiric feature with a seafloor-oriented end which looks like a mud volcano on the Western High. This structure pierces the crest of an anticline within less than 1 km off the fault zone, and allows to convey gas to seeps on the seafloor. Based on new heat flow data acquired during the same cruise, and on published geochemical study of the petroleum system of the Thrace basin, the location of the gas-prone layer is at depths greater than ~2 km below seafloor, well into the seismogenic zone. Hence, it is expected that the physical, and possible the chemical, properties of the fluids within the conduit of the mud volcano-like structure change systematically with the state of stress and strain in the fault zone, and accordingly might be linked to earthquake cycle.

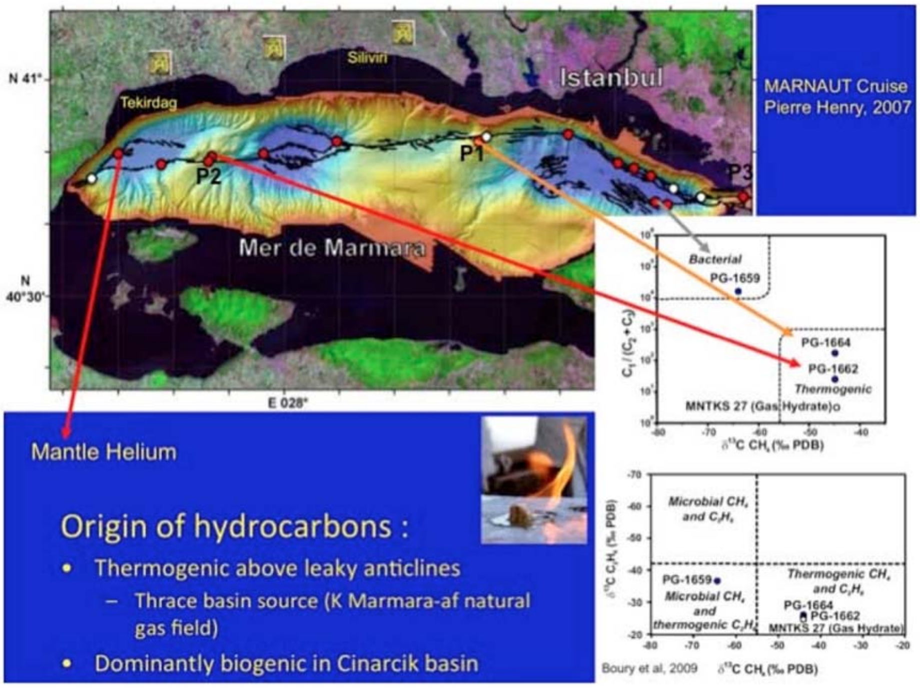


Figure 2 : Summary of the main results obtained during the MarNaut Cruise (Chief of Expedition: Pierre Henry) based on the geochemical analysis of gas sampled in-situ with Nautile submersible [e.g. Bourry et al, 2009].

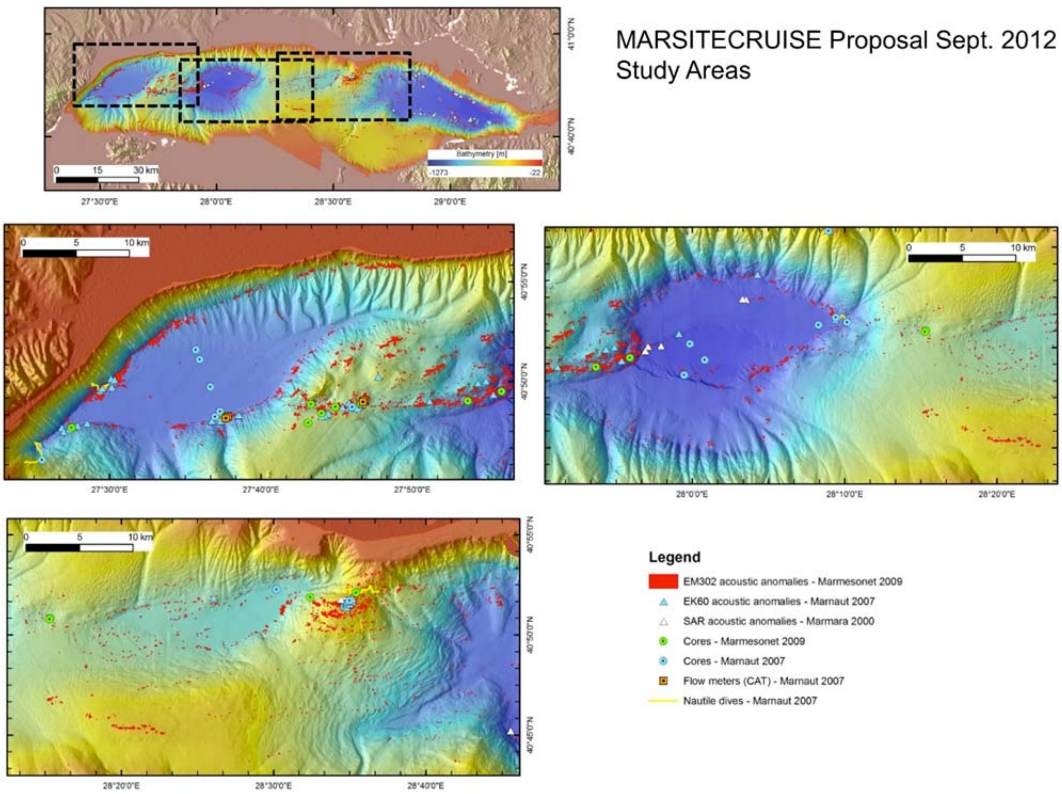


Figure 3 : Distribution of gas emission sites acoustically detected during the Marmesonet cruise in november 2009 (Chief of Expedition: Louis Géli).

Overall, it is clear that due to its broad regional occurrences, gas seeps 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 seeps may also be influenced by earthquake occurrences (Cormier et al., 2006; Kuscu et al., 2005; Kuscu et al., 2008). These seeps are also key elements for the development of the ecosystems characterized by a large variety of habitats of chemosynthetic species.

Accordingly, the leg-2 of MARSITECruise has represented a unique opportunity to investigate both relationships between fluid migration and faulting, and the dynamics of cold seeps in the SoM. These two topics will be studied by using an approach based on geochemistry, geology, geophysics, micro- and biology.

The specific objectives of the cruise were:

1. To sample gas bubbles at key seismogenic locations in the SoM in order to reconstruct the gas migration pattern. Such a sampling appears in first place in the list as it has the highest priority because of the critical need to better constraint the hydrocarbon sources, the mixing between sources and the role of the fault network on fluid migration.

2. To undertake ROV dives for fluid, carbonate and sediment sampling combined with a visual inspection of the seep activity and the associated ecosystems.

3. To conduct coring operations in the vicinity of the sampled gas seeps, and also away from them in order to get reference cores.

4. To deploy CTD-Rosette associated with two methane sensors in the surrounding of the gas seeps. As mentioned previously, methane is overwhelmingly present in the released gases. It appears clear that, in the frame of the development of seafloor observatories, monitoring methane emission in the water column is key.

5. To carry out acoustic survey of both the water column and the sediment at the sampled gas seeps.

1.3. **Team**

1.3.1. Scientific and technical staff

Table 1 : Scientific and technical staff

Surname	Given Name	Position	Institution
Ruffine	Livio	Geochemist- Chief of the Expedition	IFREMER
Géli	Louis	Geophysicist	IFREMER
Scalabrin	Carla	Acoustic data specialist	IFREMER
Ondréas	Hélène	Geologist	IFREMER
Donval	Jean-Pierre	Engineer- Geochemist	IFREMER
Bignon	Laurent	Technician- Mechanics	IFREMER
Germain	Yoan	Technician - Geochemist	IFREMER
Alix	Anne-Sophie	Technician - GIS	IFREMER
Legoix	Ludovic	Ph D- Geochemist	IFREMER
Ponzévera	Emmanuel	Engineer - Geochemist	IFREMER
Croguennec	Claire	Engineer - Geochemist	IFREMER
Etoubleau	Joel	Technician - Geochemist	IFREMER
Lesongeur	Françoise	Technician - Microbiology	IFREMER
Birot	Dominique	Engineer - Geochemist	IFREMER
Perchoc	Jonathan	Training Engineer- Electronician	IFREMER
Podeur	Christian	Technician- Mechanics	IFREMER
Knoery	Joel	Geochemist	IFREMER
Thomas	Bastien	Technician - Chemist	IFREMER
Rinnert	Emmanuel	Engineer - Chemist	IFREMER
Tarditi	Corinne	Technician - Data management and reporting	IFREMER
Roubi	Angélique	Technician - Geologist	IFREMER
Blanc-Valleron	Marie-Madeleine	Geologist	CNRS/ MNHN
Chevalier	Nicolas	Geochemist	Müenster University
Teichert	Barbara	Geochemist	Müenster University
Lu	Hailong	Geochemist	Peking University
Burnard	Peter	Geochemist	CNRS/ CRPG
Özbeki	Eyyüp	Biologist	MTA
Olgun Kiyak	Nazli	Geologist	ITU
Özaksoy	Volkan	Geologist	MTA

1.3.2. Pourquoi pas? Crew

Table 2 : Pourquoi pas ?Crew

Surname	Given Name	Position
ALIX	THIERRY	COMMANDANT
ROBBE	PHILIPPE	2ND CAPITAINE
GRILLON	MAXENCE	LIEUTENANT·2
TEDDE	PHILIPPE	LIEUTENANT-1
BERLEMONT	FRANCOIS	ELEVE POLYVALENT
MARTIN	PAULINE	ELEVE POLYVALENT
LE ROY	PATRICK	CHEF MECANICIEN
DAVID	FREDERIC	2ND MECANICIEN
DARCHEN	FANNY	OFFICIER MECANICIEN
FEVRE	QUENTIN	OFFICIER POLYVALENT
TRELUYER	LOIC	OFFICIER ELECTRONICIEN SUP
CAGNA	RENAUD	OFFICIER ELECTRONICIEN RESP
TAGATAMANOGI	VISESIO	MAITRE D'EQUIPAGE
LANDY	LAURENT	MAITRE D'EQUIPAGE
TANGUY	ERWAN	MAITRE DE MANOEUVRE
QUINTON	FREDERIC	CHEF DE BORDEE
GUILLERME	ALAIN	CHEF DE BORDEE
GARCIA	SERGE	MATELOT-2
LE QUELLEC	LOIC	MATELOT-6
LE CHELARD	DAVID	MATELOT-5
LE BERRE	TONY	MATELOT-4
ROGER	JEAN LUC	MAITRE MECANICIEN
JACOB	STEPHANE	MAITRE MECANICIEN
LE GUILLOUX	ANTHONY	MAITRE ELECTRICIEN
LE REUN	DAVID	OUVRIER ELECTR ICIEN
MILLOUR	JEAN PHILIPPE	NETTOYEUR
DESCLOU	JEAN FRANCOIS	1ER CUISINIER
CAUDAN	YVON	2ND CUISINIER
LE GAC	REGIS	AIDE DE CUISINE
LE BRIS	JEAN LUC	1ER MAITRE D'HOTEL
TRINQUART	GWENAEL	2ND MAITRE D'HOTEL
LE BRAS	LEO	GARCON-1
GARC IA	GAELLE	GARCON-2
LE BERRE	TONY	MATELOT-4
LE COZ	RONAN	MATELOT-4

1.3.3. ROV team

Table 3 : ROV team

Surname	Given Name	Position
CHEILAN	PATRICK	HEAD OF THE TEAM
BAUSSAN	CLEMENT	MECANICIEN
BONNET	LOIC	MECANICIEN
BOUILLET	HEINRICH	MECANICIEN
CHRISTOPHE	ALAIN	INGENIEUR
DE PARSEVAL	GUILLAUME	ELECTRONICIEN
LAJOIE	DAVID	ELECTRONICIEN
MORVAN	LAURENCE	ELECTRONICIEN
PLACAUD	XAVIER	ELECTRONICIEN
SAINT LAURENT	XAVIER	ELECTRONICIEN
SANDEL	THOMAS	ELECTRONICIEN

2. Working areas and scheduled operations

ROV dives were performed along fault segments in order to perform visual inspection of the seafloor and search for gas emissions.

During the dives, various samples were taken :

- Gas bubbles for molecular and isotopic (δ13C and δD) composition measurements, Pore fluids for both organic and mineral dissolved-element measurements,
- Small sediment cores for microbiology study, and XRD and XRD analyses onshore,
- Carbonates and other solid phases outcropping to the seafloor for mineralogy study.

Besides ROV dives, coring operations and CTD-Rosette deployment were carried out at a vigourous gas seep selected from the previous ROV dive.

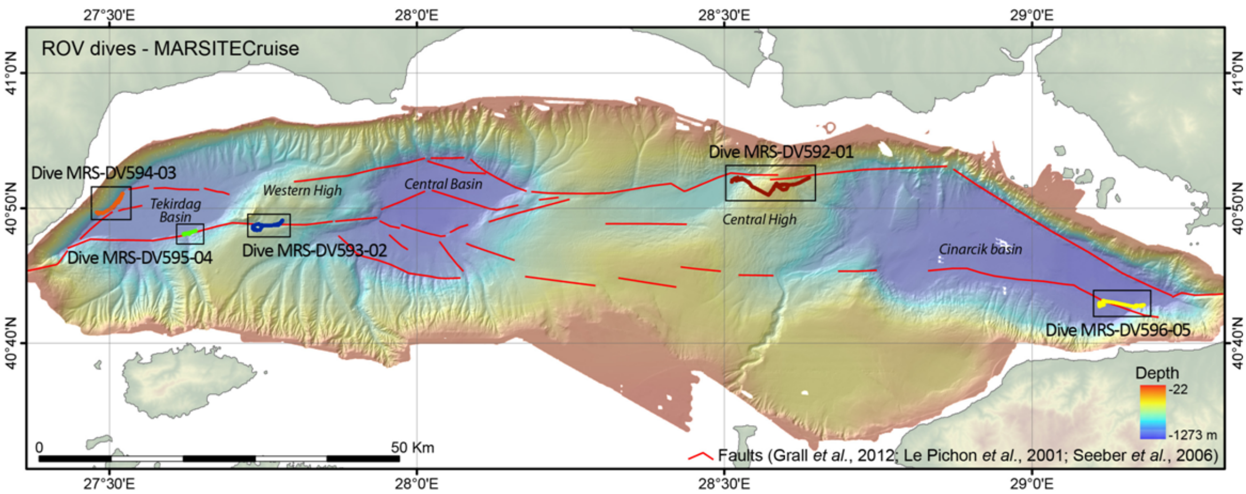


Figure 4 : General map of the Sea of Marmara showing the five investigated fault segments

3. Tools used

3.1. ROV Victor 6000 and associated tools

The Remotely Operated Vehicle Victor 6000 can be deployed at water depth up to 6000 m.

Figure 5 : ROV Victor 6000 (courtesy of Emmanuel Ponzévéra)

It allows two dive configurations :

- When the Side scan sonar Seabat 7125, commonly called -Module de Mesures en Routes- MMR, is mounted, very accurate bathymetric surveys can be performed. Structures as small as ~25 cm scale can be identified.
- When the sampling module is mounted, collection of a large variety of materials (sediment cores, bottom water, carbonates, gas bubbles, megafauna, etc.).

Its main purpose for MARSITECruise was to explore the deep-sea by visual inspection, together with sampling geochemical and micro-biological materials. Bathymetric surveys have not been undertaken.

3.1.1. Push corer

Using the ROV arm, it is possible to sample the upper 30 cm of sediment with a push corer. Such a system is suitable for the sampling of sediment associated with microbial mat.

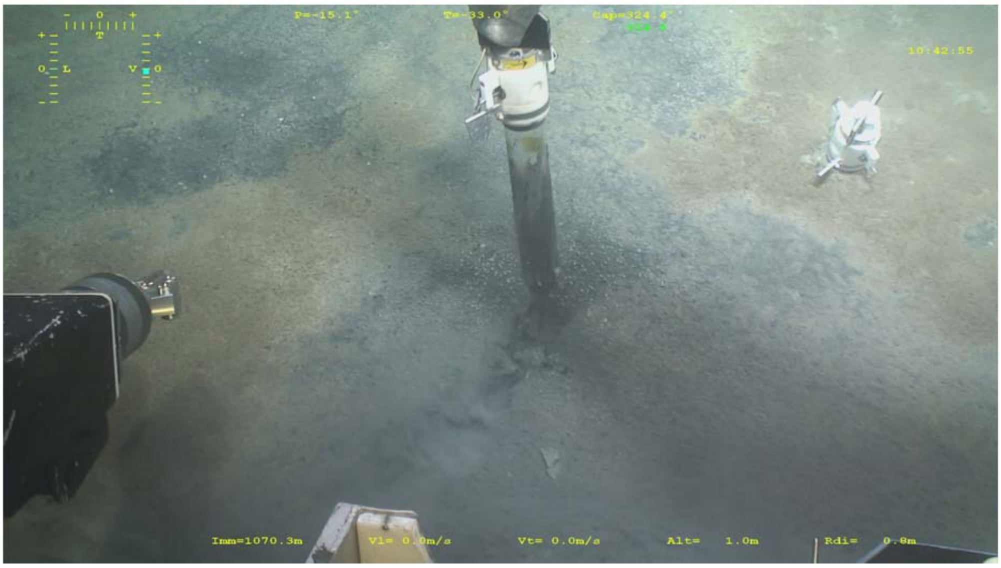


Figure 6 : Sediment sampling by ROV using a push core.

3.1.2. Blade corer

Using the ROV arm, it is possible to sample the upper 30 cm of sediment over a surface of around 600 cm^3 with a blade corer. Such a system is suitable to sample sediment associated with microbial mat and megafauna.

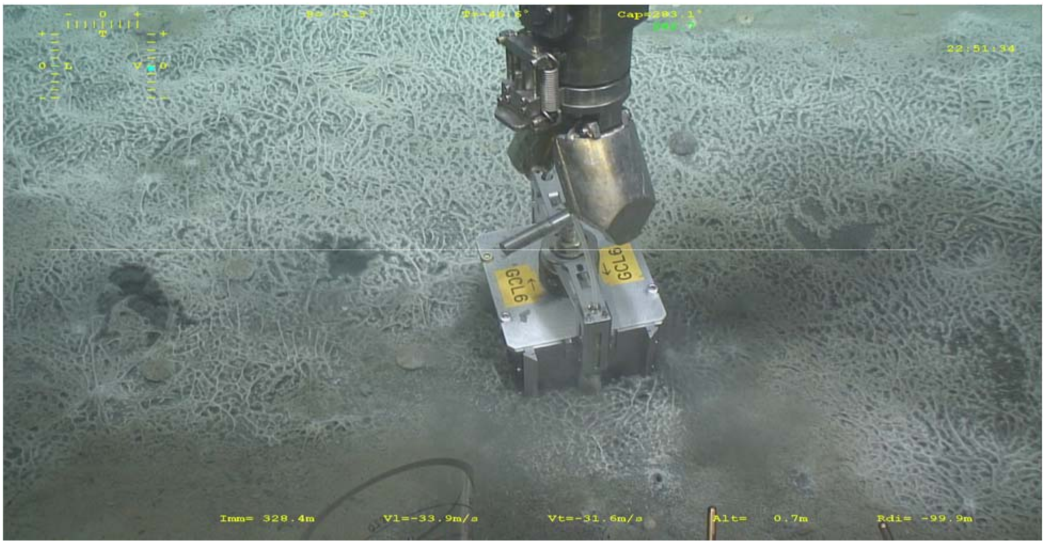


Figure 7 : Sediment sampling by ROV using a blade core.

3.1.3. Titanium syringe

The titanium syringe allows the sampling of fluids, especially liquid, emanating from the seafloor.

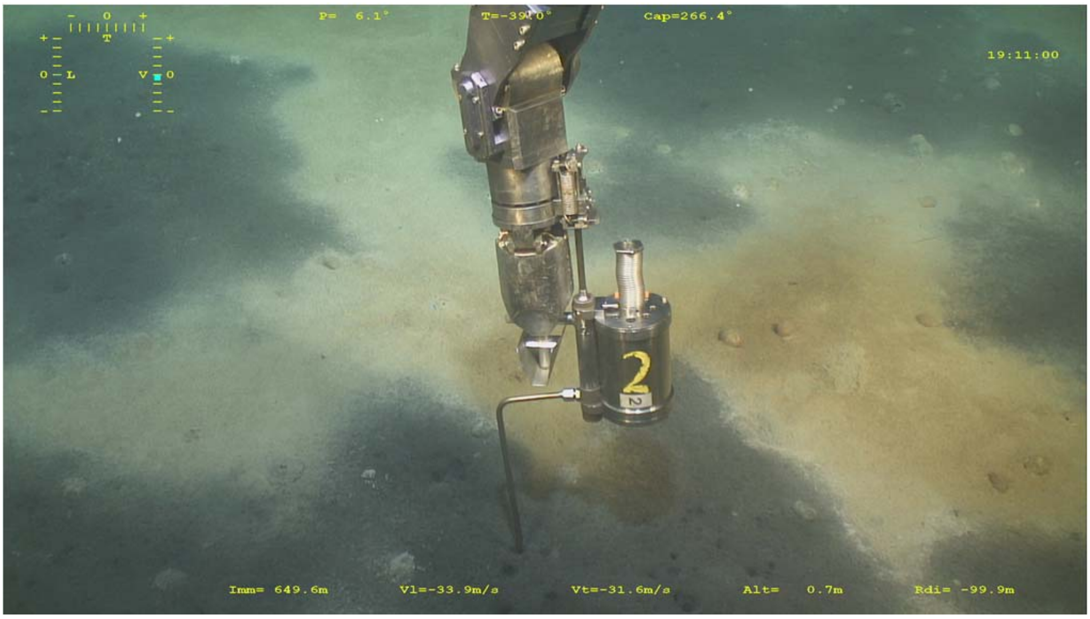


Figure 8 : Fluid sampling by ROV using a titanium syringe.

3.1.4. PEGAZ sampler

The PEGAZ sampler allows the sampling of gas bubbles emanating from the seafloor.

Figure 9 : Gas sampling by ROV using the PEGAZ sampler.

3.1.5. Flowmeter

This instrument allows the measurement of gas flow at seep vent.

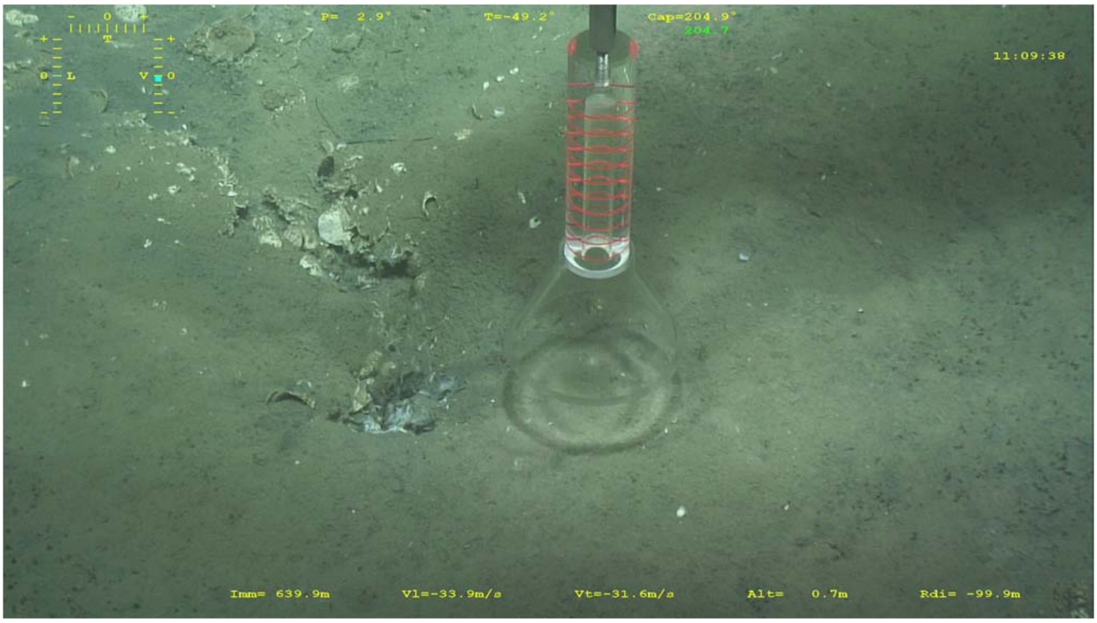


Figure 10 : Flow measurement on a gas seep.

3.1.6. *In situ* Raman spectrometer

The *in situ* Raman spectrometer "Ramses" allows a quick measurement of major chemical components present in the gas bubbles.

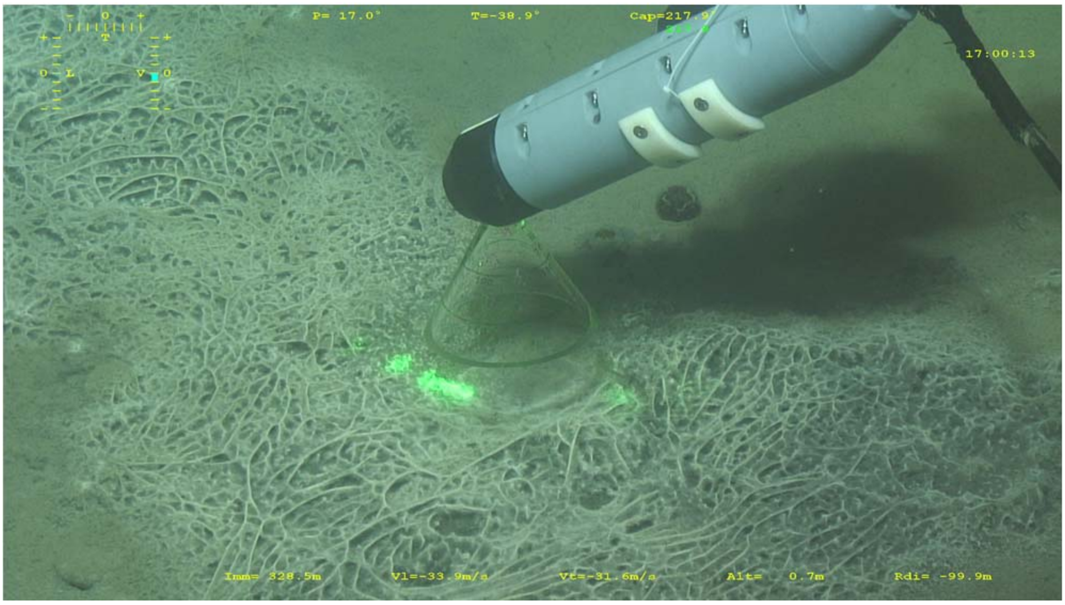


Figure 11: Chemical analysis of gas bubbles using a Raman spectrometer.

3.2. Calypso piston corer

The Calypso piston corer allows the recovery of long gravity core up to 36-m length.

Figure 12: Recovery of a giant piston core Calypso (courtesy of Emmanuel Ponzevera)

3.3. CTD- Hydrocast

The CTD- Hydrocast system allows the measurements of physical properties of the water column (Conductivity, Temperature and Depth), and the sampling of seawater. It is equipped with two methane sensors.

Figure 13 : CTD- Hydrocast system equipped with methane sensors (courtesy of Emmanuel Ponzevera)

3.4. **Multibeam survey**

Prior to each ROV dive, an acoustic survey of the water column was carried out in order to detect evidence of fluid emissions, in particular gas plumes. The multibeam echosounder SeaBat 7150 from Reson was used at a frequency of 12-24 kHz. The received echo-signals were processed using Ifremer‘s software SonarScope.

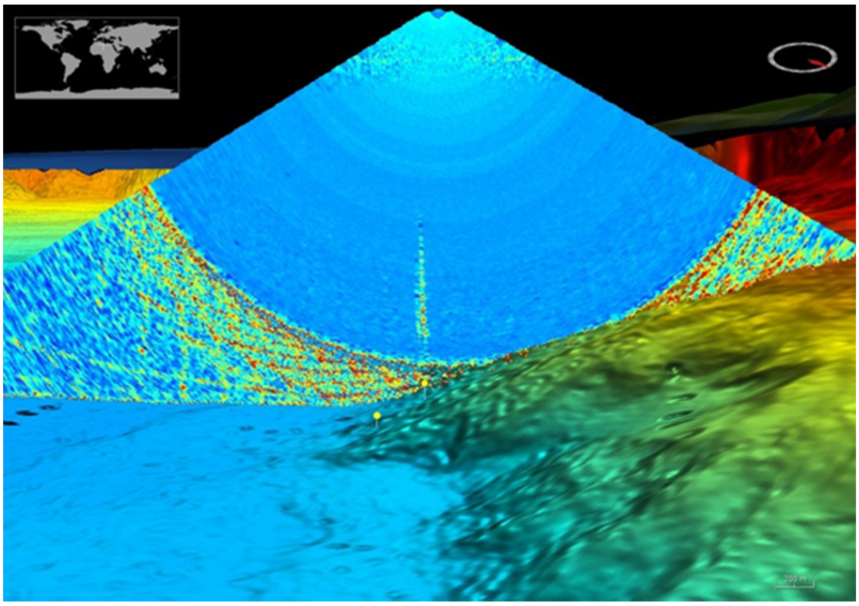


Figure 14 : Gas plume into the water column detected from the acoustic survey

4. Chronology of the cruise

4.1. **Timetable**

Table 4 : Timetable

Local Time (BEGIN OF OPERATION)	**Duration** (hours)	**OPERATION**	**Working Area**
1/11/14 23:00		Exchange of personnel – Start of Leg 2	
2/11/14 2:09	39,5	Start of ROV Dive 1 (Checking of the Deodesic deployment + geochemical sampling)	Central High
3/11/14 17:39	1	End ROV-Dive 1	
3/11/14 18:39	4	Coring on the Central High	
3/11/14 22:39	12,3	Transit close to Istanbul area for personnel exchange	
4/11/14 10:57	30,35	Start of ROV-Dive 2 (Deployment of BoB and ADCP + geochemical sampling)	Western High
5/11/14 17:18	2	End of ROV-Dive 2	
5/11/14 19:18	2	CTD-Hydrocast on the Western High	

Local Time (BEGIN OF OPERATION)	Duration (hours)	OPERATION	Working Area
5/11/14 21:18	5	Coring on the Western High	
6/11/14 2:18	5,2	Transit to Tekirdag Western flank with multibeam survey	
6/11/14 7:30	33	Start of ROV- Dive 3 on the Tekirdag Western Flank (Geochemical sampling)	Western Tekirdag
7/11/14 16:30	2	End of ROV- Dive 3	
7/11/14 18:30	4	CTD-Hydrocast on the Tekirdag Western flank	
7/11/14 22:30	4,7	Coring on the Tekirdag Western flank	
8/11/14 3:12	18,45	Start of ROV- Dive 4 on the Southeast Tekirdag basin (Geochemical sampling)	Southeastern Tekirdag
8/11/14 21:39	2	End of ROV- Dive 4	
8/11/14 23:39	2	CTD-Hydrocast on Southeast Tekirdag basin	
9/11/14 1:39	6	Coring on Eastern Tekirdag basin	
9/11/14 7:39	2	Coring Western High (Hydrate Mount)	
9/11/14 9:39	2	CTD-Hydrocast on Western High (Black bubble site)	
9/11/14 11:39	7	Transit to Kumburgaz basin	
9/11/14 18:39	3	Coring in Kumburgaz basin	
9/11/14 21:39	5	CTD-Hydrocast in Kumburgaz basin	
10/11/14 2:39	12	Transit to Cinarcik basin with multibeam survey	Cinarcik basin
10/11/14 14:39	26,65	Start of ROV- Dive 5 in Cinarcik basin (Geochemical sampling)	Cinarcik basin
11/11/14 17:18	2	End of ROV- Dive 5 in Cinarcik basin	
11/11/14 19:18	2	CTD-Hydrocast in Cinarcik basin	
11/11/14 21:18	5	Coring in Cinarcik basin	
12/11/14 2:18	30	Core processing- Fluid extraction- CTD-Hydrocast- Acoustic survey of the water column	
13/11/14 8:18	0	End of Operations for Leg 2- Transit to Istanbul Area	
13/11/14 8:18		Exchange of personnel -End Leg 2	
13/11/14 8:18		Start of Leg 3	

4.2. **Overall acquisition**

Table 5 : Summary of the overall acquisition

	PEGAZ	Raman	Flow	PC	BC	Ti	CS	CTD	Carbonates
Area of Dive 1	3	5	11	8	-	1	3	1	3
Area of Dive 2	2	2	2	8	-	1	3	2	2
Area of Dive 3	6	8	14	8	1	2	3	2	3
Area of Dive 4	3	5	5	4	-	1	0	2	2
Kumburgaz	-	-	-	-	-	-	1	-	-
Area of Dive 1	4	8	9	7	1	2	2	1	2
Total	18	28	41	35	2	7	12	8	12

5. ROV dives

Five dives have been carried out in the frame of Leg-2. All were devoted to seafloor exploration combined with geochemical sampling. However, Dives 1 and 2 allowed the checking of the geodesic deployment performed during Leg-1 and the deployment of the Bubble oBservatory (BoB), respectively.

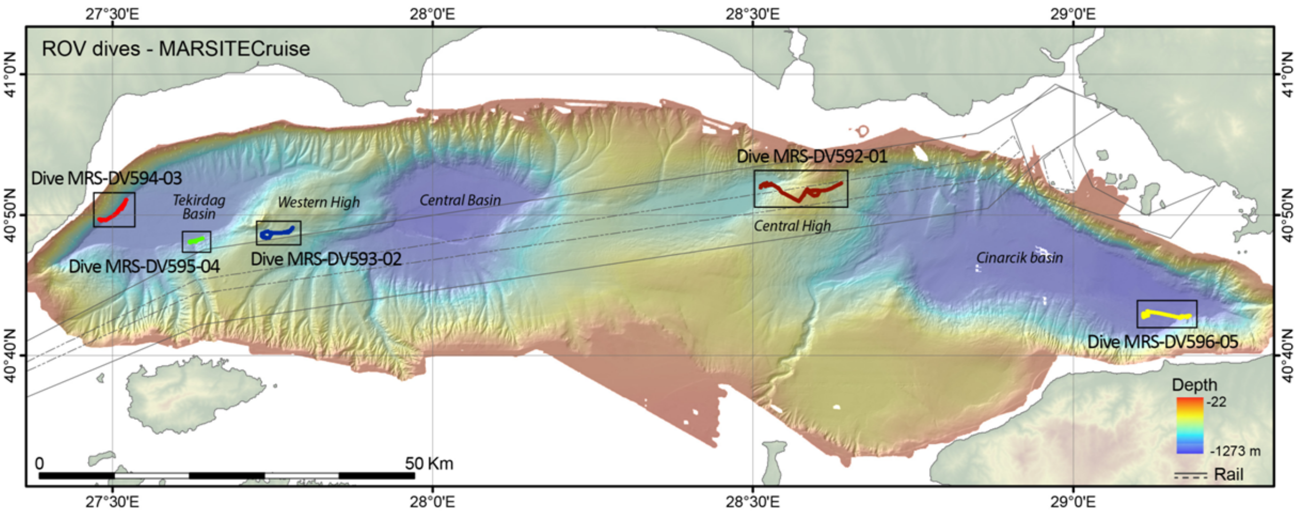
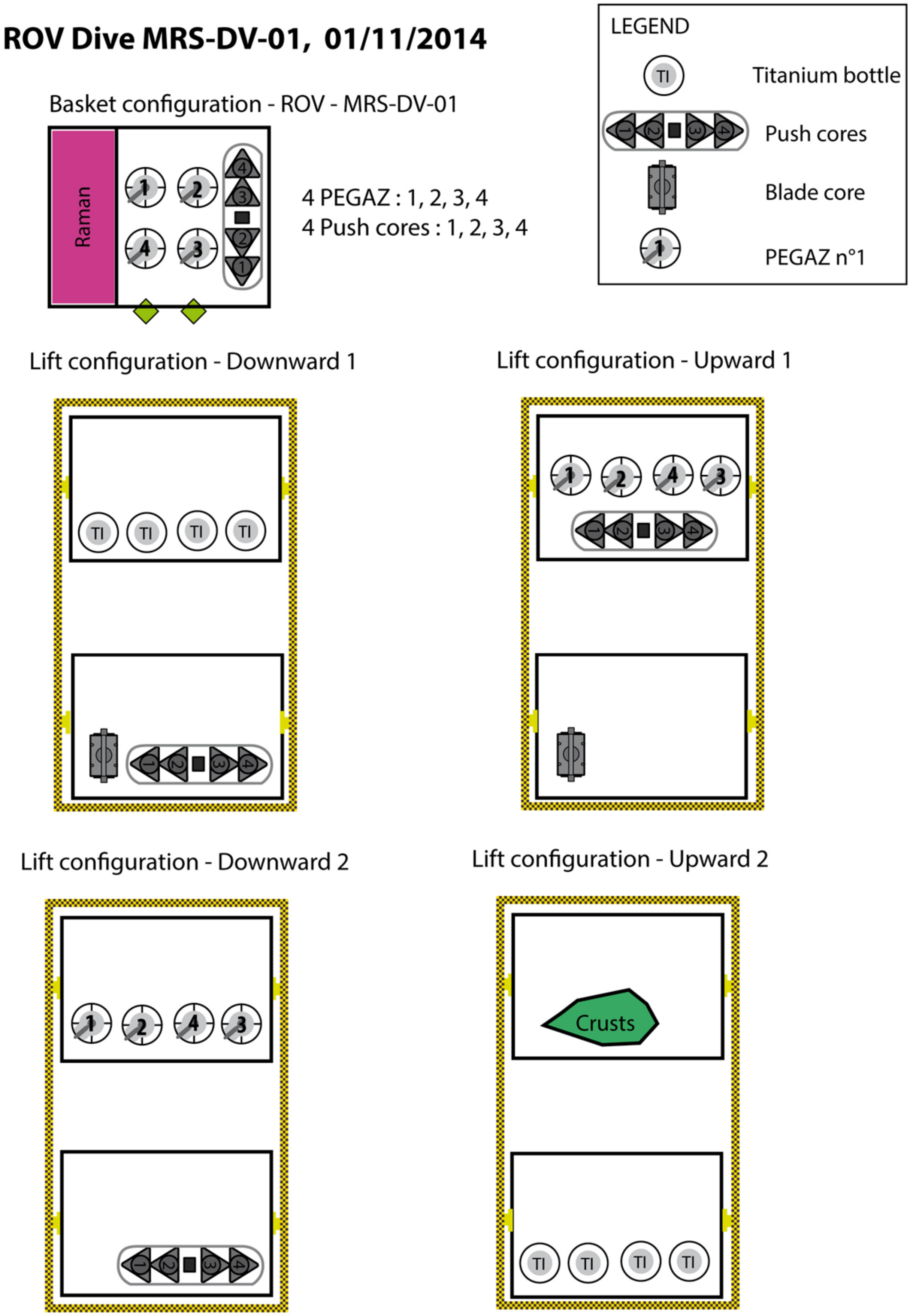


Figure 15 : General map showing the dive locations on the navigation rail

5.1. Dive MRS-PL592-01 (Central High)



Mission	
Marsitecruise01	
Date	02/11/2014 - 03/11/2014
Dive number	MRS-DV592-01
Responsable operation	CHEILAN P.
Vehicule	Victor
Vessel	Pourquoi Pas
Central Point	N40.862°, E28.583°
Latitude min	40.843988°
Longitude min	28.559278°
Latitude max	40.880007°
Longitude max	28.606722°
Geodetic system navigation	WGS84

Time		
Start from desk	02/11/2014 00:09:52	39:29 h
Arrival on desk	03/11/2014 15:38:11	
Under water	02/11/2014 00:28:45	38:37 h under water
Surface arrival	03/11/2014 15:05:01	
Arrival on sea bottom	02/11/2014 01:17:29	37:08 h on bottom
Departure from bottom	03/11/2014 14:25:29	23 km

Objectives:

- Detect any evidence of fluid seepages from visual inspection of the seafloor
- Sample gas bubbles from PEGAZ sampler to determine sources
- Sample bottom water to characterize dense-fluid emission and heavy-dissolved compounds
- Collect living communities associated with the seeps

Sampling and *in situ* measurements:

- PEGAZ
- Push Core
- Titanium bottle
- Raman spectrometer
- Flowmeter

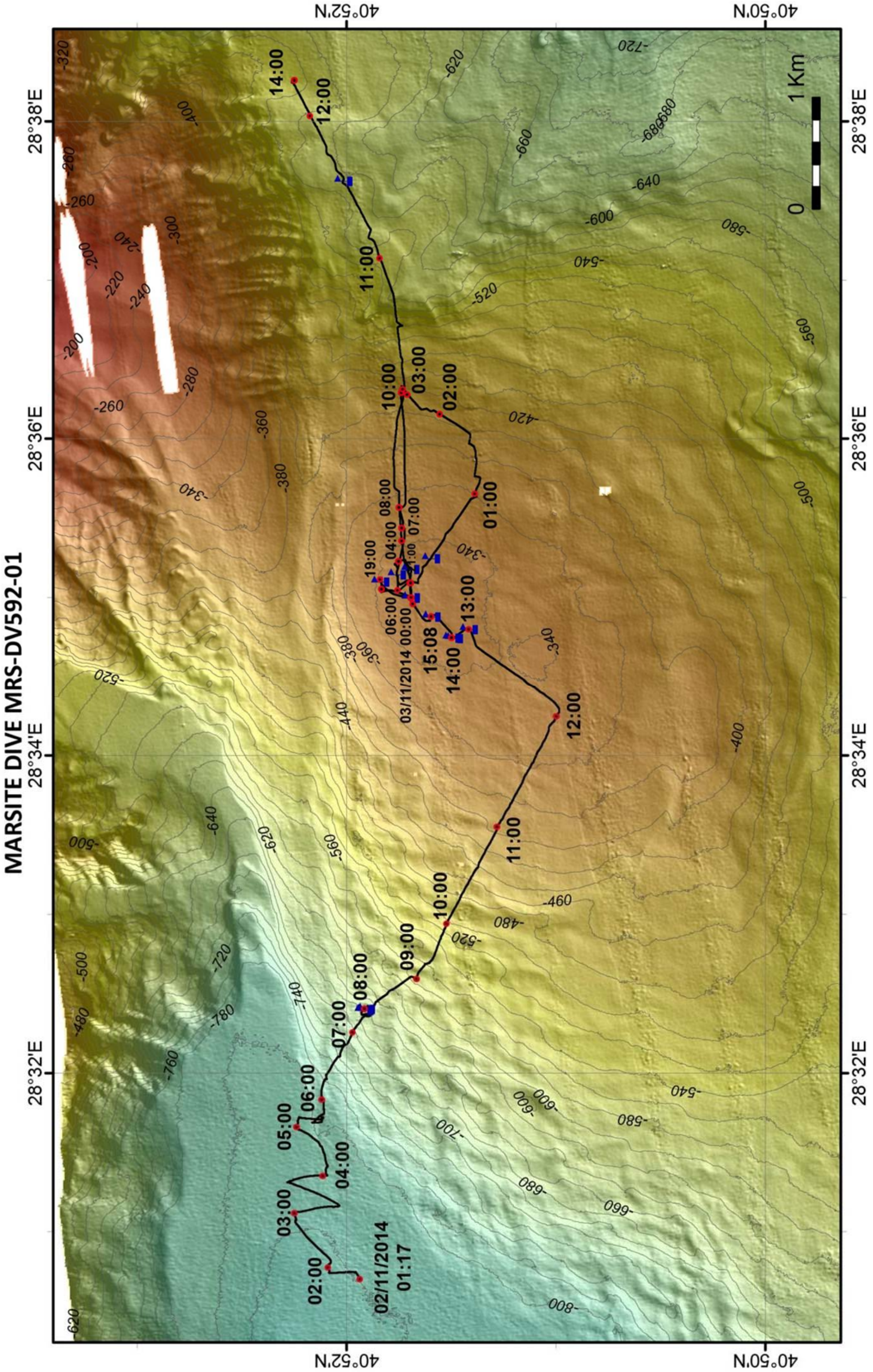


Figure 16 : MARSITE DIVE MRS-DV592-01

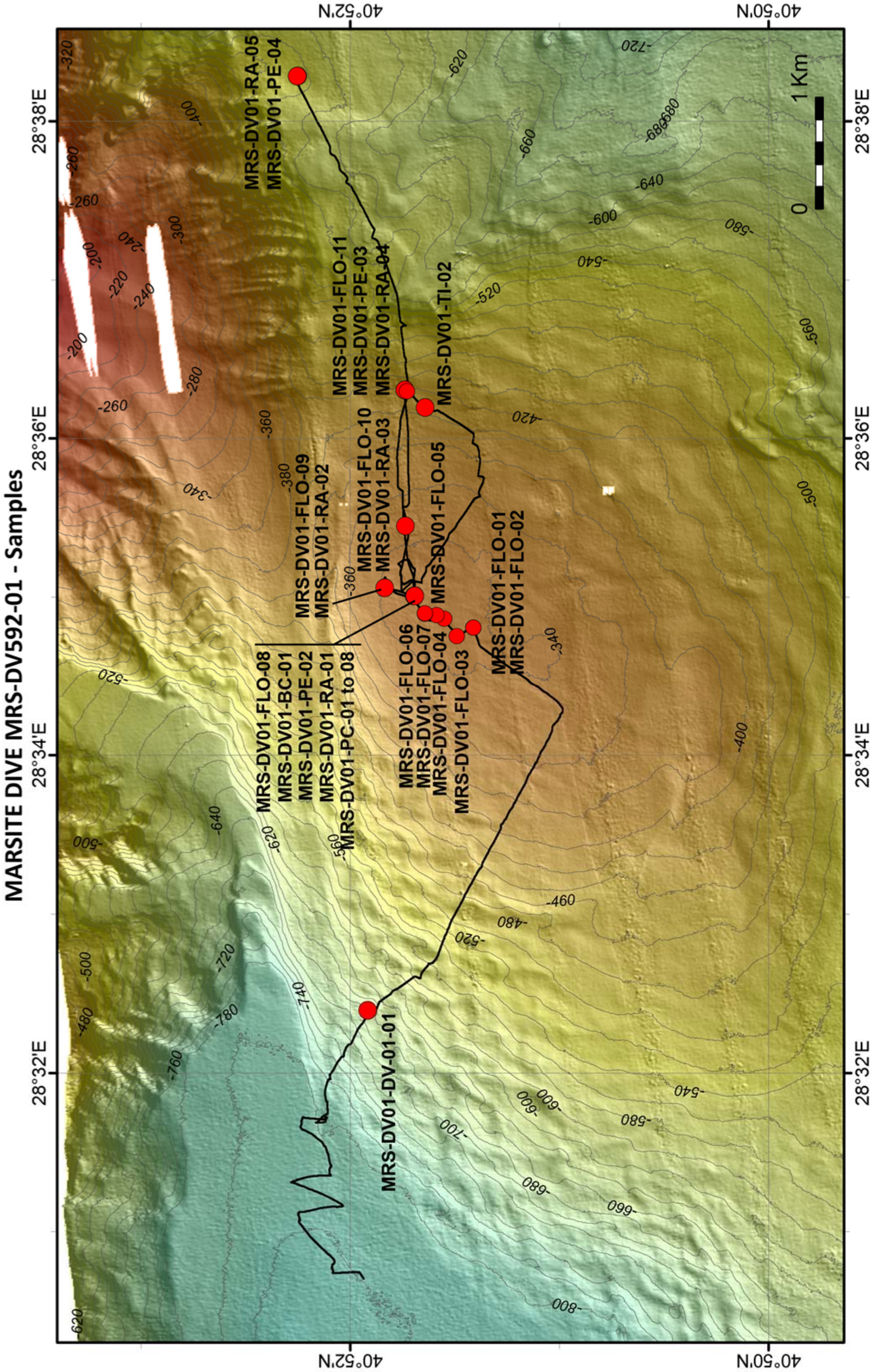


Figure 17 : MARSITE DIVE MRS-DV592-01 – SAMPLES

Table 6 : Marsite ROV dive MRS-PL592-01 diary

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV592-01	02/11/2014	01:28:08	40.8664649	28.5124214	813.07	bioturbation of sediment
MRS-DV592-01	02/11/2014	01:29:27	40.8666570	28.5124056	814.19	very poor visibility
MRS-DV592-01	02/11/2014	01:39:55	40.8680513	28.5123389	818.55	geodetic beacon G4 on the bottom
MRS-DV592-01	02/11/2014	01:49:15	40.8680663	28.5123408	818.09	View on tripod foot
MRS-DV592-01	02/11/2014	02:04:46	40.8681125	28.5132224	816.76	Balise F4
MRS-DV592-01	02/11/2014	02:14:39	40.8684494	28.5143139	817.44	Bioturbation
MRS-DV592-01	02/11/2014	02:36:12	40.8704801	28.5171648	811.22	Bioturbation on sediment
MRS-DV592-01	02/11/2014	02:42:19	40.8707561	28.5178229	808.61	G1 beacon
MRS-DV592-01	02/11/2014	02:54:19	40.8708122	28.5185973	806.79	F1
MRS-DV592-01	02/11/2014	02:56:49	40.8708074	28.5186108	806.80	picture anchorage F1
MRS-DV592-01	02/11/2014	02:57:46	40.8708062	28.5186196	806.40	F1
MRS-DV592-01	02/11/2014	03:00:59	40.8708274	28.5186378	806.33	F1 for camera orientation in ROV axis
MRS-DV592-01	02/11/2014	03:15:26	40.8677533	28.5192787	807.41	bioturbation
MRS-DV592-01	02/11/2014	03:18:20	40.8674274	28.5193209	806.07	patch dark sediments
MRS-DV592-01	02/11/2014	03:20:06	40.8673809	28.5193262	805.47	sediment patch
MRS-DV592-01	02/11/2014	03:22:22	40.8673743	28.5193236	805.58	sediment patch black and white
MRS-DV592-01	02/11/2014	03:42:04	40.8711388	28.5217748	801.56	Dogfish
MRS-DV592-01	02/11/2014	03:43:53	40.8713889	28.5218603	801.20	G6
MRS-DV592-01	02/11/2014	03:46:03	40.8714043	28.5218754	801.11	G6 anchorage
MRS-DV592-01	02/11/2014	04:02:34	40.8682568	28.5225701	797.72	G2
MRS-DV592-01	02/11/2014	04:03:21	40.8682523	28.5225732	797.73	G2 feet
MRS-DV592-01	02/11/2014	04:05:38	40.8682498	28.5225730	797.68	G2 foot
MRS-DV592-01	02/11/2014	04:06:57	40.8682459	28.5225707	796.05	G2 head
MRS-DV592-01	02/11/2014	04:07:55	40.8682451	28.5225884	797.52	bioturbation + small fish
MRS-DV592-01	02/11/2014	04:11:22	40.8683071	28.5227040	799.25	bioturbation holls
MRS-DV592-01	02/11/2014	04:11:45	40.8683069	28.5227030	799.17	bioturbation scale with ROV arm
MRS-DV592-01	02/11/2014	04:17:44	40.8683232	28.5232862	796.55	sediment patch
MRS-DV592-01	02/11/2014	04:18:04	40.8683149	28.5233149	796.54	sediment patch black
MRS-DV592-01	02/11/2014	04:18:24	40.8683026	28.5233459	796.49	black patch
MRS-DV592-01	02/11/2014	04:18:40	40.8682841	28.5233841	796.39	patch
MRS-DV592-01	02/11/2014	04:21:19	40.8682009	28.5235457	795.55	F2 feet in the sediment
MRS-DV592-01	02/11/2014	04:24:12	40.8682153	28.5235961	795.45	photo pour orientation F2
MRS-DV592-01	02/11/2014	04:25:29	40.8682123	28.5235958	795.45	picture for F2 frame orientation
MRS-DV592-01	02/11/2014	04:41:57	40.8687926	28.5257226	797.68	metallic anchor
MRS-DV592-01	02/11/2014	04:44:30	40.8688772	28.5259598	796.81	shark
MRS-DV592-01	02/11/2014	04:44:46	40.8688898	28.5259889	796.84	shark
MRS-DV592-01	02/11/2014	04:45:42	40.8689468	28.5260949	796.22	shark
MRS-DV592-01	02/11/2014	04:58:06	40.8706463	28.5276573	798.25	G3
MRS-DV592-01	02/11/2014	04:58:43	40.8706504	28.5276776	797.13	G3 anchorage

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV592-01	02/11/2014	04:59:53	40.8706633	28.5276997	796.25	G3 head
MRS-DV592-01	02/11/2014	05:08:55	40.8704850	28.5286542	798.38	F3
MRS-DV592-01	02/11/2014	05:10:26	40.8704723	28.5286788	798.33	F3 feet
MRS-DV592-01	02/11/2014	05:30:09	40.8686856	28.5285092	789.05	Carbonate crust
MRS-DV592-01	02/11/2014	05:30:49	40.8686818	28.5285209	789.14	Carbonate crust
MRS-DV592-01	02/11/2014	05:31:21	40.8686850	28.5285301	788.97	small crab on crust
MRS-DV592-01	02/11/2014	05:41:46	40.8694260	28.5281122	796.80	bioturbation
MRS-DV592-01	02/11/2014	05:56:14	40.8685157	28.5302796	790.67	flotteur peche
MRS-DV592-01	02/11/2014	06:02:21	40.8686807	28.5310424	788.70	Dogfish
MRS-DV592-01	02/11/2014	06:16:05	40.8682930	28.5327068	769.92	picture to see the tilt G5
MRS-DV592-01	02/11/2014	06:16:51	40.8682813	28.5327104	769.84	Dogfish
MRS-DV592-01	02/11/2014	06:17:32	40.8682704	28.5327046	766.19	G5 oblique
MRS-DV592-01	02/11/2014	06:17:44	40.8682706	28.5327076	765.72	G5
MRS-DV592-01	02/11/2014	06:18:49	40.8682606	28.5327057	766.82	G5 no current. ROV is horizontal, tilt visible
MRS-DV592-01	02/11/2014	06:22:21	40.8682777	28.5327104	767.91	G5 all
MRS-DV592-01	02/11/2014	06:43:45	40.8672809	28.5350555	730.47	cable?
MRS-DV592-01	02/11/2014	06:44:13	40.8672662	28.5350556	730.59	cable
MRS-DV592-01	02/11/2014	06:44:54	40.8672354	28.5350655	729.60	cable
MRS-DV592-01	02/11/2014	06:53:55	40.8667247	28.5363447	717.00	float?
MRS-DV592-01	02/11/2014	06:55:21	40.8666112	28.5364543	715.85	bioturbated bottom
MRS-DV592-01	02/11/2014	07:08:48	40.8651672	28.5393960	669.02	Dogfish
MRS-DV592-01	02/11/2014	07:11:29	40.8650408	28.5392969	664.33	Another dogfish
MRS-DV592-01	02/11/2014	07:18:06	40.8650554	28.5395173	668.28	Patch
MRS-DV592-01	02/11/2014	07:19:48	40.8650978	28.5395167	669.86	echinoïds?
MRS-DV592-01	02/11/2014	07:22:41	40.8651064	28.5395183	670.87	Worms?
MRS-DV592-01	02/11/2014	07:44:03	40.8653336	28.5399787	671.14	Crusts
MRS-DV592-01	02/11/2014	07:44:22	40.8653214	28.5399851	670	Old crust
MRS-DV592-01	02/11/2014	07:44:39	40.8653128	28.5399986	670.35	Crusts
MRS-DV592-01	02/11/2014	07:45:18	40.8652893	28.5400108	670.29	Crusts
MRS-DV592-01	02/11/2014	07:47:09	40.8652564	28.5400489	671.56	Crusts
MRS-DV592-01	02/11/2014	07:49:01	40.8652668	28.5400497	671.58	Bacterian mat
MRS-DV592-01	02/11/2014	07:53:26	40.8652625	28.5400570	671.53	worms in black + carbonate crust
MRS-DV592-01	02/11/2014	07:53:41	40.865259	28.5400559	671	Patch 2
MRS-DV592-01	02/11/2014	07:56:22	40.8652712	28.5400552	671.54	Sample MRS-DV01-DV-01-01
MRS-DV592-01	02/11/2014	08:04:03	40.8652277	28.5401480	670.56	patch
MRS-DV592-01	02/11/2014	08:05:14	40.8652207	28.5401528	670.80	echinoïds
MRS-DV592-01	02/11/2014	08:10:27	40.8651376	28.5401636	670	Very big patch 3
MRS-DV592-01	02/11/2014	08:16:32	40.8650134	28.5402918	670.48	White patch
MRS-DV592-01	02/11/2014	08:34:18	40.8644326	28.5405696	646.42	carbonate
MRS-DV592-01	02/11/2014	09:00:24	40.8610848	28.5432866	564.88	black patch
MRS-DV592-01	02/11/2014	09:10:15	40.8604783	28.5446602	554.87	carbonate

