Cruise Report

Belgica 10/17a

Guilvinec Canyon

Bay of Biscay

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RCMG

Renard Centre of Marine Geology

Ghent University, Belgium

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1. Cruise schedule & staff

1.1 Schedule

Departure: Zeebrugge (B)	07.06.2010, at 13.00h.
Arrival: La Rochelle (F)	16.06.2010, at 09.00h.

→ Belgica 10/17a

1.2 Coordination

Chief scientist: Prof. Dr. Jean-Pierre HENRIET
Renard Centre of Marine Geology (RCMG),
Ghent University, Belgium

Co-chief scientist: Lies DE MOL

1.3 Scientific staff

Prof. Dr. Jean-Pierre HENRIET	UGent, RCMG
Willem VERSTEEG	UGent, RCMG
Lies DE MOL	UGent, RCMG
Katrien HEIRMAN	UGent, RCMG
Brigitte GUILLAUMONT	Ifremer, France
Griet NEUKERMANS	MUMM
Andres RUGGEBERG	UGent, RCMG
Xavier MERIAUX	ULCO, France
Jeroen VERCRUYSSE	UGent, RCMG
Dries BOONE	UGent, RCMG
Koen DEGRENDELE *1	FOD Economie
Marc ROCHE *1	FOD Economie
Xavier LURTON *2	Ifremer, France
Marc NOKIN *2	Ifremer, France
Christophe VRIGNAUD *2	SHOM, France

**1 07/06 – 10/06/2010; *2 09/06 – 10/06/2010*

2. Framework and objectives

2.1 Framework

The research programme of the Belgica cruise 2010/17a frames into several international and national projects. They all build upon achievements of previous projects such as FWO Genesis, EC FP6 HERMES, ESF EuroDIVERSITY MiCROSYSTEMS...

- **EC FP7 Integrated Project HERMIONE**

  HERMIONE is the ecological follow-up of the EC FP6 IP HERMES project and stand for "*Hotspot Ecosystem Research and Man's Impact on European Seas*". Together with its 38 partners, it will focus on ecosystem research along key sites on the European margin. It will try to investigate the dimensions, distribution and interconnection of deep-sea ecosystems, as well as to understand the influence of climate change, anthropogenic impact and large-scale episodic events (hydrologic or geologic). The results of this project will be directly coupled to the EU policy (among others).

- **PhD project of L. De Mol (IWT-Vlaanderen): "Mound-4D: an ROV supported study of the 4D architecture of carbonate mounds"**

  The aim of this research is a detailed study of the 4D architecture of carbonate mounds based on ROV footage, side-scan sonar data, boxcores and gravity cores:

  1. Study of the characteristics of individual coral plates, including the spatial (3D) characteristics of the plates, their present colonization and the sedimentological and (micro)biological processes within these plates,
  2. 4D study of carbonate mounds by having a look at the organization and migrations of coral plates in space and geological time.

  The main topic are the cold-water coral mounds in the El Arraiche mud volcano field in the Gulf of Cadiz but we will also have a look at the cold-water corals in the Gulf of Biscay.

2.2 Objectives

The area in between the Audierne and St. Nazaire canyons (Gascogne area) along the French Armorican margin was one of the areas where the "massifs coralliens" were described for the very first time (Le Danois, 1948). A compilation of historical studies which have retrieved deep-water corals indeed indicate this area as a high potential for coral growth (Réveillaud *et al.*, 2008). In 2008, a first surveying of the Guilvinec and Penmarc'h canyons was performed during the R/V Belgica 08/13a cruise. Within the framework of the EC FP7 HERMIONE project, this area will be further investigated in detail using the multibeam echosounder, high resolution seismic profiling, ROV observations, CTD measurements and boxcoring. This cruise will be executed in cooperation with IFREMER (Brest, France) and IFM-GEOMAR (Kiel, Germany).

This campaign will focus on the following objectives within the study area:

1. ***Multibeam echosounder:*** detailed mapping of the mini-mounds
2. ***High-resolution seismic profiling:*** investigation of the stratigraphic framework and the sedimentary environment.
3. ***ROV operations:*** visual observations of deep-water ecosystems for habitat and environmental mapping.
4. ***Seabed sampling:*** boxcore sampling of the ROV-investigated sites.
5. ***CTD measurement:*** hydrographic environment

Besides this, multibeam measurements will be done by FOD Economie offshore Brest. During the whole cruise, water samples will be taken by MUMM-REMSEM.

A short overview of the objectives of each research group is given below.

(1) IFREMER (Brigitte Guillaumont)

Cold-water corals (CWC) and sponges grounds are declared Vulnerable Marine Ecosystems by several international organisations. According to the international conventions and European regulations, the impact of fisheries must be assessed and Marine Protected Areas have to be defined on these deep-sea priority habitats. So, one of the first step needed is to provide habitats maps. The main stages in making a habitat map is by integrating sample data (or videos) considered as ground truth and full coverage physical data (MESH Guide to marine habitat mapping). All along the northern margin of the Bay of Biscay, the succession of interfluves and deep canyons has shaped the passive margin. The complex and the vast canyons systems play an important role in determining benthic habitat distribution and development. Due to various cruises including BOBGEO1 cruises, the knowledge of the morphology is improved. However, occurrences of CWC have been only sparsely documented by fishermen and scientists (including the Biscosystem cruise, 2006).

The objectives of this cruise are to:

- Use videos to improve the link between particular morphology or hard sediment outcrops and VMEs occurrence.
- Improve the link between VMEs as occurring on images and species identification by sampling some undetermined taxa using ROV and box cores (150 coral taxa have been recorded on this bay and we are building a catalogue for image recognition).
- Collect coral samples for genetic studies.
- Assess CWC ecological status and detect impacts of fisheries.