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV592-01	02/11/2014	09:10:55	40.8604701	28.5447549	553.99	old carbonate
MRS-DV592-01	02/11/2014	09:16:41	40.8600873	28.5449210	548.02	bubbles? Seen, but intermittently
MRS-DV592-01	02/11/2014	09:19:37	40.8600965	28.5449144	547.39	white spots one of which bubbles
MRS-DV592-01	02/11/2014	09:20:23	40.8600889	28.5449279	548.82	no bubbles visible here close up of vent that bubbled
MRS-DV592-01	02/11/2014	09:28:33	40.8599719	28.5451026	546.67	hole emitting bubbles intermittently
MRS-DV592-01	02/11/2014	09:30:22	40.8599703	28.5450999	546.67	bacterial mat with bubbles
MRS-DV592-01	02/11/2014	10:04:52	40.8583685	28.5499018	484.78	Bioturbated bottom
MRS-DV592-01	02/11/2014	10:39:06	40.8561728	28.5552537	432.36	Bioturbed sediment
MRS-DV592-01	02/11/2014	10:52:30	40.8552575	28.5575118	407.53	echinoïd
MRS-DV592-01	02/11/2014	10:53:03	40.8552226	28.5575830	404.97	many echinoïds on the bottom
MRS-DV592-01	02/11/2014	11:21:48	40.8531349	28.5627621	368.60	Grey spot
MRS-DV592-01	02/11/2014	11:30:57	40.8522818	28.5649697	356.66	Carbonated crust
MRS-DV592-01	02/11/2014	11:31:01	40.8522787	28.5649807	356.58	Carbonated crust
MRS-DV592-01	02/11/2014	11:35:49	40.8518295	28.5659395	350.74	Sediment with bioturbations and echinoïds
MRS-DV592-01	02/11/2014	11:40:12	40.8515155	28.5669359	348.46	Rubbish
MRS-DV592-01	02/11/2014	11:40:44	40.8514961	28.5670100	348.12	Rubbish
MRS-DV592-01	02/11/2014	11:51:33	40.8505779	28.5696158	340.97	Rubbish
MRS-DV592-01	02/11/2014	12:02:11	40.8497651	28.5712128	338.41	Sediment with bioturbations and echinoïds
MRS-DV592-01	02/11/2014	12:14:43	40.8519381	28.5740277	334.91	bioturbation
MRS-DV592-01	02/11/2014	12:43:08	40.8565966	28.5791050	331.73	shark
MRS-DV592-01	02/11/2014	12:48:37	40.8569136	28.5800568	330.68	Black patch and bacteria
MRS-DV592-01	02/11/2014	12:53:56	40.8569511	28.5800442	330	Active site 1
MRS-DV592-01	02/11/2014	13:04:27	40.8569688	28.5800799	332.53	bubbles
MRS-DV592-01	02/11/2014	13:09:00	40.856964	28.580073	333	Flowmeter sample MRS-DV01-FLO-01
MRS-DV592-01	02/11/2014	13:12:00	40.856966	28.580072	333	MRS-DV01-FLO-02
MRS-DV592-01	02/11/2014	13:25:15	40.8581094	28.5791033	329.15	seep
MRS-DV592-01	02/11/2014	13:28:20	40.8581230	28.5790742	330.34	bubbles
MRS-DV592-01	02/11/2014	13:29:33	40.8581241	28.5790778	330.23	bacterial map
MRS-DV592-01	02/11/2014	13:31:29	40.8581334	28.5790806	330	Active site 2
MRS-DV592-01	02/11/2014	13:35:58	40.8583191	28.5791364	330	Active site 3
MRS-DV592-01	02/11/2014	13:37:29	40.8583188	28.5791395	330.47	Bubbles, bacterial map
MRS-DV592-01	02/11/2014	13 :52 :00	40.858323	28.579152	331	MRS-DV01-FLO-03
MRS-DV592-01	02/11/2014	14:10:06	40.8592794	28.5809991	327.91	Bubbles 12
MRS-DV592-01	02/11/2014	14:13:01	40.8592843	28.5809966	329.22	Bubbles between point 10 and 12
MRS-DV592-01	02/11/2014	14:17:35	40.8592869	28.5809935	329.23	measure MRS-DV01-FLO-04
MRS-DV592-01	02/11/2014	14:36:12	40.8598498	28.5814262	326.98	patch
MRS-DV592-01	02/11/2014	14:42:59	40.8599043	28.5813740	327.99	5 bubblers between points 7 and 9
MRS-DV592-01	02/11/2014	14:50:05	40.8599054	28.5813732	328.02	measure flow MRS-DV01-FLO-05
MRS-DV592-01	02/11/2014	14:50:44	40.8599055	28.5813731	328.01	measure on 3 holes

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV592-01	02/11/2014	14:57:55	40.8599067	28.5813722	29	SITE_8 flow measure
MRS-DV592-01	02/11/2014	15:00:32	40.8599072	28.5813719	326.40	Crusts, navigation problem
MRS-DV592-01	02/11/2014	15:05:20	40.8599080	28.5813713	324.82	navigation problem, we stop
MRS-DV592-01	02/11/2014	15:09:56	40.8599799	28.5812694	327.09	Calibration estimate navigation
MRS-DV592-01	02/11/2014	15:12:03	40.8600400	28.5810586	326.53	nav OK
MRS-DV592-01	02/11/2014	15:13:12	40.8600471	28.5809390	327.33	Arrived on point 13
MRS-DV592-01	02/11/2014	15:16:50	40.8600498	28.5809448	328.06	4 bubblers mini on point 13
MRS-DV592-01	02/11/2014	15:20:53	40.8600625	28.5809482	327.32	no measure on point 13
MRS-DV592-01	02/11/2014	15:21:13	40.8600663	28.5809386	326.93	Start to point 11
MRS-DV592-01	02/11/2014	15:27:30	40.8606677	28.5812279	326.48	we arrive on point 11
MRS-DV592-01	02/11/2014	15:27:59	40.8607565	28.5813847	327.24	Bubbles
MRS-DV592-01	02/11/2014	15:28:53	40.8607809	28.5814335	327.84	Crust
MRS-DV592-01	02/11/2014	15:29:51	40.8607844	28.5814405	327.84	At least 6 bubblers
MRS-DV592-01	02/11/2014	15:30:46	40.8607877	28.5814472	327.86	Filaments observed, dead shells
MRS-DV592-01	02/11/2014	15:32:26	40.8607937	28.5814593	327.85	Big bubble
MRS-DV592-01	02/11/2014	15:34:15	40.8608003	28.5814725	326.94	Flowmeter on these big
MRS-DV592-01	02/11/2014	15:36:53	40.8608098	28.5814916	327.89	Flowmeter sample
MRS-DV592-01	02/11/2014	15:40:02	40.8608210	28.5815143	327.89	Flow measure MRS-DV01-FLO-06
MRS-DV592-01	02/11/2014	15:43:01	40.8608299	28.5815333	327.91	Occasionaly a big bubble
MRS-DV592-01	02/11/2014	15 :48 :00	40.860845	28.581565	328	Flow measure MRS-DV01-FLO-07
MRS-DV592-01	02/11/2014	15:51:22	40.8608549	28.5815865	325.87	Small bubbles
MRS-DV592-01	02/11/2014	15:52:15	40.8608575	28.5815921	326.24	Go to point 6
MRS-DV592-01	02/11/2014	15:55:55	40.8610281	28.5819392	326.57	Navigation problem, estime nav recalculation
MRS-DV592-01	02/11/2014	16:04:44	40.8617979	28.5833585	327.95	Arrived on point 6
MRS-DV592-01	02/11/2014	16:13:05	40.8615892	28.5833745	327.54	Microbial mat
MRS-DV592-01	02/11/2014	16:15:03	40.8615704	28.5833429	327.56	Bubbles
MRS-DV592-01	02/11/2014	16:15:47	40.8615712	28.5833409	327.92	2 bubblers
MRS-DV592-01	02/11/2014	16:18:02	40.8615706	28.5833373	328.46	Flowmeter measure
MRS-DV592-01	02/11/2014	16:21:22	40.8615684	28.5833393	328.46	MRS-DV01-FLO-08
MRS-DV592-01	02/11/2014	16:32:42	40.8615670	28.5833513	328.36	Pegaz sample MRS- DV01-PE-02
MRS-DV592-01	02/11/2014	17:06:49	40.8615567	28.5833510	328.45	measure RAMAN MRS-DV01-RA-01
MRS-DV592-01	02/11/2014	17:13:03	40.8615642	28.5833646	328.45	End measure
MRS-DV592-01	02/11/2014	17:17:22	40.8615588	28.5833637	328.14	Bacterial mat
MRS-DV592-01	02/11/2014	17:18:11	40.8615589	28.5833639	668	Patch 1
MRS-DV592-01	02/11/2014	17:18:25	40.8615609	28.5833622	327.76	Start to point 5
MRS-DV592-01	02/11/2014	17:34:06	40.8637907	28.5839665	332.43	Arrival on point 5
MRS-DV592-01	02/11/2014	17:35:56	40.8639127	28.5839358	333.70	Bacterian mat
MRS-DV592-01	02/11/2014	17:39:46	40.8639239	28.5839281	333.72	Bubbler
MRS-DV592-01	02/11/2014	17:42:32	40.8639426	28.5838963	333.85	New bubbler
MRS-DV592-01	02/11/2014	17:45:48	40.8639174	28.5841314	333.64	New bubblers
MRS-DV592-01	02/11/2014	17:46:26	40.8639174	28.5841324	333.68	Flowmeter preparation

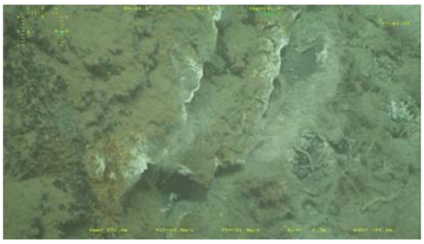
DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV592-01	02/11/2014	17:52:11	40.8639168	28.5841417	334.22	Flowmeter sample MRS-DV01-FLO-09
MRS-DV592-01	02/11/2014	18:01:55	40.8639158	28.5841575	334.22	End measure
MRS-DV592-01	02/11/2014	18:18:00	40.863914	28.584184	334.20	Raman measure MRS-DV01-RA-02
MRS-DV592-01	02/11/2014	18:36:37	40.8639284	28.5849490	333.14	Bacterial mat
MRS-DV592-01	02/11/2014	18:41:21	40.8638764	28.5852547	333.69	Bacterial mat
MRS-DV592-01	02/11/2014	18:43:02	40.8638758	28.5852592	333.61	Bacterial mat with bubble
MRS-DV592-01	02/11/2014	18:43:36	40.8638758	28.5852625	334.76	Bacterial mat 2
MRS-DV592-01	02/11/2014	18:44:42	40.8638778	28.5852636	335.59	Bacterial mat with gas
MRS-DV592-01	02/11/2014	18:45:55	40.8638841	28.5853074	333.96	Bacterial mat with bubble
MRS-DV592-01	02/11/2014	18:46:45	40.8638999	28.5853643	333.96	Another bacterial mat
MRS-DV592-01	02/11/2014	18:47:27	40.8639072	28.5853894	334.55	Bacterial mat
MRS-DV592-01	02/11/2014	18:49:49	40.8639354	28.5854150	336.18	Carbonate crust
MRS-DV592-01	02/11/2014	18:51:36	40.8639111	28.5853945	334.29	Bacterial mat
MRS-DV592-01	02/11/2014	18:53:10	40.8639188	28.5852944	333.96	Bacterial patch with bubble
MRS-DV592-01	02/11/2014	18:55:25	40.8639537	28.5852336	334.13	patch
MRS-DV592-01	02/11/2014	18:57:38	40.8639835	28.5852509	334.20	Bacterial patch
MRS-DV592-01	02/11/2014	18:58:58	40.8639905	28.5852538	336.15	Bubbles and bacterial mat
MRS-DV592-01	02/11/2014	18:59:56	40.8639916	28.5852525	336.14	General view of bacterial mat
MRS-DV592-01	02/11/2014	19:00:57	40.8639778	28.5852208	334.31	carbonate crust
MRS-DV592-01	02/11/2014	19:03:34	40.8639856	28.5851002	334.25	Bacterial patch
MRS-DV592-01	02/11/2014	19:04:08	40.8639941	28.5850768	334.65	Bacterial patches
MRS-DV592-01	02/11/2014	19:05:06	40.8640060	28.5850333	333.92	Bacterial patch
MRS-DV592-01	02/11/2014	19:06:38	40.8640038	28.5850198	334	Lift
MRS-DV592-01	02/11/2014	19:23:20	40.8618764	28.5834002	326.48	Carbonate crust
MRS-DV592-01	02/11/2014	19:26:55	40.8615859	28.5833535	326.44	Carbonate crust
MRS-DV592-01	02/11/2014	19:27:15	40.8615672	28.5833516	326	Push core site found
MRS-DV592-01	02/11/2014	19:27:46	40.8615465	28.5833514	326.49	Bacterial patch
MRS-DV592-01	02/11/2014	19:29:25	40.8615359	28.5833530	326.67	Bacterial mat
MRS-DV592-01	02/11/2014	19:51:35	40.8615246	28.5833532	328.45	Push core sample MRS-DV01-PC-04
MRS-DV592-01	02/11/2014	19:58:00	40.861522	28.583355	328.45	MRS-DV01-PC-02
MRS-DV592-01	02/11/2014	20:03:00	40.861518	28.583362	328.45	MRS-DV01-PC-01
MRS-DV592-01	02/11/2014	20:10:00	40.86152	28.583366	328.45	MRS-DV01-PC-03
MRS-DV592-01	02/11/2014	21:58:00	40.861517	28.583361	328.45	MRS-DV01-PC-06
MRS-DV592-01	02/11/2014	22:13:00	40.861511	28.583362	328.45	MRS-DV01-PC-07
MRS-DV592-01	02/11/2014	22:32:00	40.861517	28.583358	328.45	MRS-DV01-PC-05
MRS-DV592-01	02/11/2014	22:41:00	40.861514	28.583363	328.45	MRS-DV01-PC-08
MRS-DV592-01	02/11/2014	22:51:32	40.8615160	28.5833529	328.44	Blade core sample MRS-DV01-BC-01
MRS-DV592-01	02/11/2014	23:05:28	40.8616789	28.5849166	321.77	we arrive on the lift
MRS-DV592-01	03/11/2014	00:02:55	40.8614663	28.5849753	325.84	start of exploration to the south east
MRS-DV592-01	03/11/2014	00:19:36	40.8601184	28.5872433	328.84	rubbish

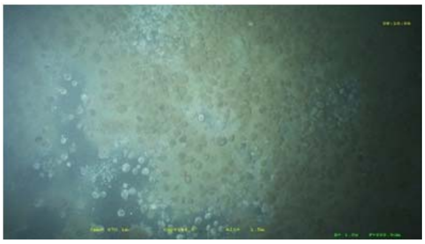
DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV592-01	03/11/2014	00:21:07	40.8599645	28.5874806	328	target pp?
MRS-DV592-01	03/11/2014	00:33:41	40.8588135	28.5899209	335.56	white patch
MRS-DV592-01	03/11/2014	01:01:55	40.8563729	28.5946375	355.96	white patch
MRS-DV592-01	03/11/2014	01:04:28	40.8563671	28.5946743	356.93	Discontinued bubbles
MRS-DV592-01	03/11/2014	01:12:08	40.8560395	28.5958202	364.19	White patch
MRS-DV592-01	03/11/2014	02:13:15	40.8607128	28.6030835	401.27	beautiful black patch and bacterial mat, occasionally bubbled
MRS-DV592-01	03/11/2014	02:31:01	40.8607209	28.6030767	402.16	Sample MRS-DV01-TI-02
MRS-DV592-01	03/11/2014	02:34:14	40.8607156	28.6030830	400.47	Bottle in the basket
MRS-DV592-01	03/11/2014	02:46:22	40.8607173	28.6030900	401.61	We continue
MRS-DV592-01	03/11/2014	02:56:51	40.8617185	28.6045054	411.02	Black patch, bacterial mat
MRS-DV592-01	03/11/2014	02:57:47	40.8617451	28.6045610	410.68	Continue bubbling
MRS-DV592-01	03/11/2014	03:01:09	40.8618911	28.6047562	411.92	Black patch, bacterial mat
MRS-DV592-01	03/11/2014	03:03:12	40.8619417	28.6048609	412.94	Patches and bubbling area
MRS-DV592-01	03/11/2014	03:04:31	40.8619971	28.6049279	413.58	3 bubbling vents
MRS-DV592-01	03/11/2014	04:14:16	40.8616552	28.5850663	321.57	Lift
MRS-DV592-01	03/11/2014	04:24:46	40.8616853	28.5849824	321.76	Lift closed
MRS-DV592-01	03/11/2014	04:44:17	40.8626674	28.5856195	329.74	Amphora
MRS-DV592-01	03/11/2014	04:46:43	40.8626874	28.5857819	330	Amphora
MRS-DV592-01	03/11/2014	04:47:16	40.8626776	28.5857696	329.69	+18 amphora
MRS-DV592-01	03/11/2014	05:07:48	40.8620393	28.5872959	328.13	Between points 7 and 6
MRS-DV592-01	03/11/2014	05:09:13	40.8620038	28.5871399	326.33	To the lift
MRS-DV592-01	03/11/2014	05:12:40	40.8616140	28.5863175	326.23	Wreck
MRS-DV592-01	03/11/2014	05:14:37	40.8616124	28.5863608	324	Wreck
MRS-DV592-01	03/11/2014	05:16:18	40.8615355	28.5861655	326.96	Return to the lift
MRS-DV592-01	03/11/2014	06:05:32	40.8626434	28.5856541	328.34	Amphora
MRS-DV592-01	03/11/2014	06:06:05	40.8626512	28.5856730	329.73	Amphora
MRS-DV592-01	03/11/2014	06:08:09	40.8626829	28.5856503	329.55	Amphora
MRS-DV592-01	03/11/2014	06:09:53	40.8626725	28.5856622	331.16	Amphora
MRS-DV592-01	03/11/2014	06:10:15	40.8626733	28.5856628	331.15	Amphora
MRS-DV592-01	03/11/2014	06:11:25	40.8627009	28.5857055	329.87	Amphora
MRS-DV592-01	03/11/2014	06:30:12	40.8622753	28.5905986	339.86	Bacterial patch
MRS-DV592-01	03/11/2014	06:31:04	40.8622883	28.5906293	341.24	Bacterial patch
MRS-DV592-01	03/11/2014	06:35:01	40.8622987	28.5906379	342.04	Bacterial patch
MRS-DV592-01	03/11/2014	06:35:31	40.8622938	28.5906387	342.04	Bacterial patch
MRS-DV592-01	03/11/2014	06:36:07	40.8622944	28.5906404	342.04	Bacterial patch with bubbles
MRS-DV592-01	03/11/2014	06:57:07	40.8622905	28.5906387	342.05	End of the Gas flow measurement MRS-DV01-FLO-10
MRS-DV592-01	03/11/2014	07:03:00	40.862291	28.590646	342	MRS-DV01-RA-03 Raman measure
MRS-DV592-01	03/11/2014	08:51:04	40.8623159	28.6048923	413.75	bacterial mat at point C
MRS-DV592-01	03/11/2014	08:51:35	40.8623167	28.6048916	413.75	bacterial mat
MRS-DV592-01	03/11/2014	08:53:03	40.8623140	28.6048896	413.76	bubbles in mat

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV592-01	03/11/2014	09:03:30	40.8623086	28.6048958	413.8	flow measure MRS-DV01-FLO-11
MRS-DV592-01	03/11/2014	09:16:00	40.862306	28.604887	413.8	MRS-DV01-RA-04 Raman measure
MRS-DV592-01	03/11/2014	09:30:51	40.862307	28.60489	413.78	pegaz3 sample MRS-DV01-PE-03
MRS-DV592-01	03/11/2014	11:29:06	40.8669361	28.6271458	567	Big Amphora
MRS-DV592-01	03/11/2014	12:17:46	40.8709618	28.6374249	524.46	Black patch
MRS-DV592-01	03/11/2014	12:18:39	40.8709676	28.6374571	525.46	Patch and worms
MRS-DV592-01	03/11/2014	12:22:02	40.8709708	28.6374543	524.90	White patch
MRS-DV592-01	03/11/2014	12:24:29	40.8709870	28.6374978	525.24	Worms and shells
MRS-DV592-01	03/11/2014	12:31:18	40.8708190	28.6376709	526.12	Bubbles
MRS-DV592-01	03/11/2014	12:32:17	40.8708171	28.6376733	526.49	Bubbles
MRS-DV592-01	03/11/2014	12:38:06	40.8708166	28.6377040	527.65	Bubbles
MRS-DV592-01	03/11/2014	12:41:18	40.8708283	28.6376918	527.67	pegaz 4 sample MRS-DV01-PE-04
MRS-DV592-01	03/11/2014	12:56:57	40.8708162	28.6376916	527.67	Langoustine
MRS-DV592-01	03/11/2014	12:57:26	40.8708220	28.6376872	527.67	shrimp
MRS-DV592-01	03/11/2014	13:26:38	40.8708467	28.6376939	527.62	Raman measure MRS-DV01-RA-05
MRS-DV592-01	03/11/2014	13:28:15	40.8708503	28.6376919	527.63	shrimp

Figure 18 : Dive MRS-PL592-01- Selection of sampling sites and finding

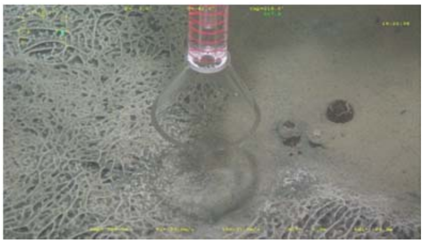
MARSITE - Dive 01 - Central High

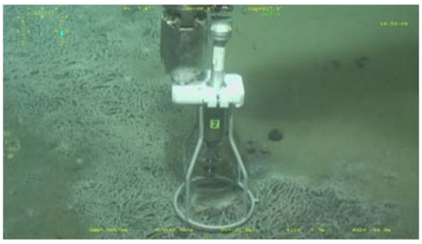

07h49 Carbonates and possibly bivalves

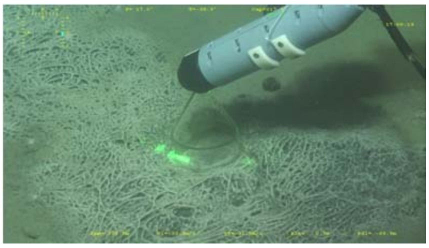

08H10 Bivalves on black patches


13H59 Flow measurement on bacterial mat

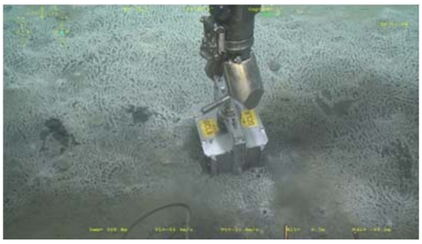

14H39 Bivalve shells

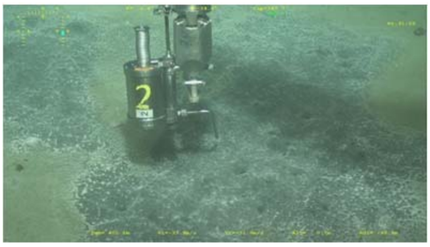

16H22 Flow measurement

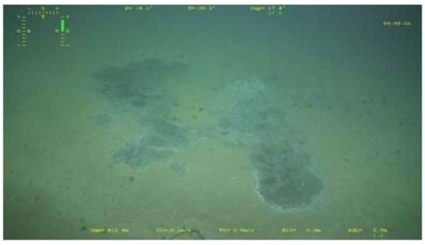

16H50 Pegaz 02 sampling on bacterial mat


17H00 Raman measurement


20H05 Push cores 01, 02, 03


22H51 Blade core in bacterial mat (and 04 out of the picture frame)


02H31 Titanium bottle on black patch


03H02 Black patches with bacterial mat


04H45 Amphora

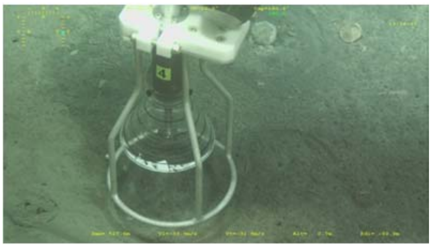
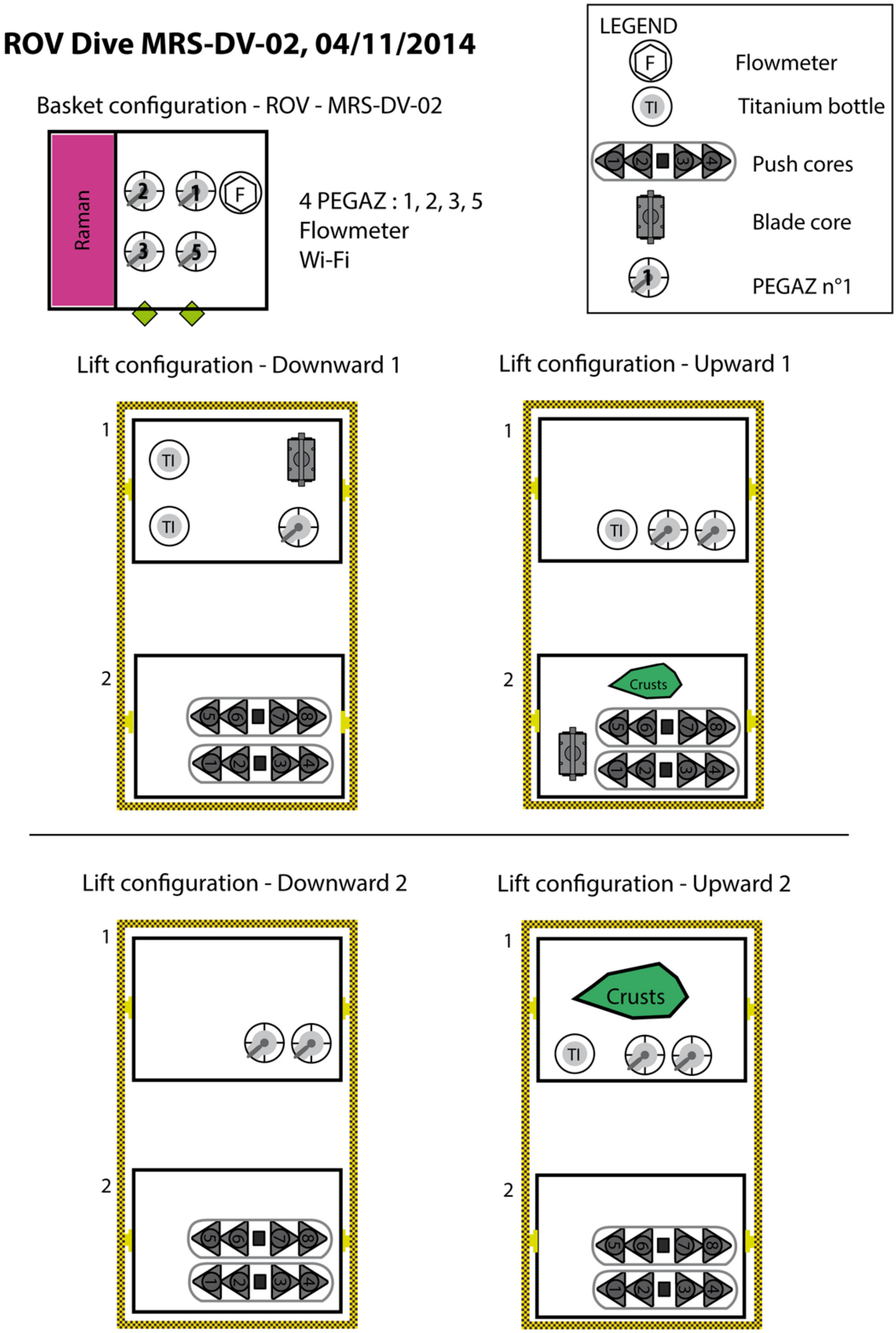

13H16 Pegaz 04 sampling

Table 7 : Marsite ROV dive MRS-PL592-01 samples

DIVE	DATE	HOUR	DEPTH (m)	Sample code	TOOL	LATITUDE	LONGITUDE
MRS-DV592-01	02/11/2014	07:56:00		MRS-DV01-DV-01-01	Basket	40.865267	28.540051
MRS-DV592-01	02/11/2014	13:09:00	333	MRS-DV01-FLO-01	Flowmeter	40.856964	28.580073
MRS-DV592-01	02/11/2014	13:12:00	333	MRS-DV01-FLO-02	Flowmeter	40.856966	28.580072
MRS-DV592-01	02/11/2014	13:52:00	331	MRS-DV01-FLO-03	Flowmeter	40.858323	28.579152
MRS-DV592-01	02/11/2014	14:19:00	329	MRS-DV01-FLO-04	Flowmeter	40.859288	28.580996
MRS-DV592-01	02/11/2014	14:51:00	328	MRS-DV01-FLO-05	Flowmeter	40.859906	28.581373
MRS-DV592-01	02/11/2014	15:42:00	328	MRS-DV01-FLO-06	Flowmeter	40.860827	28.581527
MRS-DV592-01	02/11/2014	15:48:00	328	MRS-DV01-FLO-07	Flowmeter	40.860845	28.581565
MRS-DV592-01	02/11/2014	16:21:00	328	MRS-DV01-FLO-08	Flowmeter	40.861569	28.583340
MRS-DV592-01	02/11/2014	16:49:00	328.5	MRS-DV01-PE-02	Pegaz	40.861564	28.583343
MRS-DV592-01	02/11/2014	17:06:00	328.5	MRS-DV01-RA-01	Raman	40.861561	28.583345
MRS-DV592-01	02/11/2014	17:55:00	671	MRS-DV01-FLO-09	Flowmeter	40.863917	28.584146
MRS-DV592-01	02/11/2014	18:18:00	334.2	MRS-DV01-RA-02	Raman	40.863914	28.584184
MRS-DV592-01	02/11/2014	19:52:00	328.5	MRS-DV01-PC-04	Push core	40.861525	28.583352
MRS-DV592-01	02/11/2014	19:58:00	328.5	MRS-DV01-PC-02	Push core	40.861522	28.583355
MRS-DV592-01	02/11/2014	20:03:00	328.5	MRS-DV01-PC-01	Push core	40.861518	28.583362
MRS-DV592-01	02/11/2014	20:10:00	328.5	MRS-DV01-PC-03	Push core	40.86152	28.583366
MRS-DV592-01	02/11/2014	21:58:00	328.4	MRS-DV01-PC-06	Push core	40.861517	28.583361
MRS-DV592-01	02/11/2014	22:13:00	328.5	MRS-DV01-PC-07	Push core	40.861511	28.583362
MRS-DV592-01	02/11/2014	22:32:00	328.5	MRS-DV01-PC-05	Push core	40.861517	28.583358
MRS-DV592-01	02/11/2014	22:41:00	328.5	MRS-DV01-PC-08	Push core	40.861514	28.583363
MRS-DV592-01	02/11/2014	22:50:00	334	MRS-DV01-BC-01	Blade core	40.861515	28.583352
MRS-DV592-01	03/11/2014	02:31:00	402.2	MRS-DV01-TI-02	Titanium bottle	40.860721	28.603077
MRS-DV592-01	03/11/2014	06:57:07	342	MRS-DV01-FLO-10	Flowmeter	40.8622905	28.5906387
MRS-DV592-01	03/11/2014	07:03:00	342	MRS-DV01-RA-03	Raman	40.862291	28.590646
MRS-DV592-01	03/11/2014	09:03:30	413.8	MRS-DV01-FLO-11	Flowmeter	40.8623086	28.6048958
MRS-DV592-01	03/11/2014	09:16:00	413.8	MRS-DV01-RA-04	Raman	40.862306	28.604887
MRS-DV592-01	03/11/2014	09:31:00	413.8	MRS-DV01-PE-03	Pegaz	40.862307	28.60489
MRS-DV592-01	03/11/2014	12:46:00	527	MRS-DV01-PE-04	Pegaz	40.870822	28.637693
MRS-DV592-01	03/11/2014	13:26:00	527	MRS-DV01-RA-05	Raman	40.870846	28.637692

5.2. Dive MRS-PL-593-02 (Western High)



Mission	
Marsitecruise02	
Date	04/11/2014 - 05/11/2014
Dive number	MRS-DV593-02
Responsable operation	CHEILAN P.
Vehicule	Victor
Vessel	Pourquoi Pas
Central Point	N40.78893,E27.74580
Latitude min	40.770918°
Longitude min	27.722104°
Latitude max	40.806937°
Longitude max	27.769496°
Geodetic system navigation	WGS84

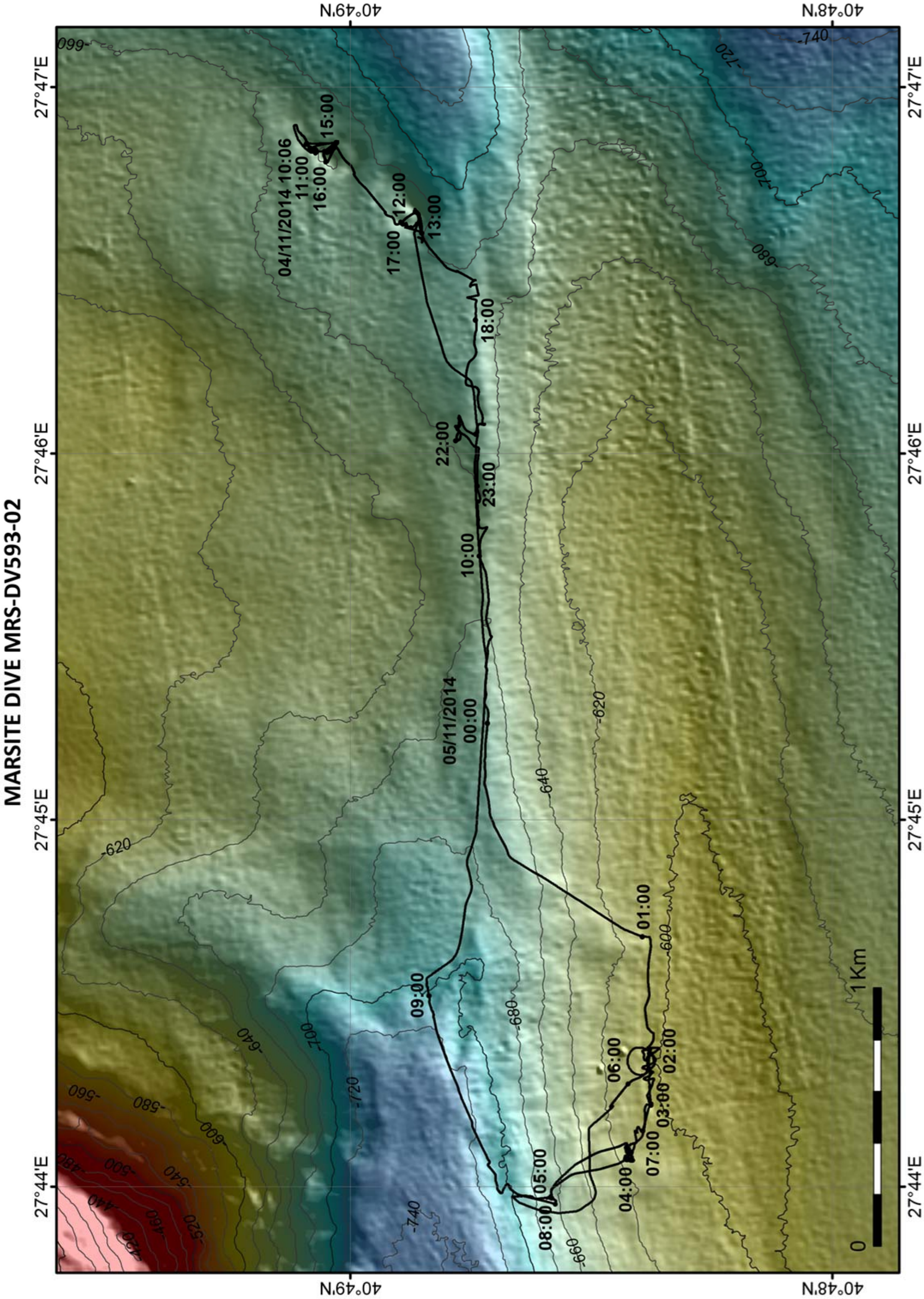
Time		
Start from desk	04/11/2014 08:56:49	30:37 h
Arrival on desk	05/11/2014 15:33:41	
Under water	04/11/2014 09:16:09	29:46 h under water
Surface arrival	05/11/2014 15:02:13	
Arrival on sea bottom	04/11/2014 10:06:40	28:23 h on bottom
Departure from bottom	05/11/2014 14:29:43	16 km

Objectives:

- Detect any evidence of fluid seepages from visual inspection of the seafloor
- Sample gas bubbles from PEGAZ sampler to determine sources
- Sample bottom water to characterize dense-fluid emission and heavy-dissolved compounds
- Collect living communities associated with the seeps

Sampling and *in situ* measurements:

- PEGAZ
- Push Core
- Titanium bottle
- Raman spectrometer
- Flowmeter



Picture 1 : MARSITE DIVE MRS-DV593-02

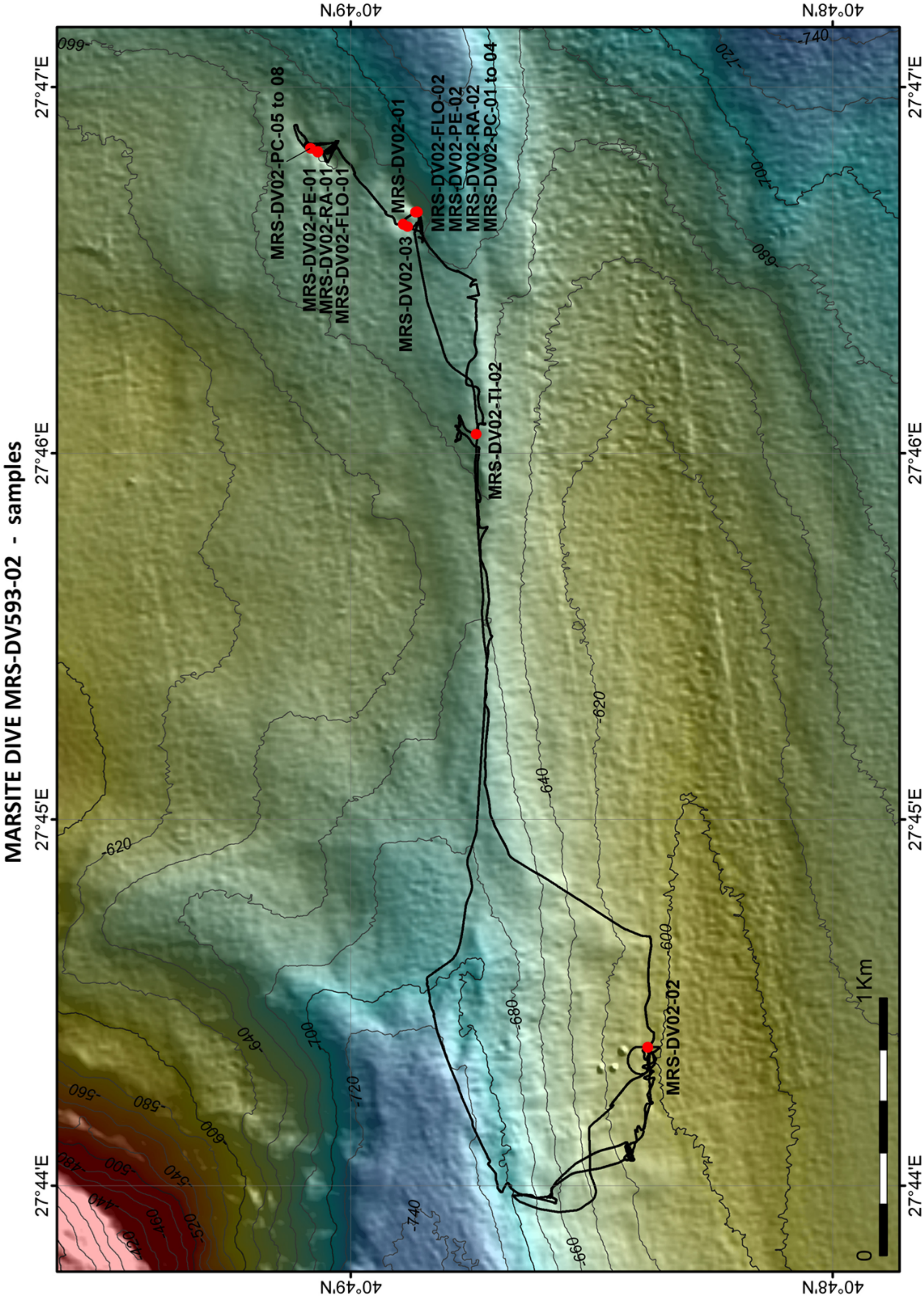


Figure 19 : MARSITE DIVE MRS-DV593-02 – SAMPLES

Table 8 : Marsite ROV dive MRS-PL593-02 diary

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV593-02	04/11/2014	10:05:57	40.81775	27.78034	630.8	ROV arrived on the bottom
MRS-DV593-02	04/11/2014	10:08:05	40.81800	27.78035	637.9	patch
MRS-DV593-02	04/11/2014	11:08:24	40.81780	27.78040	0.0	MRS-DV02-FLO-01
MRS-DV593-02	04/11/2014	11:20:00	40.81780	27.78041	640.0	MRS-DV02-PE-01
MRS-DV593-02	04/11/2014	11:27:00	40.81780	27.78041	0.0	MRS-DV02-RA-01
MRS-DV593-02	04/11/2014	11:28:13	40.81780	27.78041	639.9	oil
MRS-DV593-02	04/11/2014	11:41:04	40.81780	27.78041	639.5	gas bubbles
MRS-DV593-02	04/11/2014	11:44:09	40.81781	27.78042	639.1	gas bubbles
MRS-DV593-02	04/11/2014	11:44:40	40.81781	27.78042	639.1	spot of gas bubbles
MRS-DV593-02	04/11/2014	11:47:19	40.81782	27.78041	629.0	gas bubble flow
MRS-DV593-02	04/11/2014	11:54:36	40.81775	27.78042	638.2	carbonate crust area
MRS-DV593-02	04/11/2014	11:56:52	40.81766	27.78042	637.3	carbonate crusts
MRS-DV593-02	04/11/2014	11:57:15	40.81764	27.78042	637.0	carbonate crusts
MRS-DV593-02	04/11/2014	12:00:47	40.81750	27.78048	635.7	black patches, white bacterial mats and carbonates crusts
MRS-DV593-02	04/11/2014	12:17:17	40.81737	27.78079	642.7	Black patches
MRS-DV593-02	04/11/2014	12:51:56	40.81804	27.78058	641.1	Black bubbles
MRS-DV593-02	04/11/2014	12:52:26	40.81804	27.78058	641.1	Bubbles and fish
MRS-DV593-02	04/11/2014	12:55:07	40.81804	27.78057	641.7	2 fishes
MRS-DV593-02	04/11/2014	12:59:00	40.81804	27.78058	641.7	MRS-DV02-PC-08
MRS-DV593-02	04/11/2014	13:09:00	40.81804	27.78058	641.7	MRS-DV02-PC-06
MRS-DV593-02	04/11/2014	13:12:00	40.81804	27.78058	641.7	MRS-DV02-PC-05
MRS-DV593-02	04/11/2014	13:17:10	40.81804	27.78057	641.7	MRS-DV02-PC-07
MRS-DV593-02	04/11/2014	13:28:27	40.81804	27.78057	641.7	MRS-DV02-PC-07 broken
MRS-DV593-02	04/11/2014	13:37:37	40.81804	27.78058	641.7	Gas bubbles
MRS-DV593-02	04/11/2014	13:47:36	40.81803	27.78058	640.7	Black bubbles
MRS-DV593-02	04/11/2014	14:31:37	40.81735	27.78035	638.9	Going to the lift
MRS-DV593-02	04/11/2014	14:39:39	40.81712	27.78082	640.1	On the lift
MRS-DV593-02	04/11/2014	15:00:23	40.81712	27.78082	644.9	The lift goes up, we continue
MRS-DV593-02	04/11/2014	15:04:23	40.81717	27.78080	644.8	direction white patches and bubbles pt5
MRS-DV593-02	04/11/2014	15:14:24	40.81725	27.78048	640.6	Crusts
MRS-DV593-02	04/11/2014	15:19:14	40.81718	27.78055	642.1	to the West
MRS-DV593-02	04/11/2014	15:27:12	40.81717	27.78077	643.7	We go to C3 point
MRS-DV593-02	04/11/2014	15:30:35	40.81744	27.78051	638.1	Carbonate crust
MRS-DV593-02	04/11/2014	15:32:52	40.81755	27.78038	635.5	Crab
MRS-DV593-02	04/11/2014	15:40:22	40.81748	27.77997	636.0	Black and white patches
MRS-DV593-02	04/11/2014	15:42:30	40.81749	27.77997	636.6	Bubbles
MRS-DV593-02	04/11/2014	16:34:58	40.81543	27.77765	651.4	Piezometer
MRS-DV593-02	04/11/2014	16:49:00	40.81484	27.77711	0.0	MRS-DV02-01
MRS-DV593-02	04/11/2014	17:04:21	40.81438	27.77711	647.5	Crusts
MRS-DV593-02	04/11/2014	19:05:39	40.81231	27.76755	649.6	MRS-DV02-TI-02
MRS-DV593-02	04/11/2014	19:30:10	40.81236	27.76752	647.9	Black patches on C24
MRS-DV593-02	04/11/2014	19:41:19	40.81288	27.76812	647.3	Patches near C22
MRS-DV593-02	04/11/2014	19:42:09	40.81287	27.76809	648.5	on the point C22
MRS-DV593-02	04/11/2014	19:43:12	40.81288	27.76808	648.1	Patches at few meters of C22

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV593-02	04/11/2014	19:44:17	40.81289	27.76807	648.5	Bubbles on C22
MRS-DV593-02	04/11/2014	19:46:51	40.81290	27.76807	648.7	Bubbling hole on C22
MRS-DV593-02	04/11/2014	19:51:37	40.81290	27.76805	643.7	OBS dans le fond avec taches noies en premier plan
MRS-DV593-02	04/11/2014	19:52:34	40.81291	27.76800	646.5	OBS1 with black patches around
MRS-DV593-02	04/11/2014	19:53:18	40.81291	27.76802	646.9	OBS1
MRS-DV593-02	04/11/2014	19:55:25	40.81291	27.76800	647.1	OBS1 and one patch of 1 m2
MRS-DV593-02	04/11/2014	19:58:43	40.81285	27.76794	647.1	OBS1
MRS-DV593-02	04/11/2014	20:00:21	40.81296	27.76786	645.4	Arriving on C23
MRS-DV593-02	04/11/2014	20:02:04	40.81298	27.76785	643.2	OBS2
MRS-DV593-02	04/11/2014	20:02:57	40.81298	27.76780	645.5	OBS2
MRS-DV593-02	04/11/2014	20:04:46	40.81298	27.76787	644.7	Black patch at few meters from OBS2
MRS-DV593-02	04/11/2014	20:07:35	40.81298	27.76791	646.5	Black patches with bacterial mat near point C3
MRS-DV593-02	04/11/2014	20:11:25	40.81296	27.76787	645.7	Patches between C23 and OBS2 at Cap 43 N
MRS-DV593-02	04/11/2014	20:16:07	40.81299	27.76791	646.9	Site C23 with bubbles
MRS-DV593-02	04/11/2014	20:17:45	40.81299	27.76792	647.0	Black patches and bacterial mat
MRS-DV593-02	04/11/2014	20:22:50	40.81299	27.76792	645.5	Black patches
MRS-DV593-02	04/11/2014	20:28:38	40.81293	27.76761	643.5	Black patches
MRS-DV593-02	04/11/2014	20:31:56	40.81296	27.76754	644.1	Black patches
MRS-DV593-02	04/11/2014	20:32:48	40.81296	27.76754	644.6	Black patches
MRS-DV593-02	04/11/2014	22:28:45	40.81284	27.76757	642.6	Black patches
MRS-DV593-02	04/11/2014	22:33:12	40.81295	27.76773	644.3	Black patches
MRS-DV593-02	04/11/2014	22:56:12	40.81227	27.76601	641.7	anemone
MRS-DV593-02	04/11/2014	22:59:27	40.81228	27.76535	637.9	shrimp
MRS-DV593-02	04/11/2014	23:03:02	40.81217	27.76465	635.8	Black patches
MRS-DV593-02	04/11/2014	23:06:29	40.81227	27.76439	633.8	point 14
MRS-DV593-02	04/11/2014	23:09:20	40.81221	27.76367	633.9	shark
MRS-DV593-02	04/11/2014	23:12:15	40.81197	27.76330	636.3	Fault
MRS-DV593-02	04/11/2014	23:13:50	40.81198	27.76318	636.2	slope on the left
MRS-DV593-02	04/11/2014	23:17:30	40.81218	27.76222	634.6	shark
MRS-DV593-02	04/11/2014	23:20:28	40.81201	27.76133	635.4	Fault on the left
MRS-DV593-02	04/11/2014	23:22:20	40.81193	27.76072	637.4	Patches in a hole along the fault
MRS-DV593-02	04/11/2014	23:38:37	40.81195	27.75722	643.7	Crabs and crusts
MRS-DV593-02	04/11/2014	23:41:00	40.81196	27.75713	644.8	Dead shells
MRS-DV593-02	04/11/2014	23:44:00	40.81197	27.75695	645.4	Black patches
MRS-DV593-02	04/11/2014	23:49:28	40.81198	27.75631	648.7	Big shark
MRS-DV593-02	05/11/2014	00:08:56	40.81202	27.75261	653.6	point 39
MRS-DV593-02	05/11/2014	00:15:26	40.81201	27.75187	654.5	anemone
MRS-DV593-02	05/11/2014	00:19:31	40.81196	27.75131	657.1	black patches
MRS-DV593-02	05/11/2014	00:23:22	40.81185	27.75043	656.7	point C40
MRS-DV593-02	05/11/2014	00:24:56	40.81183	27.75017	656.6	shark
MRS-DV593-02	05/11/2014	01:00:25	40.80658	27.74468	588.7	patch
MRS-DV593-02	05/11/2014	01:22:23	40.80643	27.74162	583.8	bioturbated sediment
MRS-DV593-02	05/11/2014	01:28:47	40.80634	27.74047	583.6	patch
MRS-DV593-02	05/11/2014	01:32:23	40.80618	27.74017	582.5	patch

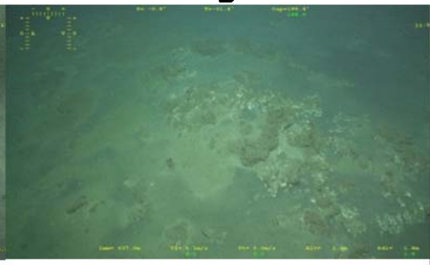
DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV593-02	05/11/2014	01:39:49	40.80636	27.73963	584.5	discontinuous bubbles
MRS-DV593-02	05/11/2014	01:41:26	40.80638	27.73964	585.8	carbonate crust
MRS-DV593-02	05/11/2014	01:47:00	40.80639	27.73963	586.0	MRS-DV02-02 crust sample
MRS-DV593-02	05/11/2014	01:53:17	40.80626	27.73962	583.1	small patch
MRS-DV593-02	05/11/2014	01:54:27	40.80615	27.73964	581.7	patch
MRS-DV593-02	05/11/2014	01:55:36	40.80605	27.73963	580.5	patch
MRS-DV593-02	05/11/2014	02:01:01	40.80629	27.73937	583.4	patches
MRS-DV593-02	05/11/2014	02:05:47	40.80638	27.73904	584.2	patch
MRS-DV593-02	05/11/2014	04:44:39	40.80979	27.73286	649.5	point C46
MRS-DV593-02	05/11/2014	05:00:29	40.80969	27.73281	646.0	Bubbles
MRS-DV593-02	05/11/2014	05:10:04	40.80973	27.73280	646.8	Discontinuous bubbles on point C46
MRS-DV593-02	05/11/2014	05:20:06	40.81074	27.73288	673.4	point 21
MRS-DV593-02	05/11/2014	06:10:02	40.80652	27.73963	583.7	Bacterial patches
MRS-DV593-02	05/11/2014	06:18:09	40.80634	27.73930	582.9	Bacterial patches
MRS-DV593-02	05/11/2014	06:19:10	40.80635	27.73939	583.7	Bacterial patches
MRS-DV593-02	05/11/2014	06:19:45	40.80634	27.73941	583.2	Bacterial patches
MRS-DV593-02	05/11/2014	06:21:37	40.80636	27.73941	585.1	Bacterial patch
MRS-DV593-02	05/11/2014	06:28:21	40.80632	27.73869	581.9	Bacterial patches
MRS-DV593-02	05/11/2014	06:29:01	40.80630	27.73864	581.8	Bacterial patches
MRS-DV593-02	05/11/2014	06:34:04	40.80631	27.73763	582.6	Bacterial patches
MRS-DV593-02	05/11/2014	06:34:55	40.80631	27.73758	583.2	Bacterial patches
MRS-DV593-02	05/11/2014	06:36:56	40.80630	27.73735	584.2	Bacterial patches
MRS-DV593-02	05/11/2014	06:38:01	40.80630	27.73729	584.9	Bacterial patches
MRS-DV593-02	05/11/2014	06:38:44	40.80629	27.73727	584.9	Bacterial patch
MRS-DV593-02	05/11/2014	06:41:37	40.80628	27.73718	585.1	Bacterial patches
MRS-DV593-02	05/11/2014	06:42:26	40.80629	27.73714	585.3	Bacterial patches
MRS-DV593-02	05/11/2014	06:42:58	40.80629	27.73712	585.4	Bacterial patches
MRS-DV593-02	05/11/2014	06:44:34	40.80628	27.73711	585.4	Bacterial patches
MRS-DV593-02	05/11/2014	06:44:53	40.80627	27.73712	585.5	Bacterial patches
MRS-DV593-02	05/11/2014	06:46:42	40.80627	27.73715	585.3	Bacterial patches with bubbles
MRS-DV593-02	05/11/2014	06:47:21	40.80627	27.73714	585.9	Bacterial patches with bubbles
MRS-DV593-02	05/11/2014	06:51:13	40.80627	27.73715	586.6	Bacterial patch with bubbles
MRS-DV593-02	05/11/2014	06:53:11	40.80627	27.73716	586.6	Bacterial patches
MRS-DV593-02	05/11/2014	07:02:39	40.80677	27.73538	587.4	Bacterial patches
MRS-DV593-02	05/11/2014	07:08:02	40.80696	27.73459	594.2	Bacterial patches
MRS-DV593-02	05/11/2014	07:08:17	40.80697	27.73459	594.3	Bacterial patches
MRS-DV593-02	05/11/2014	07:47:56	40.80976	27.73292	648.2	carbonate crust
MRS-DV593-02	05/11/2014	08:10:14	40.81118	27.73334	678.9	patch
MRS-DV593-02	05/11/2014	08:13:33	40.81141	27.73300	680.2	patch and oxidation
MRS-DV593-02	05/11/2014	08:14:24	40.81151	27.73310	682.1	bubbles
MRS-DV593-02	05/11/2014	08:21:22	40.81165	27.73361	684.1	Arrival C45
MRS-DV593-02	05/11/2014	08:30:04	40.81192	27.73460	686.2	patch
MRS-DV593-02	05/11/2014	08:36:49	40.81243	27.73618	701.7	patch
MRS-DV593-02	05/11/2014	08:41:13	40.81284	27.73742	708.3	black patch
MRS-DV593-02	05/11/2014	08:41:43	40.81285	27.73748	707.9	black patch
MRS-DV593-02	05/11/2014	08:42:49	40.81293	27.73777	706.9	black patches
MRS-DV593-02	05/11/2014	08:43:19	40.81293	27.73784	706.7	patch