(2) Cooperation RCMG/IFM-GEOMAR (Andres Rüggeberg)

The environmental control of scleractinian coral reef growth is characterized by physical parameters such as temperature, salinity, and the deduced density as a function of temperature, salinity, and pressure, as well as oxygen availability and currents. These physical factors have been predominantly reported for tropical shallow-water zooxanthellate coral reefs (e.g. Veron, 1993; Dullo, 2005).

Previous studies have shown that cold-water corals occur mainly in areas with a high current regime where exposed hard ground serves as a substrate on which filter-feeding organisms can settle (Rogers, 1999, De Mol et al., 2002, Freiwald, 2002). Bryan and Metaxas (2006) reported that bottom topography could be used as a proxy for locations with hard substrates, since areas of pronounced topographic relief will exhibit low sedimentation rates (Freiwald et al., 1999, Herring, 2002). For example, seamounts and canyons are areas with pronounced vertical relief with hard substrata providing ideal settling sites for corals, often associated with a strong current regime and therefore low sediment deposition (Herring, 2002). The scleractinian *Lophelia pertusa* has been recorded on morainic ridges, lithified sediments, and vertical cliffs (Freiwald et al., 1999, Noé et al., 2006), but also in coarse sand habitats (Foubert et al., 2005, Huvenne et al., 2005, Wheeler et al., 2005). It is assumed that the coral initially settles on a hard substrate such as a pebble or a shell (e.g. Mortensen et al., 2001), but only in areas where environmental conditions are favourable for coral growth. These are associated with an adequate nutrient supply and removal of resuspended sediment. In a numerical simulation, Thiem et al. (2006) demonstrated that *Lophelia* reefs form in areas where they encounter rate of food is sufficiently high and stable over long periods of time. This condition is favoured particularly on outer shelves and shelf breaks. Additionally, the study of Dullo et al. (2008) has shown that irrespective of depth and location, each site on the NW European Margin (Norway and Ireland) showed living cold-water coral reefs in a well-defined density envelope of 27.35 to 27.65 kg m^{-3}.

In the past years cold-water corals became more and more the focus of marine scientific interest as they occur worldwide along the continental margins. The Bay of Biscay hosts a large number of known and potential sites with deep-water fauna. The aim of this study is to measure the present-day environmental setting at Guilvinec Canyon at possible sites of cold-water coral reef and/or deep-sea oyster bank occurrences. As deep-water coral skeletons and oyster shells also represent a climate archive of up to several decades, we intent to sample skeletons and/or shells where possible to use these for reconstructing paleo-environmental parameters.

- Are possible cold-water coral occurrences in the Guilvinec Canyon related to the seawater density envelope described by Dullo et al. 2008?
- Can we use seawater density data (including other parameters) to possibly find new sites of coral occurrences?
- What are the environmental characteristics of possible coral and deep-sea oyster sites?
- What is the role of the Mediterranean Outflow Water in these areas?

These investigations will form a basis for a HERMIONE cruise with R/V METEOR (S. Flögel, IFM-GEOMAR, June 2011) to study deep-water corals in the southern Bay of Biscay and its controlling environmental parameters. This cruise aims to set the Biscay coral sites into the context of global CWC distribution by comparing similarities and differences of their distribution and environmental setting.

(3) FOD Economie in cooperation with IFREMER and SHOM (Koen Degrendele)

In order to maintain the quality and precision of the EM3002D (and EM1002S) multibeam system on board of the R/V Belgica, an extensive quality control is necessary. For this purpose, a few tests are already planned on the Belgian Continental Shelf (e.g. Vandammesluis, simultaneous measurements with Ter Streep), but especially a survey of a reference area close to Brest, in cooperation with SHOM and IFREMER, is necessary. This area is the reference area for the multibeam systems of both organizations. The measurements of R/V Belgica will be compared with a reference model, made by SHOM. This comparison will result in a quantitative and qualitative evaluation of both multibeam systems on board of R/V Belgica.

(4) MUMM-REMSEM/ULCO (Griet Neukermans)

The general objective of the BELSPO-funded BELCOLOUR-2 project is to improve the quality of existing optical remote sensing products for marine, coastal and inland waters based on new scientific knowledge and to develop new products (including partial pressure of CO2 and primary production) for key applications such as aquaculture and air-sea CO2 flux quantification. In addition to algorithm work and image processing BELCOLOUR-2 participates in seaborne cruises for the purposes of calibration of algorithms and for validation of the end products. The primary objectives of this campaign are making in-situ measurements of marine reflectance and optical properties of marine particles simultaneous with satellite overpasses of MERIS (Medium Resolution Imaging Spectrometer) and MODIS (Moderate Resolution Imaging Spectrometer).

3. Working area

The working area is located on the Armorican Margin, at water depths between 250 and 1500 m depth (Fig.1) within the area: 5°40’ W/4°50’ W/46°30’ N/47°00’ N.