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV593-02	05/11/2014	08:53:57	40.81379	27.74105	693.7	black patch
MRS-DV593-02	05/11/2014	08:57:54	40.81387	27.74147	685.8	black patches
MRS-DV593-02	05/11/2014	08:58:12	40.81389	27.74152	684.9	patch
MRS-DV593-02	05/11/2014	09:00:11	40.81390	27.74187	680.1	black patches
MRS-DV593-02	05/11/2014	09:01:47	40.81399	27.74235	676.9	patches
MRS-DV593-02	05/11/2014	09:03:11	40.81402	27.74243	678.1	patch
MRS-DV593-02	05/11/2014	09:18:24	40.81249	27.74674	659.3	black patch
MRS-DV593-02	05/11/2014	09:22:20	40.81259	27.74834	659.2	black patches
MRS-DV593-02	05/11/2014	09:22:43	40.81256	27.74843	659.0	black patch
MRS-DV593-02	05/11/2014	09:44:45	40.81195	27.75676	646.6	black patch
MRS-DV593-02	05/11/2014	09:45:34	40.81195	27.75689	644.7	patch
MRS-DV593-02	05/11/2014	09:45:49	40.81197	27.75691	644.6	carbonate crust
MRS-DV593-02	05/11/2014	09:46:29	40.81197	27.75700	644.8	carbonate crust
MRS-DV593-02	05/11/2014	09:58:35	40.81215	27.76135	635.2	black patch
MRS-DV593-02	05/11/2014	11:10:00	40.81436	27.77769	643.0	MRS-DV02-FLO-02
MRS-DV593-02	05/11/2014	11:15:00	40.81436	27.77768	643.0	MRS-DV02-PE-02
MRS-DV593-02	05/11/2014	11:38:00	40.81435	27.77766	643.0	MRS-DV02-RA-02
MRS-DV593-02	05/11/2014	12:15:00	40.81469	27.77702	646.0	MRS-DV02-03 : carbonate crusts with potential mussels on the crust
MRS-DV593-02	05/11/2014	13:08:45	40.81440	27.77768	643.1	black patch with bacterial mat for push core sampling
MRS-DV593-02	05/11/2014	13:17:00	40.81440	27.77767	643.0	MRS-DV02-PC-04
MRS-DV593-02	05/11/2014	13:21:00	40.81441	27.77768	643.0	MRS-DV02-PC-02
MRS-DV593-02	05/11/2014	13:24:00	40.81441	27.77768	643.0	MRS-DV02-PC-01
MRS-DV593-02	05/11/2014	13:30:00	40.81441	27.77768	643.0	MRS-DV02-PC-03

Figure 20 : Dive MRS-PL593-02

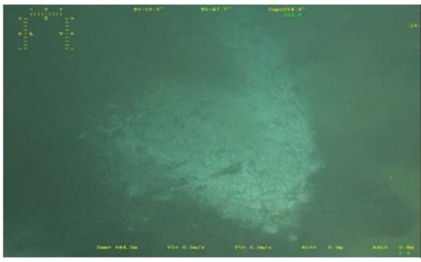
MARSITE – Dive 02 - Western High

11:09 Flow measurement on large bubbles

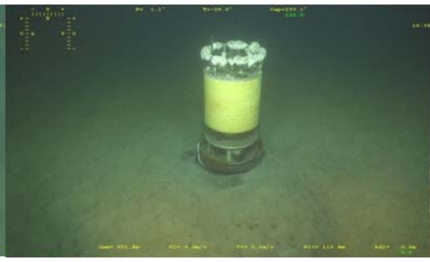


11:57 Carbonate crusts

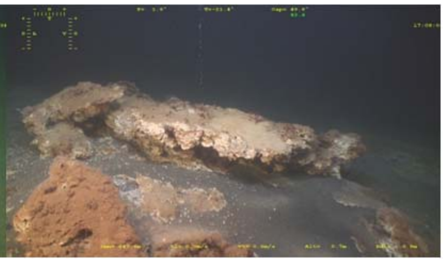
13:09 Coring at an oil-seeping site



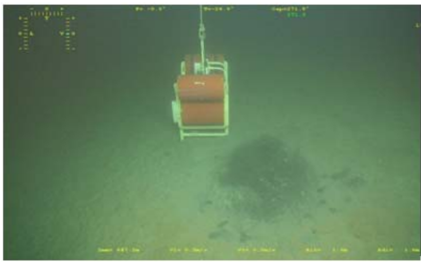
16:20 White patches



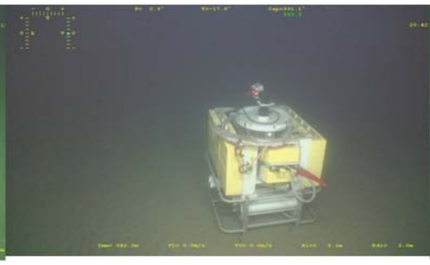
16:34 Piezometer



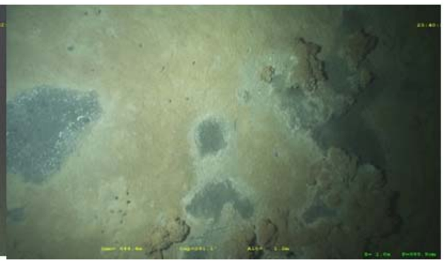
18:08 Massive carbonate crusts and gas bubbles



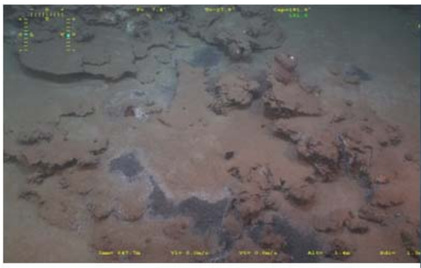
19:55 OBS near the Bob location



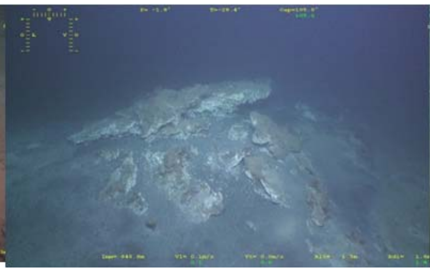
20:42 BOB location



23:40 Black patches and carbonate crusts



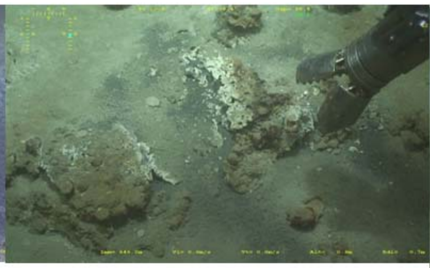
04:55 (5/11) Carbonate crusts and discontinuous bubbles



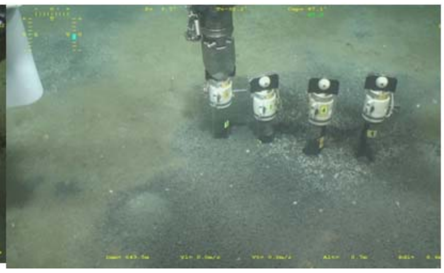
10:48 Summit of the carbonate mound

11:02 Bubble area (at acoustic anomaly C9)

11:16 Pegaz sampling (643m) at an oil-seeping site



12:14 Carbonate sampling



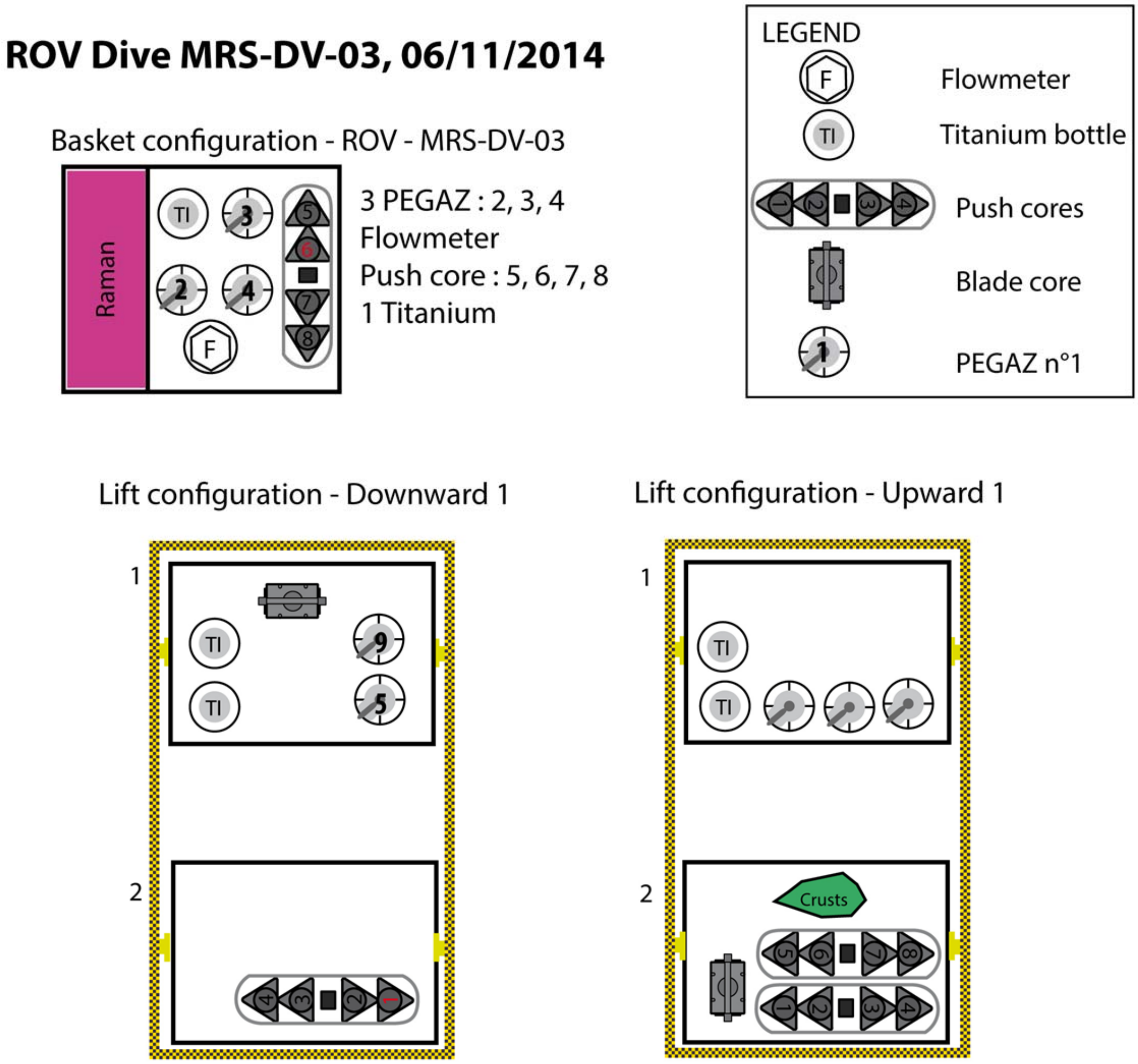
13:30 Push core sampling (5 m near bubble site)

Table 9 : Marsite ROV dive MRS-PL593-02 samples

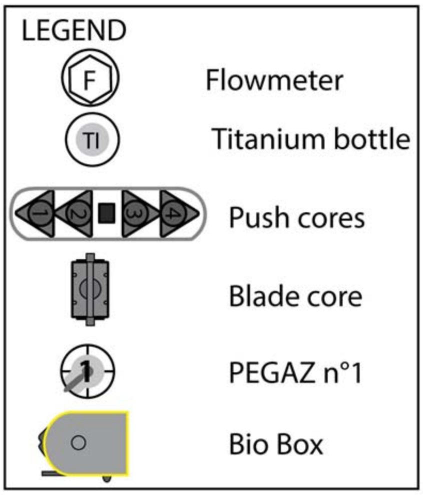
DIVE	DATE	HOUR	DEPTH	SAMPLE NAME	TOOL	LATITUDE	LONGITUDE
MRS-DV593-02	04/11/2014	11:08:24		MRS-DV02-FLO-01	Flowmeter	40.817654	27.780437
MRS-DV593-02	04/11/2014	11:20:00	640	MRS-DV02-PE-01	Pegaz	40.817645	27.780438
MRS-DV593-02	04/11/2014	11:27:00		MRS-DV02-RA-01	Raman	40.817640	27.780439
MRS-DV593-02	04/11/2014	12:59:00		MRS-DV02-PC-08	Push core	40.818034	27.780576
MRS-DV593-02	04/11/2014	13:09:00		MRS-DV02-PC-06	Push core	40.818034	27.780576
MRS-DV593-02	04/11/2014	13:12:00		MRS-DV02-PC-05	Push core	40.818038	27.780576
MRS-DV593-02	04/11/2014	13:17:00		MRS-DV02-PC-07	Push core	40.818037	27.780575
MRS-DV593-02	04/11/2014	16:49:00		MRS-DV02-01	Basket	40.814827	27.777115
MRS-DV593-02	04/11/2014	18:43:00		MRS-DV02-TI-02	Titanium bottle	40.812307	27.767549
MRS-DV593-02	05/11/2014	01:47:00	586	MRS-DV02-02	Basket	40.806382	27.739630
MRS-DV593-02	05/11/2014	11:10:00	643	MRS-DV02-FLO-02	Flowmeter	40.814343	27.777670
MRS-DV593-02	05/11/2014	11:15:00	643	MRS-DV02-PE-02	Pegaz	40.814349	27.777668
MRS-DV593-02	05/11/2014	11:38:00	643	MRS-DV02-RA-02	Raman	40.814356	27.777662
MRS-DV593-02	05/11/2014	12:15:00	646	MRS-DV02-03	Basket	40.814688	27.777024
MRS-DV593-02	05/11/2014	13:17:00	643	MRS-DV02-PC-04	Push core	40.814405	27.777685
MRS-DV593-02	05/11/2014	13:21:00	643	MRS-DV02-PC-02	Push core	40.814408	27.777683
MRS-DV593-02	05/11/2014	13:24:00	643	MRS-DV02-PC-01	Push core	40.814409	27.777686
MRS-DV593-02	05/11/2014	13:30:00	643	MRS-DV02-PC-03	Push core	40.814410	27.777684

5.3. Dive MRS-PL594-03 (Northwest Tekirdag Basin)

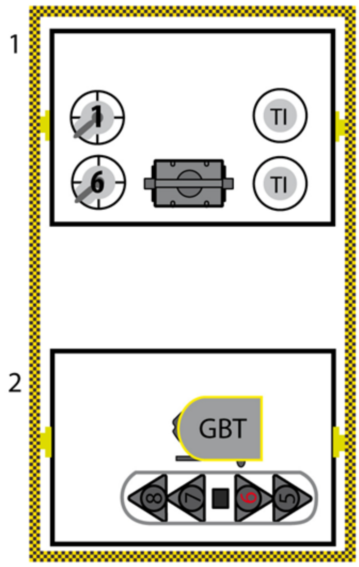
Previous study from Marnaut (2007) has shown that mantle helium was found in the fluids emanating from the seafloor. In addition, it is well known that the Thrace basin extends to the western part of the Tekirdag basin. Therefore, deep-seated sources are likely supplying the gas seeps observe on the seafloor.



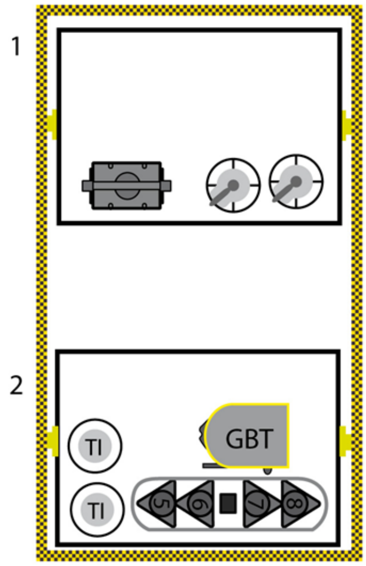
ROV Dive MRS-DV-03, 07/11/2014
2nd lift of the dive



Lift configuration - Downward 2



Lift configuration - Upward 2



Mission	
Date	06/11/2014 - 07/11/2014
Dive number	MRS-DV594-03
Responsable operation	CHEILAN P.
Vehicule	Victor
Vessel	Pourquoi Pas
Central Point	N40.858000,E27.53000
Latitude min	40°50.3993'N
Longitude min	27°30.3768'E
Latitude max	40°52.5604'N
Longitude max	27°33.2232'E
Geodetic system navigation	WGS84

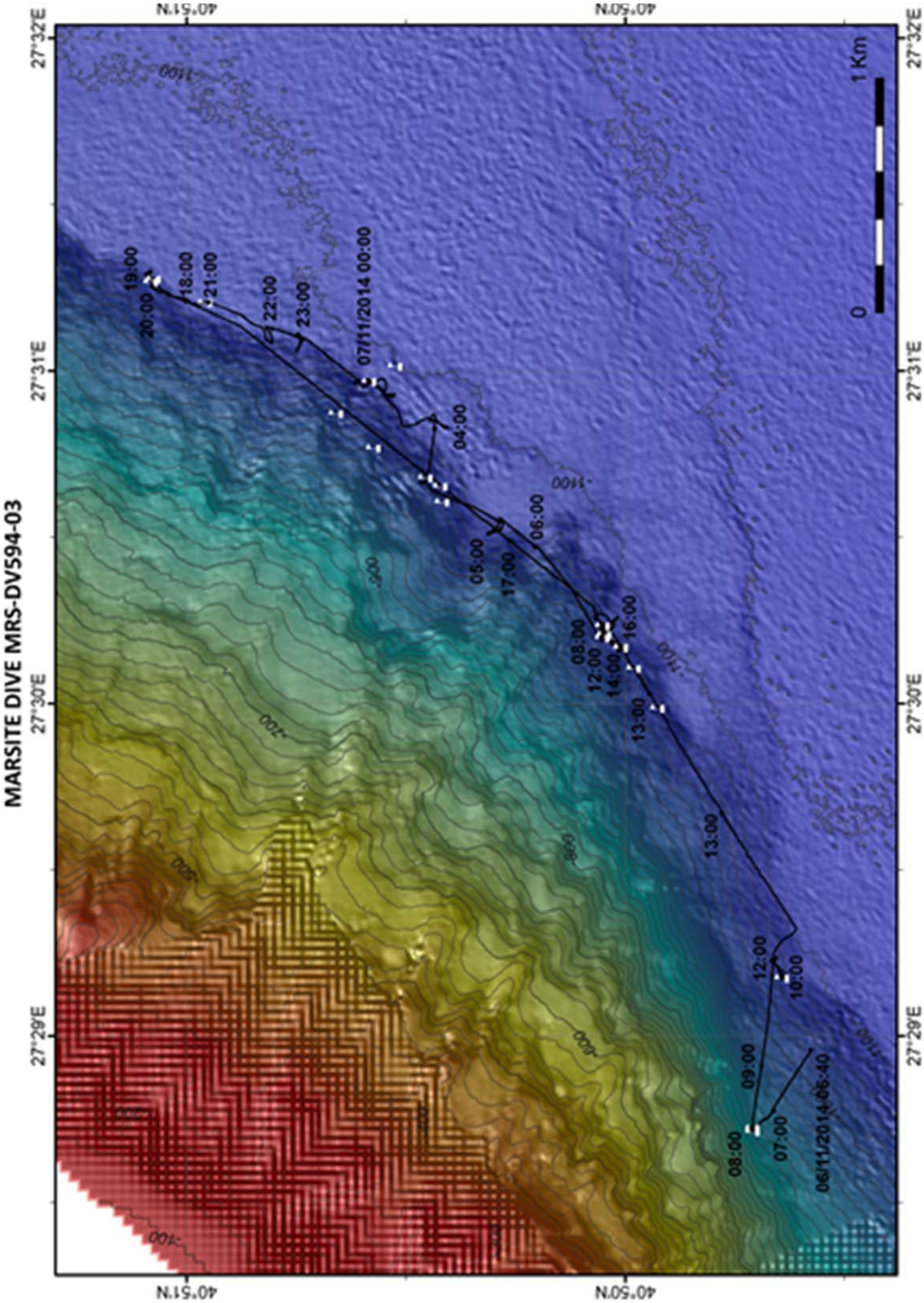
Time		
Start from desk	06/11/2014 05:29:48	33:09 h
Arrival on desk	07/11/2014 14:38:43	
Under water	06/11/2014 05:49:44	32:24 h under water
Surface arrival	07/11/2014 14:13:27	
Arrival on sea bottom	06/11/2014 06:40:16	30:20 h on bottom
Departure from bottom	07/11/2014 13:10:33	16,59 km

Objectives :

- Detect any evidence of fluid seepages from visual inspection of the seafloor
- Sample gas bubbles from PEGAZ sampler to determine sources
- Sample bottom water to characterize dense-fluid emission and heavy-dissolved compounds
- Collect living communities associated with the seeps

Sampling and *in situ* measurements :

- PEGAZ
- Push Core
- Titanium bottle
- Blade core
- Raman spectrometer
- Flowmeter



Picture 2 : MARSITE DIVE MRS-DV594-03

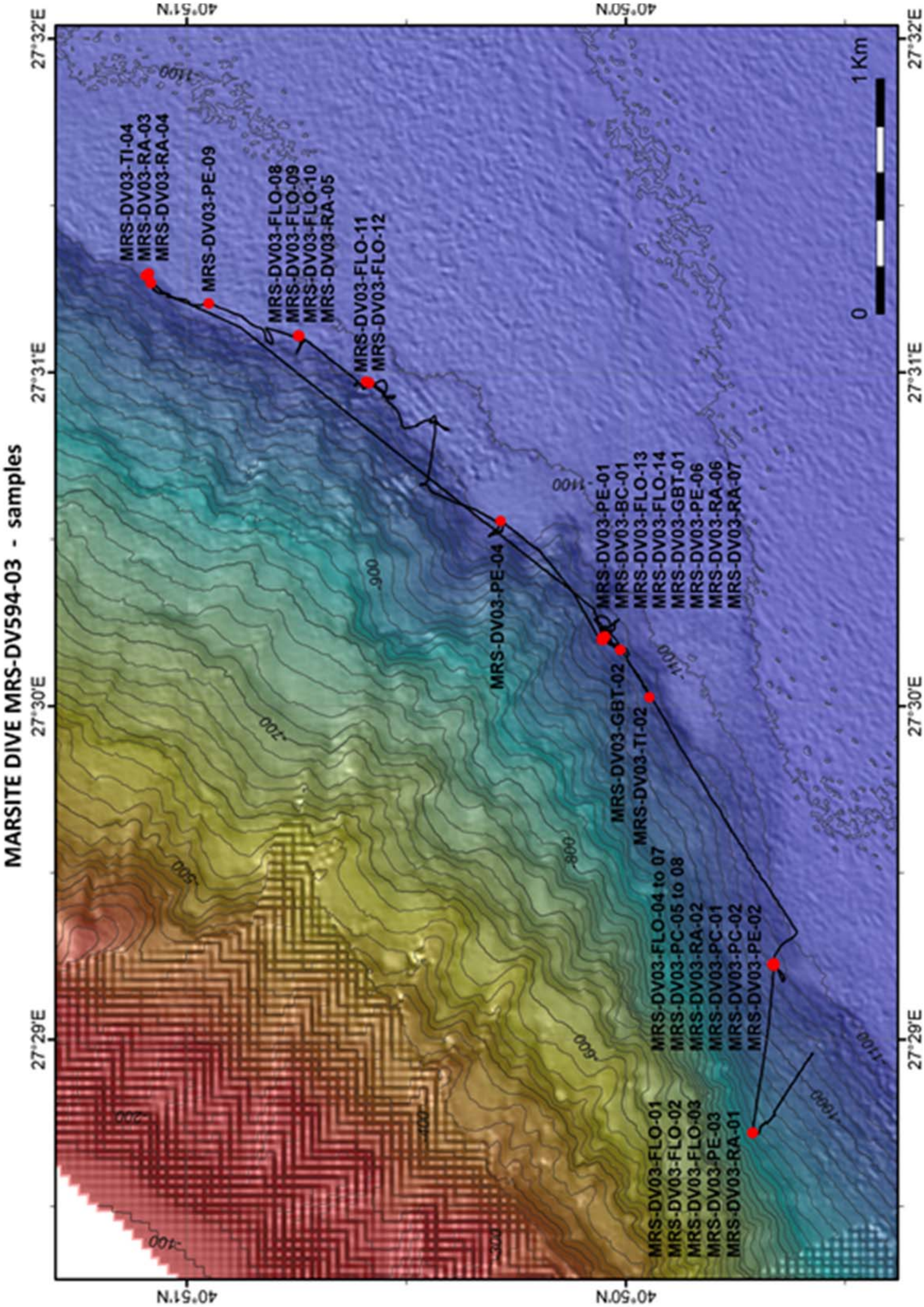


Figure 21 : MARSITE DIVE MRS-DV594-03 – SAMPLES

Table 10 : Marsite ROV dive MRS-PL594-03 diary

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV594-03	06/11/2014	06:59:02	40.8276958	27.4796199	936.73	Brine ?
MRS-DV594-03	06/11/2014	07:00:05	40.8276873	27.4796073	937.94	Brine?
MRS-DV594-03	06/11/2014	07:02:26	40.8276924	27.4795737	938.76	Brine?
MRS-DV594-03	06/11/2014	07:02:39	40.8276891	27.4795707	938.76	close up view of brine?
MRS-DV594-03	06/11/2014	07:03:58	40.8276892	27.4795513	937.76	brine and bacterial mat?
MRS-DV594-03	06/11/2014	07:04:43	40.8276878	27.4795283	937.56	sulfide
MRS-DV594-03	06/11/2014	07:05:54	40.8277111	27.4795306	936.26	brine and bacterial mat
MRS-DV594-03	06/11/2014	07:06:25	40.8277049	27.4795316	936.60	close up view of same structure
MRS-DV594-03	06/11/2014	07:07:13	40.8277229	27.4795163	936.61	bacterial mat
MRS-DV594-03	06/11/2014	07:08:03	40.8277381	27.4794958	934.36	bacterial mat
MRS-DV594-03	06/11/2014	07:09:17	40.8278112	27.4793762	930.38	bacterial mat
MRS-DV594-03	06/11/2014	07:10:04	40.8278705	27.4792981	926.22	bacterial mat
MRS-DV594-03	06/11/2014	07:10:21	40.8278923	27.4792621	924.92	bacterial mat
MRS-DV594-03	06/11/2014	07:10:43	40.8279190	27.4792289	923.42	bacterial mat and clasts
MRS-DV594-03	06/11/2014	07:11:15	40.8279290	27.4792015	922.42	bacterial mat
MRS-DV594-03	06/11/2014	07:11:59	40.8279551	27.4791768	921.60	close up view of bacterial mat
MRS-DV594-03	06/11/2014	07:12:27	40.8279686	27.4791647	922.10	close up view bacterial mat
MRS-DV594-03	06/11/2014	07:13:02	40.8279882	27.4791829	922.11	bacterial mat
MRS-DV594-03	06/11/2014	07:14:12	40.8280091	27.4792107	921.74	brine
MRS-DV594-03	06/11/2014	07:14:29	40.8280084	27.4792103	922.05	closer up view of brine
MRS-DV594-03	06/11/2014	07:14:55	40.8279975	27.4792121	922.28	brine
MRS-DV594-03	06/11/2014	07:15:15	40.8279990	27.4792077	921.72	bacterial mat
MRS-DV594-03	06/11/2014	07:15:35	40.8280181	27.4792015	921.14	bacterial mat
MRS-DV594-03	06/11/2014	07:15:56	40.8280206	27.4791827	920.86	bacterial mat
MRS-DV594-03	06/11/2014	07:16:22	40.8280192	27.4791784	921.33	close up view bacterial mat
MRS-DV594-03	06/11/2014	07:17:07	40.8280531	27.4791677	919.41	bacterial mat
MRS-DV594-03	06/11/2014	07:18:10	40.8281234	27.4790812	915.24	scattered stones
MRS-DV594-03	06/11/2014	07:20:15	40.8282338	27.4788835	908.12	scattered angular clasts
MRS-DV594-03	06/11/2014	07:23:12	40.8283172	27.4786302	898.50	angular clasts
MRS-DV594-03	06/11/2014	07:28:32	40.8285026	27.4785346	889.33	Bubbles with bacterial mat and brine flows?
MRS-DV594-03	06/11/2014	07:29:14	40.8285162	27.4785366	888.79	bubbles
MRS-DV594-03	06/11/2014	07:29:55	40.8285151	27.4785447	889.11	bubbles
MRS-DV594-03	06/11/2014	07:35:34	40.8285090	27.4787579	885.68	oil bubbles
MRS-DV594-03	06/11/2014	07:39:28	40.8285127	27.4787003	892.86	oil bubbles
MRS-DV594-03	06/11/2014	07:41:03	40.8284990	27.4787012	894.88	oil bubbles
MRS-DV594-03	06/11/2014	07:41:20	40.8284913	27.4787023	894.55	oil bubbles
MRS-DV594-03	06/11/2014	07:45:24	40.8284987	27.4787079	895.00	oil bubbles
MRS-DV594-03	06/11/2014	07:45:38	40.8285075	27.4787052	895.01	oil bubbles
MRS-DV594-03	06/11/2014	07:48:38	40.8285003	27.4787204	895.01	oil seeps while pegaz sampling
MRS-DV594-03	06/11/2014	07:51:00	40.828516	27.478706	895	MRS-DV03-PE-03 Pegaz sample
MRS-DV594-03	06/11/2014	08:12:00	40.828496	27.478711	895	MRS-DV03-RA-01 Raman measure

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV594-03	06/11/2014	08:25:00	40.828521	27.478698	895	MRS-DV03-FLO-01 Flowmeter measure
MRS-DV594-03	06/11/2014	08:28:00	40.828510	27.478710	895	MRS-DV03-FLO-02 Flowmeter measure
MRS-DV594-03	06/11/2014	08:40:00	40.828504	27.478711	895	MRS-DV03-FLO-03 Flowmeter measure
MRS-DV594-03	06/11/2014	09:14:23	40.8278060	27.4854664	1048.33	dark sulfide patches
MRS-DV594-03	06/11/2014	09:20:03	40.8277195	27.4868836	1067.07	dark patch
MRS-DV594-03	06/11/2014	09:20:55	40.8277093	27.4870097	1067.94	patchy sediment
MRS-DV594-03	06/11/2014	09:21:29	40.8276974	27.4870550	1069.47	bubbles
MRS-DV594-03	06/11/2014	09:21:48	40.8276909	27.4870652	1069.94	bubbles stream
MRS-DV594-03	06/11/2014	09:25:16	40.8276771	27.4870873	1069.99	bubbles
MRS-DV594-03	06/11/2014	09:25:57	40.8276744	27.4870717	1070.00	collecting gas
MRS-DV594-03	06/11/2014	09:26:00	40.827676	27.487076	1070	MRS-DV03-PE-02 Pegaz sample
MRS-DV594-03	06/11/2014	09:32:00	40.827694	27.487052	1070	MRS-DV03-RA-02 Raman measure
MRS-DV594-03	06/11/2014	09:32:39	40.8276839	27.4870506	1070.02	Raman measurement
MRS-DV594-03	06/11/2014	09:38:00	40.827693	27.487066	1070	MRS-DV03-FLO-04 Flowmeter measure
MRS-DV594-03	06/11/2014	09:42:00	40.827689	27.487063	1070	MRS-DV03-FLO-05 Flowmeter measure
MRS-DV594-03	06/11/2014	09:44:00	40.827691	27.487061	1070	MRS-DV03-FLO-06 Flowmeter measure
MRS-DV594-03	06/11/2014	09:48:00	40.827696	27.487056	1070	MRS-DV03-FLO-07 Flowmeter measure
MRS-DV594-03	06/11/2014	10:19:03	40.8277183	27.4871199	1070.25	push cores site
MRS-DV594-03	06/11/2014	10:22:00	40.827712	27.487146	1070	MRS-DV03-PC-05 Push core sample
MRS-DV594-03	06/11/2014	10:26:00	40.827699	27.487139	1070	MRS-DV03-PC-06 Push core sample
MRS-DV594-03	06/11/2014	10:27:00	40.827691	27.487178	1070	MRS-DV03-PC-07 Push core sample
MRS-DV594-03	06/11/2014	10:30:00	40.827673	27.487141	1070	MRS-DV03-PC-08 Push core sample
MRS-DV594-03	06/11/2014	10:50:14	40.8277177	27.4871542	1070.07	return to the lift
MRS-DV594-03	06/11/2014	11:59:00	40.827742	27.487103	1070	MRS-DV03-PC-01 Push core sample
MRS-DV594-03	06/11/2014	12:03:00	40.827752	27.487120	1070	MRS-DV03-PC-02 Push core sample
MRS-DV594-03	06/11/2014	12:11:30	40.8276957	27.4871104	1070.64	temperature on gas bubbles
MRS-DV594-03	06/11/2014	13:03:02	40.8298423	27.4949742	1056.83	fish
MRS-DV594-03	06/11/2014	13:11:31	40.8305505	27.4964483	1058.37	fish
MRS-DV594-03	06/11/2014	13:11:47	40.8305775	27.4965003	1058.75	patches
MRS-DV594-03	06/11/2014	13:12:00	40.8305980	27.4965469	1059.29	patch
MRS-DV594-03	06/11/2014	13:12:40	40.8306817	27.4966925	1061.01	piece from scarf
MRS-DV594-03	06/11/2014	13:15:05	40.8309302	27.4972546	1068.21	white bioturbated points
MRS-DV594-03	06/11/2014	13:19:17	40.8313540	27.4981475	1072.95	sponge
MRS-DV594-03	06/11/2014	13:20:34	40.8314457	27.4983687	1071.83	sponge in the slope
MRS-DV594-03	06/11/2014	13:20:53	40.8314665	27.4984178	1071.86	sponge
MRS-DV594-03	06/11/2014	13:21:20	40.8314918	27.4984996	1072.60	slope
MRS-DV594-03	06/11/2014	13:25:37	40.8317741	27.4991657	1074.58	superview of scarf
MRS-DV594-03	06/11/2014	13:25:52	40.8317876	27.4991995	1073.77	patch at the foot
MRS-DV594-03	06/11/2014	13:27:06	40.8318611	27.4993639	1070.00	Steep scarf
MRS-DV594-03	06/11/2014	13:29:05	40.8319810	27.4996204	1071.15	angular rock pieces and sponges
MRS-DV594-03	06/11/2014	13:29:34	40.8320165	27.4996850	1074.98	patch

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV594-03	06/11/2014	13:32:45	40.8322074	27.5001087	1072.79	rock pieces from scarf
MRS-DV594-03	06/11/2014	13:34:48	40.8323590	27.5004071	1069.05	patches and rocks
MRS-DV594-03	06/11/2014	13:35:23	40.8324000	27.5004822	1067.00	patch
MRS-DV594-03	06/11/2014	13:37:26	40.8325393	27.5007666	1060.57	sponge
MRS-DV594-03	06/11/2014	13:37:35	40.8325542	27.5007887	1060.81	sponge
MRS-DV594-03	06/11/2014	13:45:14	40.8332090	27.5022033	1063.89	bioturbated sediment
MRS-DV594-03	06/11/2014	13:48:48	40.8334327	27.5027013	1074.20	patch and rock
MRS-DV594-03	06/11/2014	13:49:52	40.8334415	27.5027322	1075.31	large patch
MRS-DV594-03	06/11/2014	13:51:29	40.8334603	27.5027370	1074.48	rock
MRS-DV594-03	06/11/2014	13:52:33	40.8334847	27.5027404	1073.90	patch
MRS-DV594-03	06/11/2014	13:52:43	40.8334864	27.5027376	1073.90	scarf rocks
MRS-DV594-03	06/11/2014	13:54:30	40.8335004	27.5027274	1073.46	mussels on
MRS-DV594-03	06/11/2014	13:54:52	40.8335008	27.5027243	1073.50	mussel
MRS-DV594-03	06/11/2014	13:56:17	40.8334951	27.5027428	1073.58	mussel
MRS-DV594-03	06/11/2014	14:00:32	40.8335037	27.5027872	1072.77	mollusk shells on rocks
MRS-DV594-03	06/11/2014	14:11:44	40.8335118	27.5027962	1073.14	Mussels in Victor arm
MRS-DV594-03	06/11/2014	14:13:59	40.8335147	27.5028013	1072.73	Put mussels in the GBT box
MRS-DV594-03	06/11/2014	14:14:52	40.8335185	27.5027961	1072.80	In the basket
MRS-DV594-03	06/11/2014	14:18:04	40.8334996	27.5028570	1074.27	start to point 8
MRS-DV594-03	06/11/2014	14:29:30	40.8340439	27.5032293	1057.50	Arrival on BB Bubbles site
MRS-DV594-03	06/11/2014	14:49:34	40.8342130	27.5033111	1053.80	bubbles
MRS-DV594-03	06/11/2014	14:51:03	40.8342132	27.5033423	1053.94	Bulo vent
MRS-DV594-03	06/11/2014	14:53:32	40.8341582	27.5034239	1056.66	Chnikov vent
MRS-DV594-03	06/11/2014	15:24:51	40.8342261	27.5033417	1054.85	Boubouns vent
MRS-DV594-03	06/11/2014	15:40:31	40.8341708	27.5034253	1057.51	Chnikov vent
MRS-DV594-03	06/11/2014	15:59:01	40.8335898	27.5026973	1067.89	yellowish patches
MRS-DV594-03	06/11/2014	17:03:55	40.8384590	27.5089504	1041.88	Observing an echo sonar to the east
MRS-DV594-03	06/11/2014	17:13:25	40.8403457	27.5109047	1026.68	Echo sonar 2
MRS-DV594-03	06/11/2014	17:15:31	40.8407546	27.5113484	1023.32	echo sonar 3
MRS-DV594-03	06/11/2014	17:22:01	40.8421196	27.5127626	1015.29	echo sonar 4
MRS-DV594-03	06/11/2014	17:30:14	40.8439997	27.5147454	1013.41	echosonar 5
MRS-DV594-03	06/11/2014	18:04:13	40.8506599	27.5205276	1082.82	Bacterial mats
MRS-DV594-03	06/11/2014	18:08:59	40.8511378	27.5209572	1079.39	Black patches
MRS-DV594-03	06/11/2014	18:09:51	40.8511869	27.5210143	1078.67	black patch and bacterial patch
MRS-DV594-03	06/11/2014	18:11:31	40.8512317	27.5212219	1080.95	black patch
MRS-DV594-03	06/11/2014	18:11:49	40.8512328	27.5212234	1081.27	black patch and fluids
MRS-DV594-03	06/11/2014	18:16:46	40.8514412	27.5216176	1083.53	black and bacterial patches
MRS-DV594-03	06/11/2014	18:16:58	40.8514441	27.5216412	1083.54	Black patches and gas
MRS-DV594-03	06/11/2014	18:17:43	40.8514410	27.5216467	1084.88	Black patches and bubbles
MRS-DV594-03	06/11/2014	18:18:20	40.8514389	27.5216487	1085.04	bubbles
MRS-DV594-03	06/11/2014	18:25:22	40.8513445	27.5216012	1084.28	black and bacterial patches

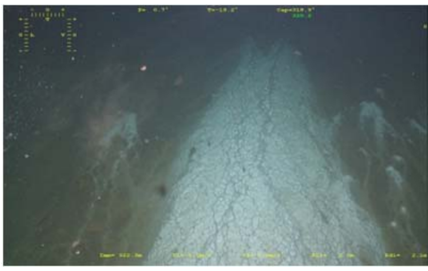
DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV594-03	06/11/2014	18:28:38	40.8514330	27.5216436	1084.85	black and bacterial patches with weak bubbles
MRS-DV594-03	06/11/2014	18:30:24	40.8514400	27.5216329	1085.03	bubbles
MRS-DV594-03	06/11/2014	18:38:00	40.851440	27.521627	1085	MRS-DV03-RA-03 Raman measure
MRS-DV594-03	06/11/2014	19:25:00	40.851559	27.521530	1085	MRS-DV03-TI-04 Titanium bottle sample
MRS-DV594-03	06/11/2014	19:32:17	40.8513730	27.5211964	1081.35	Black patches
MRS-DV594-03	06/11/2014	19:38:39	40.8513691	27.5211235	1082.61	fluid
MRS-DV594-03	06/11/2014	19:39:03	40.8513648	27.5211161	1082.59	Fluid seep
MRS-DV594-03	06/11/2014	19:39:48	40.8513700	27.5211294	1082.59	Fluid seep
MRS-DV594-03	06/11/2014	19:46:02	40.8513647	27.5211332	1082.58	floating crude oil pieces
MRS-DV594-03	06/11/2014	19:48:00	40.851360	27.521141	1085	MRS-DV03-RA-04 Raman measure
MRS-DV594-03	06/11/2014	19:59:55	40.8513161	27.5209479	1079.31	black and bacterial patches
MRS-DV594-03	06/11/2014	20:03:03	40.8512873	27.5208293	1078.28	carbonate crust and black patches
MRS-DV594-03	06/11/2014	20:07:17	40.8509000	27.5206387	1082.18	Black patches
MRS-DV594-03	06/11/2014	20:09:09	40.8508274	27.5205914	1083.43	Bubbles !
MRS-DV594-03	06/11/2014	20:09:45	40.8508343	27.5205998	1084.25	Stop bubbling. Intermittent bubbling site. Few liquid drops are raising in surface.
MRS-DV594-03	06/11/2014	20:20:49	40.8493678	27.5200784	1084.09	Arrival on C25 point, first patches appeared
MRS-DV594-03	06/11/2014	20:21:39	40.8493151	27.5200997	1084.49	Patches
MRS-DV594-03	06/11/2014	20:22:47	40.8493118	27.5201141	1085.59	Black pearls are petroleum
MRS-DV594-03	06/11/2014	20:25:07	40.8493057	27.5201097	1085.59	Black points on C25, small drops are rising up
MRS-DV594-03	06/11/2014	20:27:39	40.8492986	27.5201083	1085.59	A big black stretched drop of petroleum is raising
MRS-DV594-03	06/11/2014	20:29:33	40.8492942	27.5201000	1085.60	Idem
MRS-DV594-03	06/11/2014	20:34:13	40.8492127	27.5201056	1084.17	Bubbles and petroleum are seeped
MRS-DV594-03	06/11/2014	20:35:30	40.8491947	27.5201150	1084.61	Seeped petroleum, releasing gas
MRS-DV594-03	06/11/2014	20:38:46	40.8491665	27.5201323	1083.75	Bubble train on C22
MRS-DV594-03	06/11/2014	20:53:00	40.849156	27.520125	1085	MRS-DV03-PE-09 Pegaz sample
MRS-DV594-03	06/11/2014	20:53:48	40.8491504	27.5201307	1085.76	Intermittent gas flow from 2 holes
MRS-DV594-03	06/11/2014	21:11:19	40.8491622	27.5201306	1085.76	Oil drops trapped in Pegaz cone
MRS-DV594-03	06/11/2014	21:51:28	40.8469995	27.5183331	1082.83	Black patches on C21
MRS-DV594-03	06/11/2014	22:43:00	40.845762	27.518517	1092	MRS-DV03-FLO-08 Flowmeter measure
MRS-DV594-03	06/11/2014	23:04:00	40.845753	27.518504	1092	MRS-DV03-RA-05 Raman measure
MRS-DV594-03	06/11/2014	23:10:00	40.845735	27.518514	1092	MRS-DV03-FLO-09 Flowmeter measure
MRS-DV594-03	06/11/2014	23:31:00	40.845743	27.518513	1092	MRS-DV03-FLO-10 Flowmeter measure
MRS-DV594-03	07/11/2014	00:09:22	40.8433243	27.5158932	1088.30	arrival on point C18
MRS-DV594-03	07/11/2014	00:14:36	40.8430756	27.5161412	1090.15	Oil emission
MRS-DV594-03	07/11/2014	00:47:00	40.843186	27.516241	1092	MRS-DV03-FLO-11 Flowmeter measure
MRS-DV594-03	07/11/2014	01:13:53	40.8424837	27.5155524	1087.91	near point C17
MRS-DV594-03	07/11/2014	01:29:38	40.8424923	27.5156130	1088.19	bubbles

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV594-03	07/11/2014	01:38:22	40.8430451	27.5161397	1089.74	Return on Dallas site
MRS-DV594-03	07/11/2014	01:40:38	40.843053	27.516151	1090	MRS-DV03-FLO-12 Flowmeter measure
MRS-DV594-03	07/11/2014	01:58:31	40.8430629	27.5161367	1090.25	On Dallas site for Pegaz
MRS-DV594-03	07/11/2014	02:08:07	40.8430511	27.5161299	1090.25	Pegaz04 essay
MRS-DV594-03	07/11/2014	03:06:26	40.8430620	27.5161477	1090.27	Lost of PEGAZ due to lost of ROV arm communication
MRS-DV594-03	07/11/2014	03:31:52	40.8414806	27.5139423	1085.00	Moving towards Carla's point C16
MRS-DV594-03	07/11/2014	03:34:39	40.8412583	27.5140229	1074.09	Gas hydrates?
MRS-DV594-03	07/11/2014	03:44:40	40.8400543	27.5137882	1075.54	Gas Hydrates??
MRS-DV594-03	07/11/2014	04:10:18	40.8409370	27.5111513	1049.57	Slope ascension to echo sonar 3
MRS-DV594-03	07/11/2014	04:15:15	40.8408500	27.5109975	1030.74	We go to the point C14
MRS-DV594-03	07/11/2014	04:51:55	40.8382119	27.5086421	1078.78	C12
MRS-DV594-03	07/11/2014	04:53:54	40.8382722	27.5086106	1077.75	Very week bubbles seep
MRS-DV594-03	07/11/2014	04:57:05	40.8385250	27.5084730	1073.99	Release of bubbles on point C13
MRS-DV594-03	07/11/2014	05:45:00	40.838069	27.509277	1090	MRS-DV03-PE-04 Pegaz sample
MRS-DV594-03	07/11/2014	06:01:40	40.8366909	27.5078478	1059.29	Bedrock (Kesan Formation?)
MRS-DV594-03	07/11/2014	06:22:39	40.8342334	27.5033376	1054.34	Bubbles
MRS-DV594-03	07/11/2014	06:24:21	40.8342399	27.5033562	1054.24	Bubbles at vent Boubouns
MRS-DV594-03	07/11/2014	06:27:22	40.8341513	27.5034510	1058.09	Bubbles at Chnikov vent
MRS-DV594-03	07/11/2014	06:28:05	40.8341443	27.5034494	1058.50	Bubbles at Chnikov vent
MRS-DV594-03	07/11/2014	06:29:22	40.8341534	27.5034190	1057.76	Bubbles at vent Chnikov
MRS-DV594-03	07/11/2014	06:50:41	40.8342168	27.5033462	1054.31	Boris:Boubouns vent
MRS-DV594-03	07/11/2014	06:51:09	40.8342260	27.5033365	1054.62	Boubouns vent
MRS-DV594-03	07/11/2014	06:52:59	40.8341939	27.5033295	1054.53	PC good area
MRS-DV594-03	07/11/2014	07:02:42	40.8342177	27.5033145	1055.13	PC-3 sampling
MRS-DV594-03	07/11/2014	07:10:23	40.8342530	27.5033284	1054.52	bubbles
MRS-DV594-03	07/11/2014	08:05:55	40.8342263	27.5033590	1053.93	Bubbles
MRS-DV594-03	07/11/2014	08:06:57	40.8342244	27.5033428	1054.83	bubbles
MRS-DV594-03	07/11/2014	08:09:00	40.834224	27.503344	1055	MRS-DV03-PE-06 Pegaz sample on Boubouns vent
MRS-DV594-03	07/11/2014	08:12:00	40.834232	27.503351	1055	MRS-DV03-RA-06 Raman measure
MRS-DV594-03	07/11/2014	08:15:39	40.8342342	27.5033385	1054.72	Flux measurement at Boubouns
MRS-DV594-03	07/11/2014	08:17:51	40.8342248	27.5033476	1054.72	Bubbles at Boubouns
MRS-DV594-03	07/11/2014	08:18:00	40.834223	27.503346	1055	MRS-DV03-FLO-13 Flowmeter measure
MRS-DV594-03	07/11/2014	08:18:22	40.8342257	27.5033412	1054.71	Flux measurements always on at Boubouns vent
MRS-DV594-03	07/11/2014	08:27:00	40.834137	27.503466	1059	MRS-DV03-FLO-14 Flowmeter measure
MRS-DV594-03	07/11/2014	08:36:00	40.834116	27.503465	1059	MRS-DV03-PE-01 Pegaz sample on Chnikov vent
MRS-DV594-03	07/11/2014	08:40:00	40.834118	27.503462	1059	MRS-DV03-RA-07 Raman measure
MRS-DV594-03	07/11/2014	09:22:41	40.8342195	27.5033976	1055.51	Fracture in filled by blackpatch
MRS-DV594-03	07/11/2014	09:29:00	40.834205	27.503333	1055	MRS-DV03-BC-01 Blade core sample
MRS-DV594-03	07/11/2014	09:35:39	40.8342076	27.5033462	1054.05	Raman at boubouns

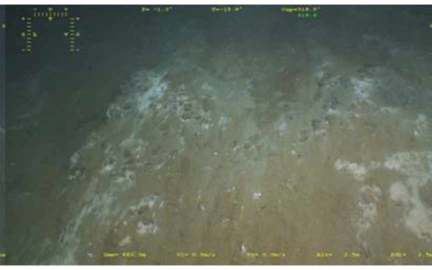
DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV594-03	07/11/2014	09:39:48	40.8342102	27.5033365	1054.81	Fracture at Boubouns vent
MRS-DV594-03	07/11/2014	09:49:03	40.8342003	27.5033659	1055.40	Bulo vent, no bubble release
MRS-DV594-03	07/11/2014	09:53:15	40.8342230	27.5034994	1054.59	Mussels area
MRS-DV594-03	07/11/2014	09:55:00	40.834222	27.503436	1054	MRS-DV03-GBT-01 Big Bio Box sample for mussels
MRS-DV594-03	07/11/2014	10:29:06	40.8334640	27.5028019	1074.33	shark
MRS-DV594-03	07/11/2014	10:43:19	40.8335403	27.5028907	1074.10	mussels
MRS-DV594-03	07/11/2014	10:51:00	40.833530	27.502826	1073	MRS-DV03-GBT-02 Big Bio Box sample for mussels
MRS-DV594-03	07/11/2014	11:07:17	40.8341350	27.5033833	1057.22	not a PC site because it's too hard
MRS-DV594-03	07/11/2014	13:02:00	40.832412	27.500473	1071	MRS-DV03-TI-02 Titanium bottle sample

Figure 22 : Dive MRS-PL594-03

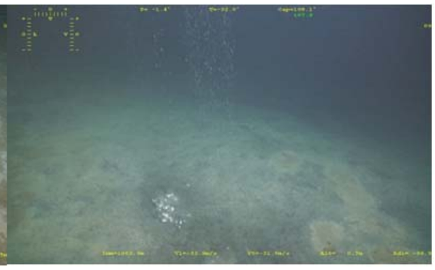
MARSITE - Dive 03 – Tekirdag



07:14 Large bacterial mat

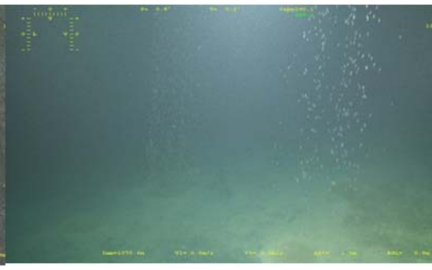


07:28 Bubbles on summit of the massive bacterial mat

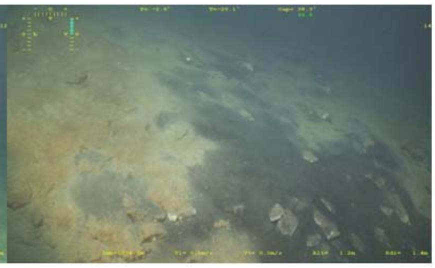


09:21 Bubbles (in the center of black patch)

12:11 Temperature measurement close to a bubble conduit (14.7°C)



12:14 View of rising bubbles

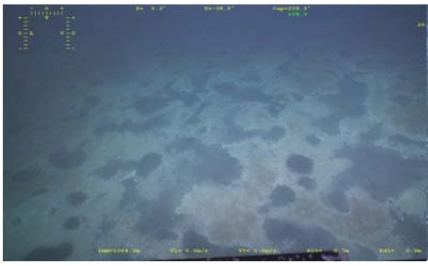


14:18 Black patch between Mussel sites and Boris bubbler

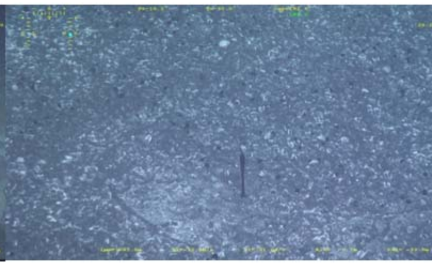
15:25 Boubouns Site

16:10 Mussels on sedimentary rocks

19:39 Temperature on shimmering fluid chimney



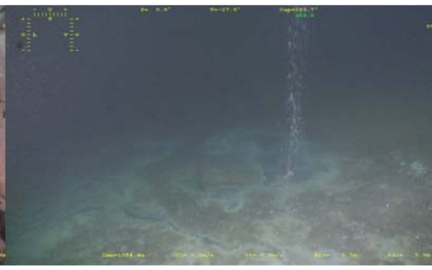
20:09 Black patches associated with oil drops



20:29 Oil seeping out on a black patch

00:17 Rising oil from the seafloor (Dallas site)

06:01 View on sedimentary rocks



06:22 Boris bubbler site

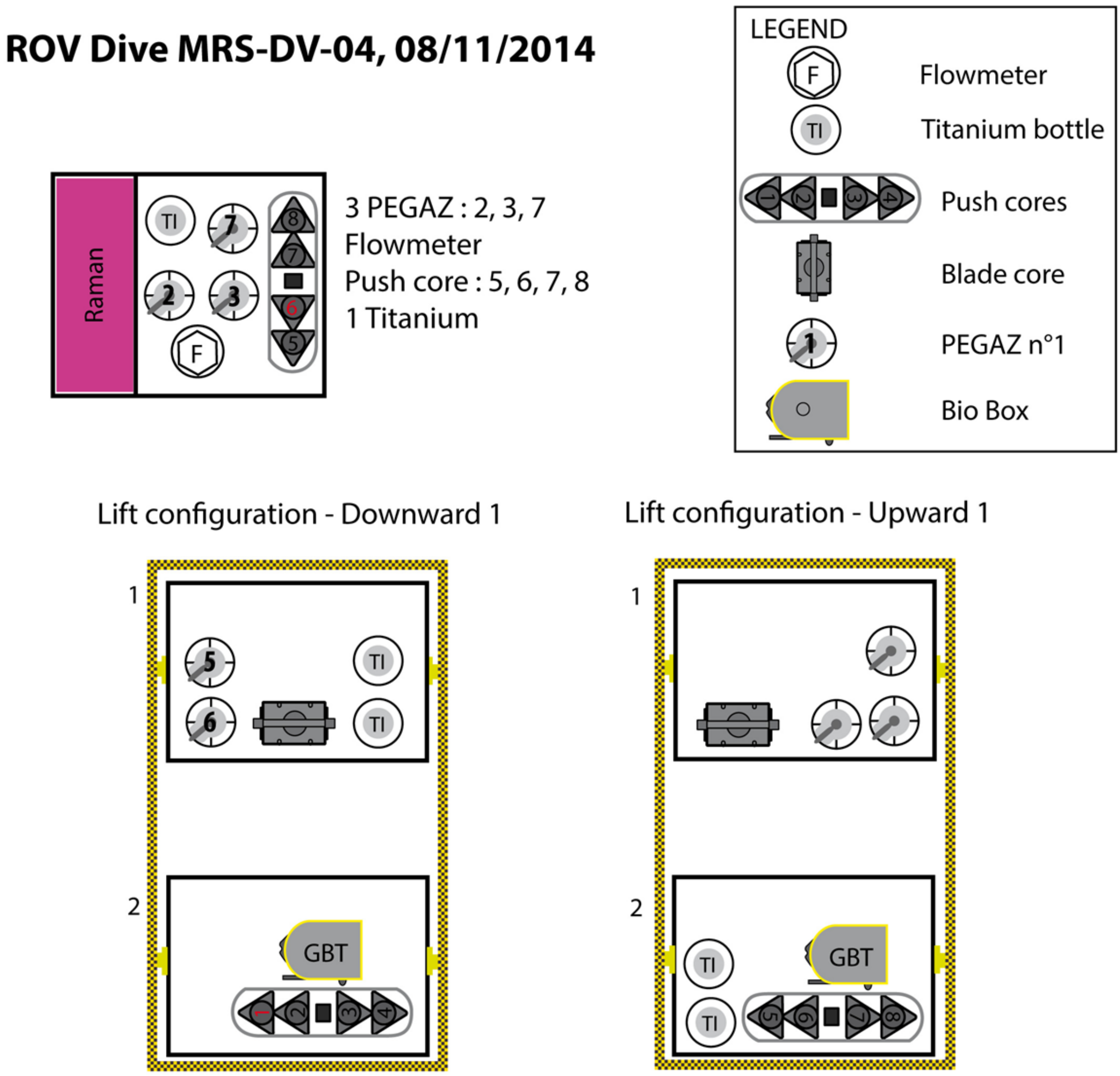
06:51 Boubouns site

Table 11 : Marsite ROV dive MRS-PL594-03 samples

DIVE	DATE/	HOUR	DEPTH (m)	SAMPLE NAME	TOOL	LATITUDE	LONGITUDE
MRS-DV594-03	06/11/2014	07:51:00	895	MRS-DV03-PE-03	Pegaz	40.82852	27.47871
MRS-DV594-03	06/11/2014	08:12:00	895	MRS-DV03-RA-01	Raman	40.82850	27.47871
MRS-DV594-03	06/11/2014	08:25:00	895	MRS-DV03-FLO-01	Flowmeter	40.82852	27.47870
MRS-DV594-03	06/11/2014	08:28:00	895	MRS-DV03-FLO-02	Flowmeter	40.82851	27.47871
MRS-DV594-03	06/11/2014	08:40:00	895	MRS-DV03-FLO-03	Flowmeter	40.82850	27.47871
MRS-DV594-03	06/11/2014	09:26:00	1070	MRS-DV03-PE-02	Pegaz	40.82768	27.48708
MRS-DV594-03	06/11/2014	09:32:00	1070	MRS-DV03-RA-02	Raman	40.82769	27.48705
MRS-DV594-03	06/11/2014	09:38:00	1070	MRS-DV03-FLO-04	Flowmeter	40.82769	27.48707
MRS-DV594-03	06/11/2014	09:42:00	1070	MRS-DV03-FLO-05	Flowmeter	40.82769	27.48706
MRS-DV594-03	06/11/2014	09:44:00	1070	MRS-DV03-FLO-06	Flowmeter	40.82769	27.48706
MRS-DV594-03	06/11/2014	09:48:00	1070	MRS-DV03-FLO-07	Flowmeter	40.82770	27.48706
MRS-DV594-03	06/11/2014	10:22:00	1070	MRS-DV03-PC-05	Push core	40.82771	27.48715
MRS-DV594-03	06/11/2014	10:26:00	1070	MRS-DV03-PC-06	Push core	40.82770	27.48714
MRS-DV594-03	06/11/2014	10:27:00	1070	MRS-DV03-PC-07	Push core	40.82769	27.48718
MRS-DV594-03	06/11/2014	10:30:00	1070	MRS-DV03-PC-08	Push core	40.82767	27.48714
MRS-DV594-03	06/11/2014	11:59:00	1070	MRS-DV03-PC-01	Push core	40.82774	27.48710
MRS-DV594-03	06/11/2014	12:03:00	1070	MRS-DV03-PC-02	Push core	40.82775	27.48712
MRS-DV594-03	06/11/2014	18:38:00	1085	MRS-DV03-RA-03	Raman	40.85144	27.52163
MRS-DV594-03	06/11/2014	19:25:00	1085	MRS-DV03-TI-04	Titanium bottle	40.85156	27.52153
MRS-DV594-03	06/11/2014	19:48:00	1085	MRS-DV03-RA-04	Raman	40.85136	27.52114
MRS-DV594-03	06/11/2014	20:53:00	1085	MRS-DV03-PE-09	Pegaz	40.84916	27.52013
MRS-DV594-03	06/11/2014	22:43:00	1092	MRS-DV03-FLO-08	Flowmeter	40.84576	27.51852
MRS-DV594-03	06/11/2014	23:04:00	1092	MRS-DV03-RA-05	Raman	40.84575	27.51850
MRS-DV594-03	06/11/2014	23:10:00	1092	MRS-DV03-FLO-09	Flowmeter	40.84574	27.51851
MRS-DV594-03	06/11/2014	23:31:00	1092	MRS-DV03-FLO-10	Flowmeter	40.84574	27.51851
MRS-DV594-03	07/11/2014	00:47:00	1092	MRS-DV03-FLO-11	Flowmeter	40.84319	27.51624
MRS-DV594-03	07/11/2014	01:40:38	1090	MRS-DV03-FLO-12	Flowmeter	40.84305	27.51615
MRS-DV594-03	07/11/2014	05:45:00	1090	MRS-DV03-PE-04	Pegaz	40.83807	27.50928
MRS-DV594-03	07/11/2014	08:09:00	1055	MRS-DV03-PE-06	Pegaz	40.83422	27.50334
MRS-DV594-03	07/11/2014	08:12:00	1055	MRS-DV03-RA-06	Raman	40.83423	27.50335
MRS-DV594-03	07/11/2014	08:18:00	1055	MRS-DV03-FLO-13	Flowmeter	40.83422	27.50335
MRS-DV594-03	07/11/2014	08:27:00	1059	MRS-DV03-FLO-14	Flowmeter	40.83414	27.50347
MRS-DV594-03	07/11/2014	08:40:00	1059	MRS-DV03-RA-07	Raman	40.83412	27.50346
MRS-DV594-03	07/11/2014	08:36:00	1059	MRS-DV03-PE-01	Pegaz	40.83412	27.50347
MRS-DV594-03	07/11/2014	09:29:00	1055	MRS-DV03-BC-01	Blade core	40.83421	27.50333
MRS-DV594-03	07/11/2014	09:55:00	1054	MRS-DV03-GBT-01	Big Bio Box	40.83422	27.50344
MRS-DV594-03	07/11/2014	10:51:00	1073	MRS-DV03-GBT-02	Big Bio Box	40.83353	27.50283
MRS-DV594-03	07/11/2014	13:02:00	1071	MRS-DV03-TI-02	Titanium bottle	40.83241	27.50047

5.4. Dive MRS-PL-595-04 (Southeast Tekirdag Basin)

This area has not been sampled from Marnaut cruise (2007). Its survey is very important as it may provide useful information regarding the link between Tekirdag basin and the Western High.



Mission	
Date	08/11/2014 - 08/11/2014
Dive number	MRS-DV595-04
Responsable operation	CHEILAN P.
Vehicule	Victor
Vessel	Pourquoi Pas
Central Point	N40.8032 , E27.6296
Latitude min	40.785188°
Longitude min	27.605899°
Latitude max	40.821207°
Longitude max	27.653301°
Geodetic system navigation	WGS84

Time		
Start from desk	08/11/2014 01:07:37	18:26 h
Arrival on desk	08/11/2014 19:33:15	
Under water	08/11/2014 01:23:13	17:37 h under water
Surface arrival	08/11/2014 19:00:17	
Arrival on sea bottom	08/11/2014 02:22:28	15:33 h on bottom
Departure from bottom	08/11/2014 17:55:54	5,25 km

Objectives :

- Detect any evidence of fluid seepages from visual inspection of the seafloor
- Sample gas bubbles from PEGAZ sampler to determine sources
- Sample bottom water to characterize dense-fluid emission and heavy-dissolved compounds
- Collect living communities associated with the seeps
- Sample the chimney called “Jack The Smoker”

Sampling and *in situ* measurements :

- PEGAZ
- Push Core
- Titanium bottle
- Raman spectrometer
- Flowmeter

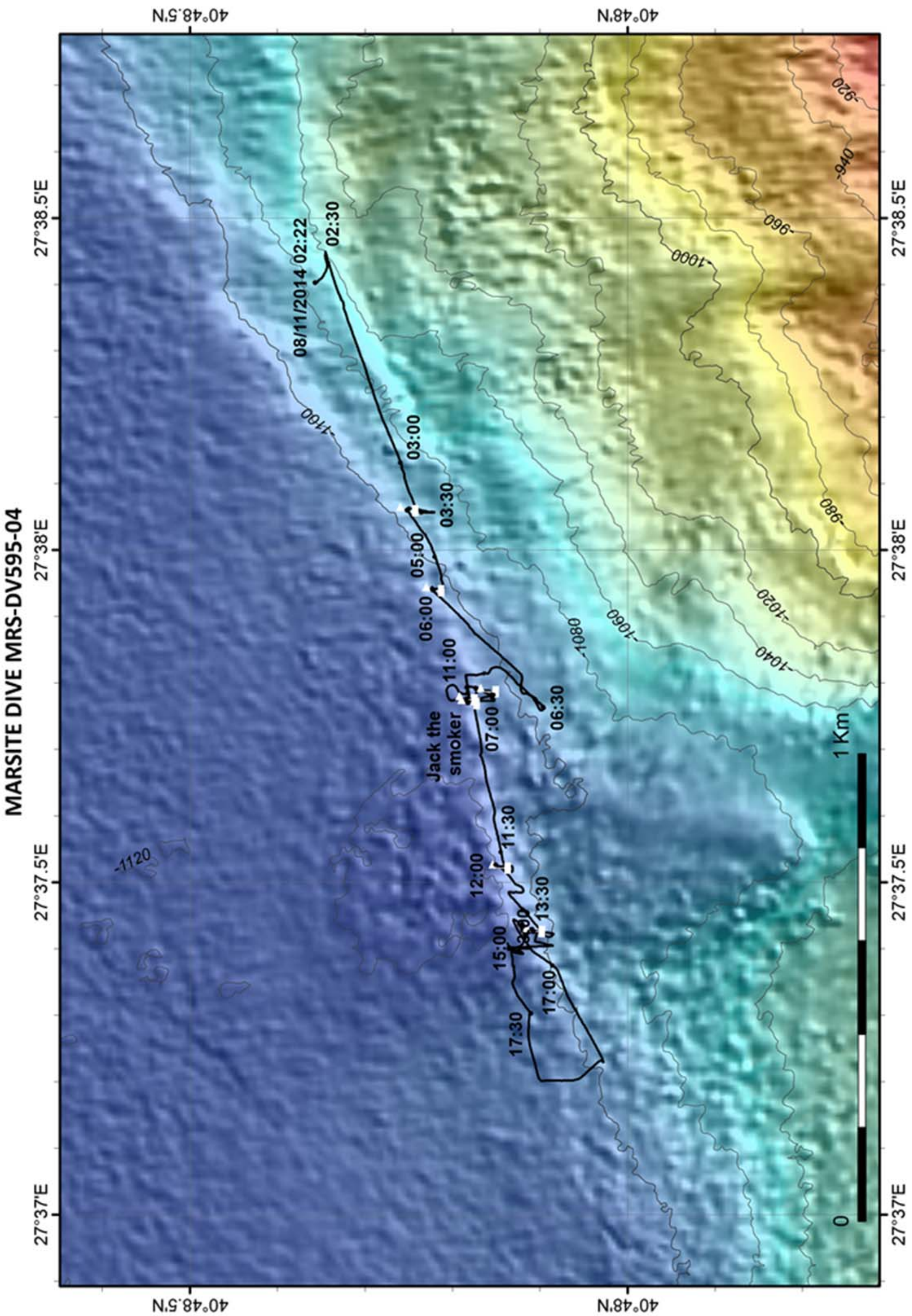


Figure 23 : MARSITE DIVE MRS-DV595-04

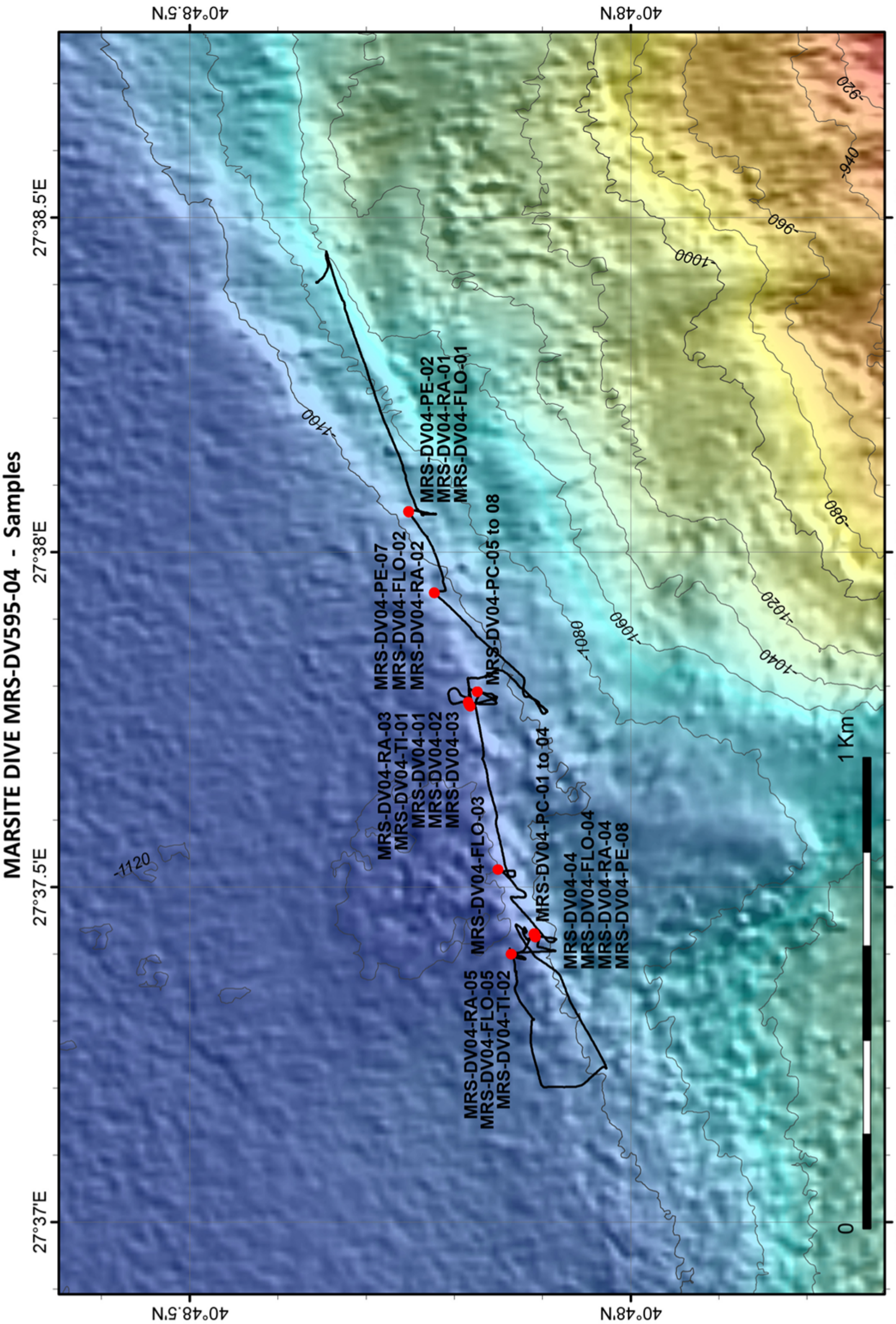


Figure 24 : MARSITE DIVE MRS-DV595-04 – SAMPLES

Table 12 : Marsite ROV dive MRS-PL595-04 diary

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV595-04	08/11/2014	02:24:47	40.80578	27.64024	1059.4	Victor reaches the bottom
MRS-DV595-04	08/11/2014	02:30:53	40.80566	27.64038	1052.4	Exploration of segment 1
MRS-DV595-04	08/11/2014	02:34:44	40.80552	27.63982	1058.1	Patches
MRS-DV595-04	08/11/2014	02:37:36	40.80546	27.63965	1056.7	Strong scarp
MRS-DV595-04	08/11/2014	02:52:18	40.80470	27.63674	1075.0	Burrows
MRS-DV595-04	08/11/2014	02:56:24	40.80452	27.63619	1076.3	Seafloor
MRS-DV595-04	08/11/2014	02:57:52	40.80445	27.63596	1078.9	Shark
MRS-DV595-04	08/11/2014	03:03:56	40.80412	27.63468	1077.4	Very dispersed and small black patches
MRS-DV595-04	08/11/2014	03:16:38	40.80415	27.63438	1077.3	Gas bubbles
MRS-DV595-04	08/11/2014	03:16:58	40.80415	27.63439	1078.5	Gas bubbles
MRS-DV595-04	08/11/2014	03:17:30	40.80417	27.63439	1081.4	Gas bubbles
MRS-DV595-04	08/11/2014	03:18:10	40.80417	27.63439	1082.5	Multiple gas seeps
MRS-DV595-04	08/11/2014	03:19:05	40.80418	27.63438	1083.3	Small fish eastwards
MRS-DV595-04	08/11/2014	03:19:56	40.80417	27.63438	1083.2	Small crab
MRS-DV595-04	08/11/2014	03:21:54	40.80418	27.63439	1083.4	Gas seeps in front of the black patch
MRS-DV595-04	08/11/2014	03:22:53	40.80418	27.63437	1083.4	Two gas seeps
MRS-DV595-04	08/11/2014	03:23:33	40.80418	27.63434	1083.3	Multiple gas seeps
MRS-DV595-04	08/11/2014	03:28:10	40.80418	27.63436	1083.8	Site near the PEGAZ sampling
MRS-DV595-04	08/11/2014	03:32:17	40.80418	27.63435	1084.2	Small fish
MRS-DV595-04	08/11/2014	03:37:00	40.80419	27.63434	895.0	MRS-DV04-PE-02
MRS-DV595-04	08/11/2014	03:41:15	40.80419	27.63434	1085.0	Gas bubble sampling
MRS-DV595-04	08/11/2014	03:47:55	40.80419	27.63434	1085.0	Small fish
MRS-DV595-04	08/11/2014	03:54:34	40.80418	27.63434	1085	Gas bubbles near bacterial mat
MRS-DV595-04	08/11/2014	04:13:00	40.80420	27.63435	1083.0	MRS-DV04-FLO-01
MRS-DV595-04	08/11/2014	04:40:00	40.80419	27.63435	0.0	MRS-DV04-RA-01
MRS-DV595-04	08/11/2014	04:55:56	40.80384	27.63371	1082.3	Bacterial mat
MRS-DV595-04	08/11/2014	05:09:03	40.80369	27.63238	1096	gas bubbles near bacterial mat
MRS-DV595-04	08/11/2014	05:11:05	40.80371	27.63234	1096.6	Bacterial mat
MRS-DV595-04	08/11/2014	05:33:00	40.80371	27.63233	1098.0	MRS-DV04-FLO-02
MRS-DV595-04	08/11/2014	05:44:00	40.80370	27.63234	1098.0	MRS-DV04-RA-02
MRS-DV595-04	08/11/2014	05:44:02	40.80370	27.63233	1098.3	Transfer from flowmeter to Raman
MRS-DV595-04	08/11/2014	06:02:00	40.80370	27.63235	1098.0	MRS-DV04-PE-07
MRS-DV595-04	08/11/2014	06:21:44	40.80203	27.62988	1090.0	Black patch
MRS-DV595-04	08/11/2014	06:23:43	40.80187	27.62970	1087.2	linear feature
MRS-DV595-04	08/11/2014	06:24:40	40.80179	27.62965	1087.5	black patches
MRS-DV595-04	08/11/2014	06:25:13	40.80177	27.62963	1087.8	black patch
MRS-DV595-04	08/11/2014	06:25:32	40.80175	27.62962	1087.6	black patch
MRS-DV595-04	08/11/2014	06:26:11	40.80173	27.62957	1087.4	Black patches
MRS-DV595-04	08/11/2014	06:26:51	40.80170	27.62952	1087.4	Black patches and stone
MRS-DV595-04	08/11/2014	06:27:23	40.80167	27.62949	1087.1	carbonate crust
MRS-DV595-04	08/11/2014	06:27:53	40.80164	27.62946	1086.4	Black patches
MRS-DV595-04	08/11/2014	06:28:13	40.80162	27.62943	1086.2	fish and Black patches
MRS-DV595-04	08/11/2014	06:28:32	40.80161	27.62942	1086.1	carbonate crust
MRS-DV595-04	08/11/2014	06:29:11	40.80160	27.62941	1086.4	carbonate crust
MRS-DV595-04	08/11/2014	06:29:50	40.80160	27.62941	1087.2	carbonate crust close up
MRS-DV595-04	08/11/2014	06:30:32	40.80160	27.62941	1087.2	Bubbles

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV595-04	08/11/2014	06:32:49	40.80158	27.62938	1085.8	close up carbonate crust
MRS-DV595-04	08/11/2014	06:34:22	40.80159	27.62937	1086.3	bubbles
MRS-DV595-04	08/11/2014	06:35:27	40.80160	27.62937	1086.6	jelly fish
MRS-DV595-04	08/11/2014	06:39:10	40.80173	27.62948	1087.4	Black patches
MRS-DV595-04	08/11/2014	06:42:26	40.80210	27.62998	1090.7	Black patches
MRS-DV595-04	08/11/2014	06:47:38	40.80274	27.63025	1097.6	Black patches
MRS-DV595-04	08/11/2014	06:48:03	40.80274	27.63023	1097.6	Black patches
MRS-DV595-04	08/11/2014	06:48:36	40.80274	27.63023	1099.2	bubbles and Black patches
MRS-DV595-04	08/11/2014	06:55:14	40.80303	27.63020	1103.2	Black patches
MRS-DV595-04	08/11/2014	06:55:42	40.80307	27.63020	1104.3	bubbles black patches
MRS-DV595-04	08/11/2014	06:57:35	40.80307	27.63009	1105.0	Black patches
MRS-DV595-04	08/11/2014	06:58:07	40.80306	27.63004	1105.3	Black patches bubbles
MRS-DV595-04	08/11/2014	06:58:41	40.80306	27.62994	1105.6	Black patches
MRS-DV595-04	08/11/2014	06:58:48	40.80306	27.62992	1105.6	carbonate crust and Black patches
MRS-DV595-04	08/11/2014	07:00:09	40.80303	27.62975	1105.1	Black patches
MRS-DV595-04	08/11/2014	07:00:32	40.80303	27.62971	1105.9	Black patches
MRS-DV595-04	08/11/2014	07:00:52	40.80303	27.62968	1106.2	carbonate crust
MRS-DV595-04	08/11/2014	07:03:48	40.80302	27.62958	1106.0	Black patches and carbonate
MRS-DV595-04	08/11/2014	07:05:35	40.80303	27.62952	1107.5	carbonate crust
MRS-DV595-04	08/11/2014	07:06:31	40.80303	27.62952	1107.8	fluid seep
MRS-DV595-04	08/11/2014	07:07:01	40.80303	27.62951	1107.8	fluid seep
MRS-DV595-04	08/11/2014	07:07:25	40.80303	27.62952	1107.8	fluid seep
MRS-DV595-04	08/11/2014	07:07:46	40.80303	27.62952	1107.8	close up fluid seep
MRS-DV595-04	08/11/2014	07:09:31	40.80302	27.62951	1107.6	Jack the smoker with fish
MRS-DV595-04	08/11/2014	07:14:23	40.80302	27.62951	1107.6	temperature measurement Jack the smoker site
MRS-DV595-04	08/11/2014	07:24:06	40.80255	27.62970	1107	ASCE
MRS-DV595-04	08/11/2014	07:25:16	40.80303	27.62951	1107.4	overview of Jack the Smoker site
MRS-DV595-04	08/11/2014	07:30:44	40.80303	27.62951	1107.3	Raman collection Jack the Smoker site
MRS-DV595-04	08/11/2014	07:31:00	40.80303	27.62951	1107.0	MRS-DV04-RA-03
MRS-DV595-04	08/11/2014	07:50:00	40.80303	27.62952	1107.0	MRS-DV04-TI-01
MRS-DV595-04	08/11/2014	07:58:54	40.80304	27.62953	1107.4	2^{nd} T measurement
MRS-DV595-04	08/11/2014	08:03:33	40.80303	27.62952	1107.4	Rock sample location
MRS-DV595-04	08/11/2014	08:06:00	40.80304	27.62953	1107.0	MRS-DV04-01
MRS-DV595-04	08/11/2014	08:24:36	40.80256	27.62972	1093.9	rock sample in elevator
MRS-DV595-04	08/11/2014	08:46:08	40.80260	27.62978	1094	MARQ
MRS-DV595-04	08/11/2014	08:49:45	40.80303	27.62992	1104.6	fracture aligned w Jack the Smoker site
MRS-DV595-04	08/11/2014	08:59:45	40.80305	27.62991	1107.0	fracture w carbonate crusts leading to Jack the Smoker site
MRS-DV595-04	08/11/2014	09:02:03	40.80305	27.62980	1105.9	patch for coring close to Jack the Smoker site (10 m E)
MRS-DV595-04	08/11/2014	09:04:44	40.80305	27.62978	1107.8	PC 6 in place
MRS-DV595-04	08/11/2014	09:25:35	40.80289	27.62988	1102.5	Black patch w bubbles. Target for push core
MRS-DV595-04	08/11/2014	09:26:40	40.80289	27.62988	1103.0	same black patch
MRS-DV595-04	08/11/2014	09:27:19	40.80289	27.62988	1102.9	max penetration
MRS-DV595-04	08/11/2014	09:28:38	40.80289	27.62989	1103.0	2nd coring attempt liquid bubbles (co2?)

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV595-04	08/11/2014	09:31:00	40.80290	27.62987	1103.0	MRS-DV04-PC-06
MRS-DV595-04	08/11/2014	09:32:41	40.80289	27.62988	1103.0	PC5 same patch
MRS-DV595-04	08/11/2014	09:34:00	40.80289	27.62988	1103.0	MRS-DV04-PC-05
MRS-DV595-04	08/11/2014	09:37:22	40.80290	27.62989	1103.0	bubbles emanating from 2different holes
MRS-DV595-04	08/11/2014	09:42:00	40.80290	27.62988	1103.0	MRS-DV04-PC-07
MRS-DV595-04	08/11/2014	09:46:00	40.80289	27.62987	1103.0	MRS-DV04-PC-08
MRS-DV595-04	08/11/2014	10:32:39	40.80255	27.62959	1094.3	Lift goes up
MRS-DV595-04	08/11/2014	10:47:00	40.80306	27.62958	1107.0	MRS-DV04-02
MRS-DV595-04	08/11/2014	10:55:58	40.80306	27.62962	1107.7	Crust too hard to be sampled
MRS-DV595-04	08/11/2014	10:56:32	40.80306	27.62962	1107.7	Thread of fishing ?
MRS-DV595-04	08/11/2014	11:01:00	40.80307	27.62961	1107.0	MRS-DV04-03
MRS-DV595-04	08/11/2014	11:01:56	40.80244	27.62296	11	PP? target
MRS-DV595-04	08/11/2014	11:03:08	40.80306	27.62961	1107.8	DV04-03
MRS-DV595-04	08/11/2014	11:15:46	40.80281	27.62819	1108.6	carbonate pavement
MRS-DV595-04	08/11/2014	11:39:55	40.80247	27.62544	1092	Site ?
MRS-DV595-04	08/11/2014	12:01:00	40.80251	27.62546	1112.0	MRS-DV04-FLO-03
MRS-DV595-04	08/11/2014	12:28:29	40.80214	27.62454	1102.0	low visibility
MRS-DV595-04	08/11/2014	12:40:08	40.80177	27.62378	1098.0	gas seep
MRS-DV595-04	08/11/2014	12:42:23	40.80180	27.62379	1085	On site detected in water column
MRS-DV595-04	08/11/2014	12:47:00	40.80179	27.62378	1099.0	MRS-DV04-FLO-04
MRS-DV595-04	08/11/2014	12:47:02	40.80179	27.62378	1099.8	gas seep points
MRS-DV595-04	08/11/2014	13:00:00	40.80179	27.62377	1099.0	MRS-DV04-RA-04
MRS-DV595-04	08/11/2014	13:06:00	40.80180	27.62378	1099.0	MRS-DV04-PE-08
MRS-DV595-04	08/11/2014	13:18:00	40.80179	27.62378	1099.0	MRS-DV04-04
MRS-DV595-04	08/11/2014	13:23:48	40.80179	27.62379	1099.8	carbonate crust
MRS-DV595-04	08/11/2014	13:30:06	40.80180	27.62378	1099.8	corals
MRS-DV595-04	08/11/2014	13:36:44	40.80179	27.62379	1099.8	hard floor no push core sample
MRS-DV595-04	08/11/2014	13:40:00	40.80181	27.62384	1100.0	MRS-DV04-PC-03
MRS-DV595-04	08/11/2014	13:52:00	40.80181	27.62385	1100.0	MRS-DV04-PC-04
MRS-DV595-04	08/11/2014	14:01:00	40.80182	27.62385	1100.0	MRS-DV04-PC-02
MRS-DV595-04	08/11/2014	14:09:00	40.80182	27.62384	1100.0	MRS-DV04-PC-01
MRS-DV595-04	08/11/2014	14:37:25	40.80186	27.62377	1101.0	Going to the point C44
MRS-DV595-04	08/11/2014	14:38:51	40.80196	27.62357	1108.7	Oil bubbles (petroleum)
MRS-DV595-04	08/11/2014	14:45:04	40.80205	27.62322	1106.3	Point C44
MRS-DV595-04	08/11/2014	14:50:00	40.80223	27.62333	1107.0	Bubbles
MRS-DV595-04	08/11/2014	14:53:53	40.80227	27.62335	1111.0	Carbonate crust
MRS-DV595-04	08/11/2014	14:55:51	40.80225	27.62335	1112.2	Point C44
MRS-DV595-04	08/11/2014	15:05:00	40.80225	27.62335	0.0	MRS-DV04-FLO-05
MRS-DV595-04	08/11/2014	15:38:00	40.80225	27.62335	0.0	MRS-DV04-RA-05
MRS-DV595-04	08/11/2014	15:56:00	40.80225	27.62335	1112.0	MRS-DV04-TI-02
MRS-DV595-04	08/11/2014	16:46:34	40.80200	27.62388	1107.1	Bubbles seen in direction N65
MRS-DV595-04	08/11/2014	16:50:29	40.80211	27.62403	1108.1	Carbonate crusts in the fissure alignment
MRS-DV595-04	08/11/2014	16:52:04	40.80215	27.62399	1112.2	Carbonate crusts and black patches along the fissures along the fault

Figure 25 : Dive MRS-PL595-04

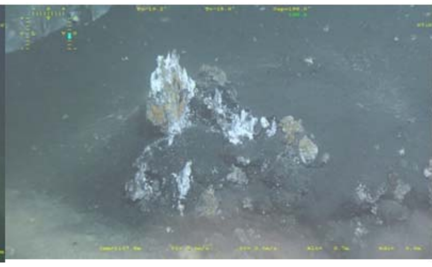
MARSITE - Dive 04 – South Eastern Tekirdag

03:17 Strong gas bubbling on black patch

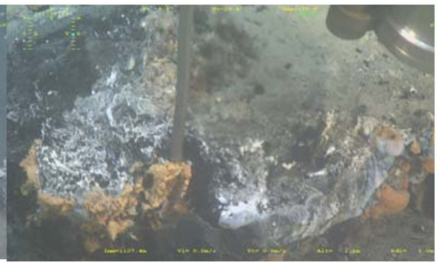
03:22 Gas bubbling on black patch

06:29 Carbonate pavement

07:00 N80 elongated black patch

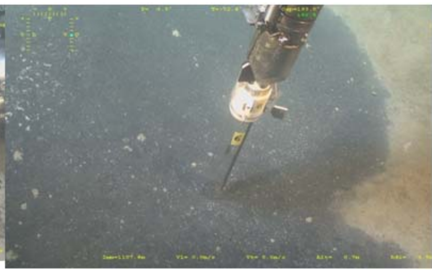


07:07 Jack the smoker



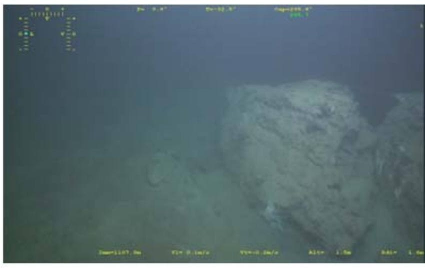
07:50 Titanium bottle on Jack the smoker

08:05 Carbonate crust sampling



09:04 Push core on black patch near Jack the smoker

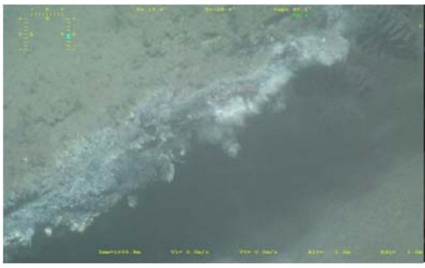
10:40 Full view of Jack the smoker



11:16 Carbonate pavement

12:45 Flow measurement on bubbles (Carla site)

13:19 Carbonate crust sampling



13:29 Coral and anemone on crust

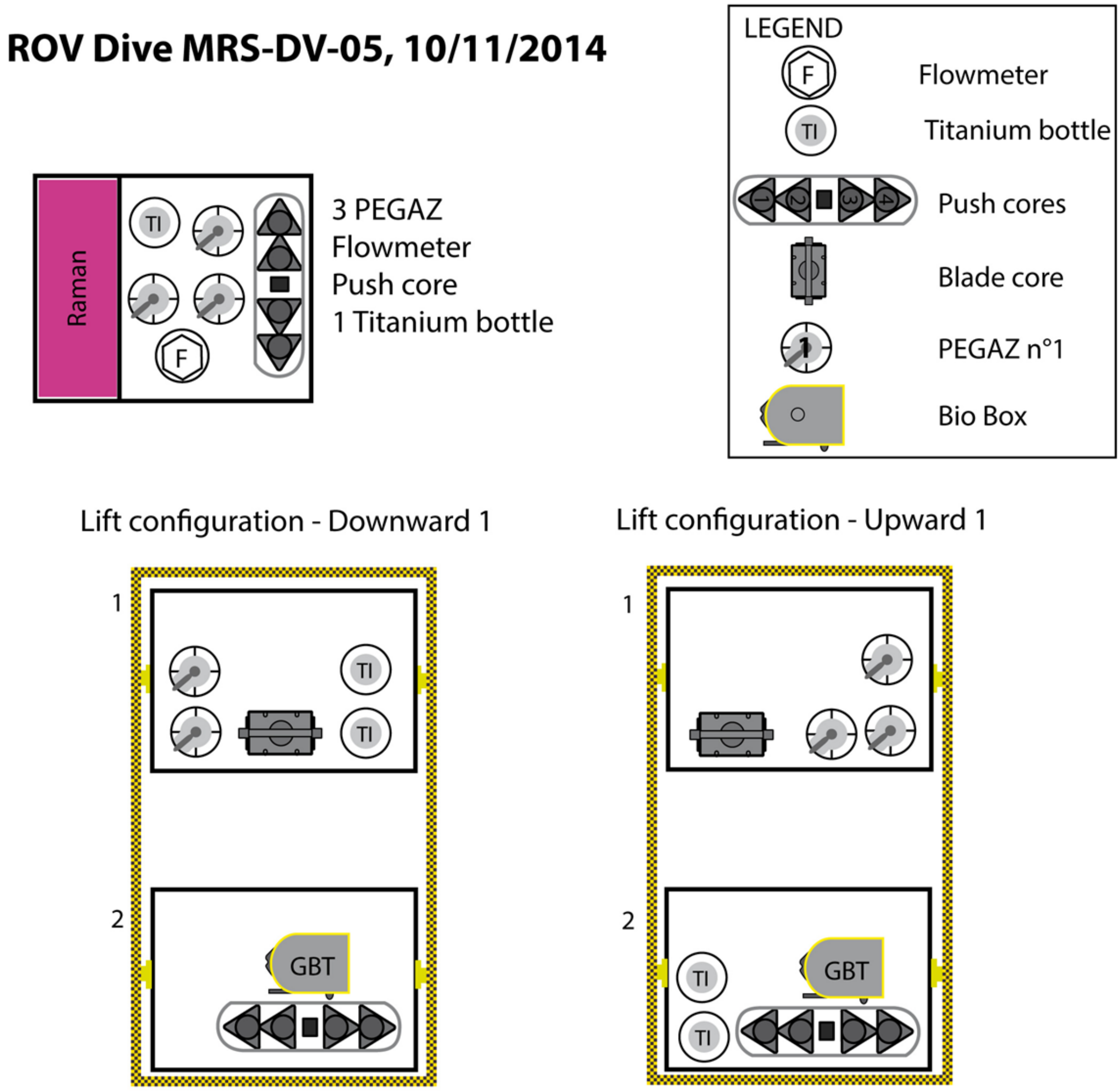
14:18 Push core on Carla site

15:55 Titanium bottle

Table 13 : Marsite ROV dive MRS-PL595-04 samples

DIVE	DATE	HOUR	DEPTH (m)	SAMPLE NAME	TOOL	LATITUDE	LONGITUDE
MRS-DV595-04	08/11/2014	03:37:00	895	MRS-DV04-PE-02	Pegaz	40.804185	27.634338
MRS-DV595-04	08/11/2014	04:13:00	1083	MRS-DV04-FLO-01	Flowmeter	40.804195	27.634346
MRS-DV595-04	08/11/2014	05:33:00	1098	MRS-DV04-FLO-02	Flowmeter	40.803706	27.632333
MRS-DV595-04	08/11/2014	05:44:00	1098	MRS-DV04-RA-02	Raman	40.803703	27.632335
MRS-DV595-04	08/11/2014	06:02:00	1098	MRS-DV04-PE-07	Pegaz	40.803704	27.632346
MRS-DV595-04	08/11/2014	07:31:00	1107	MRS-DV04-RA-03	Raman	40.803025	27.629514
MRS-DV595-04	08/11/2014	07:50:00	1107	MRS-DV04-TI-01	Titanium bottle	40.803034	27.629524
MRS-DV595-04	08/11/2014	08:06:00	1107	MRS-DV04-01	Basket	40.803041	27.629529
MRS-DV595-04	08/11/2014	09:31:00	1103	MRS-DV04-PC-06	Push core	40.802899	27.629871
MRS-DV595-04	08/11/2014	09:34:00	1103	MRS-DV04-PC-05	Push core	40.802894	27.629880
MRS-DV595-04	08/11/2014	09:42:00	1103	MRS-DV04-PC-07	Push core	40.802896	27.629878
MRS-DV595-04	08/11/2014	09:46:00	1103	MRS-DV04-PC-08	Push core	40.802890	27.629874
MRS-DV595-04	08/11/2014	10:47:00	1107	MRS-DV04-02	Basket	40.803055	27.629575
MRS-DV595-04	08/11/2014	11:01:00	1107	MRS-DV04-03	Basket	40.803067	27.629614
MRS-DV595-04	08/11/2014	12:01:00	1112	MRS-DV04-FLO-03	Flowmeter	40.802509	27.625455
MRS-DV595-04	08/11/2014	12:47:00	1099	MRS-DV04-FLO-04	Flowmeter	40.801790	27.623784
MRS-DV595-04	08/11/2014	13:00:00	1099	MRS-DV04-RA-04	Raman	40.801793	27.623771
MRS-DV595-04	08/11/2014	13:18:00	1099	MRS-DV04-04	Basket	40.801790	27.623779
MRS-DV595-04	08/11/2014	13:40:00	1100	MRS-DV04-PC-03	Push core	40.801811	27.623839
MRS-DV595-04	08/11/2014	13:52:00	1100	MRS-DV04-PC-04	Push core	40.801814	27.623846
MRS-DV595-04	08/11/2014	14:01:00	1100	MRS-DV04-PC-02	Push core	40.801818	27.623846
MRS-DV595-04	08/11/2014	14:09:00	1100	MRS-DV04-PC-01	Push core	40.801823	27.623838
MRS-DV595-04	08/11/2014	15:56:00	1112	MRS-DV04-TI-02	Titanium bottle	40.802252	27.623350
MRS-DV595-04	08/11/2014	04:40:00		MRS-DV04-RA-01	Raman	40.804187	27.634349
MRS-DV595-04	08/11/2014	13:06:00	1099	MRS-DV04-PE-08	Pegaz	40.801796	27.623779
MRS-DV595-04	08/11/2014	15:38:00		MRS-DV04-RA-05	Raman	40.802251	27.623345
MRS-DV595-04	08/11/2014	15:05:00		MRS-DV04-FLO-05	Flowmeter	40.802246	27.623352

5.5. Dive MRS-PL-596-05 (Southeast Cinarcik Basin)



Mission	
Marsitecruise05	
Date	10/11/2014 - 11/11/2014
Dive number	MRS-DV596-05
Responsable operation	CHEILAN P.
Vehicule	Victor
Vessel	Pourquoi Pas
Central Point	N40.711,E29.139
Latitude min	40.692945°
Longitude min	29.115276°
Latitude max	40.729050°
Longitude max	29.162724°
Geodetic system navigation	WGS84

Time		
Start from desk	10/11/2014 12:34:56	26:48 h
Arrival on desk	11/11/2014 15:22:12	
Under water	10/11/2014 13:02:41	25:55 h under water
Surface arrival	11/11/2014 14:57:01	
Arrival on sea bottom	10/11/2014 14:12:38	23:25 h on bottom
Departure from bottom	11/11/2014 13:37:19	12,8 km

Objectives :

- Detect any evidence of fluid seepages from visual inspection of the seafloor
- Sample gas bubbles from PEGAZ sampler to determine sources
- Sample bottom water to characterize dense-fluid emission and heavy-dissolved compounds
- Collect living communities associated with the seeps
- Sample the chimney called “Jack The Smoker”

Sampling and *in situ* measurements :

- PEGAZ
- Push Core
- Titanium bottle
- Blade core
- Raman spectrometer
- Flowmeter

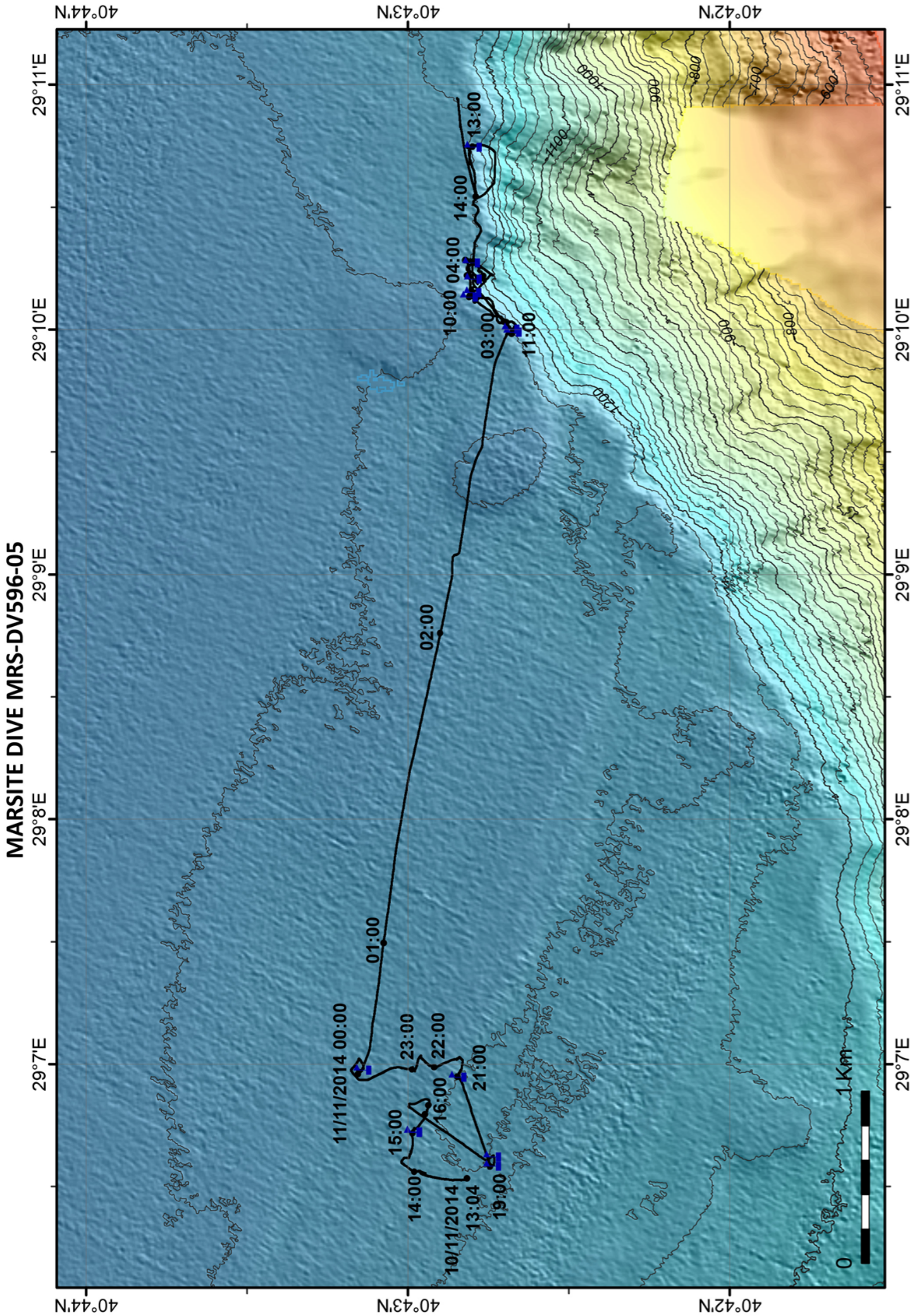


Figure 26 : MARSITE DIVE MRS-DV596-05

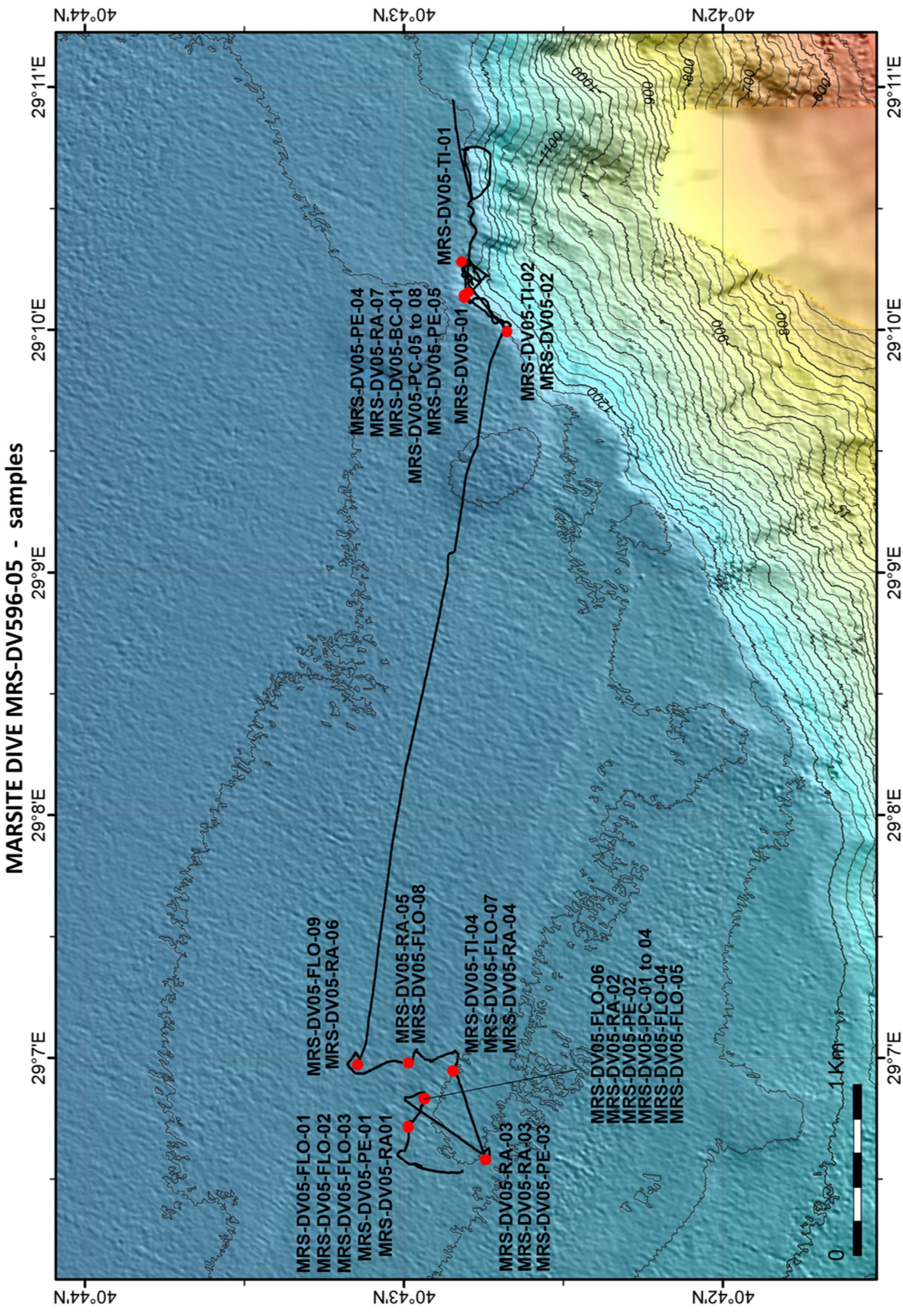


Figure 27 : MARSITE DIVE MRS-DV596-05 – SAMPLES

Table 14 : Marsite ROV dive MRS-PL596-05 diary

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV596-05	10/11/2014	14:17:33	40.71644	29.11096	1230	point C13
MRS-DV596-05	10/11/2014	14:23:49	40.71648	29.11189	1235	point C15
MRS-DV596-05	10/11/2014	14:24:02	40.71648	29.11191	1236	point C15, bubbles
MRS-DV596-05	10/11/2014	14:29:12	40.71641	29.11207	1237	DEPA
MRS-DV596-05	10/11/2014	14:29:32	40.71640	29.11208	1237	Lac Clement
MRS-DV596-05	10/11/2014	14:36:32	40.71670	29.11168	1238	Bubbles on C15
MRS-DV596-05	10/11/2014	14:49:50	40.71643	29.11196	1238	MRS-DV05-FLO-01, small bubbles
MRS-DV596-05	10/11/2014	15:00:33	40.71644	29.11196	1238	MRS-DV05-FLO-02, big bubbles
MRS-DV596-05	10/11/2014	15:12:47	40.71643	29.11196	1238	MRS-DV05-RA01
MRS-DV596-05	10/11/2014	15:22:00	40.71644	29.11192	1238	MRS-DV05-PE-01
MRS-DV596-05	10/11/2014	15:25:00	40.71644	29.11192	1238	MRS-DV05-FLO-03
MRS-DV596-05	10/11/2014	16:14:00	40.71558	29.11385	1238	MRS-DV05-RA-02
MRS-DV596-05	10/11/2014	16:15:06	40.71556	29.11388	1238	3 vents
MRS-DV596-05	10/11/2014	16:33:00	40.71558	29.11388	1238	MRS-DV05-PE-02
MRS-DV596-05	10/11/2014	16:50:00	40.71560	29.11390	1238	MRS-DV05-FLO-04
MRS-DV596-05	10/11/2014	16:59:00	40.71559	29.11390	1238	MRS-DV05-FLO-05
MRS-DV596-05	10/11/2014	17:03:00	40.71560	29.11389	1238	MRS-DV05-FLO-06
MRS-DV596-05	10/11/2014	17:13:00	40.71559	29.11388	1238	MRS-DV05-PC-04
MRS-DV596-05	10/11/2014	17:21:00	40.71559	29.11387	1238	MRS-DV05-PC-01
MRS-DV596-05	10/11/2014	17:31:48	40.71559	29.11389	1238	We go on other bacterian mat
MRS-DV596-05	10/11/2014	17:41:00	40.71557	29.11389	1238	MRS-DV05-PC-02
MRS-DV596-05	10/11/2014	17:47:00	40.71557	29.11389	1238	MRS-DV05-PC-03
MRS-DV596-05	10/11/2014	18:12:43	40.71664	29.11375	1239	bubbles from a hole
MRS-DV596-05	10/11/2014	18:13:32	40.71663	29.11377	1239	bubbles
MRS-DV596-05	10/11/2014	18:26:40	40.71411	29.11147	1229	on the way between C16 to C14
MRS-DV596-05	10/11/2014	18:28:35	40.71371	29.11110	1228	cable
MRS-DV596-05	10/11/2014	18:34:58	40.71230	29.11040	1226	Circular active site
MRS-DV596-05	10/11/2014	18:35:58	40.71230	29.11039	1227	70 m E of C14
MRS-DV596-05	10/11/2014	18:40:20	40.71230	29.10977	1227	C14 bubbles
MRS-DV596-05	10/11/2014	18:41:24	40.71232	29.10974	1229	active site
MRS-DV596-05	10/11/2014	18:41:57	40.71235	29.10970	1230	normal sediment
MRS-DV596-05	10/11/2014	18:42:40	40.71236	29.10972	1230	boundary between normal site and black patch
MRS-DV596-05	10/11/2014	18:43:44	40.71236	29.10967	1230	black patches
MRS-DV596-05	10/11/2014	18:44:13	40.71238	29.10965	1230	patch
MRS-DV596-05	10/11/2014	18:44:54	40.71240	29.10964	1231	black patch
MRS-DV596-05	10/11/2014	18:45:08	40.71241	29.10964	1231	different colors
MRS-DV596-05	10/11/2014	18:45:50	40.71242	29.10963	1230	bacteria?
MRS-DV596-05	10/11/2014	18:46:32	40.71244	29.10960	1230	boundary
MRS-DV596-05	10/11/2014	18:46:59	40.71244	29.10960	1228	drop
MRS-DV596-05	10/11/2014	18:48:10	40.71243	29.10960	1231	recover
MRS-DV596-05	10/11/2014	18:48:28	40.71243	29.10960	1231	recover
MRS-DV596-05	10/11/2014	18:48:57	40.71243	29.10960	1231	recovered
MRS-DV596-05	10/11/2014	18:49:44	40.71243	29.10960	1230	dark patch
MRS-DV596-05	10/11/2014	18:50:52	40.71248	29.10957	1231	bioturbated sediment
MRS-DV596-05	10/11/2014	18:51:25	40.71250	29.10957	1228	different colors
MRS-DV596-05	10/11/2014	18:52:13	40.71248	29.10959	1229	bioturbation