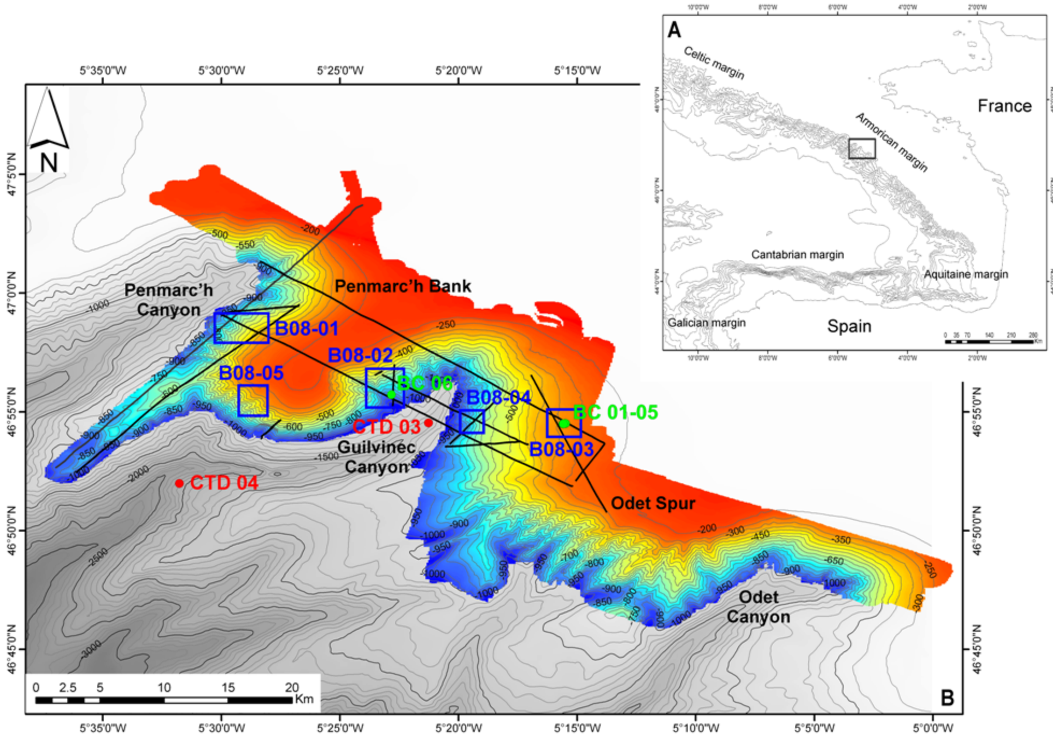


Figure 1: *Working area in the Bay of Biscay with the location of the previously obtained data (R/V Belgica 08/13a cruise).*

4. Operations

4.1 Overview of activities

4.1.1 Multibeam survey (FOD Economie)

07/06/2010

1. **Draft at quay Zeebrugge 10h00**

SV =3.71 ; BV = 3.76 ; SA =1.12 ; BA =1.21

EM1002		EM3002D	
P1	5.874	P1	5.874
P2	3.321	P2	3.321
Refafst	36.376	refafst	36.376
Tdafst	1.497	mruafst	2.616
Tdref	9.075	mruref	7.149
Gemv	3.735	gemv	3.735
Gema	1.165	gema	1.165
difva_refvlak	0.017	difva_refvlak	0.017
Dekhelling	0.0005	dekhelling	0.0005
difvtd_refvlak	0.0007	difvmru_refvlak	0.0012
Draft EM1002	**5.341**	**Draft EM3002D= MRU**	**3.415**

Draft pressure sensor = 5.58 m (?!)

- Draft EM3002D= MRU = Draft pressure sensor – 0.876 = 4.704 m
- ∆(Draft pressure sensor – Draft geometrical method) = 1.30 m (non sense)

2. **Draft Zeebrugge 13h30**

Draft pressure sensor = 4.62 m (?!)

- Draft EM3002D= MRU = Draft pressure sensor – 0.876 = 3.744 m
- ∆(Draft pressure sensor – Draft geometrical method) = 0.329 m

08/06/2010

1. **Test SVP probe**

SVP AML PROFILER	Mini SVP VALEPORT	ODAS SVS VALUE
1496.3 080610_131900_1.asvp	1498.2	1496.1

2. **Test SVP probe**

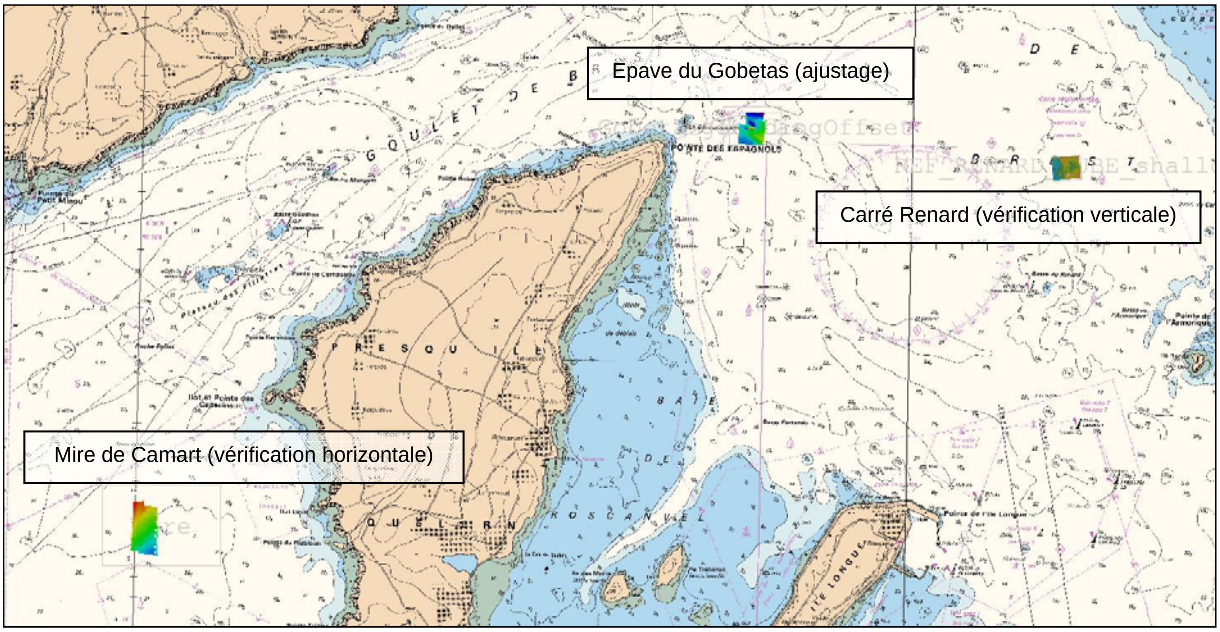
SVP AML PROFILER	Mini SVP VALEPORT	ODAS SVS VALUE
1497.5 080610_164900_1.asvp	1500.6	1498.0

Conclusions:

- MINI SVP measures are ~ 2 m/s higher than the AML SVP profiler and the ODAS estimated values.
- The AML SVP Profiler and the ODAS values are consistent.
- An offset of -2 m/s should be introduced in SIS for the EM3002D.