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV596-05	10/11/2014	18:52:42	40.71248	29.10958	1230	bioturbation
MRS-DV596-05	10/11/2014	18:53:13	40.71248	29.10959	1230	boundary
MRS-DV596-05	10/11/2014	19:03:05	40.71239	29.10969	1231	holes where bubbles emanate
MRS-DV596-05	10/11/2014	19:04:11	40.71239	29.10968	1231	at the moment no bubbles
MRS-DV596-05	10/11/2014	19:06:54	40.71239	29.10969	1231	no bubbles
MRS-DV596-05	10/11/2014	19:08:38	40.71239	29.10969	1231	bubble measurment
MRS-DV596-05	10/11/2014	19:26:59	40.71239	29.10969	1229	traces from Victor
MRS-DV596-05	10/11/2014	19:28:13	40.71238	29.10967	1231	ebulition site, C14
MRS-DV596-05	10/11/2014	19:28:28	40.71238	29.10967	1231	bubbles
MRS-DV596-05	10/11/2014	19:29:19	40.71238	29.10968	1231	ebulition site, C14
MRS-DV596-05	10/11/2014	19:29:50	40.71238	29.10969	1231	flow meter at C14
MRS-DV596-05	10/11/2014	19:33:11	40.71239	29.10968	1231	bubbles
MRS-DV596-05	10/11/2014	19:33:41	40.71238	29.10967	1231	flow meter at C14
MRS-DV596-05	10/11/2014	19:37:25	40.71239	29.10967	1231	flow meter with gas
MRS-DV596-05	10/11/2014	19:38:45	40.71240	29.10969	1231	bacteria at bubble site
MRS-DV596-05	10/11/2014	19:38:49	40.71240	29.10969	1231	bacteria
MRS-DV596-05	10/11/2014	19:38:58	40.71240	29.10968	1231	bacteria
MRS-DV596-05	10/11/2014	19:39:08	40.71241	29.10968	1231	bubbles
MRS-DV596-05	10/11/2014	19:39:27	40.71241	29.10968	1231	worms?
MRS-DV596-05	10/11/2014	19:40:13	40.71240	29.10968	1231	bubbles
MRS-DV596-05	10/11/2014	19:40:18	40.71240	29.10968	1231	bubbles
MRS-DV596-05	10/11/2014	19:40:27	40.71240	29.10968	1231	bubbles
MRS-DV596-05	10/11/2014	19:46:00	40.71239	29.10969	1231	MRS-DV05-RA-03
MRS-DV596-05	10/11/2014	19:55:00	40.71239	29.10969	1231	MRS-DV05-PE-03
MRS-DV596-05	10/11/2014	20:42:00	40.71407	29.11576	1236	MRS-DV05-FLO-07
MRS-DV596-05	10/11/2014	20:42:40	40.71410	29.11582	1235	bubbles
MRS-DV596-05	10/11/2014	20:43:17	40.71410	29.11581	1236	bubbles
MRS-DV596-05	10/11/2014	20:59:00	40.71410	29.11582	1236	MRS-DV05-RA-04
MRS-DV596-05	10/11/2014	21:01:44	40.71411	29.11581	1236	Flow measure.
MRS-DV596-05	10/11/2014	21:05:35	40.71411	29.11581	1236	bacterial filament
MRS-DV596-05	10/11/2014	21:10:00	40.71411	29.11581	1236	MRS-DV05-TI-04
MRS-DV596-05	10/11/2014	21:22:10	40.71404	29.11604	1236	bacterial filament
MRS-DV596-05	10/11/2014	21:34:17	40.71409	29.11706	1242	white filament
MRS-DV596-05	10/11/2014	21:37:35	40.71411	29.11703	1242	bubbles
MRS-DV596-05	10/11/2014	21:38:22	40.71411	29.11703	1243	skeleton of??
MRS-DV596-05	10/11/2014	21:39:40	40.71412	29.11700	1243	gray patches on dark gray patch
MRS-DV596-05	10/11/2014	21:41:36	40.71413	29.11697	1243	close up view of gray patch
MRS-DV596-05	10/11/2014	21:43:56	40.71413	29.11698	1243	white filaments in gray patch
MRS-DV596-05	10/11/2014	22:11:09	40.71602	29.11714	1242	C25
MRS-DV596-05	10/11/2014	22:23:30	40.71638	29.11622	1240	C21
MRS-DV596-05	10/11/2014	22:34:10	40.71643	29.11632	1244	gas bubbles
MRS-DV596-05	10/11/2014	22:44:00	40.71643	29.11633	1244	MRS-DV05-FLO-08
MRS-DV596-05	10/11/2014	22:51:00	40.71642	29.11633	1242	MRS-DV05-RA-05
MRS-DV596-05	10/11/2014	23:24:09	40.71940	29.11586	1245	C19
MRS-DV596-05	10/11/2014	23:35:32	40.71899	29.11640	1242	near C20
MRS-DV596-05	10/11/2014	23:38:58	40.71897	29.11637	1244	Worm mooving
MRS-DV596-05	10/11/2014	23:39:29	40.71897	29.11637	1245	Very discontinuous and poor bubbling
MRS-DV596-05	10/11/2014	23:42:49	40.71902	29.11631	1245	Vent

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV596-05	10/11/2014	23:44:59	40.71906	29.11627	1245	Vent
MRS-DV596-05	10/11/2014	23:46:08	40.71903	29.11629	1244	Site St-Ex DCD.
MRS-DV596-05	10/11/2014	23:47:14	40.71904	29.11628	1245	Regular bubbling area
MRS-DV596-05	10/11/2014	23:48:17	40.71906	29.11620	1242	patch near C20
MRS-DV596-05	10/11/2014	23:52:25	40.71926	29.11607	1243	On point C19
MRS-DV596-05	10/11/2014	23:52:59	40.71924	29.11605	1245	petites langoustines blanches
MRS-DV596-05	10/11/2014	23:53:33	40.71923	29.11605	1245	Bubbling vent
MRS-DV596-05	10/11/2014	23:54:44	40.71924	29.11604	1245	Bubbling vent
MRS-DV596-05	10/11/2014	23:54:57	40.71924	29.11604	1245	Discontinuous bubbling vent
MRS-DV596-05	10/11/2014	23:56:45	40.71926	29.11600	1245	worms
MRS-DV596-05	10/11/2014	23:57:19	40.71926	29.11600	1245	Bacterial mat
MRS-DV596-05	11/11/2014	00:01:27	40.71913	29.11611	1245	Between C19 and C20
MRS-DV596-05	11/11/2014	00:01:56	40.71910	29.11618	1245	Saint Ex (C20)
MRS-DV596-05	11/11/2014	00:09:00	40.71908	29.11622	1246	MRS-DV05-FLO-09
MRS-DV596-05	11/11/2014	00:18:00	40.71907	29.11623	1246	MRS-DV05-RA-06
MRS-DV596-05	11/11/2014	02:07:29	40.71452	29.14897	1249	Gray seafloor with extensive biological holes
MRS-DV596-05	11/11/2014	02:26:17	40.71348	29.15608	1259	Seafloor in the depression without biological hole
MRS-DV596-05	11/11/2014	02:29:50	40.71328	29.15723	1259	Seafloor with biological holes
MRS-DV596-05	11/11/2014	02:51:58	40.71162	29.16613	1246	C31
MRS-DV596-05	11/11/2014	02:53:00	40.71150	29.16641	1245	C31, just arrived
MRS-DV596-05	11/11/2014	02:54:17	40.71152	29.16638	1242	C31
MRS-DV596-05	11/11/2014	02:56:32	40.71146	29.16638	1240	Bacterial
MRS-DV596-05	11/11/2014	02:56:57	40.71145	29.16639	1240	Bacterial mat
MRS-DV596-05	11/11/2014	02:57:20	40.71143	29.16639	1239	Bacterial mats
MRS-DV596-05	11/11/2014	02:59:13	40.71137	29.16636	1239	Bacterial mat
MRS-DV596-05	11/11/2014	03:01:18	40.71124	29.16648	1231	Bacterial mat
MRS-DV596-05	11/11/2014	03:02:03	40.71122	29.16653	1231	Gas bubbles
MRS-DV596-05	11/11/2014	03:03:33	40.71123	29.16651	1233	Gas bubbles from carbonate crust
MRS-DV596-05	11/11/2014	03:04:08	40.71123	29.16651	1233	Carbonate crust
MRS-DV596-05	11/11/2014	03:04:36	40.71123	29.16652	1232	Gas bubbles
MRS-DV596-05	11/11/2014	03:04:58	40.71123	29.16652	1232	Bacterial mat
MRS-DV596-05	11/11/2014	03:05:00	40.71123	29.16654	1232	Continuous small bubbling
MRS-DV596-05	11/11/2014	03:10:05	40.71111	29.16694	1223	Seafloor with pits
MRS-DV596-05	11/11/2014	03:13:52	40.71109	29.16699	1221	Seafloor with biological holes but without bacterial mat
MRS-DV596-05	11/11/2014	03:15:12	40.71117	29.16710	1222	Cliff
MRS-DV596-05	11/11/2014	03:17:18	40.71127	29.16720	1228	Bacterial mat
MRS-DV596-05	11/11/2014	03:28:35	40.71222	29.16798	1237	Soft string?
MRS-DV596-05	11/11/2014	03:33:48	40.71239	29.16869	1225	Left bottom corner?
MRS-DV596-05	11/11/2014	03:34:32	40.71249	29.16880	1225	Right side
MRS-DV596-05	11/11/2014	03:43:13	40.71351	29.16891	1245	Gas bubbles, C33
MRS-DV596-05	11/11/2014	03:43:25	40.71351	29.16892	1244	Bulle
MRS-DV596-05	11/11/2014	03:44:07	40.71351	29.16892	1248	C33, gas bubbles
MRS-DV596-05	11/11/2014	03:46:10	40.71351	29.16890	1250	Bubbling hole (center bottom)
MRS-DV596-05	11/11/2014	04:21:53	40.71339	29.17129	1232	Gas bubbles
MRS-DV596-05	11/11/2014	04:25:39	40.71341	29.17126	1234	Bubble
MRS-DV596-05	11/11/2014	04:27:57	40.71339	29.17126	1234	Gas bubbles

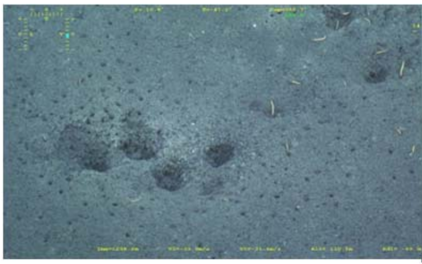
DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV596-05	11/11/2014	04:52:33	40.71300	29.17062	1215	Bacterial mat in developing?
MRS-DV596-05	11/11/2014	05:16:54	40.71330	29.17015	1232	ASCE
MRS-DV596-05	11/11/2014	06:30:00	40.71366	29.17139	1232	MRS-DV05-TI-01
MRS-DV596-05	11/11/2014	06:38:01	40.71366	29.17138	1233	exchange at elevator
MRS-DV596-05	11/11/2014	06:40:03	40.71366	29.17138	1233	lift
MRS-DV596-05	11/11/2014	06:45:14	40.71366	29.17138	1232	placing Pegaz in Victor
MRS-DV596-05	11/11/2014	06:47:30	40.71366	29.17138	1233	lift
MRS-DV596-05	11/11/2014	06:49:40	40.71366	29.17138	1232	transferring blade core
MRS-DV596-05	11/11/2014	06:50:05	40.71366	29.17138	1232	blade core
MRS-DV596-05	11/11/2014	06:53:03	40.71366	29.17138	1233	closing lift
MRS-DV596-05	11/11/2014	06:53:09	40.71366	29.17138	1233	closing lift
MRS-DV596-05	11/11/2014	06:53:44	40.71366	29.17138	1233	lift
MRS-DV596-05	11/11/2014	06:54:05	40.71366	29.17138	1233	particles in water column
MRS-DV596-05	11/11/2014	06:55:02	40.71366	29.17138	1233	leaving lift
MRS-DV596-05	11/11/2014	06:55:09	40.71367	29.17139	1232	leaving lift
MRS-DV596-05	11/11/2014	06:55:42	40.71367	29.17139	1232	lift
MRS-DV596-05	11/11/2014	06:57:40	40.71368	29.17139	1232	lift
MRS-DV596-05	11/11/2014	06:57:57	40.71368	29.17139	1233	lift
MRS-DV596-05	11/11/2014	06:58:36	40.71369	29.17140	1233	leaving lift
MRS-DV596-05	11/11/2014	06:58:50	40.71370	29.17141	1232	leaving lift
MRS-DV596-05	11/11/2014	07:00:13	40.71371	29.17141	1233	lift
MRS-DV596-05	11/11/2014	07:01:20	40.71371	29.17141	1232	lift going up
MRS-DV596-05	11/11/2014	07:06:59	40.71363	29.17138	1235	lift marks on seafloor
MRS-DV596-05	11/11/2014	07:08:34	40.71348	29.17141	1234	bioturbated seafloor
MRS-DV596-05	11/11/2014	07:08:52	40.71345	29.17141	1234	bioturbation
MRS-DV596-05	11/11/2014	07:09:39	40.71340	29.17140	1234	small lobster
MRS-DV596-05	11/11/2014	07:10:02	40.71340	29.17143	1234	small lobster
MRS-DV596-05	11/11/2014	07:10:43	40.71340	29.17136	1233	black patch
MRS-DV596-05	11/11/2014	07:11:13	40.71337	29.17132	1233	transition
MRS-DV596-05	11/11/2014	07:11:43	40.71337	29.17132	1233	small lobster in black patch
MRS-DV596-05	11/11/2014	07:12:03	40.71338	29.17132	1233	edge of black patch
MRS-DV596-05	11/11/2014	07:13:03	40.71336	29.17128	1233	bacteria in hole
MRS-DV596-05	11/11/2014	07:13:41	40.71337	29.17126	1233	holes
MRS-DV596-05	11/11/2014	07:14:31	40.71338	29.17124	1233	bubbles
MRS-DV596-05	11/11/2014	07:18:02	40.71344	29.17126	1234	bubbles
MRS-DV596-05	11/11/2014	07:18:34	40.71344	29.17126	1235	holes
MRS-DV596-05	11/11/2014	07:19:10	40.71344	29.17126	1235	bubbles
MRS-DV596-05	11/11/2014	07:21:06	40.71344	29.17126	1235	trash and bacteria
MRS-DV596-05	11/11/2014	07:22:13	40.71344	29.17126	1235	trash and languste
MRS-DV596-05	11/11/2014	07:24:25	40.71344	29.17126	1235	black patches
MRS-DV596-05	11/11/2014	07:25:52	40.71341	29.17125	1234	black patch
MRS-DV596-05	11/11/2014	07:45:06	40.71323	29.16929	1234	black patch
MRS-DV596-05	11/11/2014	07:45:58	40.71327	29.16929	1235	black patch close up
MRS-DV596-05	11/11/2014	07:46:23	40.71330	29.16927	1235	carbonate?
MRS-DV596-05	11/11/2014	07:48:02	40.71330	29.16927	1237	Close-up view carbonate
MRS-DV596-05	11/11/2014	07:50:04	40.71331	29.16926	1237	carbonate
MRS-DV596-05	11/11/2014	07:51:39	40.71331	29.16926	1237	carbonate
MRS-DV596-05	11/11/2014	07:57:00	40.71330	29.16925	1237	MRS-DV05-01 ,Carbonate crust

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV596-05	11/11/2014	07:58:10	40.71330	29.16922	1238	victor sampled
MRS-DV596-05	11/11/2014	08:00:11	40.71333	29.16924	1237	MARQ
MRS-DV596-05	11/11/2014	08:04:45	40.71336	29.16918	1240	carbonate crust
MRS-DV596-05	11/11/2014	08:06:41	40.71338	29.16922	1240	coral knob
MRS-DV596-05	11/11/2014	08:07:20	40.71339	29.16922	1240	corals
MRS-DV596-05	11/11/2014	08:07:43	40.71338	29.16922	1240	carbonate mound
MRS-DV596-05	11/11/2014	08:07:46	40.71338	29.16922	1240	coral knob
MRS-DV596-05	11/11/2014	08:08:16	40.71339	29.16922	1240	corals
MRS-DV596-05	11/11/2014	08:08:55	40.71338	29.16922	1240	coral knob
MRS-DV596-05	11/11/2014	08:09:12	40.71338	29.16923	1240	close up view of coral knob
MRS-DV596-05	11/11/2014	08:09:44	40.71338	29.16923	1240	corals
MRS-DV596-05	11/11/2014	08:09:49	40.71338	29.16923	1240	coral knob
MRS-DV596-05	11/11/2014	08:10:14	40.71338	29.16924	1240	sampling the coral
MRS-DV596-05	11/11/2014	08:10:34	40.71337	29.16924	1240	corals
MRS-DV596-05	11/11/2014	08:11:40	40.71337	29.16925	1240	sampled coral
MRS-DV596-05	11/11/2014	08:11:49	40.71337	29.16925	1240	coral sampling
MRS-DV596-05	11/11/2014	08:11:58	40.71338	29.16925	1240	sample of coral
MRS-DV596-05	11/11/2014	08:15:04	40.71336	29.16933	1239	carbonate crust
MRS-DV596-05	11/11/2014	08:16:38	40.71332	29.16938	1236	black patch
MRS-DV596-05	11/11/2014	08:17:41	40.71330	29.16944	1236	coral knob
MRS-DV596-05	11/11/2014	08:18:52	40.71331	29.16948	1235	coral knob
MRS-DV596-05	11/11/2014	08:21:54	40.71335	29.16938	1236	black patch and carbonate crust
MRS-DV596-05	11/11/2014	08:22:25	40.71333	29.16931	1235	carbonate
MRS-DV596-05	11/11/2014	08:23:09	40.71335	29.16922	1239	black patch
MRS-DV596-05	11/11/2014	08:27:11	40.71349	29.16892	1247	Bubbles
MRS-DV596-05	11/11/2014	08:28:34	40.71348	29.16890	1249	bubbles near C33
MRS-DV596-05	11/11/2014	08:30:44	40.71349	29.16890	1248	bubbles and black patch
MRS-DV596-05	11/11/2014	08:35:00	40.71349	29.16891	1250	MRS-DV05-PE-05
MRS-DV596-05	11/11/2014	08:36:10	40.71349	29.16890	1250	bubbles
MRS-DV596-05	11/11/2014	08:36:29	40.71349	29.16890	1250	bubbles
MRS-DV596-05	11/11/2014	08:49:00	40.71349	29.16892		MRS-DV05-PE-04
MRS-DV596-05	11/11/2014	08:58:22	40.71349	29.16890	1251	triggered, but did not work
MRS-DV596-05	11/11/2014	09:10:00	40.71350	29.16891	1250	MRS-DV05-RA-07
MRS-DV596-05	11/11/2014	09:25:40	40.71349	29.16891	1249	traces of Victor
MRS-DV596-05	11/11/2014	09:25:44	40.71349	29.16891	1248	black patches
MRS-DV596-05	11/11/2014	09:29:55	40.71348	29.16893	1250	PC08 at the rim of a black patch white bacteria, 1249,6 m
MRS-DV596-05	11/11/2014	09:34:00	40.71346	29.16895	1247	MRS-DV05-PC-08, Broken
MRS-DV596-05	11/11/2014	09:34:19	40.71345	29.16895	1248	small black patch
MRS-DV596-05	11/11/2014	09:38:00	40.71347	29.16900	1247	MRS-DV05-PC-07
MRS-DV596-05	11/11/2014	09:38:26	40.71346	29.16901	1247	carbonate
MRS-DV596-05	11/11/2014	09:40:01	40.71346	29.16900	1247	taking PC07 next to carbonate in a dark patch, 1247,3m, very soft sediment
MRS-DV596-05	11/11/2014	09:45:00	40.71347	29.16900	1247	MRS-DV05-PC-06
MRS-DV596-05	11/11/2014	09:45:59	40.71346	29.16900	1247	something hard in the ground_another try
MRS-DV596-05	11/11/2014	09:48:26	40.71346	29.16899	1248	color change, short core
MRS-DV596-05	11/11/2014	09:52:30	40.71346	29.16900	1248	no color change
MRS-DV596-05	11/11/2014	09:53:00	40.71347	29.16900	1247	MRS-DV05-PC-05

DIVE	DATE	HOUR	LATITUDE	LONGITUDE	DEPTH (m)	COMMENTS
MRS-DV596-05	11/11/2014	10:05:40	40.71346	29.16899	1248	choosing site for blade core
MRS-DV596-05	11/11/2014	10:17:00	40.71352	29.16905	1247	MRS-DV05-BC-01
MRS-DV596-05	11/11/2014	11:05:21	40.71132	29.16658	1233	crust
MRS-DV596-05	11/11/2014	11:06:14	40.71134	29.16648	1233	big carbonate crust
MRS-DV596-05	11/11/2014	11:12:47	40.71130	29.16650	1234	wars on the mat
MRS-DV596-05	11/11/2014	11:14:45	40.71124	29.16657	1232	where are the bubbles
MRS-DV596-05	11/11/2014	11:21:46	40.71127	29.16655	1232	gas bubbles
MRS-DV596-05	11/11/2014	11:35:00	40.71127	29.16655	1233	MRS-DV05-TI-02
MRS-DV596-05	11/11/2014	11:53:00	40.71126	29.16656	1230	MRS-DV05-02, Crusts fragments
MRS-DV596-05	11/11/2014	11:55:35	40.71135	29.16675	1228	target PP?
MRS-DV596-05	11/11/2014	12:01:28	40.71181	29.16739	1241	patch
MRS-DV596-05	11/11/2014	12:10:30	40.71330	29.16987	1229	crust
MRS-DV596-05	11/11/2014	12:58:59	40.71334	29.17918	1230	Shrimps!
MRS-DV596-05	11/11/2014	13:01:03	40.71331	29.17913	1230	Shrimps site

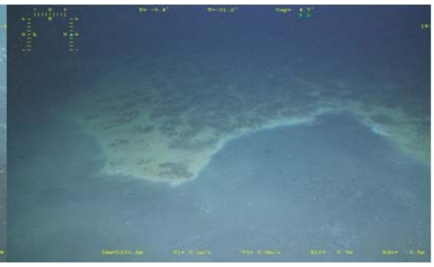
Figure 28 : Dive MRS-PL596-05

MARSITE – Dive05 – Cinarcik



14:41 Bubbles coming from small conduits

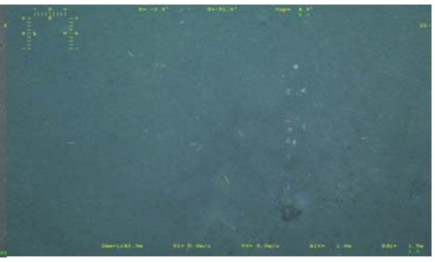
16:23 Flow measurement on bubbles



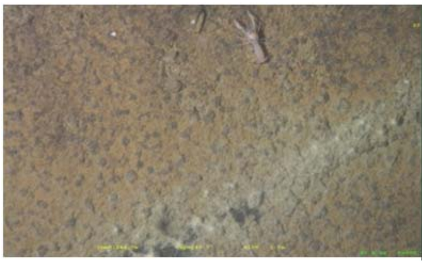
18:45 Black patch (acoustic anomaly C14)

21:22 Bacterial mat (at acoustic anomaly C23)

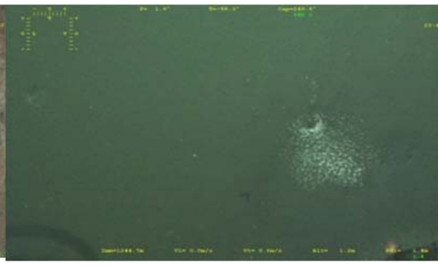
21:34 Bacterial filaments



22:25 Bubbles on “Marnaut” site

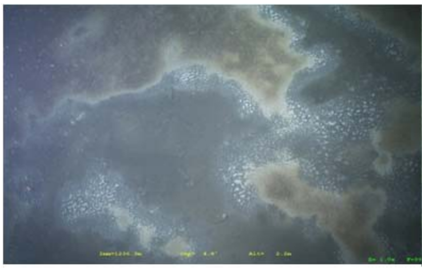


23:41 « Langoustine » (at anomaly C20 - 1244m)



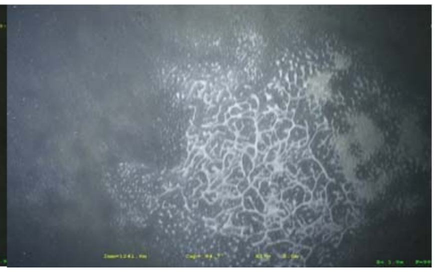
23:45 Bacterial mat and bubbles (at acoustic anomaly C19)

03:04 Carbonate crusts and bubbles (at acoustic anomaly C31)

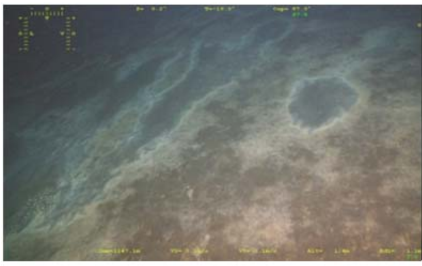


03:04 C31 – Black patches and bubbles

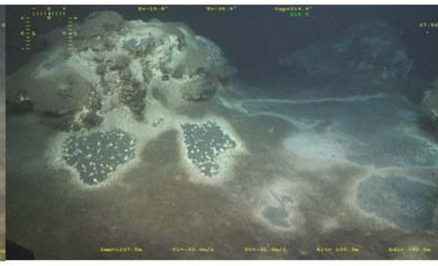
03:20 Black patches between acoustic anomalies C31 and C32



03:26 Bacterial filaments

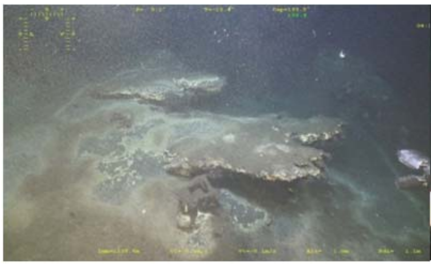


03:40 Elongated patches (at acoustic anomaly C33)

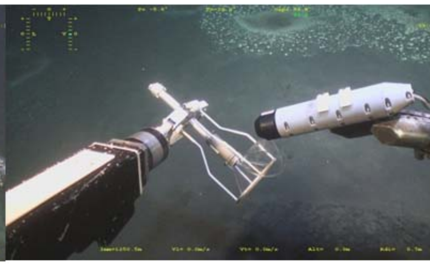


07:50 Carbonate pavement and patches

08:08 Corals on rock



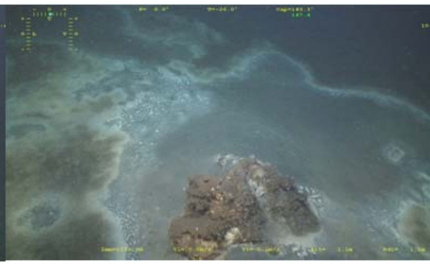
08:15 large carbonate crusts



09:09 Raman measurement from Pegaz filling-cone

10:17 Blade core on each side of black patch

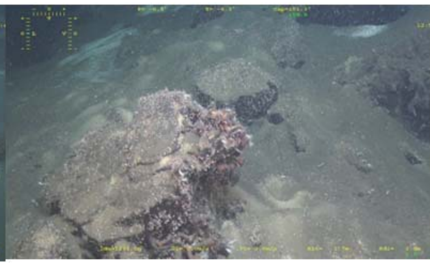
10:45 Black patch and bacterial mat



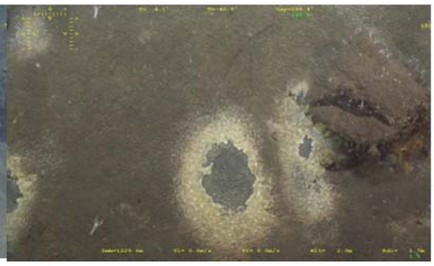
10:58 Small bubbling over large carbonate crust (associated with dead corals)

11:35 Titanium bottle on bubble conduit

12:49 Large site with shrimps (?), coral and"langoustine" (absence of bubbles)



12:54 Carbonate crusts



12:54 White patches

Table 15 : Marsite ROV dive MRS-PL596-05 samples

DIVE	DATE	HEURE	DEPTH (m)	NUMPREL	TOOL	LATITUDE	LONGITUDE
MRS-DV596-05	10/11/2014	14:49:50	1238	MRS-DV05-FLO-01	Flowmeter	40.716429	29.111955
MRS-DV596-05	10/11/2014	15:00:33	1238	MRS-DV05-FLO-02	Flowmeter	40.716438	29.111959
MRS-DV596-05	10/11/2014	15:13:00	1238	MRS-DV05-RA01	Raman	40.716429	29.111966
MRS-DV596-05	10/11/2014	15:22:00	1238	MRS-DV05-PE-01	Pegaz	40.716438	29.111922
MRS-DV596-05	10/11/2014	15:25:00	1238	MRS-DV05-FLO-03	Flowmeter	40.716438	29.111916
MRS-DV596-05	10/11/2014	16:14:00	1238	MRS-DV05-RA-02	Raman	40.71558	29.113852
MRS-DV596-05	10/11/2014	16:33:00	1238	MRS-DV05-PE-02	Pegaz	40.715577	29.113881
MRS-DV596-05	10/11/2014	16:50:00	1238	MRS-DV05-FLO-04	Flowmeter	40.715596	29.113895
MRS-DV596-05	10/11/2014	16:59:00	1238	MRS-DV05-FLO-05	Flowmeter	40.715591	29.113895
MRS-DV596-05	10/11/2014	17:03:00	1238	MRS-DV05-FLO-06	Flowmeter	40.715602	29.113887
MRS-DV596-05	10/11/2014	17:13:00	1238	MRS-DV05-PC-04	Push core	40.715587	29.113882
MRS-DV596-05	10/11/2014	17:21:00	1238	MRS-DV05-PC-01	Push core	40.715585	29.113873
MRS-DV596-05	10/11/2014	17:41:00	1238	MRS-DV05-PC-02	Push core	40.715568	29.113893
MRS-DV596-05	10/11/2014	17:47:00	1238	MRS-DV05-PC-03	Push core	40.715573	29.113894
MRS-DV596-05	10/11/2014	19:46:00	1231	MRS-DV05-RA-03	Raman	40.712388	29.109691
MRS-DV596-05	10/11/2014	19:55:00	1231	MRS-DV05-PE-03	Pegaz	40.712394	29.109688
MRS-DV596-05	10/11/2014	20:42:00	1236	MRS-DV05-FLO-07	Flowmeter	40.714068	29.115759
MRS-DV596-05	10/11/2014	20:59:00		MRS-DV05-RA-04	Raman	40.714104	29.115818
MRS-DV596-05	10/11/2014	21:10:00		MRS-DV05-TI-04	Titanium bottle	40.714107	29.115806
MRS-DV596-05	10/11/2014	22:44:00	1244	MRS-DV05-FLO-08	Flowmeter	40.716431	29.11633
MRS-DV596-05	10/11/2014	22:51:00	1242	MRS-DV05-RA-05	Raman	40.716421	29.116331
MRS-DV596-05	11/11/2014	00:09:00	1246	MRS-DV05-FLO-09	Flowmeter	40.719075	29.116222
MRS-DV596-05	11/11/2014	00:18:00	1246	MRS-DV05-RA-06	Raman	40.719066	29.116233
MRS-DV596-05	11/11/2014	06:30:00	1232	MRS-DV05-TI-01	Titanium bottle	40.713657	29.171393
MRS-DV596-05	11/11/2014	07:57:00	1237	MRS-DV05-01	Basket	40.713297	29.169253
MRS-DV596-05	11/11/2014	08:35:00	1250	MRS-DV05-PE-05	Pegaz	40.713494	29.168906
MRS-DV596-05	11/11/2014	08:49:00		MRS-DV05-PE-04	Pegaz	40.713492	29.16892
MRS-DV596-05	11/11/2014	09:10:00	1250	MRS-DV05-RA-07	Raman	40.713497	29.16891
MRS-DV596-05	11/11/2014	09:34:00	1247	MRS-DV05-PC-08	Push core	40.713456	29.168946
MRS-DV596-05	11/11/2014	09:38:00	1247	MRS-DV05-PC-07	Push core	40.713468	29.169003
MRS-DV596-05	11/11/2014	09:45:00	1247	MRS-DV05-PC-06	Push core	40.713465	29.168997
MRS-DV596-05	11/11/2014	09:53:00	1247	MRS-DV05-PC-05	Push core	40.713467	29.169001
MRS-DV596-05	11/11/2014	10:17:00	1247	MRS-DV05-BC-01	Blade core	40.713515	29.16905
MRS-DV596-05	11/11/2014	11:35:00	1233	MRS-DV05-TI-02	Titanium bottle	40.711266	29.166554
MRS-DV596-05	11/11/2014	11:53:00	1230	MRS-DV05-02	Basket	40.711259	29.166564

5.6. **Synthesis of ROV operations**

Table 16 : Marsite ROV operations – synthesis

DIVE	DATE	HOUR	DEPTH (m)	SAMPLE NAME	TOOL	LATITUDE	LONGITUDE
MRS-DV592-01	02/11/2014	06:57:07	342	MRS-DV01-FLO-10	Flowmeter	N 40 51.73743	E 28 35.43832
MRS-DV592-01	02/11/2014	07:56:00		MRS-DV01-DV-01-01	Basket	N 40 51.91600	E 28 32.40307
MRS-DV592-01	02/11/2014	09:03:30	414	MRS-DV01-FLO-11	Flowmeter	N 40 51.73851	E 28 36.29374
MRS-DV592-01	02/11/2014	13:09:00	333	MRS-DV01-FLO-01	Flowmeter	N 40 51.41785	E 28 34.80435
MRS-DV592-01	02/11/2014	13:12:00	333	MRS-DV01-FLO-02	Flowmeter	N 40 51.41795	E 28 34.80430
MRS-DV592-01	02/11/2014	13:52:00	331	MRS-DV01-FLO-03	Flowmeter	N 40 51.49939	E 28 34.74912
MRS-DV592-01	02/11/2014	14:19:00	329	MRS-DV01-FLO-04	Flowmeter	N 40 51.55729	E 28 34.85975
MRS-DV592-01	02/11/2014	14:51:00	328	MRS-DV01-FLO-05	Flowmeter	N 40 51.59433	E 28 34.88238
MRS-DV592-01	02/11/2014	15:42:00	328	MRS-DV01-FLO-06	Flowmeter	N 40 51.64961	E 28 34.89161
MRS-DV592-01	02/11/2014	15:48:00	328	MRS-DV01-FLO-07	Flowmeter	N 40 51.65068	E 28 34.89390
MRS-DV592-01	02/11/2014	16:21:00	328	MRS-DV01-FLO-08	Flowmeter	N 40 51.69412	E 28 35.00037
MRS-DV592-01	02/11/2014	16:49:00	329	MRS-DV01-PE-02	Pegaz	N 40 51.69383	E 28 35.00060
MRS-DV592-01	02/11/2014	17:06:00	329	MRS-DV01-RA-01	Raman	N 40 51.69367	E 28 35.00070
MRS-DV592-01	02/11/2014	17:55:00	671	MRS-DV01-FLO-09	Flowmeter	N 40 51.83499	E 28 35.04877
MRS-DV592-01	02/11/2014	18:18:00	334	MRS-DV01-RA-02	Raman	N 40 51.83485	E 28 35.05101
MRS-DV592-01	02/11/2014	19:52:00	329	MRS-DV01-PC-04	Push core	N 40 51.69152	E 28 35.00114
MRS-DV592-01	02/11/2014	19:58:00	329	MRS-DV01-PC-02	Push core	N 40 51.69129	E 28 35.00131
MRS-DV592-01	02/11/2014	20:03:00	329	MRS-DV01-PC-01	Push core	N 40 51.69109	E 28 35.00169
MRS-DV592-01	02/11/2014	20:10:00	328	MRS-DV01-PC-03	Push core	N 40 51.69121	E 28 35.00197
MRS-DV592-01	02/11/2014	21:58:00	328	MRS-DV01-PC-06	Push core	N 40 51.69101	E 28 35.00163
MRS-DV592-01	02/11/2014	22:13:00	329	MRS-DV01-PC-07	Push core	N 40 51.69064	E 28 35.00172
MRS-DV592-01	02/11/2014	22:32:00	329	MRS-DV01-PC-05	Push core	N 40 51.69104	E 28 35.00145
MRS-DV592-01	02/11/2014	22:41:00	329	MRS-DV01-PC-08	Push core	N 40 51.69082	E 28 35.00178
MRS-DV592-01	02/11/2014	22:50:00	334	MRS-DV01-BC-01	Blade core	N 40 51.69092	E 28 35.0011
MRS-DV592-01	03/11/2014	02:31:00	402	MRS-DV01-TI-02	Titanium bottle	N 40 51.64325	E 28 36.18459
MRS-DV592-01	03/11/2014	07:03:00	342	MRS-DV01-RA-03	Raman	N 40 51.73743	E 28 35.43874
MRS-DV592-01	03/11/2014	09:16:00	414	MRS-DV01-RA-04	Raman	N 40 51.73837	E 28 36.29323
MRS-DV592-01	03/11/2014	09:31:00	414	MRS-DV01-PE-03	Pegaz	N 40 51.73843	E 28 36.29339
MRS-DV592-01	03/11/2014	12:46:00	527	MRS-DV01-PE-04	Pegaz	N 40 52.24934	E 28 38.26158
MRS-DV592-01	03/11/2014	13:26:00	527	MRS-DV01-RA-05	Raman	N 40 52.25073	E 28 38.26149
MRS-DV593-02	04/11/2014	11:08:24		MRS-DV02-FLO-01	Flowmeter	N 40 49.06774	E 27 46.82413
MRS-DV593-02	04/11/2014	11:20:00	640	MRS-DV02-PE-01	Pegaz	N 40 49.06785	E 27 46.82428
MRS-DV593-02	04/11/2014	11:27:00		MRS-DV02-RA-01	Raman	N 40 49.06782	E 27 46.82459
MRS-DV593-02	04/11/2014	12:59:00		MRS-DV02-PC-08	Push core	N 40 49.08215	E 27 46.83467
MRS-DV593-02	04/11/2014	13:09:00		MRS-DV02-PC-06	Push core	N 40 49.08220	E 27 46.83488
MRS-DV593-02	04/11/2014	13:12:00		MRS-DV02-PC-05	Push core	N 40 49.08263	E 27 46.83475
MRS-DV593-02	04/11/2014	13:17:00		MRS-DV02-PC-07	Push core	N 40 49.08219	E 27 46.83443
MRS-DV593-02	04/11/2014	16:49:00		MRS-DV02-01	Basket	N 40 48.89012	E 27 46.62683
MRS-DV593-02	04/11/2014	18:43:00		MRS-DV02-TI-02	Titanium bottle	N 40 48.73866	E 27 46.05302
MRS-DV593-02	05/11/2014	01:47:00	586	MRS-DV02-02	Basket	N 40 48.38319	E 27 44.37772
MRS-DV593-02	05/11/2014	11:10:00	643	MRS-DV02-FLO-02	Flowmeter	N 40 48.86149	E 27 46.66125
MRS-DV593-02	05/11/2014	11:15:00	643	MRS-DV02-PE-02	Pegaz	N 40 48.86132	E 27 46.66089
MRS-DV593-02	05/11/2014	11:38:00	643	MRS-DV02-RA-02	Raman	N 40 48.86116	E 27 46.65986
MRS-DV593-02	05/11/2014	12:15:00	646	MRS-DV02-03	Basket	N 40 48.88133	E 27 46.62106
MRS-DV593-02	05/11/2014	13:17:00	643	MRS-DV02-PC-04	Push core	N 40 48.86420	E 27 46.66044

DIVE	DATE	HOUR	DEPTH (m)	SAMPLE NAME	TOOL	LATITUDE	LONGITUDE
MRS-DV593-02	05/11/2014	13:21:00	643	MRS-DV02-PC-02	Push core	N 40 48.86436	E 27 46.66059
MRS-DV593-02	05/11/2014	13:24:00	643	MRS-DV02-PC-01	Push core	N 40 48.86439	E 27 46.66066
MRS-DV593-02	05/11/2014	13:30:00	643	MRS-DV02-PC-03	Push core	N 40 48.86443	E 27 46.66070
MRS-DV594-03	06/11/2014	07:51:00	895	MRS-DV03-PE-03	Pegaz	N 40 49.71098	E 27 28.72237
MRS-DV594-03	06/11/2014	08:12:00	895	MRS-DV03-RA-01	Raman	N 40 49.70975	E 27 28.72266
MRS-DV594-03	06/11/2014	08:25:00	895	MRS-DV03-FLO-01	Flowmeter	N 40 49.71125	E 27 28.72185
MRS-DV594-03	06/11/2014	08:28:00	895	MRS-DV03-FLO-02	Flowmeter	N 40 49.71058	E 27 28.72258
MRS-DV594-03	06/11/2014	08:40:00	895	MRS-DV03-FLO-03	Flowmeter	N 40 49.71023	E 27 28.72266
MRS-DV594-03	06/11/2014	09:26:00	1070	MRS-DV03-PE-02	Pegaz	N 40 49.66058	E 27 29.22454
MRS-DV594-03	06/11/2014	09:32:00	1070	MRS-DV03-RA-02	Raman	N 40 49.66166	E 27 29.22312
MRS-DV594-03	06/11/2014	09:38:00	1070	MRS-DV03-FLO-04	Flowmeter	N 40 49.66155	E 27 29.22398
MRS-DV594-03	06/11/2014	09:42:00	1070	MRS-DV03-FLO-05	Flowmeter	N 40 49.66135	E 27 29.22379
MRS-DV594-03	06/11/2014	09:44:00	1070	MRS-DV03-FLO-06	Flowmeter	N 40 49.66146	E 27 29.22366
MRS-DV594-03	06/11/2014	09:48:00	1070	MRS-DV03-FLO-07	Flowmeter	N 40 49.66173	E 27 29.22335
MRS-DV594-03	06/11/2014	10:22:00	1070	MRS-DV03-PC-05	Push core	N 40 49.66269	E 27 29.22877
MRS-DV594-03	06/11/2014	10:26:00	1070	MRS-DV03-PC-06	Push core	N 40 49.66193	E 27 29.22835
MRS-DV594-03	06/11/2014	10:27:00	1070	MRS-DV03-PC-07	Push core	N 40 49.66145	E 27 29.23070
MRS-DV594-03	06/11/2014	10:30:00	1070	MRS-DV03-PC-08	Push core	N 40 49.6604	E 27 29.22844
MRS-DV594-03	06/11/2014	11:59:00	1070	MRS-DV03-PC-01	Push core	N 40 49.66454	E 27 29.22619
MRS-DV594-03	06/11/2014	12:03:00	1070	MRS-DV03-PC-02	Push core	N 40 49.66514	E 27 29.22717
MRS-DV594-03	06/11/2014	18:38:00	1085	MRS-DV03-RA-03	Raman	N 40 51.08641	E 27 31.29764
MRS-DV594-03	06/11/2014	19:25:00	1085	MRS-DV03-TI-04	Titanium bottle	N 40 51.09353	E 27 31.29178
MRS-DV594-03	06/11/2014	19:48:00	1085	MRS-DV03-RA-04	Raman	N 40 51.08162	E 27 31.26848
MRS-DV594-03	06/11/2014	20:53:00	1085	MRS-DV03-PE-09	Pegaz	N 40 50.94933	E 27 31.20749
MRS-DV594-03	06/11/2014	22:43:00	1092	MRS-DV03-FLO-08	Flowmeter	N 40 50.74574	E 27 31.11104
MRS-DV594-03	06/11/2014	23:04:00	1092	MRS-DV03-RA-05	Raman	N 40 50.74517	E 27 31.11024
MRS-DV594-03	06/11/2014	23:10:00	1092	MRS-DV03-FLO-09	Flowmeter	N 40 50.74409	E 27 31.11083
MRS-DV594-03	06/11/2014	23:31:00	1092	MRS-DV03-FLO-10	Flowmeter	N 40 50.74457	E 27 31.11079
MRS-DV594-03	07/11/2014	00:47:00	1092	MRS-DV03-FLO-11	Flowmeter	N 40 50.59117	E 27 30.97444
MRS-DV594-03	07/11/2014	01:40:38	1090	MRS-DV03-FLO-12	Flowmeter	N 40 50.58318	E 27 30.96903
MRS-DV594-03	07/11/2014	05:45:00	1090	MRS-DV03-PE-04	Pegaz	N 40 50.28413	E 27 30.55660
MRS-DV594-03	07/11/2014	08:09:00	1055	MRS-DV03-PE-06	Pegaz	N 40 50.05343	E 27 30.20061
MRS-DV594-03	07/11/2014	08:12:00	1055	MRS-DV03-RA-06	Raman	N 40 50.05391	E 27 30.20107
MRS-DV594-03	07/11/2014	08:18:00	1055	MRS-DV03-FLO-13	Flowmeter	N 40 50.05339	E 27 30.20074
MRS-DV594-03	07/11/2014	08:27:00	1059	MRS-DV03-FLO-14	Flowmeter	N 40 50.04822	E 27 30.20796
MRS-DV594-03	07/11/2014	08:36:00	1059	MRS-DV03-PE-01	Pegaz	N 40 50.04695	E 27 30.20790
MRS-DV594-03	07/11/2014	08:40:00	1059	MRS-DV03-RA-07	Raman	N 40 50.04708	E 27 30.20774
MRS-DV594-03	07/11/2014	09:29:00	1055	MRS-DV03-BC-01	Blade core	N 40 50.05227	E 27 30.20000
MRS-DV594-03	07/11/2014	09:55:00	1054	MRS-DV03-GBT-01	Big Bio Box	N 40 50.05331	E 27 30.20615
MRS-DV594-03	07/11/2014	10:51:00	1073	MRS-DV03-GBT-02	Big Bio Box	N 40 50.01182	E 27 30.16955
MRS-DV594-03	07/11/2014	13:02:00	1071	MRS-DV03-TI-02	Titanium bottle	N 40 49.94469	E 27 30.02838
MRS-DV595-04	08/11/2014	03:37:00	895	MRS-DV04-PE-02	Pegaz	N 40 48.25112	E 27 38.06030
MRS-DV595-04	08/11/2014	04:13:00	1083	MRS-DV04-FLO-01	Flowmeter	N 40 48.25171	E 27 38.06077
MRS-DV595-04	08/11/2014	04:40:00		MRS-DV04-RA-01	Raman	N 40 48.25120	E 27 38.06092
MRS-DV595-04	08/11/2014	05:33:00	1098	MRS-DV04-FLO-02	Flowmeter	N 40 48.22234	E 27 37.93998
MRS-DV595-04	08/11/2014	05:44:00	1098	MRS-DV04-RA-02	Raman	N 40 48.22216	E 27 37.94008
MRS-DV595-04	08/11/2014	06:02:00	1098	MRS-DV04-PE-07	Pegaz	N 40 48.22223	E 27 37.94077
MRS-DV595-04	08/11/2014	07:31:00	1107	MRS-DV04-RA-03	Raman	N 40 48.18149	E 27 37.77081
MRS-DV595-04	08/11/2014	07:50:00	1107	MRS-DV04-TI-01	Titanium bottle	N 40 48.18202	E 27 37.77146

DIVE	DATE	HOUR	DEPTH (m)	SAMPLE NAME	TOOL	LATITUDE	LONGITUDE
MRS-DV595-04	08/11/2014	08:06:00	1107	MRS-DV04-01	Basket	N 40 48.18249	E 27 37.77173
MRS-DV595-04	08/11/2014	09:31:00	1103	MRS-DV04-PC-06	Push core	N 40 48.17392	E 27 37.79224
MRS-DV595-04	08/11/2014	09:34:00	1103	MRS-DV04-PC-05	Push core	N 40 48.17364	E 27 37.79278
MRS-DV595-04	08/11/2014	09:42:00	1103	MRS-DV04-PC-07	Push core	N 40 48.17375	E 27 37.79265
MRS-DV595-04	08/11/2014	09:46:00	1103	MRS-DV04-PC-08	Push core	N 40 48.17339	E 27 37.79242
MRS-DV595-04	08/11/2014	10:47:00	1107	MRS-DV04-02	Basket	N 40 48.18328	E 27 37.77449
MRS-DV595-04	08/11/2014	11:01:00	1107	MRS-DV04-03	Basket	N 40 48.18403	E 27 37.77683
MRS-DV595-04	08/11/2014	12:01:00	1112	MRS-DV04-FLO-03	Flowmeter	N 40 48.15057	E 27 37.52727
MRS-DV595-04	08/11/2014	12:47:00	1099	MRS-DV04-FLO-04	Flowmeter	N 40 48.10741	E 27 37.42704
MRS-DV595-04	08/11/2014	13:00:00	1099	MRS-DV04-RA-04	Raman	N 40 48.10760	E 27 37.42628
MRS-DV595-04	08/11/2014	13:06:00	1099	MRS-DV04-PE-08	Pegaz	N 40 48.10776	E 27 37.42671
MRS-DV595-04	08/11/2014	13:18:00	1099	MRS-DV04-04	Basket	N 40 48.10739	E 27 37.42671
MRS-DV595-04	08/11/2014	13:40:00	1100	MRS-DV04-PC-03	Push core	N 40 48.10866	E 27 37.43036
MRS-DV595-04	08/11/2014	13:52:00	1100	MRS-DV04-PC-04	Push core	N 40 48.10885	E 27 37.43076
MRS-DV595-04	08/11/2014	14:01:00	1100	MRS-DV04-PC-02	Push core	N 40 48.10908	E 27 37.43076
MRS-DV595-04	08/11/2014	14:09:00	1100	MRS-DV04-PC-01	Push core	N 40 48.10940	E 27 37.43027
MRS-DV595-04	08/11/2014	15:05:00		MRS-DV04-FLO-05	Flowmeter	N 40 48.13477	E 27 37.40110
MRS-DV595-04	08/11/2014	15:38:00		MRS-DV04-RA-05	Raman	N 40 48.13508	E 27 37.40068
MRS-DV595-04	08/11/2014	15:56:00	1112	MRS-DV04-TI-02	Titanium bottle	N 40 48.13511	E 27 37.40102
MRS-DV596-05	10/11/2014	14:49:50	1238	MRS-DV05-FLO-01	Flowmeter	N 40 42.98576	E 29 06.71732
MRS-DV596-05	10/11/2014	15:00:33	1238	MRS-DV05-FLO-02	Flowmeter	N 40 42.98626	E 29 06.71754
MRS-DV596-05	10/11/2014	15:13:00	1238	MRS-DV05-RA01	Raman	N 40 42.98575	E 29 06.71794
MRS-DV596-05	10/11/2014	15:22:00	1238	MRS-DV05-PE-01	Pegaz	N 40 42.98628	E 29 06.71533
MRS-DV596-05	10/11/2014	15:25:00	1238	MRS-DV05-FLO-03	Flowmeter	N 40 42.98628	E 29 06.71496
MRS-DV596-05	10/11/2014	16:14:00	1238	MRS-DV05-RA-02	Raman	N 40 42.93481	E 29 06.83112
MRS-DV596-05	10/11/2014	16:33:00	1238	MRS-DV05-PE-02	Pegaz	N 40 42.93463	E 29 06.83288
MRS-DV596-05	10/11/2014	16:50:00	1238	MRS-DV05-FLO-04	Flowmeter	N 40 42.93577	E 29 06.83367
MRS-DV596-05	10/11/2014	16:59:00	1238	MRS-DV05-FLO-05	Flowmeter	N 40 42.93543	E 29 06.8337
MRS-DV596-05	10/11/2014	17:03:00	1238	MRS-DV05-FLO-06	Flowmeter	N 40 42.93614	E 29 06.83319
MRS-DV596-05	10/11/2014	17:13:00	1238	MRS-DV05-PC-04	Push core	N 40 42.93520	E 29 06.83289
MRS-DV596-05	10/11/2014	17:21:00	1238	MRS-DV05-PC-01	Push core	N 40 42.93511	E 29 06.83239
MRS-DV596-05	10/11/2014	17:41:00	1238	MRS-DV05-PC-02	Push core	N 40 42.93406	E 29 06.83358
MRS-DV596-05	10/11/2014	17:47:00	1238	MRS-DV05-PC-03	Push core	N 40 42.93437	E 29 06.83363
MRS-DV596-05	10/11/2014	19:46:00	1231	MRS-DV05-RA-03	Raman	N 40 42.74330	E 29 06.58144
MRS-DV596-05	10/11/2014	19:55:00	1231	MRS-DV05-PE-03	Pegaz	N 40 42.74364	E 29 06.58126
MRS-DV596-05	10/11/2014	20:42:00	1236	MRS-DV05-FLO-07	Flowmeter	N 40 42.84406	E 29 06.94554
MRS-DV596-05	10/11/2014	20:49:00	1236	MRS-DV05-RA-04	Raman	N 40 42.84561	E 29 06.94943
MRS-DV596-05	10/11/2014	21:10:00		MRS-DV05-TI-04	Titanium bottle	N 40 42.84641	E 29 06.94837
MRS-DV596-05	10/11/2014	22:44:00	1244	MRS-DV05-FLO-08	Flowmeter	N 40 42.98585	E 29 06.97981
MRS-DV596-05	10/11/2014	22:51:00	1242	MRS-DV05-RA-05	Raman	N 40 42.98525	E 29 06.97983
MRS-DV596-05	11/11/2014	00:09:00	1246	MRS-DV05-FLO-09	Flowmeter	N 40 43.14447	E 29 06.97331
MRS-DV596-05	11/11/2014	00:18:00	1246	MRS-DV05-RA-06	Raman	N 40 43.14397	E 29 06.97399
MRS-DV596-05	11/11/2014	06:30:00	1232	MRS-DV05-TI-01	Titanium bottle	N 40 42.81942	E 29 10.28360
MRS-DV596-05	11/11/2014	07:57:00	1237	MRS-DV05-01	Basket	N 40 42.79782	E 29 10.15516
MRS-DV596-05	11/11/2014	08:35:00	1250	MRS-DV05-PE-05	Pegaz	N 40 42.80962	E 29 10.13434
MRS-DV596-05	11/11/2014	08:49:00		MRS-DV05-PE-04	Pegaz	N 40 42.80954	E 29 10.13522
MRS-DV596-05	11/11/2014	09:10:00	1250	MRS-DV05-RA-07	Raman	N 40 42.80981	E 29 10.13457
MRS-DV596-05	11/11/2014	09:34:00	1247	MRS-DV05-PC-08	Push core	N 40 42.80739	E 29 10.13673
MRS-DV596-05	11/11/2014	09:38:00	1247	MRS-DV05-PC-07	Push core	N 40 42.80806	E 29 10.14017

DIVE	DATE	HOUR	DEPTH (m)	SAMPLE NAME	TOOL	LATITUDE	LONGITUDE
MRS-DV596-05	11/11/2014	09:45:00	1247	MRS-DV05-PC-06	Push core	N 40 42.80791	E 29 10.13984
MRS-DV596-05	11/11/2014	09:53:00	1247	MRS-DV05-PC-05	Push core	N 40 42.80801	E 29 10.14006
MRS-DV596-05	11/11/2014	10:17:00	1247	MRS-DV05-BC-01	Blade core	N 40 42.81091	E 29 10.14298
MRS-DV596-05	11/11/2014	11:35:00	1233	MRS-DV05-TI-02	Titanium bottle	N 40 42.67598	E 29 09.99325
MRS-DV596-05	11/11/2014	11:53:00	1230	MRS-DV05-02	Basket	N 40 42.67553	E 29 09.99386

6. Calypso cores

When appropriate for coring, the most vigorous gas seeps found from the ROV inspection have been targeted. A total of 15 cores have been performed, and 12 recovered. Cores MRS-CS-10, 11 and12 were not successful due to core bending for the former and empty liner core after recovery for the last two others.