<u>09/06/2010</u>

Calibration of EM1002 and EM3002D in cooperation with SHOM and IFREMER:



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1. **Draft Brest 13h00**

SV	3.870	
BV	3.970	
SA	1.170	
BA	1.310	
	EM1002	**EM3002**
P1	5.874	5.874
P2	3.321	3.321
refafst	36.376	36.376
tdafst	1.497	2.616
tdref	9.075	7.149
gemv	3.92	3.92
gema	1.19	1.24
difva_refvlak	0.177	0.127
dekhelling	0.0049	0.0035
difvtd_refvlak	0.0073	0.0091
draft	5.1622	3.2381

Measurements are delayed until 16h00 (ongoing survey by French Navy).

2. **Draft Brest 16h30**

SV	3.800
BV	3.870
SA	1.110

BA	1.210	
	EM1002	**EM3002**
P1	5.874	5.874
P2	3.321	3.321
refafst	36.376	36.376
tdafst	1.497	2.616
tdref	9.075	7.149
gemv	3.835	3.835
gema	1.16	1.16
difva_refvlak	0.122	0.122
dekhelling	0.0034	0.0034
difvtd_refvlak	0.0050	0.0088
draft	5.2450	3.3227

Mean draft entered in SIS and Merlin:

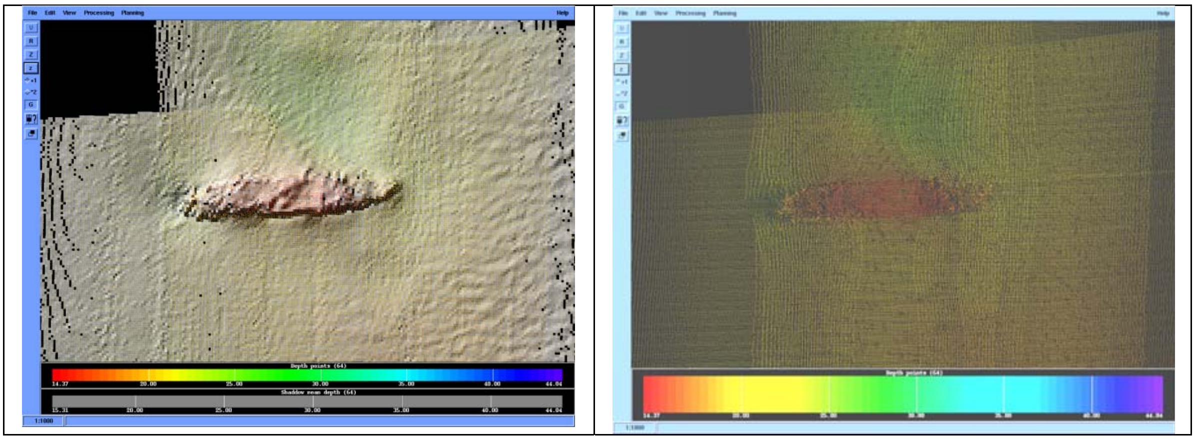
EM1002	EM3002	33	38	210
5.16	3.24	4.33	4.13	4.34
5.24	3.32	4.42	4.22	4.42
5.2	3.28	4.375	4.175	4.38

3. Calibration Gobetas

SVP AML PROFILER	Mini SVP VALEPORT	ODAS SVS VALUE
1506.71 09061650_all_down.asvp	1509.9	1506.8

EM1002
0001_20100606_152233_raw.all to 0015_20100606_203623_raw.all

MODEL AND SOUNDINGS:
WITH HEADING OFFSET -1.5° + tide correction



EM3002D
0001_20100609_152232_Belgica.all to 0018_20100609_203610_Belgica.all

4. Calibration Carré Renard

SVP AML PROFILER	Mini SVP VALEPORT	ODAS SVS VALUE
1507.09 10060020_all_down.asvp	1510.4	1508

EM1002
0016_20100606_213059_raw.all to 0027_20100606_233435_raw.all

EM3002D
0019_20100609_213043_Belgica.all to 0029_20100609_232929_Belgica.all

5. Calibration Mire de Camaret

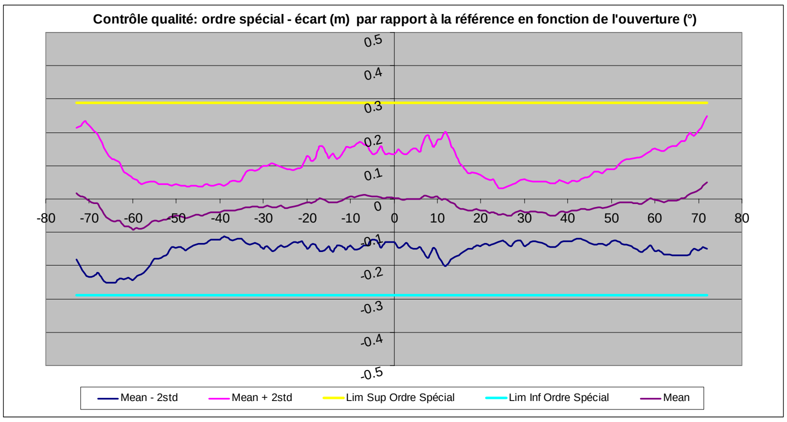
SVP AML PROFILER	Mini SVP VALEPORT	ODAS SVS VALUE
1504.42 10060230_1.asvp	1506.8	1504.4

EM1002
0028_20100607_004321_raw.all to 0031_20100607_010634_raw.all

EM3002D
0030_20100610_004302_Belgica.all to 0033_20100610_010614_Belgica.all

Results (Christophe Vrignaud - SHOM):
EM3002D:

- Vertical accuracy on Carré Renard (19m depth):



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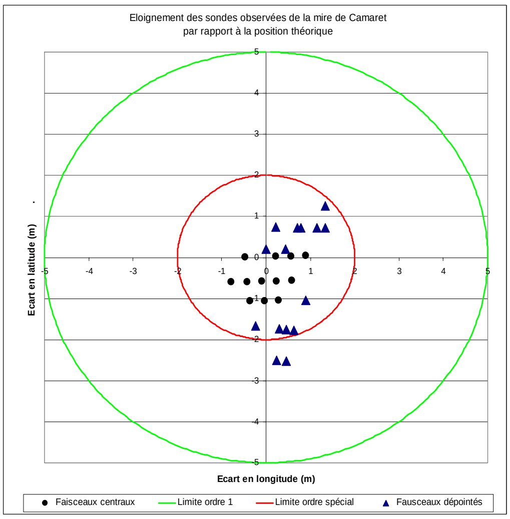
- Horizontal accuracy on Mire de Camaret:



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Special Order valid to +-73°

4.1.2 Seismic survey

About 180 kilometres of high-resolution single channel seismic data (Fig.2) were collected (11 2D lines) in the study area with a SIG sparker source (120 electrodes). The sparker was triggered every 2 s reaching 500 J energy. The sampling frequency was set at 8 kHz and a record length of 2500 ms TWT was used. The velocity of the ship during seismic work was about 3 knots. During this work, R/V Belgica operated on electrical engines for noise reduction.

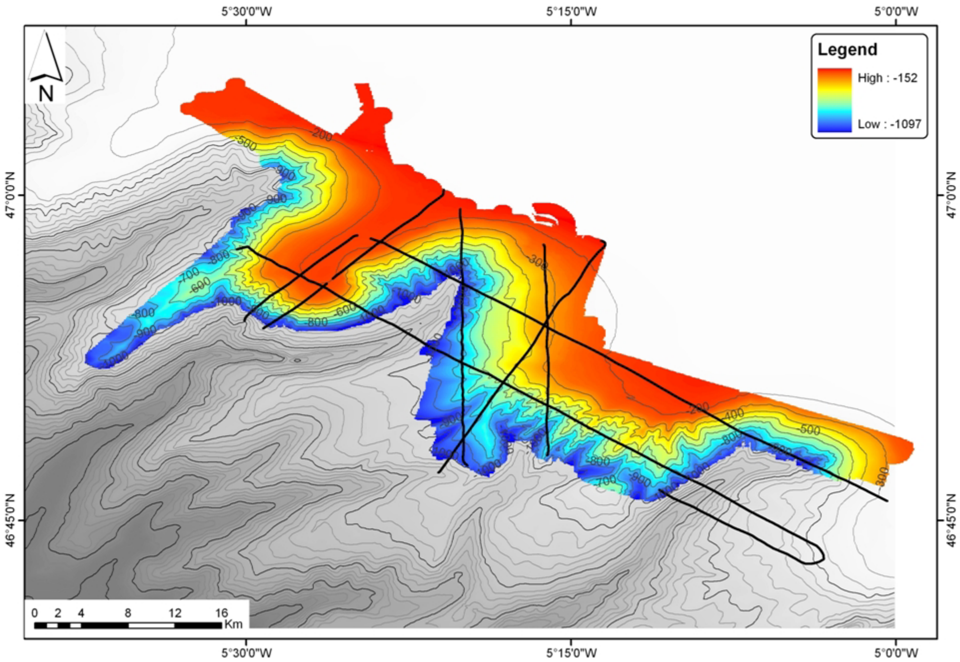

Figure 2: *2D seismic navigation (WGS84).*

4.1.3 ROV survey

The RCMG acquired a Sub-Atlantic Cherokee-type ROV “Genesis”, with TMS and shipboard winch. This winch hosts a reinforced cable of 1600 m which can bring the TMS and ROV to a safe depth prior to ROV launch (with a maximum tether of 200 m). The winch cable is connected to a pilot control interface which was installed in the ROV container. This encompasses the physical control of the ROV and its instruments, as well as the observation (and navigation cameras). 5 cameras and 1 still camera were active: one on the TMS (ROV launch & re-entry control), a backward looking within the ROV (for TMS re-entry and tether inspection), a camera on the ROV looking at the arm and tray, and the two forward-looking black & white and colour (with overlay) cameras. An overlay on the screen with navigation control information could be put on an arbitrary camera display. The main sampling tool on the ROV is the controlled grab arm and a deployable tray in which samples can be stored. An additional 5L Niskin bottle was present in this tray for water sampling. The ROV also contains a depth control, an altimeter and a forward-looking sonar for detection of seabed objects.