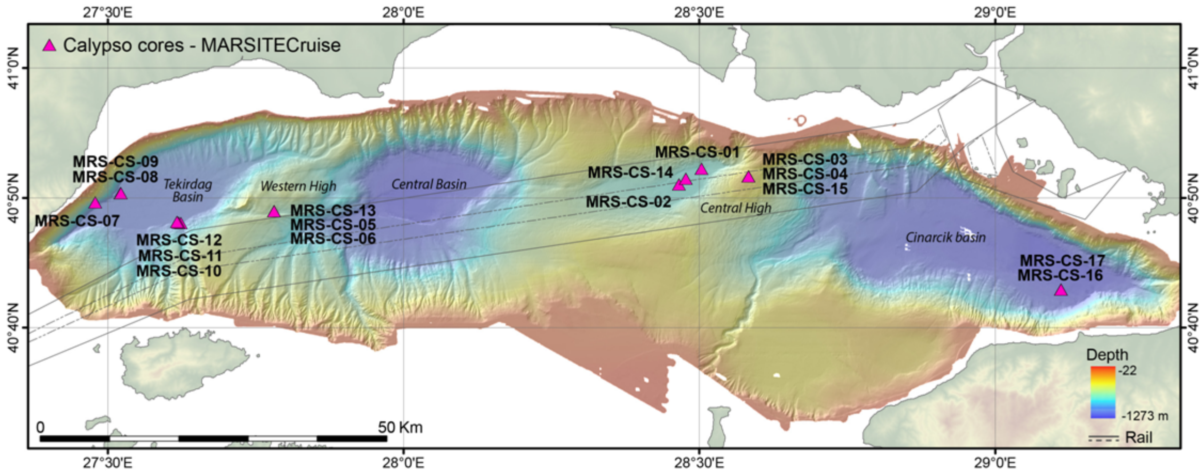


Figure 29 : General map of the coring sites

Table 17 : Cores collected during the Leg 2 of MARSITECruise

CORE	DATE	HOUR	DEPTH (m)	LENGTH (cm)	Cap	LATITUDE	LONGITUDE
MRS-CS-03	03/11/2014	20:20:40	326	975	67,59	N 40 51.694095	E 28 34.999128
MRS-CS-04	03/11/2014	22:55:49	326	638	72,07	N 40 51.691424	E 28 34.991928
MRS-CS-05	05/11/2014	16:46:08	657	907	88,20	N 40 49.027791	E 27 46.853486
MRS-CS-06	05/11/2014	20:23:31	658	875	105,66	N 40 49.023771	E 27 46.855076
MRS-CS-07	07/11/2014	17:45:23	872	497	319,59	N 40 49.702132	E 27 28.721161
MRS-CS-08	07/11/2014	20:24:23	1089	1167	36,25	N 40 50.394706	E 27 31.277479
MRS-CS-09	07/11/2014	23:09:34	1090	1007	110,41	N 40 50.395834	E 27 31.27948
MRS-CS-10	08/11/2014	22:55:00	1090	0	353,43	N 40 48.095403	E 27 37.421445
MRS-CS-11	09/11/2014	09:21:00	1108	0	75,18	N 40 48.148526	E 27 37.171306
MRS-CS-12	09/11/2014	12:43:00	1110	0	102,42	N 40 48.203295	E 27 36.983743
MRS-CS-13	09/11/2014	17:57:00	670	1180	175,63	N 40 49.033621	E 27 46.857796
MRS-CS-14	10/11/2014	03:27:00	1237	2095	29,14	N 40 51.515221	E 28 28.641631
MRS-CS-15	11/11/2014	06:15:26	330	958	3,60	N 40 51.701396	E 28 34.998675
MRS-CS-16	11/11/2014	19:27:00	1237	1013	58,24	N 40 42.977194	E 29 6.703129
MRS-CS-17	11/11/2014	22:01:00	1237	1060	57,47	N 40 42.978167	E 29 6.703819

7. CTD-Hydrocast

A total of 8 CTD-Hydrocast have been performed. Two methane sensors, a commercial one METS from Franatec and a prototype “MESSEA” from Ifremer, have been tested. They were installed on the CTD frame. For each dive, the CTD location corresponds to the coring locations.

Table 18 : CTD/Hydrocast deployed during the Leg 2 of MARSITECruise

DATE	HOUR	HYDROCAST	DEPTH (m)	LATITUDE	LONGITUDE
04/11/2014	00:03:31	MRS-HY-01	327	N 40 51.70158	E 28 34.99848
05/11/2014	18:29:31	MRS-HY-02	656	N 40 49.03374	E 27 46.86408
06/11/2014	04:21:27	MRS-HY-03	1022	N 40 50.03892	E 27 30.19854
07/11/2014	15:49:00	MRS-HY-04	807	N 40 49.68936	E 27 28.71888
08/11/2014	20:55:58	MRS-HY-05	1090	N 40 48.10062	E 27 37.40976
09/11/2014	07:01:00	MRS-HY-06	994	N 40 50.05044	E 27 30.1929
09/11/2014	16:08:39	MRS-HY-07	655	N 40 49.09614	E 27 46.85976
11/11/2014	17:15:44	MRS-HY-08	1238	N 40 42.98406	E 29 6.6882

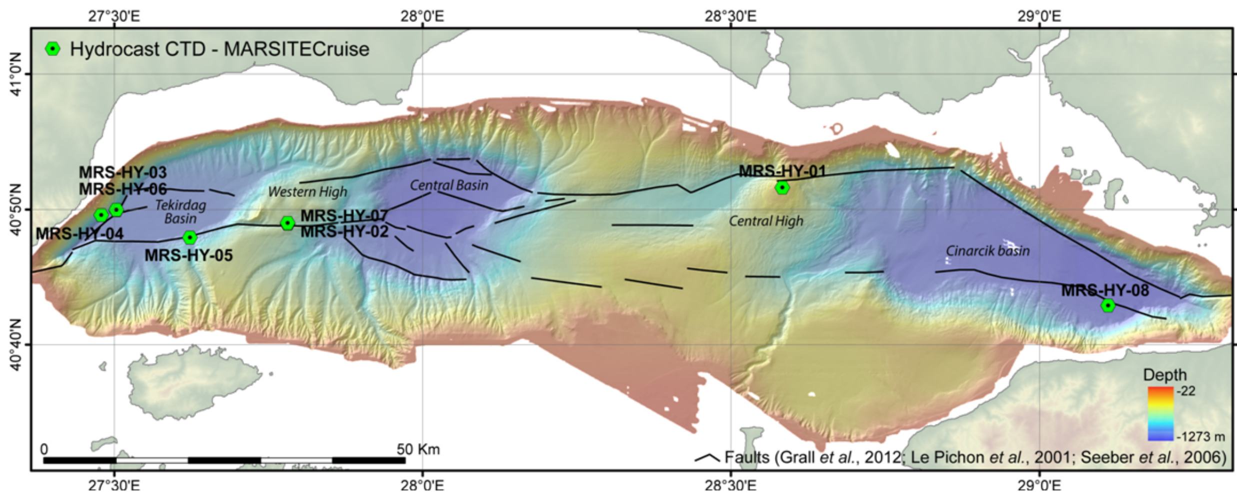


Figure 30 : General map of the CTD-Hydrocast deployment sites

8. *In situ* measurements and onboard analyses

8.1. *In situ* Raman experiment

Contributor : **E. Rinnert** (IFREMER)

Data consist in spectra presented by intensity (a.u.) *vs.* pixel (a.u.). Pixel can be converted in Raman shift (cm^{-1}) through a calibration made by the reference peaks contained in each spectrum. Data files are provided in .ngs format, which can be processed by Labspec software (Horiba Jobin-Yvon SAS).

Table 19 : Table of Raman experiments

Date	Time (TU)	Exp. name	Pathname	Comments
01/11/14	22:18		\RAMAN\MRS\DV01\Deck-tests	Noise & air
02/11/14	07:36		\RAMAN\MRS\DV01\Ground-tests	Noise & water
02/11/14	13:12		\RAMAN\MRS\DV01\Water	Water blank
02/11/14	17:07	MRS-DV01-RA01	\RAMAN\MRS\DV01\RA01	
02/11/14	18:14	MRS-DV01-RA02	\RAMAN\MRS\DV01\RA02	
03/11/14	07:05	MRS-DV01-RA03	\RAMAN\MRS\DV01\RA03	
03/11/14	09:19	MRS-DV01-RA04	\RAMAN\MRS\DV01\RA04	
03/11/14	13:29	MRS-DV01-RA05	\RAMAN\MRS\DV01\RA05	At 163m depth
04/11/14	10:05		\RAMAN\MRS\DV02\Ground-tests	Noise & water
04/11/14	11:34	MRS-DV02-RA01	\RAMAN\MRS\DV02\RA01	Fluorescence
05/11/14	11:43	MRS-DV02-RA02	\RAMAN\MRS\DV02\RA02	Fluorescence
06/11/14	07:08		\RAMAN\MRS\DV03\Ground-tests	Noise & water
06/11/14	08:48	MRS-DV03-RA01	\RAMAN\MRS\DV03\RA01	
06/11/14	09:37	MRS-DV03-RA02	\RAMAN\MRS\DV03\RA02	
06/11/14	19:14	MRS-DV03-RA03	\RAMAN\MRS\DV03\RA03	
06/11/14	19:52	MRS-DV03-RA04	\RAMAN\MRS\DV03\RA04	On fluids
06/11/14	23:07	MRS-DV03-RA05	\RAMAN\MRS\DV03\RA05	
07/11/14	08:21	MRS-DV03-RA06	\RAMAN\MRS\DV03\RA06	Fluorescence
07/11/14	08:53	MRS-DV03-RA07	\RAMAN\MRS\DV03\RA07	Fluorescence
07/11/14	09:37	MRS-DV03-RA08	\RAMAN\MRS\DV03\RA08	Water
08/11/14	04:47	MRS-DV04-RA01	\RAMAN\MRS\DV04\RA01	
08/11/14	05:49	MRS-DV04-RA02	\RAMAN\MRS\DV04\RA02	
08/11/14	07:38	MRS-DV04-RA03	\RAMAN\MRS\DV04\RA03	On fluids
08/11/14	13:08	MRS-DV04-RA04	\RAMAN\MRS\DV04\RA04	
08/11/14	15:54	MRS-DV04-RA05	\RAMAN\MRS\DV04\RA05	
10/11/14	14:11		\RAMAN\MRS\DV03\Ground-tests	Noise & water
10/11/14	15:19	MRS-DV05-RA01	\RAMAN\MRS\DV05\RA01	
10/11/14	16:45	MRS-DV05-RA02	\RAMAN\MRS\DV05\RA02	
10/11/14	20:18	MRS-DV05-RA03	\RAMAN\MRS\DV05\RA03	
10/11/14	21:01	MRS-DV05-RA04	\RAMAN\MRS\DV05\RA04	
10/11/14	22:55	MRS-DV05-RA05	\RAMAN\MRS\DV05\RA05	
11/11/14	00:21	MRS-DV05-RA06	\RAMAN\MRS\DV05\RA06	
11/11/14	09:12	MRS-DV05-RA07	\RAMAN\MRS\DV05\RA07	
11/11/14	13:28	MRS-DV05-RA08	\RAMAN\MRS\DV05\RA08	On water

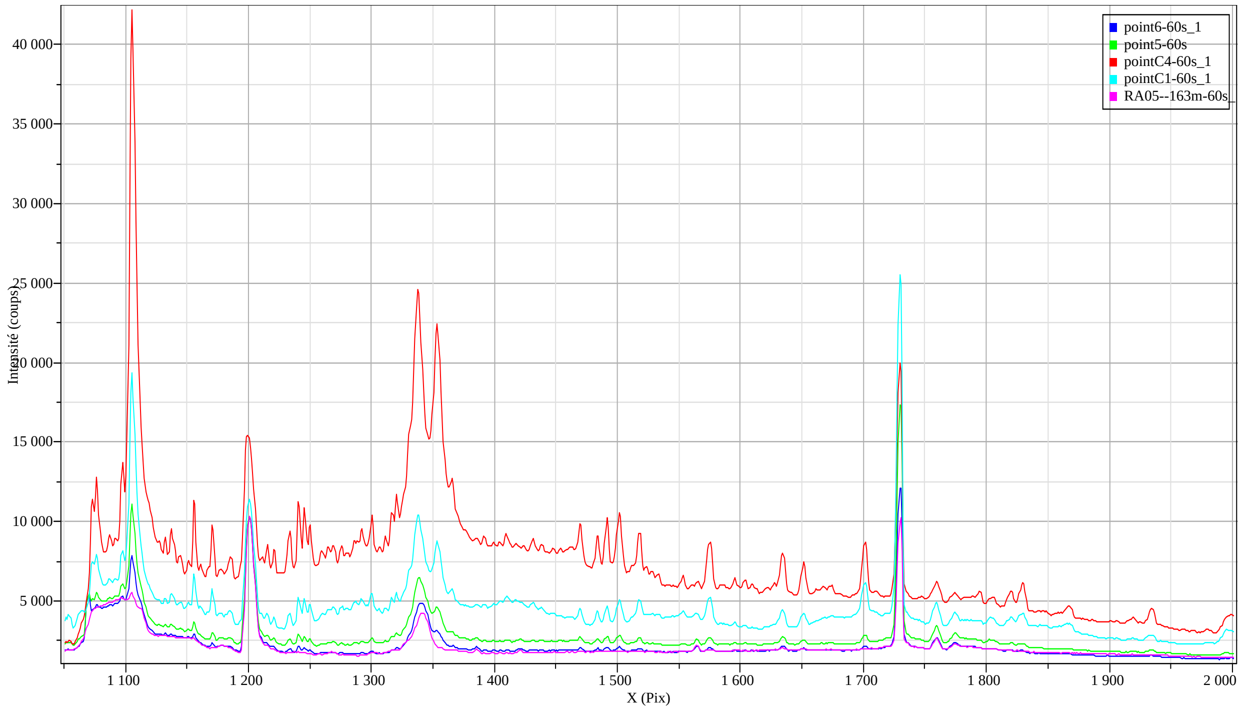


Figure 31 : In situ Raman spectra acquired during Dive 01 (from RA01 to RA05). 532nm, 3x60s

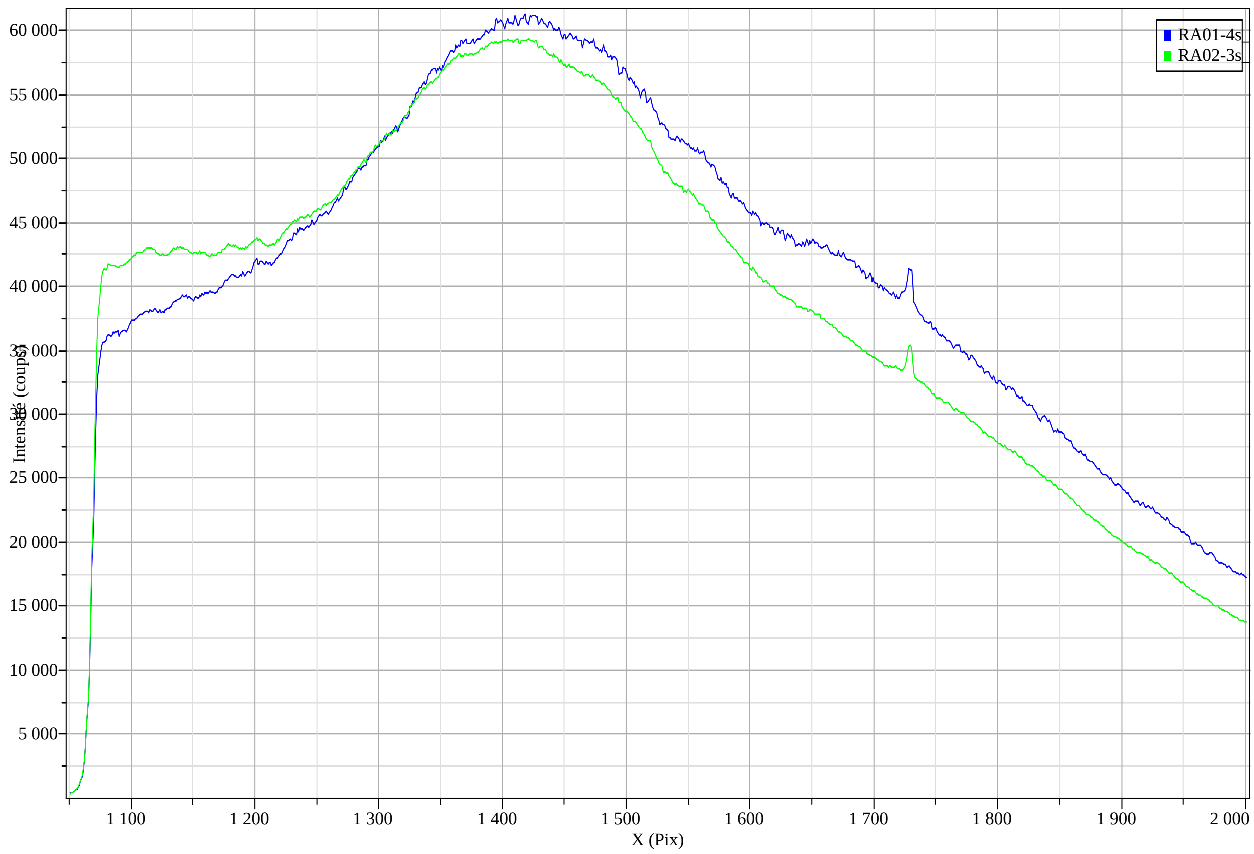


Figure 32 : In situ Raman spectra acquired during Dive 02 (from RA01 to RA02) at 532nm

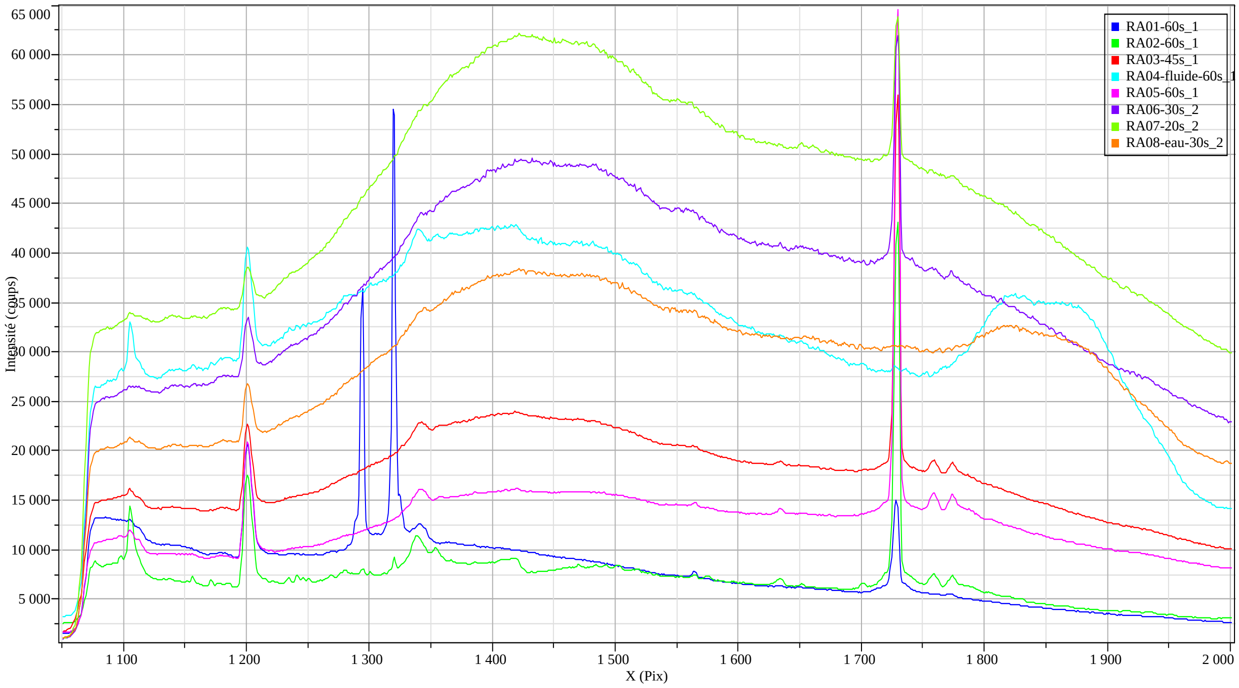


Figure 33 : In situ Raman spectra acquired during Dive 03 (from RA01 to RA08) at 532nm. RA-04 was obtained on fluids and RA-08 corresponds to water

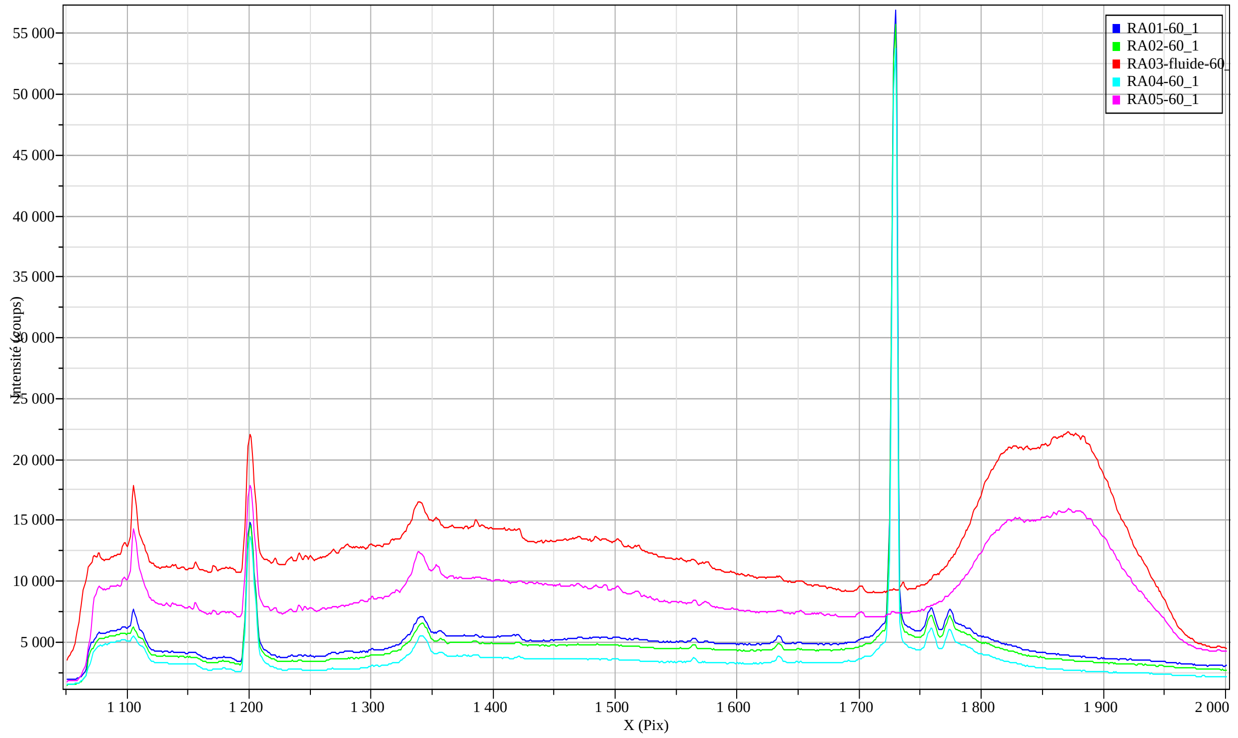


Figure 34 : In situ Raman spectra acquired during Dive 04 (from RA01 to RA05) at 532nm. RA-03 was obtained on fluids

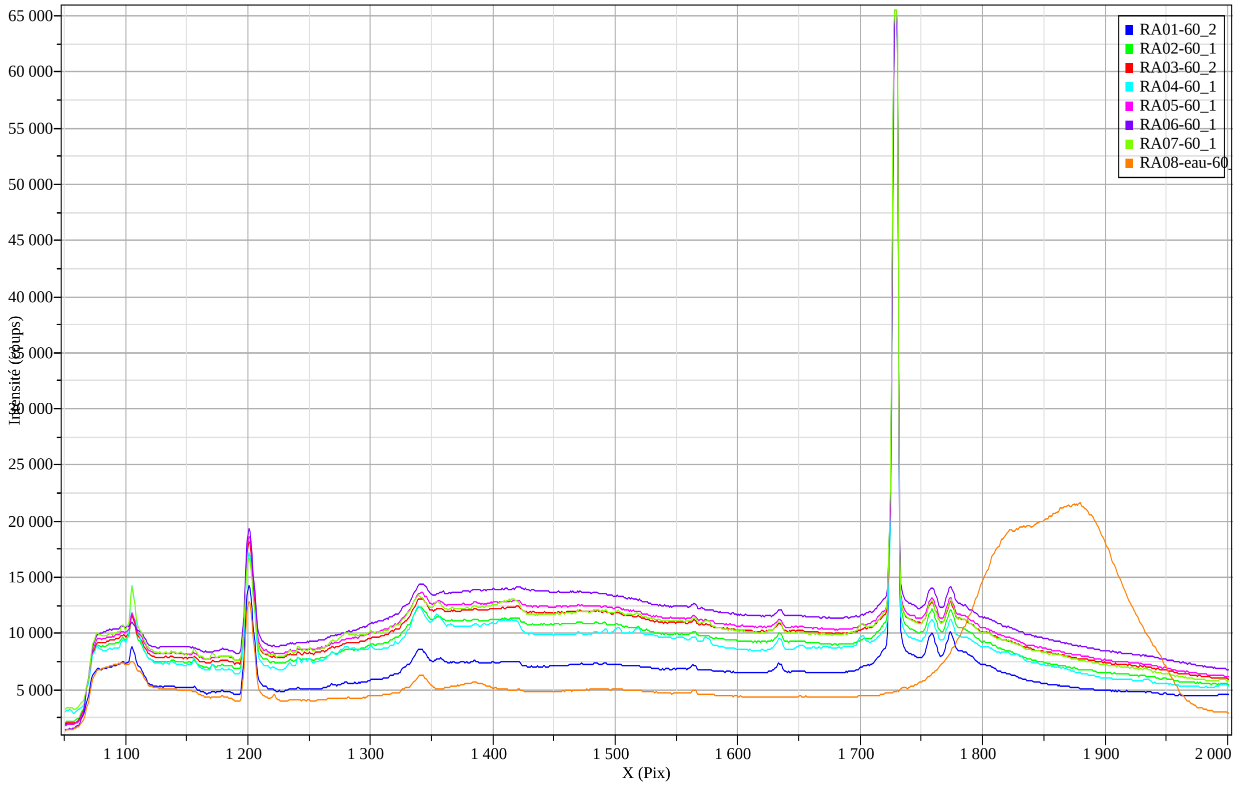


Figure 35 : In situ Raman spectra acquired during Dive 05 (from RA01 to RA08) at 532nm. RA-08 was obtained on water

8.2. *In situ* gas flow measurement

Contributor : **People on watch**

Table 20 Summary of gas flow measurements

Measurement Name	Flow, mL/min
MRS-DV01-FLO-01	14
MRS-DV01-FLO-02	14
MRS-DV01-FLO-03	8
MRS-DV01-FLO-04	12
MRS-DV01-FLO-05	12
MRS-DV01-FLO-06	9
MRS-DV01-FLO-07	15
MRS-DV01-FLO-08	8
MRS-DV01-FLO-09	5
MRS-DV01-FLO-10	3
MRS-DV01-FLO-11	7
MRS-DV02-FLO-01	214
MRS-DV02-FLO-02	25
MRS-DV03-FLO-01	14
MRS-DV03-FLO-02	6
MRS-DV03-FLO-03	13
MRS-DV03-FLO-04	3
MRS-DV03-FLO-05	45
MRS-DV03-FLO-06	23
MRS-DV03-FLO-07	3
MRS-DV03-FLO-08	4
MRS-DV03-FLO-09	2
MRS-DV03-FLO-10	1
MRS-DV03-FLO-11	1
MRS-DV03-FLO-12	1
MRS-DV03-FLO-13	1000
MRS-DV03-FLO-14	277

Measurement Name	Flow, mL/min
MRS-DV04-FLO-01	6
MRS-DV04-FLO-02	14
MRS-DV04-FLO-03	2
MRS-DV04-FLO-04	59
MRS-DV04-FLO-05	1
MRS-DV05-FLO-01	7
MRS-DV05-FLO-02	9
MRS-DV05-FLO-03	20
MRS-DV05-FLO-04	14
MRS-DV05-FLO-05	19
MRS-DV05-FLO-06	18
MRS-DV05-FLO-07	60
MRS-DV05-FLO-08	22
MRS-DV05-FLO-09	11

8.3. Titanium bottle sampling

Contributor : **Pete Burnard** (CRPG Nancy)

Summary : 9 samples from Ti bottle samplers were taken for He isotope and He/Ne ratio measurements ; 13 PEGAZ samples will also be analysed for He isotopes and He/Ne ratio. These measurements will be made by noble gas mass spectrometry (Helix SFT) at CRPG, Nancy in Q1 and Q2 2015. One of the Ti bottles was a seawater blank.

The water sampled by the Ti bottles were degassed on board the « Pourquoi Pas ? » using a variable volume expansion chamber ; the conditioned gases were retained in copper « pinch-off » tubes. There are two gas samples for each Ti bottle. Idem (2 Cu pinch tubes for each PEGAZ) for the PEGAZ samples.

Sample	Date	Hour	Place
MRS-DV01-Ti02	03/11/2014	02:31	Western High
MRS-DV02-Ti02	04/11/2014	18:43	Western High
MRS-DV03-Ti04	06/11/2014	19:25	Tekirdag
MRS-DV03-Ti02	07/11/2014	13:02	Tekirdag
MRS-DV04-Ti01	08/11/2014	07:50	Tekirdag
MRS-DV05-Ti04	10/11/2014	21:10	Cinarcik
MRS-DV05-Ti01	11/11/2014	06:30	Cinarcik
MRS-DV05-Ti02	11/11/2014	11:35	Cinarcik Est

The Ti bottles we used on Marnaut were of a different design (smaller, without a piston, requiring a vacuum in order to suck in seawater or gas) ; the Marnaut type bottles were considerably better than the piston type apparatus that we used here, notably in their effeciency in sealing in gas. This created complications once on board as the piston type (Marsite) bottles had to be rapidly transferred into the expansion system (else they leaked) and the expansion system had been dimensioned for the smaller Marnaut-type bottles. As a result, approx. 30% of every sample was simply thrown away. Nevertheless the piston bottles worked well with zero failure ; their efficiency at preseving gas will only be known once the analyses are made, but I am confident that the analyses will be reliable.

The expansion system for conditioning the gases worked without any failures.

Where bubble emissions were intermittent or weak, it would have been useful to have had more Ti bottle samples, particularly on Dives 01 and 02.

One sample that should have been taken (and wasn't) was some fluid emanations on dive 3 (06/11/2014 19h34 UTC, similar in appearance to Jack the Smoker) but unfortunately the only bottle on board the ROV had already been used.

8.4. *In situ* gas-bubble sampling, and onboard transfert and subsampling

Contributors : **Jean-Pierre Donval, Yoan Germain, Laurent Bignon** (IFREMER Brest)
Pete Burnard (CRPG Nancy)

In accordance with our interest in identifying, characterizing and understanding the spatial dynamics of gas seeps in the sea of Marmara and their fate in the water column, a gas-bubble sampler, commonly called PEGAZ for "PrElèvement de GAZ", has been designed and built.

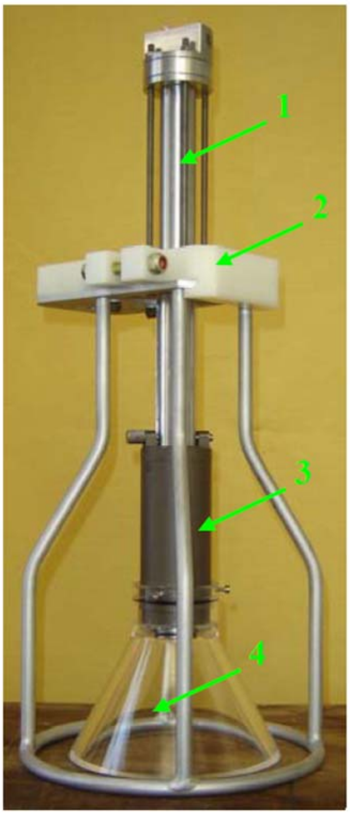


Figure 36 : PEGAZ gas-bubble sampler :
1) triggering system, 2) chassis, 3) high-pressure cell, 4) funnel

This device has been developed to meet the following requirements:

- Allow easy deployment by ROV or submersible, easy handling and low maintenance.
- Sample gas bubbles at most sea bottom temperatures, and for pressure in between 1.3 and 30 MPa.
- Measure the gas flux during sampling.
- Preserve the *in situ* pressure until the recovery of the sample and its transfer into small containers for analysis.
- Limit the sampling of seawater along with the gas bubbles.

Accordingly, the PEGAZ sampler is composed of a cylindrical high-pressure cell in Teflon®-coated titanium TA-6V, associated with an actuated piston connected to the top for sealing-after-sampling (Figure 37). The total height of the cell is 522 mm and its external diameter is ~210 mm. Thus, the gas storage capacity is of ~50 mL. The piston shaft is made of titanium TA-6V. A graduated Plexiglas funnel is connected to the bottom to collect the bubbles and supply the cell through a small aperture.

Figure 37 : Bubble sampling with Pegaz during Marsitecruise

After recovery, the PEGAZ sampler was connected to a gas transfer system for sub-sampling as shown in Figure 38. The collected gases were stored at ~3 bars in 12-mL pre-evacuated vials from Labco®. The latter was analyzed at the Laboratoire de Géochimie et Métallogénie of Ifremer for molecular composition. A gas chromatograph μGC R3000 from SRA equipped with a TCD and a PoraPlot U capillary column was used for molecular composition determination. The uncertainty in the measurements was of ±2%.

Figure 38 : Gas-extractor system used during MARSITECruise
(Courtesy of Yoan Germain)

A total of 18 gas streams have been sampled. Table 18 summarizes the locations of the sampling sites and the water depth.

Table 21 : Pegaz samples

Sample	Location	Depth (m)	Pressure after connection to the gas extractor (bar)	Initial pressure (bar)
MRS-DV01-PE02	Central high	329	32,36	34,95
MRS-DV01-PE03	Central high	414	40,56	43,80
MRS-DV01-PE04	Central high	329	36,80	39,74
MRS-DV02-PE01	Western high	640	64,68	69,85
MRS- DV02-PE02	Western high	643	65,00	70,20
MRS- DV03-PE03	Western Tekirdag	895	93,80	101,30
MRS- DV03-PE02	Western Tekirdag	1070	1,00	1,08
MRS- DV03-PE09	Western Tekirdag	1085	105,50	113,94
MRS- DV03-PE04	Western Tekirdag	1090	99,70	107,68
MRS- DV03-PE06	Western Tekirdag	1055	104,54	112,90
MRS- DV03-PE01	Western Tekirdag	1059	104,24	112,58
MRS- DV04-PE02	Southeastern Tekirdag	1083	107,00	115,56
MRS- DV04-PE7	Southeastern Tekirdag	1098	107,64	116,25
MRS- DV04-PE8	Southeastern Tekirdag	1099	108,04	116,68
MRS- DV05-PE1	Cinarcik basin	1238	122,06	131,82
MRS- DV05-PE2	Cinarcik basin	1238	124,88	134,87
MRS- DV05-PE3	Cinarcik basin	1231	122,76	132,58
MRS- DV05-PE4	Cinarcik basin	1250	120,68	130,33

8.5. Stable-carbon isotopic ratio measurement of methane in the gas samples

Contributors : **Claire Croguennec, Ludovic Legoix** (IFREMER Brest)

The source of the hydrocarbon seeps observed in the Sea of Marmara can be different from one seep to another. The degradation of organic matter in shallow marine sediments produces microbial gases, mainly methane. The carbon isotopic composition of this microbial methane generally ranges between -110 and -55‰. In contrast, methane generated at greater depth results from the thermocatalysis of deeply buried organic-matter, and supply petroleum reservoir. Its origin is then thermogenic and its carbon isotopic composition varies from -50 to -20‰. The occurrence of abiotic gases is less common on continental margins. It is produced from magmatic or post-magmatic processes, with a $\delta^{13}C$ signature either > -20‰ or ranging between -30 and -47‰, depending of the generation process.

In order to identify the origin of the methane detected from the gas-bubble samples, analyses of the stable-carbon isotopic composition were carried out on board by the Cavity Ring-Down Spectroscopy (CRDS), a near-infrared absorption technique. The spectrometer is composed of a laser, an optical cavity and a photo-detector (Figure 39). At a specific wavelength, methane molecules absorb the laser beam which enters into the optical cavity. There, the light bounces between three high-reflectivity mirrors, increasing the optical path-length up to tens of kilometers. Then, the laser is switched off, while the light continues to bounce between the mirrors with an exponential decay of its intensity due to the reflection factor (99,999%). This light decay, commonly called the 'Ring-Down', is measured as a function of time by the photo-detector. The concentration of ^{12}C and ^{13}C is then derived from the difference between the ring-down with and without sample.

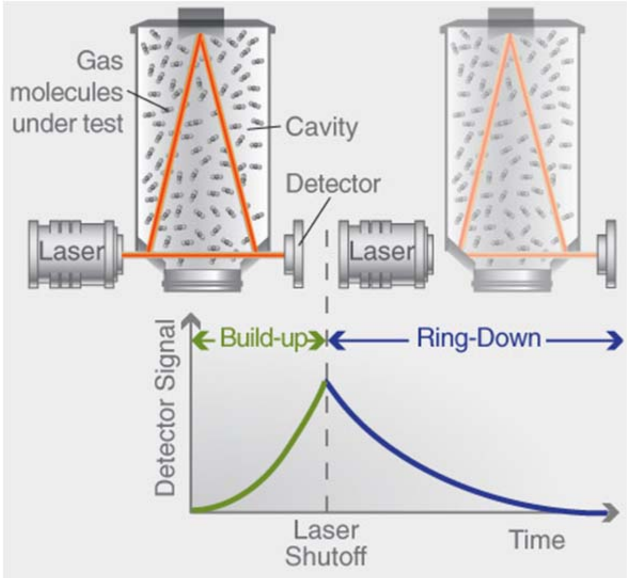


Figure 39 : Principle of the CRDS technique (from Picarro)

Measurements have been performed with a SSIM-CRDS analyzer from Picarro (G2201i) (Figure 35). The gas sample was directly injected with an appropriate gas-tight syringe in the Small Sample Injection Module (SSIM) where it is diluted with hydrocarbon-free air (Zero Air), and then transferred into the cavity of the CRDS.

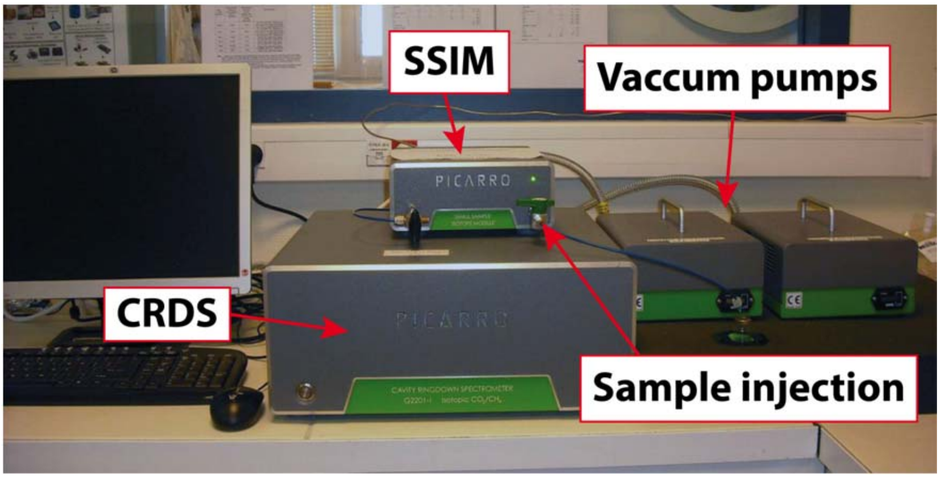


Figure 40 : SSIM-CRDS analyzer G2201i (from Picarro)

The results are given as parts per thousand (‰) relative to the PeeDee Belemnite (PDB) standard ($^{13}C/^{12}C$ = 0.0112372), according to the following formula:

$$\delta^{13}C_{\text{Sample}} = \left(\frac{^{13}C/^{12}C_{\text{Sample}}}{^{13}C/^{12}C_{\text{PDB}}} - 1 \right) \cdot 1000$$

The uncertainty on the $\delta^{13}C$ measurement varies from ±0.2 to ±1.4‰. The results are reported in Table 22. Overall, the $\delta^{13}C$ of methane ranges between -65,8 and -40,5‰. Both thermogenic and microbial sources of methane have been identified in the Sea of Marmara. Those results will be compared with measurements performed by the technique of Isotope Ratio Mass Spectrometry (IRMS). It is important to notice that we still need to combine molecular and isotopic analyses and carry out complementary analyses such as δD_{CH4} in order to decipher precisely source mixing when the source determination remains elusive.

Table 22 : Carbon isotopic composition of methane content in gas bubbles

Sample	$\delta^{13}C_{CH4}$ (‰)
MRS-DV1-PE02	-44,1
MRS-DV1-PE03	-53,0
MRS-DV2-PE01	-45,9
MRS-DV2-PE02	-43,7
MRS-DV3-PE02	-58,0
MRS-DV3-PE03	-40,5
MRS-DV3-PE01	-52,1
MRS-DV3-PE04	-55,6
MRS-DV3-PE06	-52,1
MRS-DV3-PE09	-58,0

Sample	$\delta^{13}C_{CH4}$ (‰)
MRS-DV4-PE02	-64,1
MRS-DV4-PE08	-65,8
MRS-DV4-PE07	-65,8
MRS-DV5-PE01	-63,4
MRS-DV5-PE02	-62,6
MRS-DV5-PE03	-63,6
MRS-DV5-PE04	-62,0

8.6. Mercury analysis

Contributors : **Joël Knoëry, Bastien Thomas** (IFREMER Nantes)

All Hg determinations were made using atomic fluorescence spectroscopy (AFS, Tekran, model 2500ò). Total mercury (Hg_T) was determined using an oxidation of the sample with an acidic BrCl solution (20 µmol L^{-1}). This step was followed by reduction of the oxidized Hg using an acidic stannous chloride solution (2 mmol L^{-1}), immediately before sparging the sample with Ar at 200mL/min. Elemental mercury is then volatilized and amalgamated on a gold trap before being released (heating) into an atomic fluorescence spectrometer and quantified and its subsequent quantification by AFS. This method is based on the US-EPA method N° 1631.

Accuracy for Hg_T was checked using the CRM ORMS-5 of the National Research Council of Canada. For mean (± 95% confidence limits), we found 63.9 ± 4.5 pmol L^{-1} (certified value: 62.8 ± 5.5 pmol L^{-1}) for ORMS-5. The detection limit, 3 times the standard deviation of 5 blank replicates, was 0.15 pmol L^{-1}. The analytical reproducibility (5 replicate analyses of the CRM) was better than 10%. The reproducibility estimated on a CRM is assumed to be valid for the analyzed seawater samples. The possible drift in accuracy during analyses was checked by inserting a CRM every seventh measurement.

Samples subjected to this procedure originate from the CTD/rosette, and from porewaters taken from sediment cores using acid-cleaned Rhizon® porous samplers and the associated polyethylene (PE) syringe. In both cases the oxidation step is carried out in PFA containers. It lasts between 20' and 2h for watercolumn samples, and between 1 and 2h for porewaters.

Dissolved gaseous mercury (DGM) was also determined on board. The method consisted of a direct bubbling of a 0.3 L sample, the amalgamation of elemental Hg on a gold trap and its subsequent quantification by AFS. This Hg fraction is assumed to represent both dissolved elemental Hg and the volatile dimethylmercury (DGM = Hg^0 + DMHg). The AFS calibration for DGM measurements consisted of injections, every tenth sample, of Hg vapor through a septum located before the amalgamation trap. The vapor was either saturated with mercury at a recorded temperature, or diluted from saturated vapor into a glass vial of known volume and pressure. Calibration is linear over 3 orders of magnitude. Samples subjected to this procedure originate from the CTD/rosette. Immediately after the rosette is brought on deck, samples flow hermetically into acid-cleaned PE bags where they are kept (<2h) until analysis.

Gaseous mercury (GaM) was analyzed by injecting aliquots of the vial of the pressurized PEGAZ sample into the the DGM apparatus using its calibration port. Quantification uses the same calibration as the DGM.

The purpose of the cruise was 2-fold:

- Test the hypothesis of a link between gas releases from mechanically stressed rocks and the occurrence of gaseous Hg in the fluid circulation of the subseafloor associated with the North Anatolian Fault (NAF). This implies the determination of total mercury (HgT) and dissolved gaseous mercury (DGM).

- Obtain reference samples from the sea of Marmara for Hg levels and speciation (DGM, HgT and organic forms including methylated mercury).

To meet these objectives, the following samples were obtained: porewaters from ROV pushcores, pressurized seep gases from the ROV's PEGAZ, and open-sea waters from the CTD-rosette. All samples were analyzed shipboard for HgT, DGM and where applicable for GaM. Samples for methyl mercury species will be analyzed at the shore laboratory. Additional analyses of solid phase total mercury on sediment cores will be performed once samples are obtained as soon as the cores will have been returned to Brest.

Table 23 : Samples for Mercury analysis

	HgT	DGM	GaM	Methyl mercury	Total mercury
PEGAZ			X		
Push core porewaters	X				
Calypso cores	X				X
Hydrocast	X	X		X	

8.7. **Alkanality measurement**

Contributors **: Emmanuel Ponzevera, Claire Croguennec** (IFREMER Brest)

8.7.1. Pore fluid sampling

Pore fluids were extracted from push cores and 1m-lenght sections of Calypso cores by means of Rhizon samplers connected to pre-evacuated 10-mL syringes. Sampling was performed with a depth resolution of 20 or 30 cm. The volume obtained for each sampling point was evaluated by reading on the graduated syringe and transferred in 15-ml HDPE vials. Subsamples were taken for various analyses: alkalinity, boron isotopes, sulfides, molecular and carbon-isotope composition of methane and carbon dioxide. Methane samples were preserved using NaN_3 solution. The remaining sample volume was acidified with 15 µL of concentrated HNO_3 for analyses of major and minor ions and isotopic composition of lithium, strontium and calcium. All samples were kept refrigerated at 4°C for onshore analyses.

All plastics (bottles, tips, vials) were cleaned with 10% nitric acid before use. Tests were carried out on Rhizon samplers in order to evaluate the trace metals contamination (analyses by HR-ICP-MS). Blanks were performed on board to check the cleanliness of the whole sampling method.

8.7.2. Total alkalinity analysis in pore fluid

Total alkalinity measurements were performed on board directly after sampling by titration with 0.1 N HCl using a potentiometric titrator (Titrino DMS 716). The pH-meter was regularly calibrated with buffered solutions pH=4 and pH=7. A seawater standard (standard 123) was measured for each set of analyses in order to assess the repeatability of the method. The measurements were performed at pH=4.3 for all samples.

8.7.3. Onshore analyses

Major elements (Cl, SO_4, Ca, Mg, K, Na) will be analyzed by ionic chromatography and minor elements (Ba, B, Li, Sr, Mn, Mo, Pb) by HR-ICP-MS. Isotopic analyses (Li, B, Sr) will be performed on MC-ICP-MS after a chemical separation in clean lab.

Molecular and isotopic compositions of methane will be determined by GC-FID and CRDS, respectively.

Table 24 : Summary of the pore-fluid sampling

	Core	Nb Sample	Subsamples						
			Alkalinity	Hg	HS^-	B-iso	DIC-iso	CH_4 + CH_4-iso	CO_2-iso
Calypso cores	MRS-CS-04	19	16			14		13	3
	MRS-CS-06	6	0			0		3	0
	MRS-CS-07	14	12			12		8	10
	MRS-CS-08	35	31			31		18	8
	MRS-CS-13	27	14			14		9	0
	MRS-CS-14	47	41			41		25	18
	MRS-CS-15	23	19			19		14	8
	MRS-CS-17	32	27			27		20	10
	MRS-CS-22	30	28			28		22	24
	MRS-CS-26	26	15			14		4	6
	TOTAL	***259***	***203***	***0***	***0***	***200***	***0***	***136***	***87***
Push cores	MRS-DV01-PC-05	9	9	3	9		9		
	MRS-DV01-PC-06	12	6	3	0		0		
	MRS-DV02-PC-04	13	13	3	13		13		
	MRS-DV02-PC-06	9	0	3	9	9	9		
	MRS-DV03-PC-06	18	18	0	18	18	18		
	MRS-DV04-PC-06	6	6	0	6	6	6		
	MRS-DV04-PC-01	21	0	0	21		21		
	MRS-DV05-PC-01	11	11	0	11		11		
	MRS-DV05-PC-05	13	0	0	13		13		
	TOTAL	***112***	***63***	***12***	***100***	***33***	***100***		
Blade cores	MRS-DV03-BC-01	5	5	0	**5**	5	**5**		
	MRS-DV05-BC-02	0	0	0	**13**	13	**13**		
	TOTAL	***5***	***5***	***0***	***18***	***18***	***18***		
	TOTAL	***376***	***271***	***12***	***118***	***251***	***118***	***136***	***87***

8.8. Pore Water Geochemistry : determination of Hydrogen Sulfide

Contributor **: Barbara Teichert** (University of Müenster)

Introduction

Many bacteria use the oxygen dissolved in seawater to oxidize organic matter and/or methane to carbon dioxide, water and inorganic carbon. The oxygen bound in sulfate ions is used by sulfate reducing bacteria as an electron acceptor while reducing the sulfate to sulfide (Jørgensen and Kasten, 2006). Not only seawater sulfate penetrating down into the sediment from the overlying seawater, but also methane diffusing up from below feeds sulfate reduction in the lower sulfate zone. At depth, the production of H_2S may exceed the availability of reactive metal oxides and H_2S accumulates in the pore water. The H_2S diffuses upwards along a concentration gradient that generally reaches zero at the bottom of the suboxic zone. Concurrently, the H_2S reacts with buried iron oxides to form FeS, FeS_2, S^0 and a number of other solid or dissolved intermediate products.

Analytical Method

Hydrogen sulfide concentrations were determined by spectrophotometry as methylene blue following the method in Grasshoff *et al*. (1983). Pore water samples were taken as early as possible and transferred from the syringes (attached to the Rhizons) to Eppendorf vials. Depending on expected concentrations 1.2 – 0.1 ml were subsampled. The pore water sample was directly transferred into Eppendorf vials with 100 µl of Zinc acetate gelatin to fix the sulfide. Different dilutions were prepared (1:1, 1:10, 1:100, 1:200) with oxygen-free water. Then 100 µl of color reagent (N, N-dimethyl-p-phenylenediamine dihydrochloride solution) and catalysator (Fe(III) solution) were added. After 1 hour, absorbance was measured using a spectrophotometer at 670 nm using 1 cm cuvettes. Hydrogen sulfide concentrations are determined from a standard curve.

Table 25: Number of pore water sediment and carbonate samples taken for both offshore and onshore analyses

	Total depth (cm)	Onboard Pore water HS^-	Onshore				
			Pore water			Sediment	Carbonate
			Sulfur Isotopes	Ca Isotopes	DIC		
Central High							
DV01-PC05	14.5	9	38	28	9	39	3
CS03	975.0	20					
Western High							
DV02-PC06	10.5	9				5	
DV02-PC04	14.0	13				12	
CS05	869.0		17			28	
Tekirdag Basin							
DV03-PC06	20.5	19			12		
DV03-PC01	22.5	20			10		
CS09	1103.0	6	56	58		45	
Eastern Tekirdag Basin							
DV04-PC6	7.0	6			5	6	
DV04-PC1	23.0	21			11	21	
Cinarcik Basin							
DV05-PC01	12.5	11	11		8	8	
DV05-PC05		12					
CS16	1012.0		62	62		36	

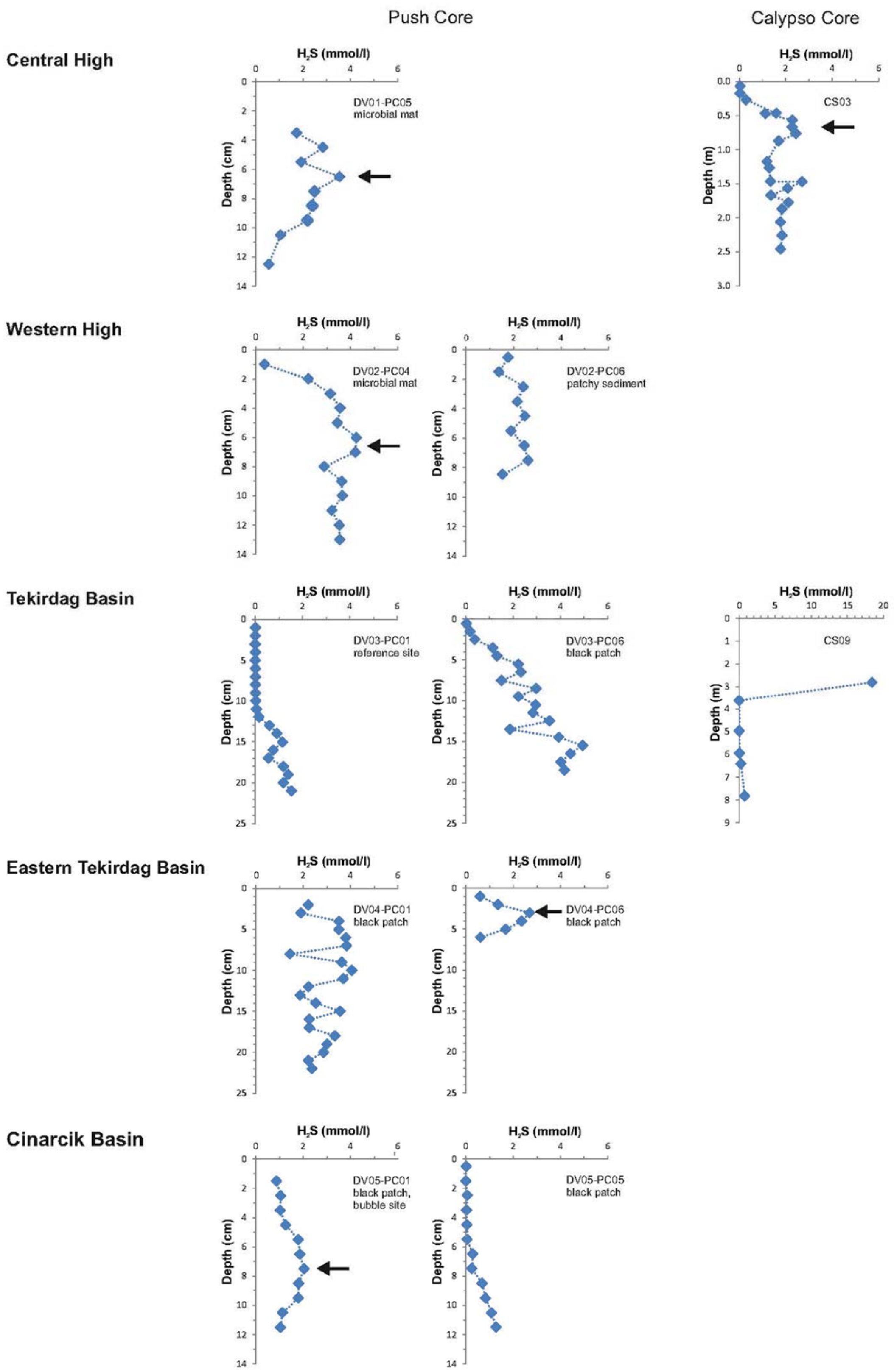


Figure 41 : On board total sulfide analysis

8.9. **Lipid biomarker analyses – samples**

Contributor **: Nicolas Chevalier** (University of Müenster, Germany)

Table 26 : Samples for lipid biomarker analyses

Sample name	Tool	Comments
MRS-DV01-PC01	Push core	20 cm (12 sediment samples)
MRS-DV01-BC06	Blade core	Bivalve shells
MRS-DV01-CC1		Carbonate crust
MRS-DV02-PC08	Push core	10 cm (6 sediment samples)
MRS-DV02-PC03	Push core	1 cm (1 sediment sample)
MRS-DV02-PC01	Push core	9 cm (7 sediment samples)
MRS-DV02	Basket	Bivalve sample
MRS-DV02-CC2	Basket	Carbonate crust
MRS-DV02-CC3	Basket	Carbonate crust
MRS-DV03-PC07	Push core	18 cm (9 sediment samples, share with Françoise)
MRS-DV03-BC06	Blade core	10 cm (4 sediment samples)
MRS-DV03-CC1	Basket	Carbonate crusts: around 40 samples of mussels in carbonate crusts
MRS-DV03-CC2	Basket	
MRS-DV03-CC3	Basket	
MRS-DV04-PC08	Push cores	17 cm (11 sediment samples)
MRS-DV04-PC04	Push cores	28 cm (13 sediment samples)
MRS-DV04-CC1	Basket	Carbonate crusts: around 20 samples of mussels in carbonate crusts
MRS-DV04-CC2	Basket	
MRS-DV04-CC3	Basket	
MRS-DV04-CC4	Basket	
MRS-DV05-PC4	Push core	8 cm (4 sediment samples, share with Françoise)
MRS-DV05-PC2	Push core	20 cm (10 sediment samples, share with Françoise)
MRS-DV05-BC06	Blade core	Right (with white bacterial mat) and left (without bacterial mat (black patch)) : 0-21 cm (9*2=18 sediment samples)
MRS-DV05	Basket	Macrofauna samples : 3 species
MRS-DV05-CC1	Basket	Carbonate crusts
MRS-CS-03	Calypso cores	40-940 cm (10 sediment samples)
MRS-CS-05	Calypso cores	40-950 cm (10 sediment samples)
MRS-CS-09	Calypso cores	50-1045 cm (11 sediment samples)
MRS-CS-15	Calypso cores	Sample of a sea urchin
MRS-CS-16	Calypso cores	22-997 cm (11 sediment samples)

Table 27 : ROV dive samples for lipid biomarker analyses

ROV VICTOR 6000 DIVES	Name of the sample	Number of sediment samples	Number of carbonate samples	Number of bivalve samples	Storage
1	MRS-DV01-PC01	12			-20°C
1	MRS-DV01-CC1		1		-20°C
2	MRS-DV02-PC08	6		1	at -80°C, -20°C and 4°C
2	MRS-DV02-PC03	1			-20°C
2	MRS-DV02-PC01	7			-20°C
2	MRS-DV02-CC2		1		-20°C
2	MRS-DV02-CC3		1		-20°C
3	MRS-DV03-PC07	9			-20°C
3	MRS-DV03-BC06	4			-20°C
3	MRS-DV03-CC1		1	20	at -80°C, -20°C and 4°C
3	MRS-DV03-CC2		1	10	at -80°C, -20°C and 4°C
3	MRS-DV03-CC3		1	10	at -80°C, -20°C and 4°C
4	MRS-DV04-PC08	11			-20°C
4	MRS-DV04-PC04	13			-20°C
4	MRS-DV04-CC1		1	6	at -80°C, -20°C and 4°C
4	MRS-DV04-CC2		1		
4	MRS-DV04-CC3		1	6	at -80°C, -20°C and 4°C
4	MRS-DV04-CC4		1	10	at -80°C, -20°C and 4°C
5	MRS-DV05-PC04	4			-20°C
5	MRS-DV05-PC02	10			-20°C
5	MRS-DV05-BC06	18			-20°C
5	MRS-DV05-CC1		1		-20°C
Total		**95**	**11**	**63**	

Table 28 : Calypso core samples for lipid biomarker analyses

CALYPSO CORES	Name of the sample	Number of sediment samples	Storage
CS03	MRS-CS03	10	-20°C
CS05	MRS-CS05	10	-20°C
CS09	MRS-CS09	11	-20°C
CS16	MRS-CS16	11	-20°C
Total		**42**	

Figure 42 : Push core sampling

Figure 43 : Mussels on the crust

Figure 44: Calypso core

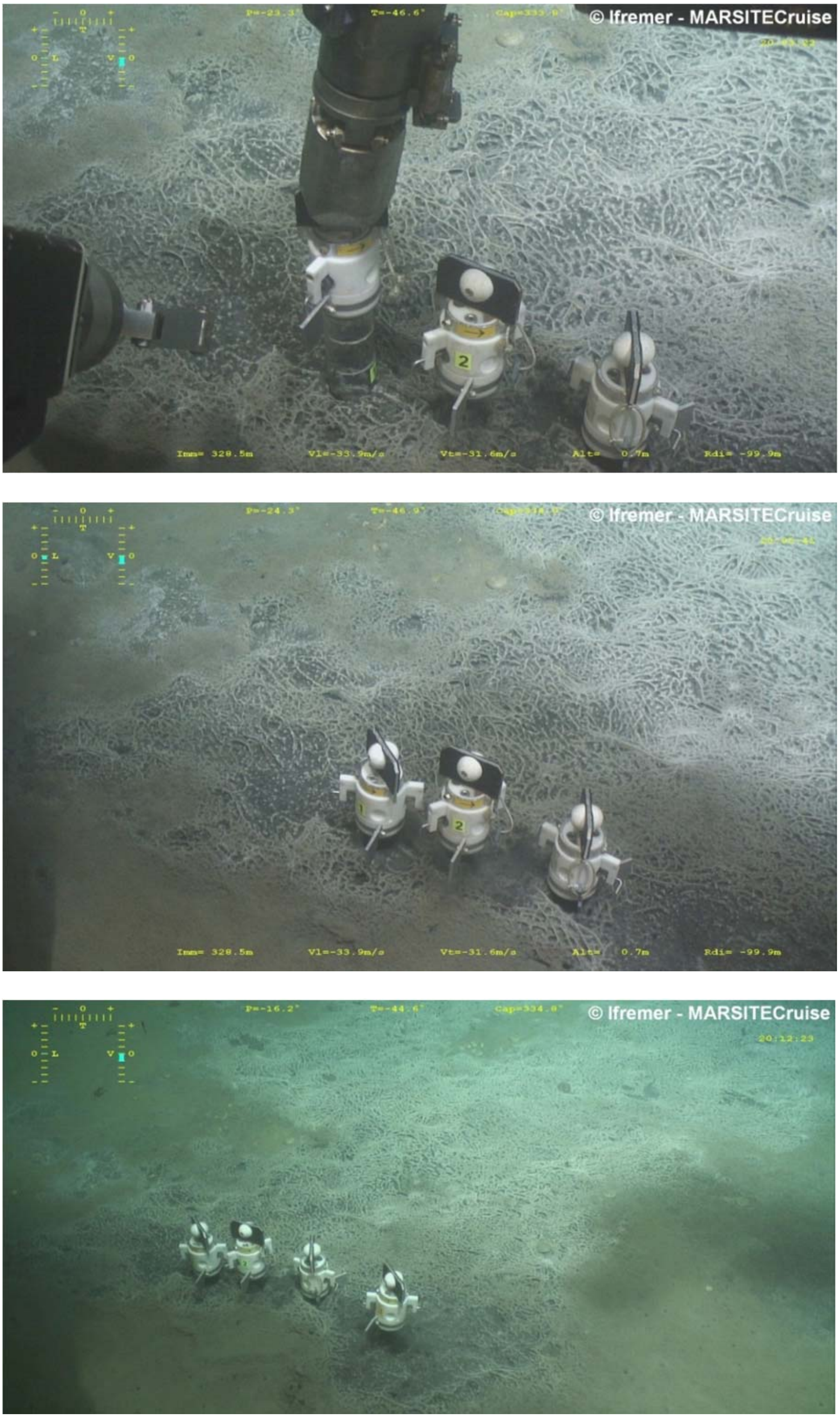


Figure 45 : MRS-DV01-PC01 = 20 cm (12 sediment samples)

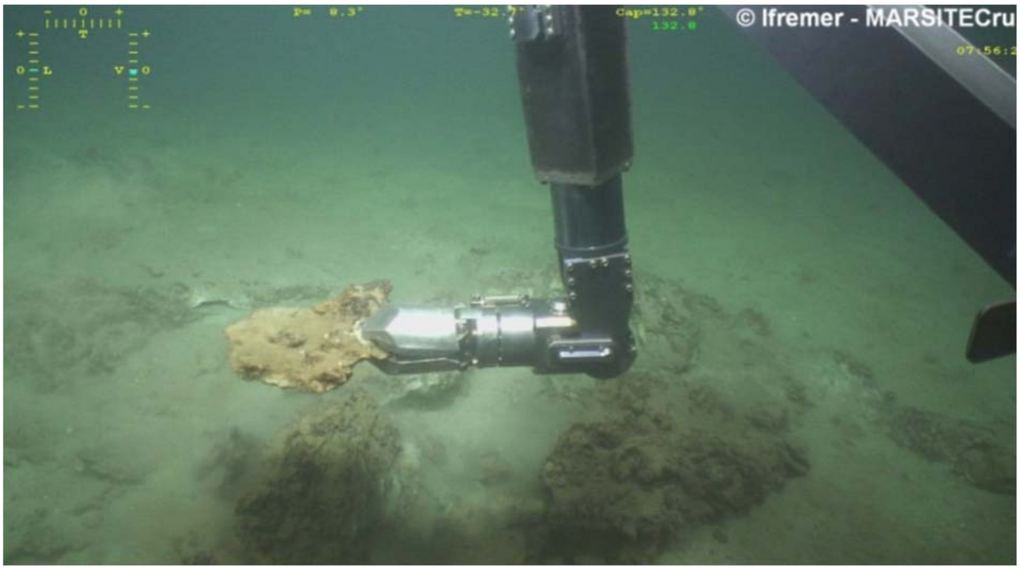


Figure 46 : MRS-DV01-CC1 - a piece of carbonate crust

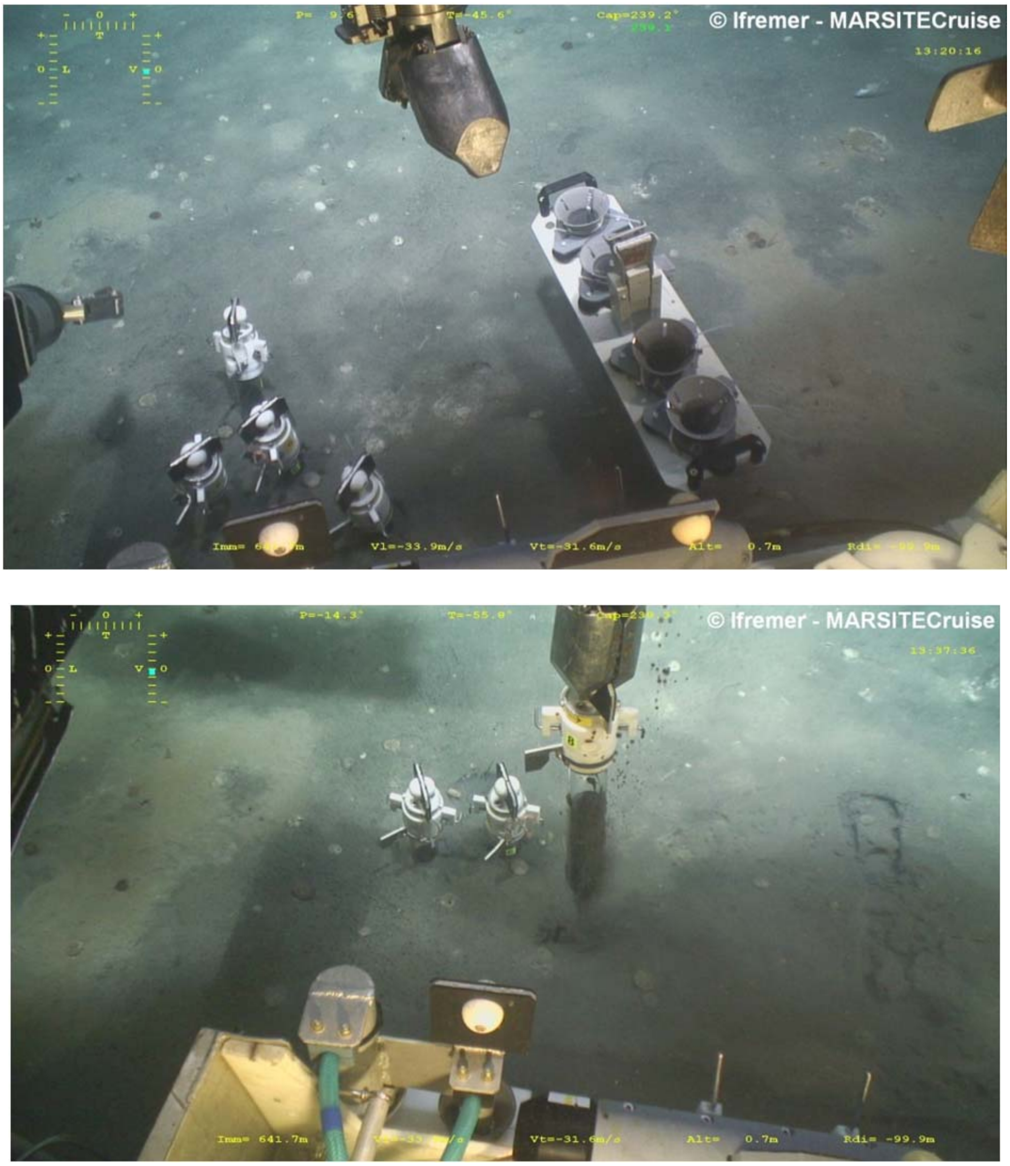


Figure 47 : MRS-DV02-PC08 = 10 cm (6 sediment samples)

Figure 48 : MRS-DV02-PC03 = 1 cm (1 sediment sample)

Figure 49 : MRS-DV02-PC01 = 9 cm (7 sediment samples)

Figure 50 : MRS-DV03-PC07 = 18 cm (9 sediment samples, shared with Françoise)

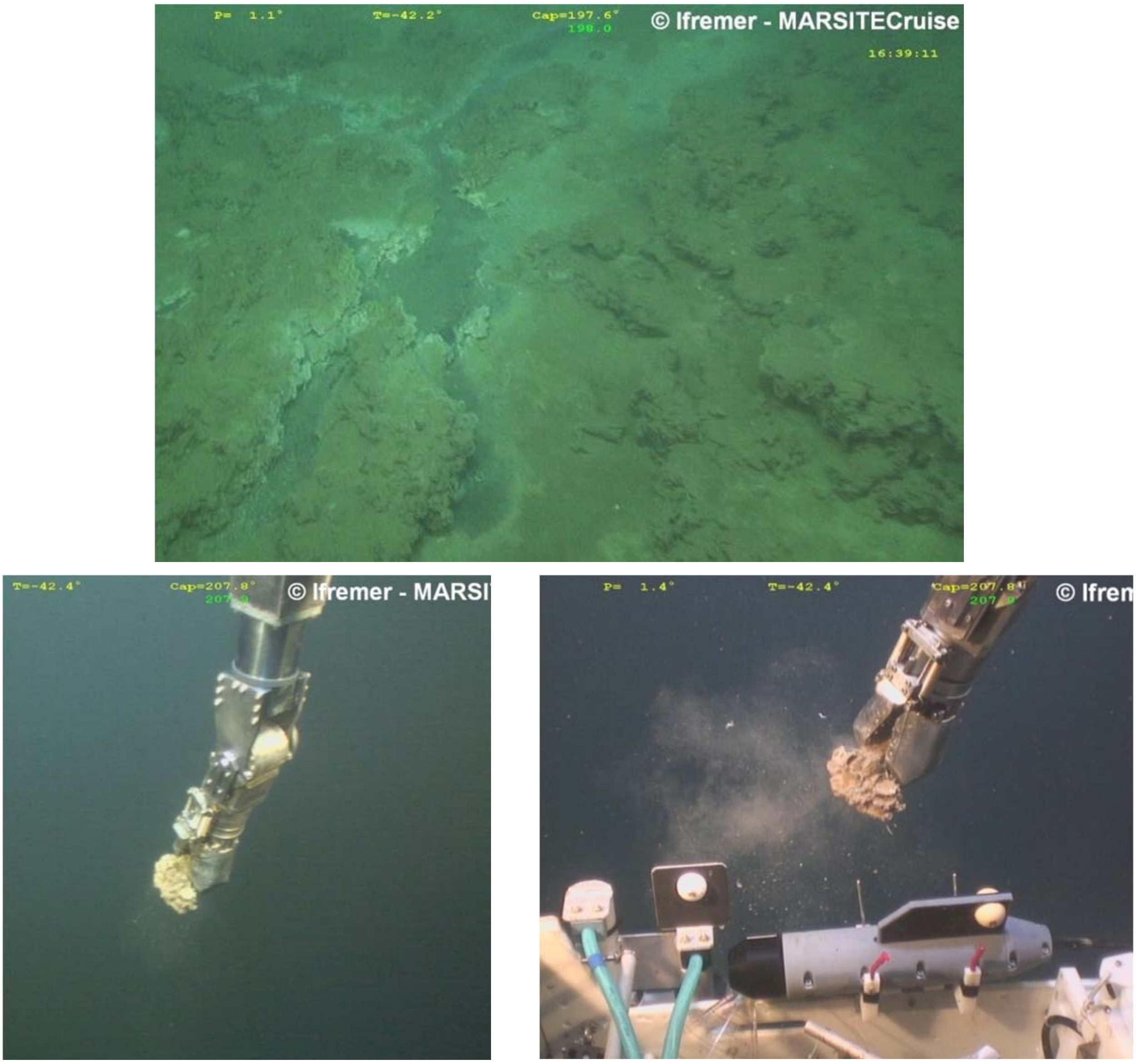


Figure 51 : 2 pieces of carbonate crust (MRS-DV02-CC2, MRS-DV02-CC3)

Figure 52 : MRS-DV03-BC06 = 10 cm (4 sediment samples)

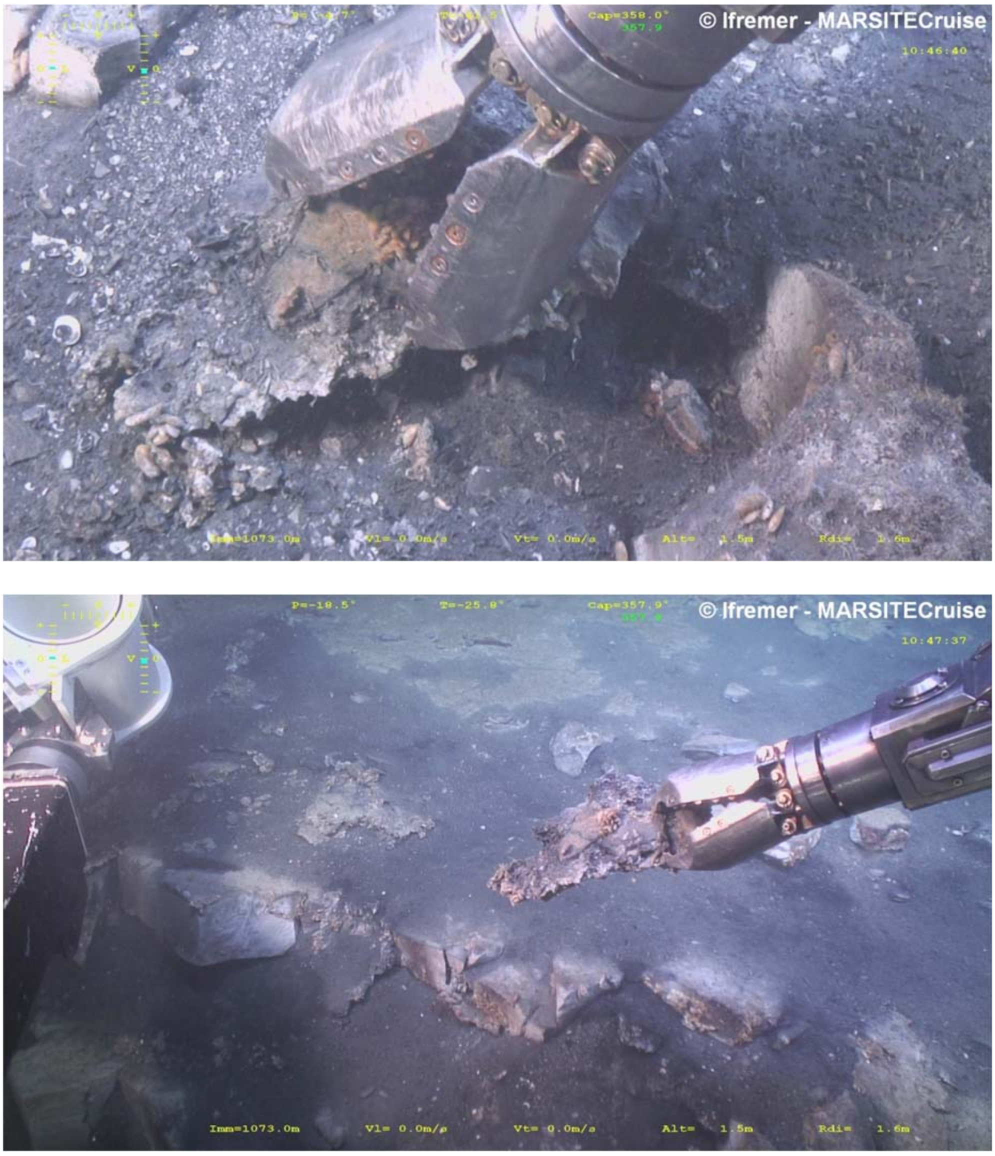
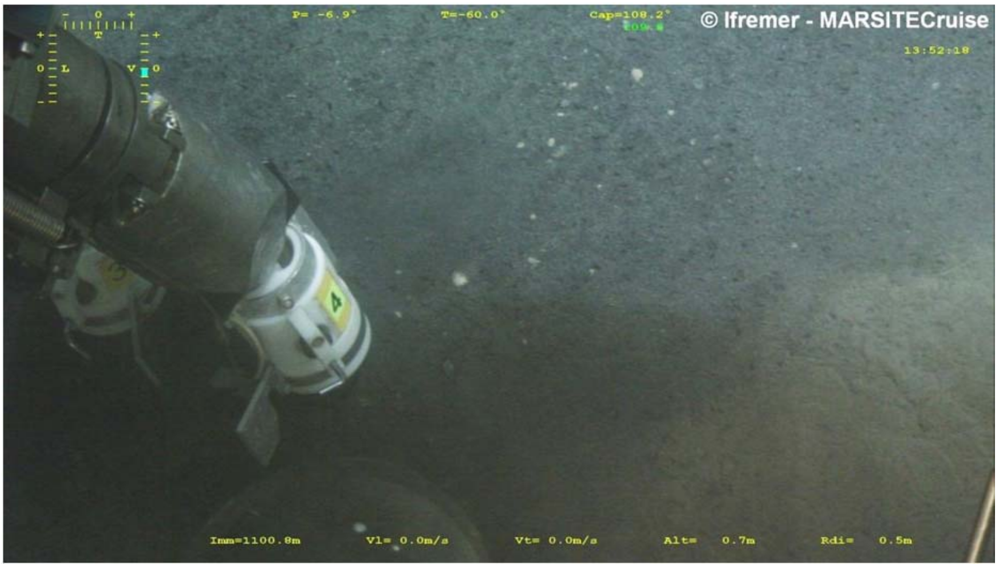
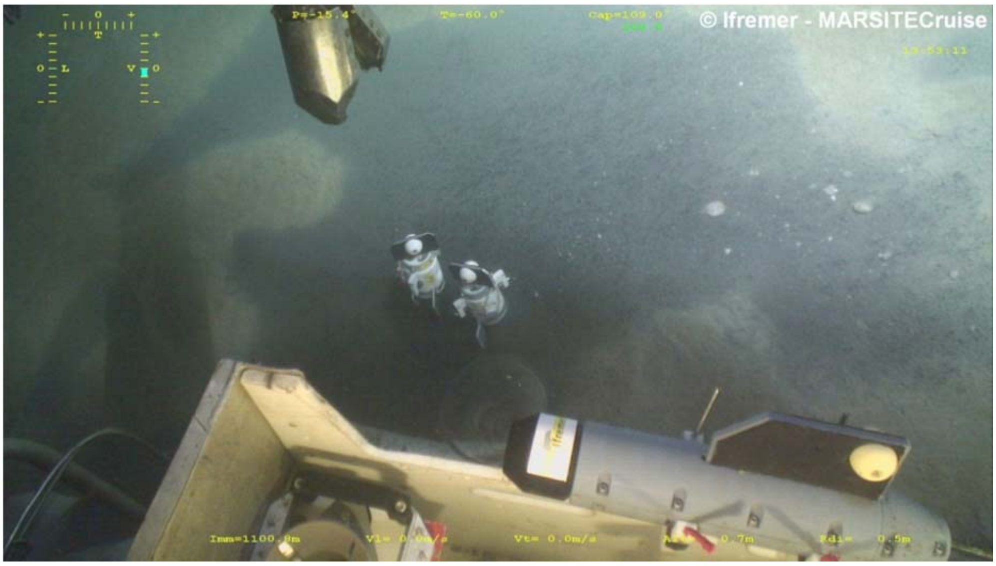


Figure 53 : DV03-Mussel samples on carbonate crusts

Figure 54 : MRS-DV04-PC08 = 17 cm (11 sediment samples)





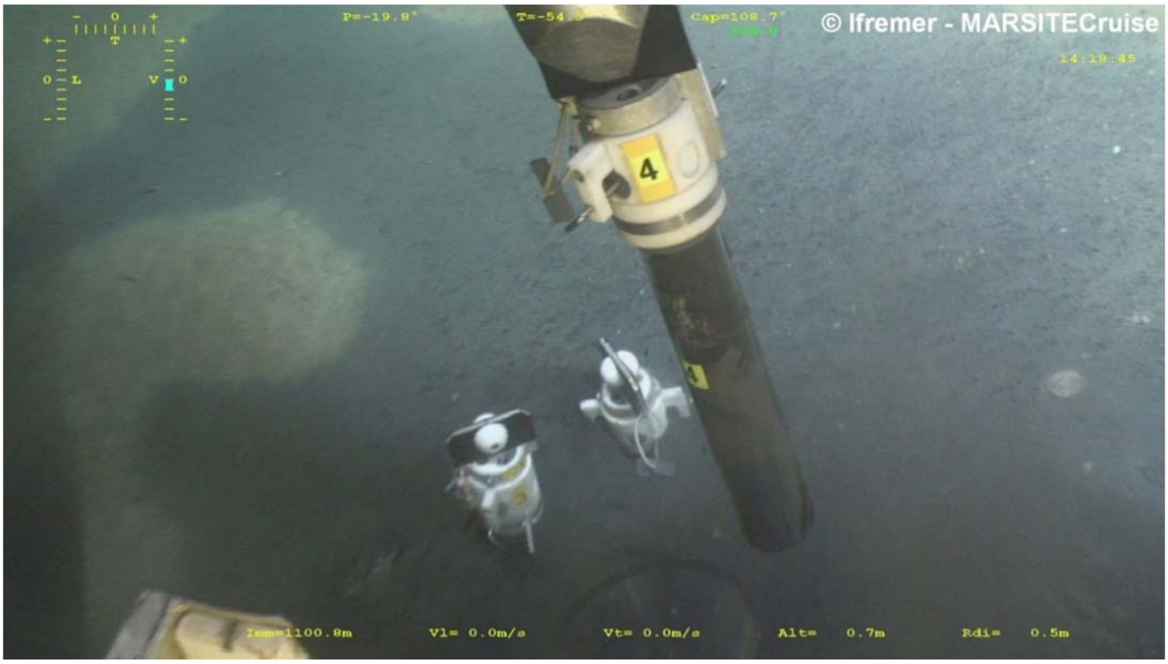


Figure 55 : MRS-DV04-PC04 = 28 cm (13 sediment samples)

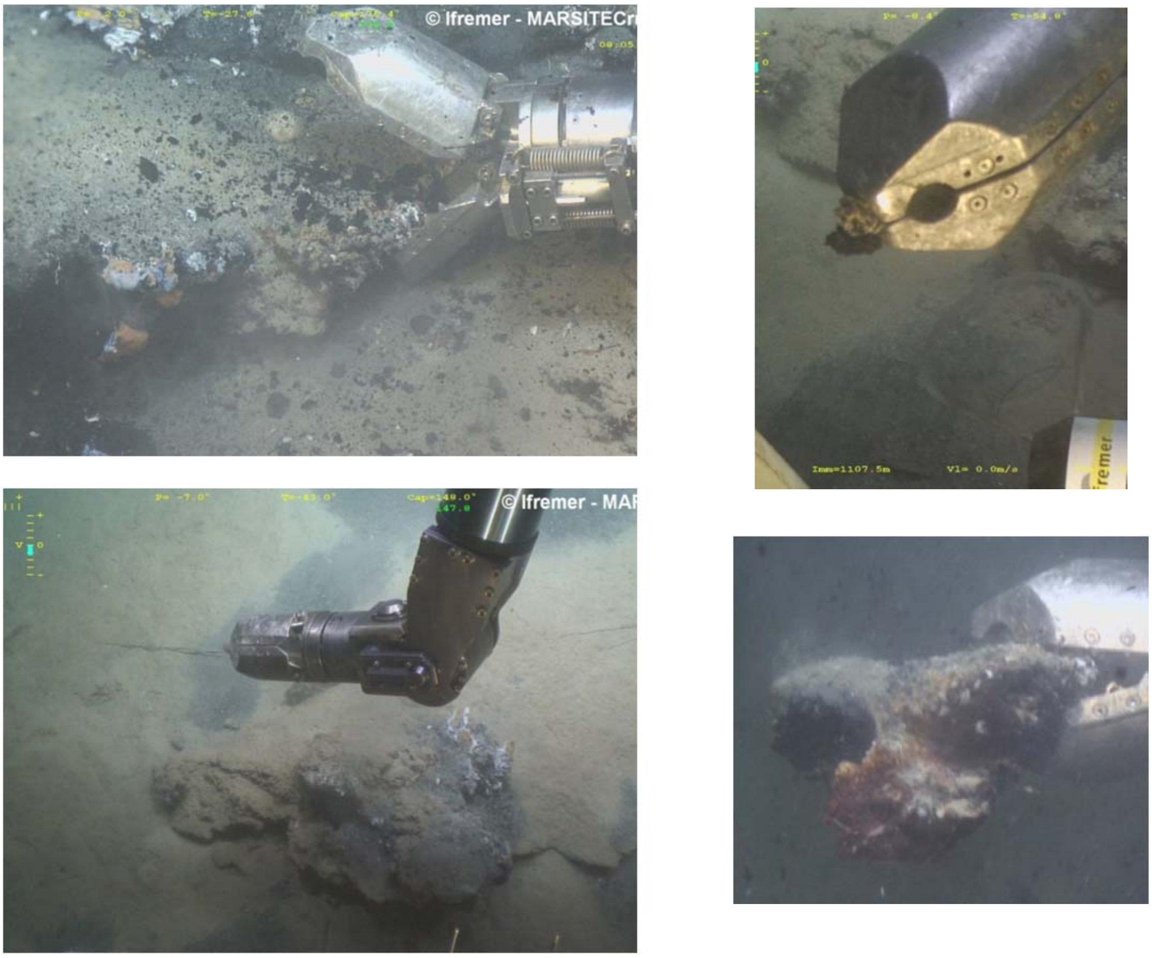


Figure 56 : DV04-carbonate crusts and mussel samples

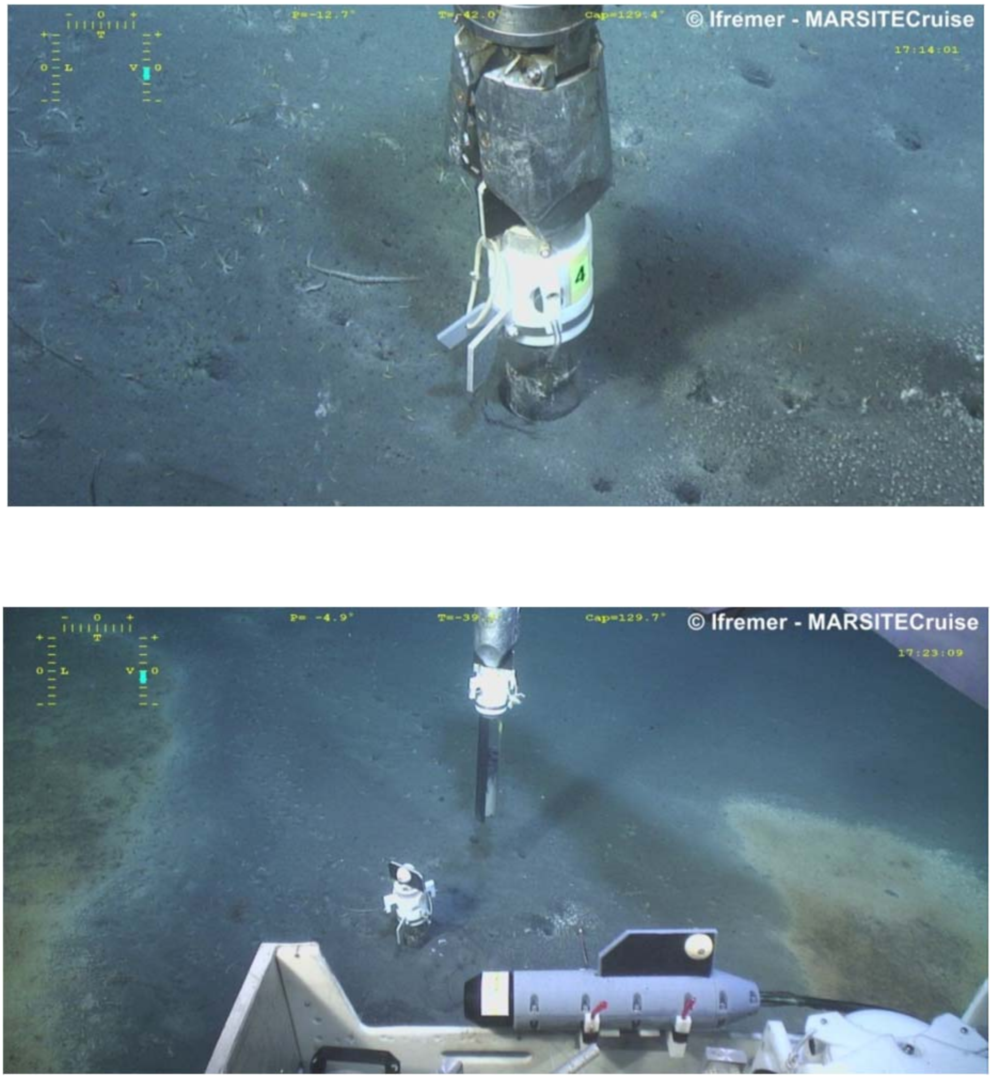


Figure 57 : MRS-DV05-PC4 = 8 cm (4 sediment samples, shared with Françoise)

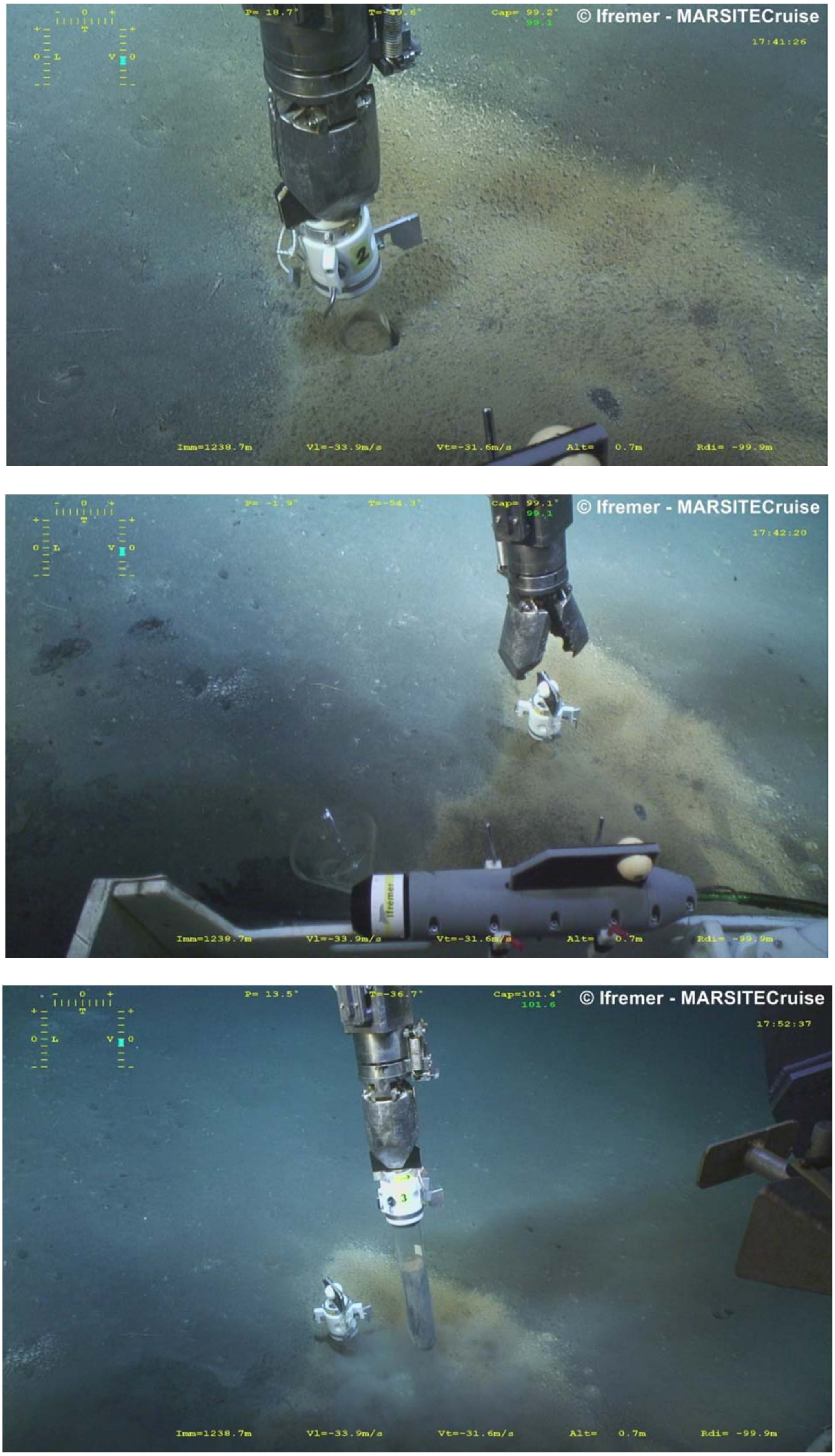


Figure 58 : MRS-DV05-PC2 = 20 cm (10 sediment samples, shared with Françoise)

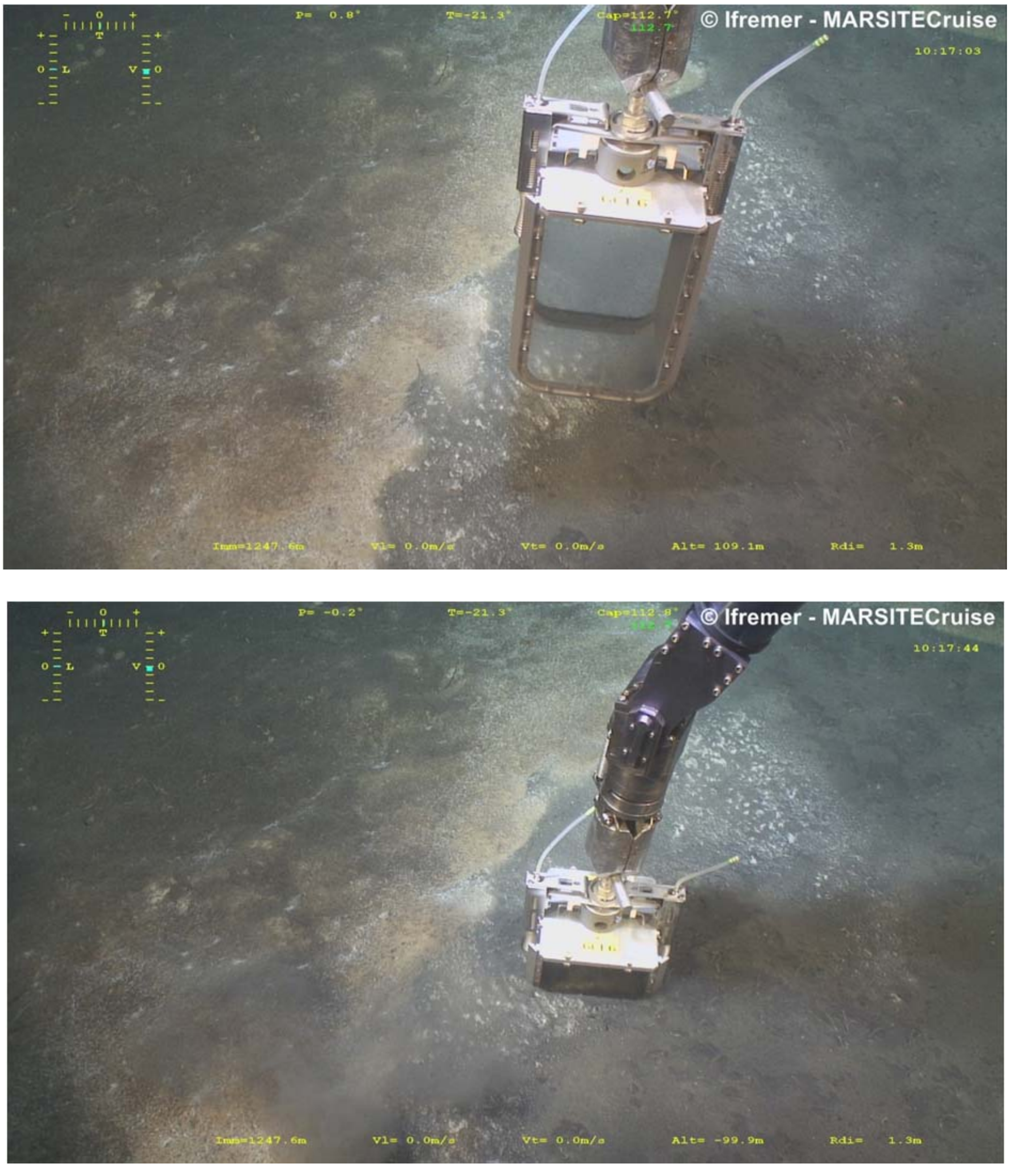


Figure 59 : MRS-DV05-BC06 Blade core sampling

Figure 60 : MRS-DV05-CC, cnidarians

8.10. **Microbiology sampling**

Contributor : **Françoise Lesongeur** (IFREMER Brest)

Push cores have been sampled to investigate microbial diversity as function of the hydrate/ gas chemistry. Slides of 1-2cm thick were collected and stored as follows:

- At -80 °C in Falcon tubes of 50 mL for the extraction of both DNA and RNA.
- At -20 °C in falcon tubes of 15 mL with a solution of PBS/ EtOH (1/1 Vol.), right after 2-3h fixation in formaldehyde 3% followed by washing in PBS 1X for Fluorescence *in situ* hybridization (FISH).

Besides, pore-water samples were also extracted from the same core for chemical analyses as follows:

- 1 sample was acidified with 20 □L of HNO_3 and stored at 4 °C for analysis of major dissolved-elements.
- 2 samples were stored at -20 °C for the analysis of dissolved-organic acids.

The dry sediment samples resulting from the pore-water extraction were stored at -20 °C in falcon tube of 50 mL.

Table 29 :

<table>
<tr><th>Dive</th><th>Sections</th><th>Description</th><th>Ifremer -80°C, -20°C, 4°C
(ei + Acide nitrique 4°C , ei -20°C)</th></tr>
<tr><td>MRS DV01 PC2</td><td>S1 0-1cm</td><td>Sédiment noir liquide, filament bacterien, très fluide</td><td rowspan="12">1 tube falcon ADN:ARN
1tube FISH
1 tubes EI</td></tr>
<tr><td></td><td>S2 1-2cm</td><td>sediment fluide pas d’odeur</td></tr>
<tr><td></td><td>S3 2-4cm</td><td>Sédiment grisatre toujours fluide</td></tr>
<tr><td></td><td>S4 4-6cm</td><td>sediment gris plus compact</td></tr>
<tr><td></td><td>S5 6-8cm</td><td>Sediment gris collant</td></tr>
<tr><td></td><td>S6 8-10cm</td><td>sediment gris plus compact</td></tr>
<tr><td></td><td>S7 10-12cm</td><td>sediment gris collant</td></tr>
<tr><td></td><td>S8 12-14cm</td><td>sediment gris collant, présence de petite coquille</td></tr>
<tr><td></td><td>S9 14-16cm</td><td>sédiment gris collant, coquille, concretion carbonate</td></tr>
<tr><td>MRS DV01 PC7</td><td>S1 0-2cm</td><td>sediment vert mou</td></tr>
<tr><td></td><td>S2 2-4 cm</td><td>sediment vert mou, coquilles</td></tr>
<tr><td>zone exterieur patch</td><td>S3 4-6cm</td><td>sediment vert mou, coquilles</td></tr>
</table>

Dive	Sections	Description	Ifremer -80°C, -20°C, 4°C (ei + Acide nitrique 4°C , ei -20°C)
	S4 6-8cm	sediment vert mou, coquilles	1 tube falcon ADN:ARN 1tube FISH 1 tubes EI
	S5 8-10cm	sediment vert mou, coquilles	
	S6 10-12cm	sediment vert mou, coquilles	
	S7 12-14cm	sediment vert mou, coquilles	
	S8 14-16cm	sediment vert mou, coquilles	
	S9 16-18cm	sediment vert collant	
	S10 18-20cm	sediment vert collant coquille	
MRS DV02 PC5	S1 0-1cm	Sédiment très fluide	1 tube falcon ADN:ARN 1tube FISH 1 tubes EI
	S2 1-2cm	présence de coquille très fotre odeur de pétrole	
	S3 2-4cm	présence de coquilles	
	S4 4-6cm	huile, coquilles, odeur de pétrole	
	S5 6-8cm	sediment plus liquide huile	
	S6 8-12cm	beaucoup de coquilles	
MRS DV02 PC5	S1 0-1cm	Sédiment très fluide	
	S2 1-2cm	présence de coquille très fotre odeur de pétrole	
MRS DV02 PC2	S1 0-2cm	sédiment très noir	1 tube falcon ADN:ARN 1tube FISH 1 tubes EI
	S2 2-4 cm	sédiment noir huile marron coquilles	
	S3 4-6cm	sédiment noir huile marron	
	S4 6-8cm	Sédiment noir coquille	
MRS DV03PC8	S1 0-2cm	sediment marron vert	1 tube falcon ADN:ARN 1tube FISH 1 tubes EI
	S2 2-4 cm	sédiment gris vert	
	S3 4-6cm	sédiment gris vert	
	S4 6-8cm	sédiment vert avec trace noire, sédiment plus compact	
	S5 8-10cm	trace noire reduite dans le sediment	
	S6 10-12cm	sédiment vert avec trace noire carbonate	
	S7 12-14cm	sédiment vert	
MRS DV03PC7	S1 0-2cm	sédiment gris vert présence de vers	1 tube falcon ADN:ARN 1tube FISH 1 tubes EI
	S2 2-4 cm	sédiment gris	
	S3 4-6cm	sédiment gris	
	S4 6-8cm	sédiment gris	
	S5 8-10cm	sédiment gris avec trace noire	
	S6 10-12cm	sédiment gris odeur de sulfur	
	S7 12-14cm	sédiment gris et compact	
	S8 14-16cm	sédiment gris et compact	
	S9 16-18cm	sédiment gris et compact	

Dive	Sections	Description	Ifremer -80°C, -20°C, 4°C (ei + Acide nitrique 4°C , ei -20°C)
MRS DV03 BC6	S1 0-1,5cm	sédiment noir présence de débris ardoise	1 tube falcon ADN:ARN 1tube FISH
	S2 1,5-3,5cm	sédiment noir	
	S3 3,5-5,5cm	sédiment gris, beaucoup de débris	
	S4 5,5-7,5cm	sédiment gris	
	S5 7,5-9cm	sédiment gris	
MRS DV4 PC5	S1 0-1cm	sédiment noir liquide	1 tube falcon ADN:ARN 1tube FISH 1 tubes EI
	S2 1-2cm	sédiment très noir	
	S3 2-3cm	sédiment très noir	
	S4 3-4cm	sédiment et petite coquille bivalve	
	S5 4-6cm	Sédiment noir et coquilles	
	S6 6-8cm	Sédiment noir et coquilles	
	S7 8-10cm	Sédiment noir et coquilles	
MRS DV04PC3	S1 0-1cm	sédiment noir liquide	1 tube falcon ADN:ARN 1tube FISH 1 tubes EI
	S2 1-2cm	sédiment noir liquide	
	S3 2-4cm	sédiment noir, forte odeur de sulfur	
	S4 4-6cm	sédiment noir	
	S5 6-8cm	sédiment noir	
	S6 8-10cm	Sédiment gris	
	S7 10-12cm	Sédiment gris	
	S8 12-14cm	Sédiment gris	
	S9 14-16cm	Sédiment gris	
	S10 16-18cm	sédiment collant gris	
	S11 18-20cm	sédiment collant gris	
	S12 20-24cm	sédiment collant gris	
MRS DV05			
MRS DV05PC4	S1 0-2cm	sédiment noir très liquide	1 tube falcon ADN:ARN 1tube FISH
	S2 2-4 cm	sédiment noir très liquide, présence de croutyes	
	S3 4-6cm	zone transition sédiment noir et gris	
	S4 6-8cm	sédiment gris	
MRS DV05 PC2	S1 0-2cm	Sédiment marron avec trace noire	1 tube falcon ADN:ARN 1tube FISH
	S2 2-4 cm	sédiment marron plus réduit	
	S3 4-6cm	sédiment marron noir poche d'eau	
	S4 6-8cm	zone de transition sédiment de plus en plus marron	
	S5 8-10cm	sédiment noir	
	S6 10-12cm	sédiment noir	
	S7 12-14cm	sédiment noir	
	S8 14-16cm	sédiment noir	

8.11. **CTD deployment and methane sensor testing**

Contributors : **Dominique Birot – Christian Podeur - Jonathan Perchoc** (IFREMER Brest)

8.11.1. Objectives

The CTD-Hydrocast deployments carried out in the frame of MARSITECruise aimed to:

a) Sample seawater at different depths within the water column. These samples were shared by several research groups, in particular those working on the fate of methane, nutrients and mercury in the water column (Table 30 summarizes the sample sharing).

b) Test two methane sensors, a prototype called MESSEA from IFREMER and a commercial one from Franatech called « METS ». They were designed to measure dissolved methane from the seawater.