Positioning of the TMS and ROV was done through the GAPS positioning system (IXSEA). This Global Acoustic Positioning System, GAPS, is a portable Ultra Short Base Line (USBL) with integrated Inertial Navigation System (INS) and Global Positioning System (GPS). The GAPS was deployed at the side and a transponder fixed on the TMS and on the ROV, resulting in the position of the Belgica, TMS and ROV. Navigation from the GAPS software is stored in raw format. During the deployments, the ship’s, TMS and ROV navigation was also recorded through the OFOP software (J. Greinert, Royal NIOZ, The Netherlands).

During ROV survey, the control is performed by the pilot and the PI scientist (scientist, co-pilot/navigator), assisted by another shipboard scientist and contact with the bridge is held. Propulsion of the ship remained diesel which enables to handle the ship in a very controlled manner, even though dynamic positioning is not available.

4.1.4 CTD measurements

CTD measurements during this campaign were acquired from Sea & Sun CTD90M attached to the ROV. Initially, it was scheduled that the CTD measurements and water sampling were acquired using the Seacat SBE-19 Plus deep-water CTD profiler of the MUMM. Due to problems with the oceanographic cable, this system could not be used during this campaign. However, collected CTD data during ROV dives recorded additional to temperature, salinity, density also turbidity, dissolved oxygen and chlorophyll a.

4.1.5 MUMM-REMSEM/ULCO measurements

MUMM and ULCO sampled at 36 stations during campaign 10/17a. An overview is given in Table 1. At each station, the following parameters were sampled:

- Particle size distribution (LISST instrument)
- Backscattering, total scattering, attenuation, absorption, fluorescence (ULCO optics package)
- Side scattering (portable turbidimeter)
- Concentrations of suspended matter, chlorophyll, particulate organic and inorganic carbon via filtration of seawater, sampled with Niskin bottles
- Secchi depth (where possible)
- Screening of watersample with stereomicroscope, equipped with a camera (where possible)

Where rotation of the ship with respect to the sun was feasible, marine reflectance was recorded. Due to strong currents and wave action it was not always possible to record Secchi depth. Due to continuous cloud cover, only one possible satellite match-up could be achieved (at ZBLR26 with MERIS). A map of the stations visited is shown in Figure 3.
Despite continuous cloud cover and harsh weather conditions, MUMM-ULCO was able to sample the necessary water parameters at a high number of stations.

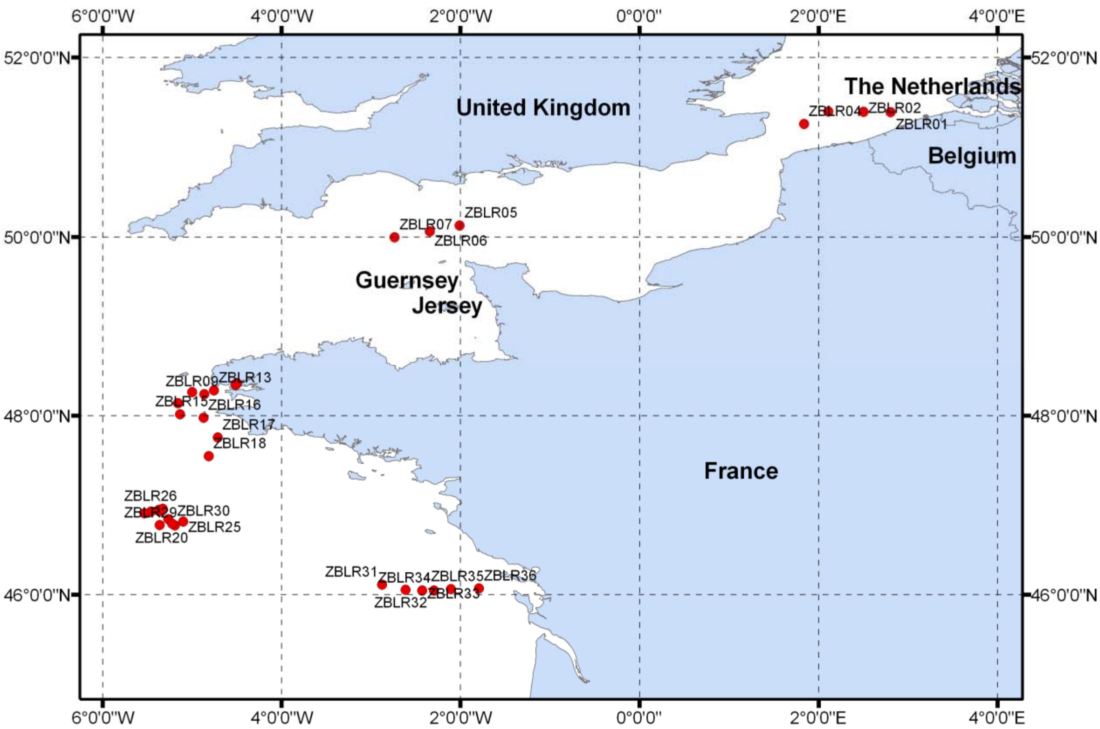

Figure 3: *Stations sampled by MUMM-ULCO during campaign 17a.*

Station	Date	Time (UTC)	Lat (deg N)	Lon (deg E)	TriOS	ULCO optics	LISST	Filtrations
ZBLR01	7-Jun-2010	13:40	51.3892	2.8089	x	x	x	x
ZBLR02	7-Jun-2010	14:57	51.3931	2.5050	x	x	x	x
ZBLR03	7-Jun-2010	16:46	51.3992	2.1118	x	x	x	x
ZBLR04	7-Jun-2010	18:36	51.2603	1.8416		x	x	x
ZBLR05	8-Jun-2010	11:05	50.1253	-2.0079		x	x	x
ZBLR06	8-Jun-2010	12:38	50.0619	-2.3429		x	x	x
ZBLR07	8-Jun-2010	14:33	49.9937	-2.7348		x	x	x
ZBLR08	9-Jun-2010	7:01	48.2637	-4.9999		x	x	x
ZBLR09	9-Jun-2010	8:02	48.2393	-4.8616		x	x	x
ZBLR10	9-Jun-2010	10:58	48.3435	-4.5117		x	x	x
ZBLR11	9-Jun-2010	13:28	48.3623	-4.4981		x	x	x
ZBLR12	9-Jun-2010	14:23	48.3499	-4.5095		x	x	x
ZBLR13	10-Jun-2010	8:33	48.2835	-4.7554	x	x	x	x
ZBLR14	10-Jun-2010	10:46	48.1381	-5.1556		x	x	x
ZBLR15	10-Jun-2010	12:12	48.0139	-5.1351		x	x	x
ZBLR16	10-Jun-2010	13:38	47.9758	-4.8723		x	x	x
ZBLR17	11-Jun-2010	7:04	47.7576	-4.7141	x	x	x	x
ZBLR18	11-Jun-2010	8:33	47.5457	-4.8146		x	x	x
ZBLR19	11-Jun-2010	13:19	46.8438	-5.2667		x	x	x
ZBLR20	12-Jun-2010	7:59	46.7794	-5.3611		x	x	x
ZBLR21	12-Jun-2010	9:32	46.9386	-5.3622		x	x	x
ZBLR22	12-Jun-2010	11:13	46.9483	-5.3696	x	x	x	x
ZBLR23	12-Jun-2010	13:00	46.9335	-5.3669		x	x	x
ZBLR24	12-Jun-2010	14:20	46.9376	-5.3616		x	x	x
ZBLR25	13-Jun-2010	8:40	46.8179	-5.0972	x	x	x	x
ZBLR26	**13-Jun-2010**	**10:49**	**46.9591**	-5.3287	**x**	**x**	**x**	**x**
ZBLR27	13-Jun-2010	13:06	46.9275	-5.4591	x	x	x	x
ZBLR28	13-Jun-2010	14:45	46.9091	-5.5338		x	x	x
ZBLR29	14-Jun-2010	7:09	46.7752	-5.1916		x	x	x
ZBLR30	14-Jun-2010	8:36	46.7922	-5.2219		x	x	x
ZBLR31	15-Jun-2010	16:48	46.111	-2.8742		x	x	x
ZBLR32	15-Jun-2010	18:20	46.0556	-2.6108		x	x	x
ZBLR33	15-Jun-2010	19:40	46.0478	-2.4255		x	x	x
ZBLR34	15-Jun-2010	20:47	46.0485	-2.2939		x	x	x
ZBLR35	15-Jun-2010	22:16	46.0646	-2.1072		x	x	x
ZBLR36	16-Jun-2010	3:03	46.0691	-1.7918		x	x	x

Table 1: *Overview of stations and actions by MUMM-ULCO during campaign 17a. Possible match-up station given in bold.*

4.2 Operational Report

It is worth noting that the time used in this cruise report is the Belgian Summer time (BRAVO TIME = UTC + 2 hours). On the ROV and seismic logsheets UTC time was used.

Monday 07.06.2010

13:20 Departure Zeebrugge and start transit to Brest
14:00 Briefing with the crew and scientists

Tuesday 08.06.2010

00:00 Continue transit to Brest

Wednesday 09.06.2010

00:00 Continue transit to Brest
12:00 Arrival Brest
13:00 Pick up of Xavier Lurton, Marc Nokin and Christophe Vrignaud
16:30 Start multibeam measurements

Thursday 10.06.2010

00:00 Continue multibeam measurements
04:30 End of multibeam
06:15 Change of scientific crew
08:00 ROV test dive
10:20 Start transit to study area
17u30 Arrival at Bay of Douarenez (bad weather)

Friday 11.06.2010

07:00 Start transit to study area
16:00 Arrival at study area
16:24 Start of line 20100601, heading 15° (av. speed 1.7 knots)
Weather conditions: 4 m waves, 6-7 Bft
23:57 End of line 20100601

Saturday 12.06.2010

01:45 Start of line 20100602, heading 2° (av. speed 3.0 knots)
05:32 End of line 20100602
06:16 Start of line 20100603, heading 217° (av. speed 3.3 knots)
09:37 End of line 20100603
14:53 ROV in the water
15:20 ROV at the bottom, start of ROV dive 01
19:09 ROV at the bottom, start of ROV dive 01b
21:20 ROV off the bottom
21:45 ROV on deck
22:39 Start of line GA100604, heading 230° (av. speed 3.5 knots)

Sunday 13.06.2010

00:00 End of line 20100604
00:09 Start of line 20100605, heading 230° (av. speed 3.7 knots)
00:55 End of line 20100605
01:17 Start of line 20100606, heading 40° (av. speed 2.5 knots)
03:16 End of line 20100606
03:25 Start of line 20100607, heading 127° (av. speed 3.1 knots)
09:45 End of line 20100607
16:03 ROV in the water
17:22 ROV at the bottom, start of ROV dive 02
20:51 ROV off the bottom
21:17 ROV on deck
22:07 Start of line 20100608, heading 130° (av. speed 3.3 knots)

Monday 14.06.2010

04:52 End of line 20100608
04:53 Start of line 20100609, heading 156° (av. speed 4.6 knots)
05:16 End of line 20100609
05:17 Start of line 20100610, heading 310° (av. speed 1.8 knots)
08:37 End of line 20100610
09:00 Cancel all operations due to bad weather

Tuesday 15.06.2010

07:00 Start transit to La Rochelle

Wednesday 16.06.2010

00:00 Continue transit to La Rochelle

09:00 Arrival at La Rochelle

5. Preliminary results

5.1 ROV observations

The locations of the 2 ROV dives are shown on figure 4. Some preliminary remarks about the ROV observations are made here. A full analysis of the video data will be done in a later stage. A recapitulative list of the ROV dives is given in table 2.