8.11.2. Equipment and deployment method

Figure 61 represents a flow diagram of the equipment. The submersible part consists of a CTD SBE19+ associated with 7 rosette casts Niskin® with a volume of 8 L. In addition to the measurements of temperature, conductivity and depth, the CTD provides real time data transmission to the surface. It is also connected to the sensor package which is composed of the methane sensors, an altimeter and a water-pumping system CHEMINI in one hand to an integrated computer, in another hand for data collection on storage. Water sampling was performed at the same coordinates than the methane measurement for comparison purpose.

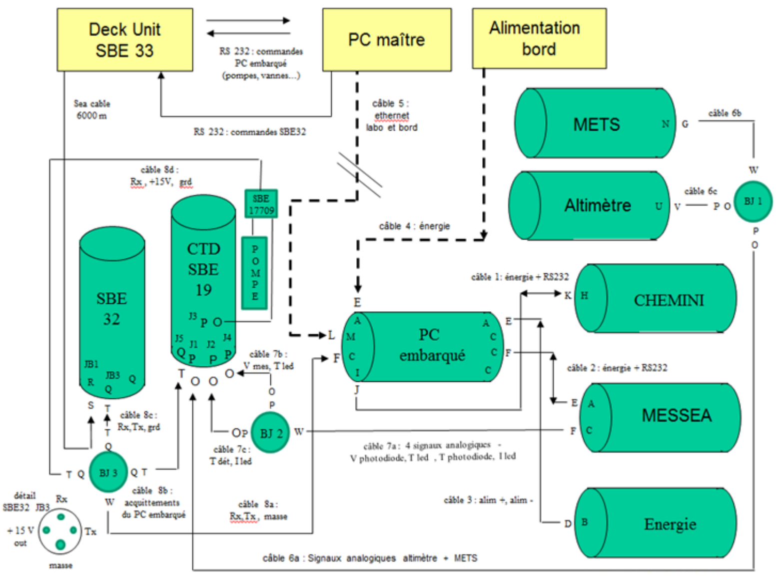


Figure 61: Flow diagram of the CTD-hydrocast. Green color represents the submersible equipment, while the onboard data processing system is in yellow.

Figure 62 : CTD/ hydrocast system with the associated methane sensors

Figure 63 :Seawater sampling for dissolved-methane measurement

Figure 64 :: Dissolved methane concentration is measured by « purge and trap » coupled Gas Chromatography

Table 30 : Sample sharing

Opération	Bottle nb	Date	Longitude	Latitude	Depth (m)	CTD Pression	Deph from altimeter (m)	Prélèvements					
								CH4 dissous		Hg	Nutri-ments	Metals	Chl a
								"purge and trap"	"head space"				
MRS HY 01	B1	04/11/14	E 28°58,3308	N 40°86,1693	327	328		✓	✓	✓			
MRS HY 01	B2	04/11/14	E 28°58,3308	N 40°86,1693	327	328		-	✓	✓			
MRS HY 01	B3	04/11/14	E 28°58,3308	N 40°86,1693	327	327		✓	✓	✓			
MRS HY 01	B4	04/11/14	E 28°58,3308	N 40°86,1693	327	327		✓	✓	✓			
MRS HY 01	B5	04/11/14	E 28°58,3308	N 40°86,1693	327	321		✓	✓	✓			
MRS HY 01	B6	04/11/14	E 28°58,3308	N 40°86,1693	327	229		✓	✓	✓			
MRS HY 01	B12	04/11/14	E 28°58,3308	N 40°86,1693	327	104		-	-	✓			
MRS HY 02	B1	05/11/14	E 27°46,864	N 40°49,034	659	659	4	✓	✓	✓			
MRS HY 02	B2	05/11/14	E 27°46,864	N 40°49,034	659	659	4	-	-	-			
MRS HY 02	B3	05/11/14	E 27°46,864	N 40°49,034	659	658	9	✓	✓	✓			
MRS HY 02	B4	05/11/14	E 27°46,864	N 40°49,034	659	-	13	✓	✓	✓			
MRS HY 02	B5	05/11/14	E 27°46,864	N 40°49,034	659	300		✓	✓	✓			
MRS HY 02	B6	05/11/14	E 27°46,864	N 40°49,034	659	30		✓	✓	✓			
MRS HY 02	B12	05/11/14	E 27°46,864	N 40°49,034	659	3		✓	✓	✓			
MRS HY 03	B1	06/11/14	E 27°30,199	N 40°50,039	1060	1066	2,5	✓	✓	✓	✓	✓	✓
MRS HY 03	B2	06/11/14	E 27°30,199	N 40°50,039	1060	1067	2,5	✓	✓	✓			
MRS HY 03	B3	06/11/14	E 27°30,199	N 40°50,039	1060	907		✓	✓	✓			
MRS HY 03	B4	06/11/14	E 27°30,199	N 40°50,039	1060	609		✓	✓	✓			
MRS HY 03	B5	06/11/14	E 27°30,199	N 40°50,039	1060	406		✓	✓	✓			
MRS HY 03	B6	06/11/14	E 27°30,199	N 40°50,039	1060	7		-	✓	✓			
MRS HY 03	B12	06/11/14	E 27°30,199	N 40°50,039	1060	6		-	✓	✓	✓	✓	✓
MRS HY 04	B1	07/11/14	E 27°28,7166	N 40°49,6839	884	906	2	-	✓	✓	✓	✓	·
MRS HY 04	B2	07/11/14	E 27°28,7166	N 40°49,6839	884	906	2	-	✓	✓	·	·	·
MRS HY 04	B3	07/11/14	E 27°28,7166	N 40°49,6839	884	730		-	✓	✓	·	·	·
MRS HY 04	B4	07/11/14	E 27°28,7166	N 40°49,6839	884	506		-	✓	✓	·	·	·
MRS HY 04	B5	07/11/14	E 27°28,7166	N 40°49,6839	884	305		-	✓	✓	·	·	·
MRS HY 04	B6	07/11/14	E 27°28,7166	N 40°49,6839	884	103		-	✓	✓	·	·	·
MRS HY 04	B12	07/11/14	E 27°28,7166	N 40°49,6839	884	5		-	✓	✓	✓	✓	✓
MRS HY 05	B1	08/11/14	E 27°37,410	N 40°48,100	1100	1116	3	-	✓	✓	✓	✓	✓
MRS HY 05	B2	08/11/14	E 27°37,410	N 40°48,100	1100	1116	3	-	✓	✓	·	·	·
MRS HY 05	B3	08/11/14	E 27°37,410	N 40°48,100	1100	1055		-	✓	✓	✓	✓	✓
MRS HY 05	B4	08/11/14	E 27°37,410	N 40°48,100	1100	811		-	✓	✓	✓	✓	✓
MRS HY 05	B5	08/11/14	E 27°37,410	N 40°48,100	1100	608		-	✓	✓	✓	✓	✓
MRS HY 05	B6	08/11/14	E 27°37,410	N 40°48,100	1100	204		-	✓	✓	✓	✓	✓
MRS HY 05	B12	08/11/14	E 27°37,410	N 40°48,100	1100	3		-	✓	✓	✓	✓	✓

Opération	Bottle nb	Date	Longitude	Latitude	Depth (m)	CTD Pression	Deph from altimeter (m)	Prélèvements					
								CH4 dissous		Hg	Nutri-ments	Metals	Chl a
								"purge and trap"	"head space"				
MRS HY 06	B1	09/11/14	E 27°30,193	N 40°50,050	1030	1060	3	-	✓	✓			
MRS HY 06	B2	09/11/14	E 27°30,193	N 40°50,050	1030	1060	3	-	✓	✓			
MRS HY 06	B3	09/11/14	E 27°30,193	N 40°50,050	1030	924		-	✓	✓			
MRS HY 06	B4	09/11/14	E 27°30,193	N 40°50,050	1030	124		-	✓	✓			
MRS HY 06	B5	09/11/14	E 27°30,193	N 40°50,050	1030	83		-	✓	✓			
MRS HY 06	B6	09/11/14	E 27°30,193	N 40°50,050	1030	42		-	✓	✓			
MRS HY 06	B12	09/11/14	E 27°30,193	N 40°50,050	1030	6		-	✓	✓			
MRS HY 07	B1	09/11/14	E 27°46,8543	N 40°49,0864	662	632	30	✓	✓	✓			
MRS HY 07	B2	09/11/14	E 27°46,8543	N 40°49,0864	662			✓	✓	✓			
MRS HY 07	B3	09/11/14	E 27°46,8543	N 40°49,0864	662	304		✓	✓	✓			
MRS HY 07	B4	09/11/14	E 27°46,8543	N 40°49,0864	662			✓	✓	✓			
MRS HY 07	B5	09/11/14	E 27°46,8543	N 40°49,0864	662			✓	✓	✓			
MRS HY 07	B6	09/11/14	E 27°46,8543	N 40°49,0864	662			✓	✓	✓			
MRS HY 07	B12	09/11/14	E 27°46,8543	N 40°49,0864	662			✓	✓	✓			
MRS HY 08	B1	11/11/14	E 29°06,700	N 40°42,984	1237	1248	3	-	✓	✓	✓	✓	
MRS HY 08	B2	11/11/14	E 29°06,700	N 40°42,984	1237	1233	18	-	✓	✓	✓	✓	
MRS HY 08	B3	11/11/14	E 29°06,700	N 40°42,984	1237	1192		-	✓	✓	✓	✓	
MRS HY 08	B4	11/11/14	E 29°06,700	N 40°42,984	1237	1086		-	✓	✓	✓	✓	
MRS HY 08	B5	11/11/14	E 29°06,700	N 40°42,984	1237	22		-	✓	✓	✓	✓	✓
MRS HY 08	B6	11/11/14	E 29°06,700	N 40°42,984	1237			-	✓	✓	✓	✓	✓
MRS HY 08	B12	11/11/14	E 29°06,700	N 40°42,984	1237			-	✓	✓	✓	✓	✓

8.12. **Geochemistry of nutriants**

Contributors : **Nazlı Olgun Kıyak, Namık M. Çağatay** (ITU)

Type of samples: Carbonate crust (ROV), sediments (PC and BC), water samples (CTD) and 1 coral

- **5 carbonate crusts** were sampled, 2 from Western High (MRS-DV02-CC02, MRS-DV02-03), 2 from Eastern Tekirdağ Basin (MRS-DV04-CC01, MRS-DV04-CC04) and 1 from Çınarcık Basin (DV05-CC01), for mineralogy and stable oxygen and carbon isotopes by Prof. M. Namık Çagatay. Crust samples shared by Marie-Madeleine Blanc-Valleron (MNHN-CNRS-Paris),Barbara and Nicolas.

- **Water samples: 4 Stations** including 3 from Tekirdağ Basin (CTD1-3) and 1 from Çınarcık Basin, for chl-a (only in upper 100 m), dissolved nitrate, phosphate, silica and some other trace metals like iron, zinc, copper, manganese in seawater, by Dr. Nazlı Olgun Kıyak.

- **7 PC and BC** were sampled for sediment including 4 cores from Tekirdağ Basin (DV02-PC2, DV02, DV03-PC6, DV4-PC2) and 3 cores from Çınarcık Basin (DV05-BC06, DV05-PC03, DV05-PC07) for organic inorganic content, biomarker for phytoplankton (pigments, biogenic barium, biogenic silica) by Dr. Nazlı Olgun Kıyak. Further analyses for bacteria may be performed.

- **And 1 small coral sample from Dive 5 on Çınarcık Basin MRS-DV05-Coral2**

Table 31 : Carbonate Crust Samples taken during ROV-Dives

Carbonate crust samples	Picture
MRS-DV02-CC02	Ligth gray crust with pores and foraminifera and warms above
MRS-DV02-CC03	Greenish crust with large mussel shells above.
MRS-DV04-CC01	Dark colored probably manganese
MRS-DV04-CC04	gravels on it
MRS-DV05-CC01	with soft dark gray parts

Table 32 : Sediment samples

Sediment samples
MRS-DV03-PC05
MRS-DV03-PC02
MRS-DV03-BC06
MRS-DV04-PC2
MRS-DV05-BC6
MRS-DV05-PC1
MRS-DV05-PC3
MRS-DV05-PC7

Table 33 : Water samples taken by CTD-Rosette with 7 Containers

Water samples	Water depth (m)	Depths	Nutrients
MRS-CTD1	1031	3 m below surface 2,5 m above seafloor	**Surface** (500 ml metals + 500 ml nutrients+ 2xChlorophyl-a+ 50 ml unfiltered **Deep** (300 ml metal+200 ml nutrients+50 ml unfiltered+ filter of 500 ml)
MRS-CTD2	794	3 m below surface 2 m above seafloor	**Surface** (500 ml metals + 500 ml nutrients+ 2xChl-a+ 50 ml unfiltered **Deep** (300 ml metal+200 ml nutrients+50 ml unfiltered+ filter of 500 ml)
MRS-CTD3		1116, 1065, 811, 608, 204, 6 m (B1,3,4,5,6,12)	200ml for trace metals, 50 ml for nitrate, 50 ml unfiltered, and 2 filters for chl-a (2x1 l)
MRS-CTD4		1235, 1180, 1080, 22, 5, 2 m (B1,2,3,4,5,6,12)	50 ml for trace metals (1 repeat at 22m), 50 ml for nitrate, chl-a (2m, 5m, 22 m x 1l each)

8.13. Geochimistry of carbonate crusts and sediments

Contributors : **Marie-Madeleine Blanc-Vallon** (CNRS), **Volkan Özaksoy** (MTA) **Angélique Roubi, Joël Etoubleau** (IFREMER Brest), **Nazlı Olgun Kıyak** (ITU)

Carbonates have been sampled either from Calypso cores, or with the ROV when outcropping to the seafloor. All collected samples are indicated in Table 34.

Table 34 Collected carbonate samples

CALYPSO Core samples			
	MRS-CS-05	blown-out carbonate	study of buried concretions
	MRS-CS-06	blown-out carbonate	study of buried concretions
	MRS-CS-09	section 11 @ 36-37.5 cm (laminated interval)	study of faint carbonate lamination around 1042 cmbsf
		section 12 @ 18.5-21 cm (laminated interval)	study of faint carbonate lamination around 1079.5 cmbsf
DIVE SAMPLES			
Dive 1 : Central High			
	MRS-DV-01-01	part of carbonate crust	study of seafloor carbonate crusts
	MRS-DV-01-PC-1	surface sediment, sediment @ 2-3 cm	2 SED samples / reference
		carbonate concretion @ 18 cm (base of NC sample)	study of seafloor carbonate crusts
	MRS-DV-01-PC-2	14-16 cm (fine piece of carbonate within FL sample)	study of seafloor carbonate crusts
		>17 cm : carbonate concretions @ base FL sample	study of seafloor carbonate crusts
	MRS-DV-01-PC-3	8 slices of sediment, every 2 cm from 0 to 18 cm	Sediment and carbonate crust study
	MRS-DV-01-BC-6	carbonate concretions @ 5-7 cm, 7-9 cm, 9-11 cm, 11-13 cm, >13 cm (shared with BT)	
		sediment @ 0-1 cm	
		fragment of urchin around 2 cm	
Dive 2 : Western High			
	MRS-DV-02-02	part of gray carbonate crust	shared with BT & Nazli
	MRS-DV-02-03	part of carbonate crust with bivalves (1 sp still alive cf NC)	shared with BT & Nazli
	MRS-DV-02-PC-01	4 samples (part of Nicolas samples) : carbonate concretions @ 2-3, 4-5, 5-7 & 7-9 cm	
Dive 3 : Tekirdag Basin			
	MRS-DV-03	small rock sample in BIOBOX (2-cm size, black slate on sea bottom cf oysters substratum)	
	MRS-DV-03-PC-06	5 slices of sediment : 0-1.5 cm, 1.5-3.5 cm, 3.5-5.5 cm ,5.5-7.5 cm, 7.5-9 cm without CC	

8.14. **Geochemistry of gas hydrates**

Contributors : **Hailong Lu** (Peking University), **Ludovic Legoix** (IFREMER Brest)

Gas hydrates have been sampled on the Western High, at a site called the “hydrate mound”. Three hydrate-bearing cores have been collected: MRS-CS 05, MRS-CS 06 and MRS-CS 13. The samples were wrapped into an aluminum foil, and then stored in a liquid N2 Dewar for onshore analyses.

8.15. **Deployment of the acoustic bubble observatory (BoB)**

Contributors : **Carla Scalabrin, Louis Géli, Laurent Bignon** (IFREMER Brest))

The objective of this experiment is to provide time series of OBS and water column acoustic data acquired over a period of ten days at a selected gas-seep site. The chosen site is located close to the NAF on the Western High (~650 m water depth). During the experiment, two OBS, an autonomous acoustic lander (BoB) for steady insonification of gas sources and an autonomous ADCP for sea current's measurement were deployed and recovered without any problem.

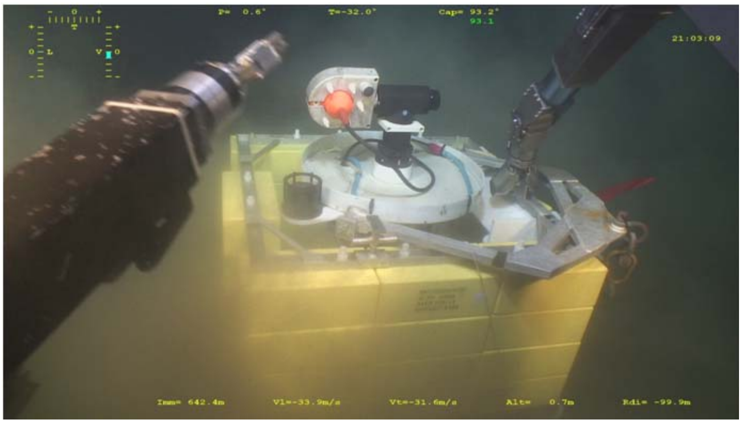


Figure 65 : Visualization of the BoB deployment

9. Proposed scientific work

9.1. Primary scientific objectives

Contributors : IFREMER – CEREGE – ITU – MTA – CNRS / CRPG – CNRS / MNHN – LOCEAN - Müenster University – Peking University

- **Reconstruction of the gas (hydrocarbons, Hg and noble gases) migration pattern**:
  - Source: Identify the different sources
  - Mixing: Unravel the source mixings
  - Fate: Estimate the gas fluxes release into the water column
  - Hydrate occurrence: Understand its formation mechanism

- **Study of pore-fluid geochemical dynamics** :
  - Identify the sources of dissolved elements
  - Identify mineralization processes (carbonates, barites…)
  - Estimate the gas fluxes consumed within the sediment
  - Investigate on the historical record of sudden gas release into the sedimentary column

- **Study of the interaction microbes/ gases/ fluids** :
  - Get insight into microbial diversity vs. seep and hydrate chemistry
  - Investigate on microbial lipid biomarkers related to methane-biogeochemical processes
  - Unravel microbial sulphur cycling associated with methane turnover
  - Investigate on calcium isotope fractionation of microbe-mediated carbonates

Finally, all data will be merged and then used to investigate on the relationships between fluid migration and the seismicity of the Marmara region. The scientific question which will drive this integrated study are :

- Is it possible to identify locked segments from seepages and clay transformations ?
- Is there a clear relationship between sulphate profile and seismicity in the SoM ?
- What are the best geothermometers applied to Marmara region to estimate reservoir depths for clay transformation ?.
- Can we estimate the amount of gas migrating into the shallow sedimentary column at each investigated seep by combining pore-water and gas bubble results ?

9.2. **Specific work**

9.2.1. Investigating on the geological context of the Marmara seeps

Contributor : **Hélène Ondréas** (IFREMER Brest)

The proposed research project aims at considering a new exploration approach of cold seeps. It can be divided in two parts:

The first part will consist on unraveling relationships between seep morphologies, seep intencity, geochemistry and biology at a macro-scale level. This will primarily involve a detailed study of video recording with the aim to establish a typology of the different kinds of seeps by taking into account the geological context of the Sea of Marmara.

In the second part, an attempt to link bubble streams measured at the investigated seeps with the detected water column anomalies will be examined.

9.2.2. Improving acoustic data processing and associated procedures for the water column

Contributors : **Carla Scalabrin , Stéphanie Dupré, Laurent Berger, Hélène Ondreas, Dominique Birot, Louis Géli, Livio Ruffine** (IFREMER Brest)

Acoustic anomalies are widespread in the Sea of Marmara. They have been detected during two cruises (Marmesonet in 2009) and now Marsite in 2014, using two different multibeam system. In order to move forwards with gas plume quantification into the water column, the two multibeam systems need to be compared between each other. This step is necessary as it will allow the coupling of data from different systems. Therefore, in the frame of this study, will be made:

1. A comparison between EM302 (Marmesonet survey) and RESON7150 (Marsite survey) acoustic performance for detection of fluid targets in the Sea of Marmara (resolution, precision of location, useful range, side lobes, etc.);

   The characterization and classification of echoes with EM302 and RESON7150 datasets;

2. Relationships between RESON7150 classified fluid echoes and ground truth of targeted sites provided by ROV VICTOR measurements and samples (number of seeps, target nature, flow rates, target size estimation, etc.). This topic should be partially developed using the results form boht H. Ondreas and D. Birot work.

9.2.3. Influence of hydrate and gas-bubble chemistry on microbial communities at cold seeps: A comparison study between seeps in the Sea of Marmara and other regions in the world

Contributors : **Françoise Lesongeur**, **Livio Ruffine** (IFREMER Brest), **Hailong Lu** (Peking University)

The Sea of Marmara is characterized by a large number of gas seeps, very diverse in composition and origin: At the western part, the gases are of thermogenic origin and overwhelmingly influenced by the Thrace petroleum-basin. There, gas hydrates have been collected and contain a high proportion of heavy hydrocarbons. Thermogenic gases have also been collected in the central part. However, the discovered seeps are methane-dominant (> 98 %-mol), and the isotopic compositions revealed that these gases have undergone severe biodegradation at depth, followed by methanogenesis. The eastern part is characterized by gas seeps of biogenic origin.

The seeps favor the development of microbial communities, especially those involve in the anaerobic oxidation of methane (and possibly other hydrocarbons).

The contrast in the gas composition highly suggests corresponding variations in the hydrate composition; with the coexistence of all three structures (sI, sII ad sH). Such a configuration has never been observed at other settings to date. Furthermore, the heterogeneity in composition between seeps raises the question of bacterial diversity between seeps.

The collected samples from the different investigated seeps represents a unique opportunity to study the relationships between the variation in hydrate and gas composition with microbial diversity. This proposal aims at providing some elements of response.

9.2.4. Evaluating marine primary productivity in the photic zone of Sea of Marmara and possible impacts of atmospheric deposition

Contributor **: Dr. Nazlı Olgun Kıyak** (Istanbul Technical University)

Nutrient and trace metal concentrations in the photic zone of the oceans impact the phytoplankton growth and population composition, which in turn effects the exchange of climate related gases like CO2 or dimethyl sulfide (Jickells et al., 2005) and the marine ecosystem (Olgun, 2014). Atmosphere is considered to be one of the major sources of nutrients in the surface ocean. Atmospheric particles are derived from different sources such as aeolian transportation from dry lands, aerosols of anthropogenic origin, episodic events large volcanic eruptions (Olgun et al., 2011) and desert dust storms (Guieu et al., 2009).

The Sea of Marmara is located in between the Black Sea and the Mediterranean Sea and therefore receives high amounts of anthropogenic aerosols from industrial and highly populated in Turkey and Europe in modern times. Over longer time scales, the Sea of Marmara also received episodic ash fall out ejected during volcanic eruptions from Santorini, Central Anatolia and from Hellenic arc (Wulf et al., 2002) and effected by changes in the atmospheric input related to climatic ad hydrological changes through the several lacustrine and marine stages (Vidal et al., 2010), The purpose of the study to evaluate the present day nutrient dynamics at The Sea of Marmara by using water samples for measuring chlorophyll-a concentrations and the dissolved nutrients like nitrate, phosphate and silica and key trace metals like iron, manganese, zinc and copper. Sediment samples taken during Scientific Marsite Cruise (Leg 2) will be used for evaluating the changes in the primary productivity through time. Uppermost loose material in the sediments (0 cm fluff; representative for last 5-10 years) taken by push cores will be used as a reference for present day primary productivity rates. Sediment push core samples ranging between 5-17 cm that are the below the fluff material will be used for comparison of primary productivity during past hundreds of years (based on 22 cm/ka sedimentation rates (Vidal et al., 2010)). Additionally, long (12-24 m) calypso cores that are going to be taken during Marsite cruise Leg 3 will be used to see the possible impact of episodic events on marine primary productivity, like Santorini eruption that deposited ash in the Sea of Marmara occurred at around 22 ka B.P. (Wulf et al., 2002).

The study is going to be interdisciplinary combining chemical oceanographic and marine geological knowledge. Also, the study is aimed to be a preliminary study to understand the role of atmospheric deposition (and especially anthropogenic aerosols) in the Turkish waters including the Black Sea and the Mediterranean through Anthropocene.

Methodology in brief: Dissolved nutrients and trace metals and chlorophyll for understanding modern time hydrology and phytoplankton will be analyzed by spectrometry. Organic biomarkers will be used to understand the total export production and also the contribution of different planktonic groups to organic carbon in the sediments (Huguet et al., 2011; Schubert et al., 1998). Chlorin content will be used to trace total export productivity (chlorophylls, which are a magnesium chlorins) and fucoxanthin/chlorin ratio will be used as indicator for abundance of specific phytoplankton such as diatoms, chrosyphtes and haptophytes. Other geochemical proxies will be utilized for a multi-proxy approach on ecosystem changes. These include the analyses of the contents of biogenic (opaline) silica (relevant to diatoms) (Reimer et al., 2009), barite and biogenic barium (relevant to export MPP) (Jeandel et al., 2000; Paytan et al., 1996), calcium and magnesium (relevant to coccolithophoride) of the sediments. These analyses will be performed at EMCOL-Sedimentology and Geochemistry Laboratory at ITU.

9.2.5. Institut für Geologie und Paläontologie Westfälische Wilhelms-Universität Münster

Contributors : **Dr. Nicolas Chevalier - Prof. Dr. Harald Strauss - Dr. Barbara Teichert**
(Münster University)

Introduction

The main objective of the Marsitecruise proposal is based on the understanding of the interplay between fluid migration and seismicity in the Sea of Marmara. Leg 2 of the proposed Marsitecruise represents a unique opportunity to construct a geochemical database on gases, pore waters, detrital sediments and authigenic minerals (carbonates, sulphates, sulphides), with the aim to deepen our knowledge on the hydrogeological system of the Sea of Marmara where fluids and gases are emitted related to faulting and likely connected to seismic events.

To participate in the success of the Marsitecruise, we offer a new international collaboration featuring a novel combination of geochemical and isotopic analyses in the different matrices that will lead to an improved understanding of biogeochemical cycling at cold seep environments of the Sea of Marmara. Our research proposal is consistent and yet extends with the general context of the Marsitecruise, provides no major additional constraints in terms of sampling and is highly complementary with other planned geochemical studies of the leg 2.

9.2.5.1. Microbial lipid biomarkers diagnostic of methane-related biogeochemical processes at Marmara Sea cold seeps" Dr Nicolas Chevalier

Keywords

Marmara Sea; Methanogenesis; Sedimentary environments; Anaerobic oxidation of methane (AOM); Sulphate reduction (SR); Methanotrophic archaea; Sulphate reducing bacteria; Authigenic carbonates; Microbial lipid biomarkers; Compound-specific carbon isotopes.

State of the scientific art and previous actions in the Marmara Sea

Since methane is among the most powerful greenhouse gases, extensive release of methane from cold seeps may potentially trigger or intensify global warming (Knittel and Boetius, 2009). Furthermore, biogenic and thermogenic methane seepage has an impact on carbon cycling in bottom oceanic waters and marine sediments, and modifies oceanic redox conditions (through methanotrophy) (e.g., Hinrichs and Boetius, 2002; Reeburgh, 2007). In marine environments, only a small amount of methane reaches the atmosphere (Reeburgh, 2007), owing to microbially mediated processes of aerobic or anaerobic oxidation of methane (AOM). This process of AOM is mainly mediated by a consortia of anaerobic methane- oxidizing archaea (ANME) and sulphate reducing bacteria (SRB) (Boetius et al., 2000; Orphan et al., 2001; Pernthaler et al., 2008) which were detected globally since their first discovery (Knittel and Boetius, 2009 and references therein). Molecular analyses in sediments from several cold seeps (e.g., Eel River Basin, Guaymas Basin, Haakon Mosby mud volcano, Nyegga pockmarks, Kazan mud volcano, Hydrate Ridge, Gulf of Mexico, Weddell Sea and Marmara Sea) have documented the phylogenetic diversity of AOM-related microbial assemblages (Orphan et al., 2001; Teske et al., 2002; Knittel et al., 2003; Werne et al., 2004; Mills et al., 2005; Lösekann et al., 2007, Niemann et al., 2009; Lazar et al., 2011; Chevalier et al., 2013). These consortia generally dominate microbial biomass and biogeochemical processes at shallow and deep water cold seeps and in ubiquitous sulphate-methane transition zones (SMTZ) of the sediments (Knittel et al., 2005; Reeburgh et al., 2007; Knittel and Boetius, 2009). The occurrence of specific consortia depends on various environmental factors such as a) type of environmental setting and b) physico-chemical conditions (cf., Rossel et al., 2011).

In sediments of the South Cinarcik Basin in the Marmara Sea (from Marnaut cruise in 2007), an increased microbial diversity was observed in the SMTZ where AOM takes place, especially in the 10- to 12-cm depth interval (Chevalier et al., 2013). Molecular data showed that ANME-2 (ANME-2a and-2c) archaea and Desulfosarcina/Desulfococcus and Desulfobulbus deltaproteobacterial clades are the major AOM assemblages, which indicate a shallow AOM community at relatively high methane flux (Chevalier et al., 2013).

In addition to AOM-related assemblages, a distinct biogeochemical role of many different phyla, such as Planctomycetales and the Candidate Division JS1 could not be assigned so far in AOM- dominated systems (Chevalier et al., 2013, and references therein). AOM-diagnostic lipid biomarkers and their carbon isotopic signatures are an excellent tool to characterize the active AOM consortia and to assess the diversity and functioning of cold seep ecosystems in detail (Hinrichs et al., 1999; Pancost et al., 2000; Aloisi et al., 2002; Blumenberg et al., 2004; Elvert et al., 2005; Knittel et al., 2005; Stadnitskaia et al., 2005; Niemann et al., 2006; Bouloubassi et al., 2006; Chevalier et al., 2010, 2011).

In the case of sediments from South Cinarcik Basin (Marmara Sea), the presence of a new ^{13}C-depleted hydrocarbon, the 7,14-tricosadiene, coincides with the presence of the JS1 bacterial group in the AOM-inferred depth zonation. Consequently, we proposed the hypothesis that the JS1 bacterial group could be the potential source of the tricosadiene (Chevalier et al., 2013). However, future testing of this hypothesis is essential to fully determine the role of this bacterial group in AOM.

AOM habitats are often characterized by a massive deposition of carbonates with various mineralogies (e.g. aragonite, Mg-calcite) and a specific stable carbon isotopic composition ($\delta^{13}C_{Carb}$ values as low as −61‰) that typifies the incorporation of methane- derived light carbon (Aloisi et al., 2002; Peckmann and Thiel, 2004; Mazzini et al., 2006; Gontharet et al., 2007; Pierre and Fouquet, 2007; Chevalier et al., 2010, 2011; Crémière et al., 2012). Diagnostic lipid biomarkers preserved in authigenic carbonates, and their stable carbon isotope composition, have documented the presence of AOM microbial assemblages during the carbonate formation in a number of recent and ancient methane seepage settings worldwide, with examples from the Eastern Mediterranean Sea (Pancost et al., 2001; Aloisi et al., 2002; Bouloubassi et al., 2006; Gontharet et al., 2009), Black Sea (Pape et al., 2005; Stadnitskaia et al., 2005; Bahr et al., 2009), Gulf of Mexico (Pancost et al., 2005; Naehr et al., 2009; Birgel et al., 2011) and the Nordic margin (Chevalier et al., 2010).

At hydrocarbon seeps of the Marmara Sea explored during Marnaut cruise (2007), in addition to AOM-derived bicarbonates, other carbon sources such as the oxidation of heavier hydrocarbons than methane or DIC produced in the methanogenic zone may have been incorporated into the carbonates as evident from their carbon isotopic composition (Chevalier et al., 2011; Crémière et al., 2012). Consequently, and in the continuity of the work of Marnaut cruise, we propose to further investigate and model assess the role and relative importance of methane and non-methane hydrocarbon oxidation in carbonate precipitation in the Marmara Sea cold seeps, its biogeochemical control and associated microbial communities.

Objectives

This research proposal (Part 1) comprises the study of lipid biomarker distribution and their carbon isotope composition from sediments and authigenic carbonates retrieved in cold seep area of the Marmara Sea, combined with different surveys of :

- Geochemical profiles (J-C Caprais, J-P. Donval and J. Etoubleau - Ifremer, Brest).
- Mineralogy and carbon and oxygen stable isotopes (A. Crémière and M-M Blanc-Valleron - LOCEAN, Paris)

- Multiple stable sulphur isotopes (H. Strauss - Münster),
- Calcium isotopes (B. Teichert - Münster)
- 16S rRNA gene data (several possibilities of collaboration).

The main objectives are:

(i) to contribute to a growing geochemical database on sediments and carbonates related to Marmara sea cold seeps,
(ii) to develop a better understanding of biogeochemical processes and microbial assemblages involved in methane turnover,
(iii) to identify the overall microbial diversity,
(iv) to estimate the contribution of AOM, and non-methane hydrocarbon oxidation, in the formation of authigenic carbonates.

Employed methodology

Study sites and sampling

Sediments cores and authigenic carbonates (concretions and crusts) will be collected during Leg 2 of the Marsite cruise from distinct cold seep areas of the Marmara Sea (Western High, Central High and Central Basin) where fluid flow will be observed. Sediment cores will be subsampled on board (±50g wet weight is needed per sediment sample). Authigenic carbonates will be subsampled on board (in collaboration with Dr. Antoine Crémière; ±100g is needed per carbonate sample). Both sediment and carbonate samples will immediately be transferred into pre-cleaned glass vials and kept frozen at -20°C until lab experiments.

Lipid biomarker analyses

Freeze-dried sediments and carbonates will be finely ground and total lipids will be extracted using different extraction protocols (Bligh and Dyer, ultrasonic and ASE). The total lipid extracts will be separated into hydrocarbon, fatty acids, phospholipids and alcohol fractions on solid phase extraction (SPE). Obtained fractions will be analysed by gas chromatography (GC-FID) and gas chromatography-mass spectrometry (GC-MS). Compound specific stable carbon isotope composition ($\delta^{13}C$) will be determined by gas chromatography isotope-ratio-monitoring-mass spectrometry (GC-C-IRMS). To determine the intact glycerol dialkyl glycerol tetraethers (GDGTs), a polar fraction will be analysed by high performance liquid chromatography-mass spectrometry (HPLC- MS).

Available equipment at Münster

- **GC-FID**: GC-2010 Plus Shimadzu
- **GC-MS**: GC-2010 Shimadzu coupled with GCMS QP2010 plus Shimadzu
- **GC-C-IRMS**: GC (Trace GC Thermo Finnigan) coupled with an isotopic mass spectrometer IRM Thermo Finnigan Deltaplus XL via a Thermo Finnigan GC-Combustion-III interface.

- **HPLC-MS**: LCMS-2020 Shimadzu DGU-20A3.

Expected results

The results to be obtained in leg 2 will lead to:

- An improved understanding of methane-related processes (methanogenesis, methane oxidation, sulphate reduction, and others) and their depth zonation in sediments (especially in SMTZ; in association with geochemical data of pore waters and sediments).
- An improved characterization of the overall microbial diversity responsible to these processes.
- A potential variability (in function of environmental conditions) of microbial taxonomy.
- The potential detection of new lipid biomarkers and the determination of their microbial precursor.
- The composition and the formational processes of the authigenic carbonates (*via* AOM and other processes; in association with geochemical data of carbonates).

9.2.5.2. Unraveling microbial sulphur cycling associated to methane turnover in cold seep environments of the Marmara Sea using multiple stable sulphur isotopes" - Prof. Dr Harald Strauss

Keywords
Microbial sulphur cycling, bacterial sulphate reduction (BSR); disproportionation of sulphur intermediates (SD); multiple sulphur isotopes

State of the Art

Bacterial sulphate reduction (BSR) represents the principal process of anaerobic recycling of sedimentary organic matter in the marine realm (e.g., Jørgensen, 1982). In the 1990s, the disproportionation of sulphur compounds of intermediate valence (SD), such as elemental sulphur or thiosulphate, was identified as an additional group of sulphur metabolisms in marine sedimentary systems (e.g., Jørgensen, 1990). Finally, the discovery of a coupling between methane oxidation and bacterial sulphate reduction revealed another linkage between microbial sulphur cycling and carbon turnover (e.g., Boetius et al., 2000; Orphan et al., 2001) which appears to be characteristic in cold seep environments, but has also been found in deep sea hydrothermal environments (e.g., Bradley and Summons, 2010).

Stable sulphur isotope analyses have been utilized successfully in order to identify BSR in modern and ancient marine sediments because this process is generally associated with a sizeable fractionation of the sulphur isotopic composition, resulting in ^{34}S-depleted, negative $\delta^{34}S$ values (for a review, see Canfield, 2001). Experiments on pure cultures (e.g., Kaplan and Rittenberg, 1964; Detmers et al., 2001) and natural populations (Habicht and Canfield, 2001) revealed an associated isotopic fractionation between 4 and -46 ‰, although the upper limit of this range has been questioned more recently on theoretical grounds (Brunner and Bernasconi, 2005). Isotopic differences between sulphate and sulphide in excess of 46 ‰, not uncommon in modern and ancient marine sediments (Canfield, 2001), have generally been attributed to a cumulative effect of two different microbial processes, namely a combination of BSR and SD (e.g., Canfield and Teske, 1996; Cypionka et al., 1998). This view has recently been challenged on the basis of culture experiments with a sulphate-reducing bacterium from coastal sediments from Cape Cod, USA (Sim et al., 2011). Empirical results from respective experiments show large sulphur isotope fractionation during sulphate reduction exceeding 60 ‰. Comparable ranges have been found before, although in part from highly sulfidic environments (Wortmann et al., 2001).

Following more than 30 years of traditional sulphur isotope research ($\delta^{34}S$) in marine biogeochemistry the recent application of multiple sulphur isotope analyses (i.e. the simultaneous measurement of ^{32}S, ^{33}S, ^{34}S, and ^{36}S) has shown to reveal additional important information in respect to microbial sulphur cycling (for a recent review, see Johnston, 2011, and references therein). Most notably, Zerkle et al. (2010) could show that the combination of distinct multiple sulphur isotope signatures provided a means for distinguishing BSR and SD at comparable $\delta^{34}S$ values.

From previous work at the Marmara Sea it is clear that sulphate reduction coupled to methane oxidation (AOM) is a prominent process in these sediments (e.g., Tryon et al., 2010; 2012). Concentration profiles of pore water sulphate and sulphide have identified a shallow sulphate-methane reaction zone. At different sites, the sediment surface is covered by microbial mats, white barite (and carbonate) precipitates and black sulphidic sediments. A study of multiple sulphur isotopes would allow to further resolve the diverse set of biogeochemical processes.

Objectives

It is the main objective of this research proposal (Part 2) to unravel (microbial) sulphur cycling in the cold seep environments of the Marmara Sea. For this, multiple sulphur isotope analyses will be applied to pore waters, sediments and authigenic barite precipitates. For dissolved pore water sulphate and authigenic barite sulphur isotope measurements will be supplemented with oxygen isotope analyses in order to further constrain conditions of sulphate reduction and/or barite precipitation.

To date, no multiple sulphur isotope study has been performed in a cold seep environment where AOM is an important process for sulphur and carbon cycling. Moreover, the combination of lipid biomarker analyses (Dr. Nicolas Chevalier), multiple sulphur isotope analyses (Prof. Dr. Harald Strauss), calcium isotopes (Dr. Barbara Teichert) and the other planned geochemical studies of the leg 2, will be a unique and novel contribution to a better understanding of microbial processes prevailing at cold seep environments in general and in the Marmara Sea in particular.

Employed methodology

Upon core recovery, pore waters will be collected using Rhizon samplers (e.g., Peters et al., 2010; 2011): 2ml for sulphate (shared with Dr. Barbara Teichert), 1ml for sulphide concentration, and as much as possible for sulphide isotopes. Sulphate concentration will be determined via ion chromatography. Sulphide concentration will be measured photometrically using the methylene blue complex (Cline, 1969). In order to preserve the dissolved sulphide fraction for stable isotope analyses, aliquots will immediately be stabilized with zinc acetate solution. Subsequently, sulphate for isotope analyses can be extracted from the same aliquot as barium sulphate precipitate, following standard procedures. At the depths of pore water sampling, sediment samples will also be obtained for sulphur isotope work (±50g per sample). Two aliquots will be collected: one third will be frozen without further treatment for determining sulphur and carbon abundances, and two thirds (for sulphur isotope work) will be treated with zinc acetate solution (and subsequently frozen) in order to prevent oxidation of sulphides. Wherever present, authigenic barite crusts/precipitates will be collected and stored without further treatment.

For multiple sulphur isotope measurements, the different forms of sedimentary sulphur iron monosulphides, pyrite, organically bound sulphur, zinc sulphide precipitates from pore water sulphide) have to be extracted and prepared as silver sulphide (Ag_2S) via wet chemical extraction (following Canfield et al., 1986, and Rice et al., 1993) Similarly, sulphates (i.e., barium sulphate precipitates from pore water sulphate, authigenic barite crusts/precipitates) have to be converted to silver sulphide (cf. Thode et al., 1961).

Subsequently, Ag_2S will be converted to SF_6 by reaction with a ~10-fold excess of F_2 at 300°C for 8 h in a Ni-Cr reaction vessel (detailed description in Ono et al., 2006). Resulting SF_6 will be purified cryogenically and chromatographically and then isolated by freezing into a liquid-nitrogen cold trap. The multiple sulphur isotope composition of the purified SF_6 will be determined by dual-inlet gas-source mass spectrometry monitoring ion beams at m/e of 127, 128, 129, and 131 using a ThermoScientific MAT 253 gas source mass spectrometer.

The oxygen isotopic composition of sulphate from pore waters and barite crusts/precipitates will be measured using a high temperature pyrolysis (TC/EA) coupled to a ThermoFinnigan Delta Plus XL mass spectrometer.

Available equipment at Münster

- Chemistry lab for the wet chemical extraction and preparation of different forms of sulphur
- ThermoFinnigan Delta Plus interfaced with an elemental analyzer (EA-IRMS) for traditional sulphur isotope measurements (SO_2)
- ThermoFinnigan Delta Plus XL interfaced with a high-temperature pyrolysis (TC/EA-IRMS) for sulphate oxygen isotope measurements.
- ThermoScientific MAT 253 interfaced with a fluorination line for multiple sulphur isotope measurements (SF_6)

Expected Results

The results to be obtained in leg 2 will lead to:

- A detailed characterization of microbial sulphur cycling in relation to methane seepage at the Marmara Sea
- An improved understanding of authigenic barite formation in relation to fluid expulsion at the Marmara Sea
- An improved understanding of microbial sulphur cycling in cold seep environments

9.2.5.3. Calcium isotope fractionation of microbially-mediated carbonates and pore waters of the Marmara Sea" - Dr Barbara Teichert

Keywords

Marmara Sea; calcium isotopes; microbially-mediated carbonates; anaerobic oxidation of methane (AOM); sulphate reduction (SR).

State of the art and previous own work in cold seep environments

Calcium isotopes expressed as $\delta^{44/40}Ca$ (= $((^{44}Ca/^{40}Ca)_{sample}$ / $(^{44}Ca/^{40}Ca)_{standard}$ - 1)·1000) have attracted increasing interest in paleoceanography as paleo-temperature archives and as indicator for changes in the oceanic Ca-budget (cf. Skulan et al., 1997; Zhu and Macdougall, 1998). During recent years, few studies also dealt with the Ca isotope fractionation in marine pore waters (Fantle and DePaolo, 2007; Ockert et al., accepted; Teichert et al., 2005c; Turchyn and DePaolo, 2011) and its impact on the Ca isotope signal in early diagenetic carbonates (Gussone et al., 2011; Teichert et al., 2005a, 2009). Calcium isotope fractionation effects during recrystallization were studied by Fantle and DePaolo (2007) suggesting equilibrium between pore water and the $CaCO_3$ precipitated from these porefluids, whereas Turchyn and DePaolo (2011) studied diagenetic dissolution and precipitation of calcite and found the dissolution rates to be lower at clay rich sites compared to $CaCO_3$ rich sites. Teichert et al. (2005a) showed that precipitation of microbially-mediated carbonates (clathrites (=gas hydrate carbonates)) can substantially alter the isotopic composition of the remaining porefluid.

Authigenic carbonate precipitation is induced in the shallow subsurface of cold seep locations due to the release of alkalinity into the pore water by anaerobic oxidation of methane (AOM) via sulphate reduction (SR) (e.g. Siegert et al., 2011). A consortium of microbes mediates this reaction (Boetius et al., 2000; Schippers et al., 2010). The resulting microbially-mediated carbonates may display a variety of mineralogical compositions and habits depending on the biogeochemical pore water environment and fluid flow rates (Teichert et al., 2005a, b). Our previous results have revealed systematic variations of $\delta^{44/40}Ca$ with sediment depth and covariation with pore water chemistry (alkalinity, CO_3^{2-}, NH_4^+) indicating precipitation-dissolution effects, influences of deep fluids, and adsorption-desorption effects (Ockert et al., in prep., accepted; Teichert et al., 2005c, 2009).

Objectives

This research proposal (Part 3) will unravel the source of Ca for the formation of authigenic, microbially-induced carbonates. Possible sources might be seawater, deep seabed fluids or fluids influenced by diagenetic reactions within the sediments. To distinguish/identify the prevailing source(s) of Ca in authigenic carbonates, the calcium isotope composition ($\delta^{44/40}Ca$) of microbially-mediated carbonates and corresponding pore waters/bottom waters will be determined.

Employed methodology

Study sites and sampling

Active cold seep sites will be sampled for authigenic carbonates and corresponding pore waters/bottom waters. Authigenic carbonates from the seafloor or from within sediment cores will be collected and stored without special treatment (sharing samples with Dr. Nicolas Chevalier). Subsampling will be accomplished on shore by micro-drill.

Pore waters/bottom waters will be sampled from sediment cores via Rhizon samplers, stored in pre-cleaned vials and acidified (sharing samples with Prof. Dr. Harald Strauss).

Calcium isotope analyses

Calcium separation for isotopic analysis of pore water samples is carried out using ion exchange columns after Teichert et al. (2009). For Ca isotope analysis of carbonates, samples will either be leached with acetic acid, if carbonates contain sediments, or directly dissolved with HCl. Samples are spiked with a ^{42}Ca-^{43}Ca Double-Spike, pore water samples are spiked prior to Ca separation. Of the purified solution Ca is loaded on filaments and measured by TIMS (thermal-ionization mass spectrometry).

Available equipment at the Universität Münster

- **TIMS** (thermal-ionization mass spectrometry): Thermofinnigan TRITON T1
- **Clean lab facilities**

Expected results

The results to be obtained in leg 2 will lead to:

- The characterization of the Ca cycling at active cold seeps in the Marmara Sea influenced by microbially-mediated carbonate formation.
- The identification of different fluid sources and diagenetic processes within the sediments.
- A better understanding of calcium isotope fractionation in authigenic, microbially-mediated carbonates.

9.2.6. Living Benthic foraminifera from the Marmara Sea: A coupled ecological and biogeochemical approach.

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Hydrocarbon seeps define benthic environments of high interest for scientists working on both biogeochemical functioning and deep-sea biodiversity of extreme environments, and also for industrial groups exploiting gas resources. These areas are characterised by methane gas and hydrogen sulphide trickling out of sediment through the sediment-water interface. Along the sediment layers, a succession of biogeochemical reactions entertains fluid seepages through the seafloor (e.g., Campbell, 2006).

First, in methanogenic zone, methane production is related to CO_2 reduction and acetate fermentation around detrital organic matter buried in the deeper sediment (e.g., Claypool and Kaplan, 1974; Borowski et al., 1999). Then, methane which migrates upward in the sediment precipitates as gas hydrates when saturation is reached and supported by fluid migration (e.g., Rehder et al., 2004). The dissolution of gas hydrates in methane can be generated either by an increase of the gas solubility due to a decrease of the temperature conditions or by a decrease (or the stop) of gas flow supplying the hydrated sediments (Davie et al., 2004). At the Sulphate-Methane Interface (SMI), close to the seafloor, methane is generally oxidized by microbial consortia, with production of hydrogen sulphide. Sulphate-reducing bacteria are involved in this methane anaerobic oxidation (e.g., Borowski et al., 1999; Treude et al., 2003; Takeuchi et al., 2007; Magalhães et al., 2012). In upper sediments, hydrogen sulphide is also provided by the anaerobic oxidation of organic detritus by seawater sulphate (e.g., Bemer, 1980; Sibuet and Olu, 1998). All these biogeochemical reactions induce an increase of alkalinity at the SMI which may enhance precipitation of authigenic carbonate (e.g., Takeuchi et al., 2007; Bayon et al., 2007, 2011; Rongemaille et al., 2011; Magalhães et al., 2012). At the sediment-water interface, hydrogen sulphide and methane which have not been fully oxidized in deeper sediments can sustain chemosynthetic communities among which endemic metazoan benthos (e.g., vesicomyid, mytilid or siboglinid) thriving with mutual endosymbiotic prokaryotes (mainly sulphide-oxidizing bacteria) (e.g., Sibuet and Olu, 1998; Sahling et al., 2002; Levin and Mendoza, 2007). Differences in sulphide and methane fluxes in the topmost sediment layer induce an obvious biozonation of chemoautotrophic prokaryotes and a patchy distribution of benthic eukaryotes (e.g., Sibuet and Olu, 1998; Sahling et al., 2002; Foucher et al., 2009).

Living benthic Foraminifera (Eukaryota, Rhizaria) from present cold seeps have been investigated in numerous studies (Akimoto et al, 1994; Sen Gupta and Aharon, 1994; Kitazato, 1996; Sen Gupta et al., 1997, 2007; Rathburn et al., 2000, 2003; Bernhard et al., 2001; Torres et al., 2003; Hill et al., 2004; Heinz et al., 2005; Panieri, 2006; Mackensen et al., 2006; Lobegeier and Sen Gupta, 2008; Fontanier et al., 2014). Most investigations agree that foraminiferal species observed in cold-seep areas are not endemic/exotic and may be recruited from adjacent non-seep zones (e.g., Sen Gupta and Aharon, 1994; Kitazato, 1996; Sen Gupta et al., 1997; Rathburn et al., 2000, 2003; Lobegeier and Sen Gupta, 2008). Metabolic adaptations (facultative anaerobic metabolism, mutualism with prokaryotes), habitat and food preference (elevated epibiotic habitat, bacteriovore) might explain foraminiferal occurrence in methane- and sulphide-enriched sediments (e.g., Bernhard et al., 2001; Panieri, 2006; Mackensen et al., 2006; Sen Gupta et al., 2007; Lobegeier and Sen Gupta, 2008). In order to test potential biogeochemical proxies of hydrate and free gas activities, the stable isotopes ($\delta^{13}C$, $\delta^{18}O$) in foraminiferal test have been studied in present cold-seep environments but also in past archives (e.g., Sen Gupta and Aharon, 1994; Rathburn et al, 2000, 2003; Torres et al., 2003; Hill et al., 2004; Mackensen et al., 2006; Wiedicke and Weiss, 2006; Hayward et al., 2011; Panieri et al., 2012; Fontanier et al., 2014). In most works, the $\delta^{13}C$ values in (living) foraminiferal tests show the influence of methane-enriched fluid, with a clear shift to lower values compared to adjacent non-seep areas (Sen Gupta and Aharon, 1994; Rathburn et al., 2000, 2003; Hill et al., 2004; Mackensen et al., 2006). However, as far as a strong disequilibrium ever exists between the $\delta^{13}C$ of living foraminiferal tests from cold-seep zone and the very low $\delta^{13}C_{DIC}$ of gas-charged fluids, it has been assumed that foraminifera calcify mostly during periods when there is little methane discharge or during intermittent episodes of seawater flow into the sediments (Torres et al., 2003). Alternatively, ^{13}C-depleted food source (e.g., methanotroph bacterial biomass) and/or prokaryotic symbionts may contribute to the depletion of the isotope signatures of foraminiferal shells (Sen Gupta and Aharon, 1994; Rathburn et al., 2003; Hill et al., 2004; Panieri, 2006; Mackensen et al., 2006). Accordingly, Panieri (2006) has noticeably documented lighter protoplasmic $\delta^{13}C$ for foraminifera living in hydrocarbon seeps compared to a non-seep adjacent area, suggesting that *Beggiatoa* (prokaryotes) may be a food source for the foraminifera. Now, the strong $\delta^{13}C$ anomaly (i.e., ^{13}C depletion) recorded in fossil foraminifera may be related to diagenetic effects consisting in post-mortem authigenic carbonate overgrowth and/or recrystallization in high-alkalinity pore water around the SMI (e.g., Torres et al., 2003; Barbieri and Panieri, 2004; Wiedicke and Weiss, 2006). It implies that the $\delta^{13}C$ of dead foraminifera might be unreliable to build accurate chronology of seep activity throughout centuries and millennia.

In this study, we propose to seek for whether Foraminifera (living) constitute relevant and reliable proxies of seepages activity. We focus on 2 benthic sites sampled with ROV, where very high-resolution bathymetry, geophysical, geological and geochemical data have revealed two different sources of methane-enriched fluid. The successive steps of our study are: (1) to detail ecological changes of living benthic communities (Foraminifera, Prokaryota) between these 2 sites, (2) to appreciate the putative imprint of seepages in foraminiferal tests by an analysis of stable isotopes ($\delta^{13}C$, $\delta^{18}O$) and trace elements (B/Ca, Sr/Ca, …). All our observations will be compared with environmental parameters (*i.e.* pore water geochemistry) in order to precise whether foraminifera are reliable and relevant bio-indicators of seepage sources.

10. References

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