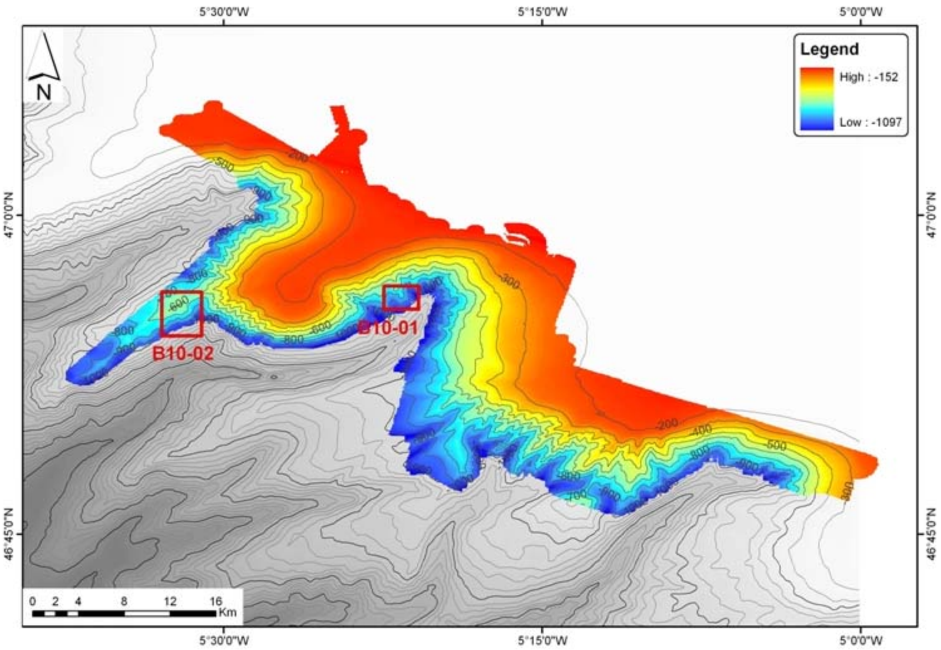

Figure 4: *Location of the ROV dives.*

Name	Start track				End track			
	Latitude	*Longitude*	*Time*	*Depth*	*Latitude*	*Longitude*	*Time*	*Depth*
B10-01a	46°56.1167’ N	5°22.0195’ W	13:20	883 m	46°56.3334’ N	5°21.6790’ W	15:33	750 m
B10-01b	46°56.2975’ N	5°21.6277’ W	17:09	942 m	46°55.9179’ N	5°21.2405’ W	19:20	770 m
B10-02	46°54.6945’ N	5°32.1003’ W	15:22	1083 m	46°55.9012’ N	5°31.5297’ W	18:51	680 m

Table 2: *Names, locations and operational data of the ROV Genesis dives. Time in UTC.*

ROV dive B10-01

Dive B10-01 is located on a small spur on the north-western flank of the canyon. The dive was split up in two upslope transect. Dive 01a is a 1 km long transect on the western flank of the spur and dive 01b is a 1.25 km long transect on the south-eastern slope of the spur. During both dives thick cold-water coral rubble graveyards with living corals on top were observed, often colonized by sponges, crinoids, antipatharians and soft corals. *Madrepora oculata* and *Lophelia pertusa* are the most common species. Also hard substrate colonized by cold-water corals and antipatharians was observed as well as soft sediment with small boulders and a patchy distribution of coral rubble.

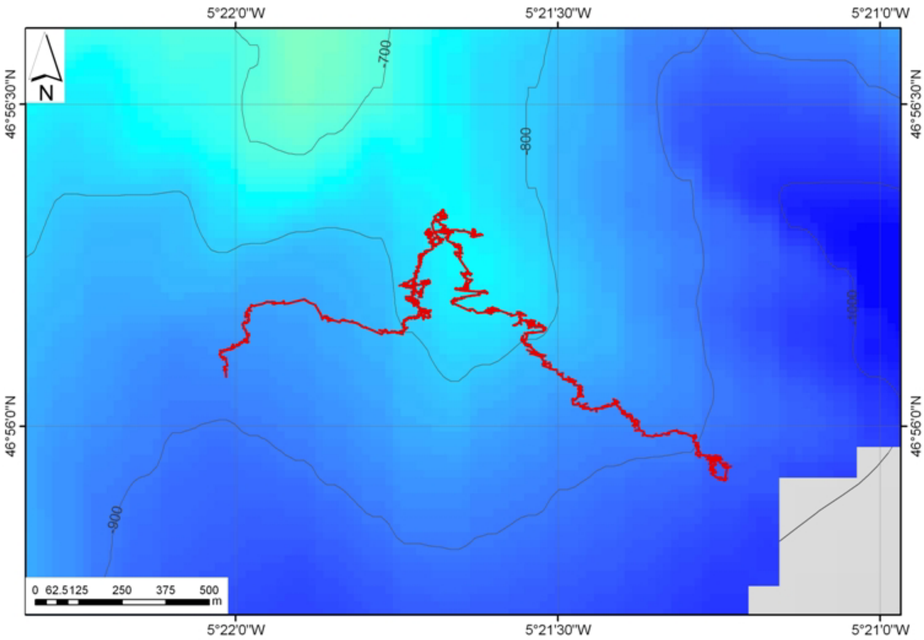

Figure 5: *Map ROV dive 01.*

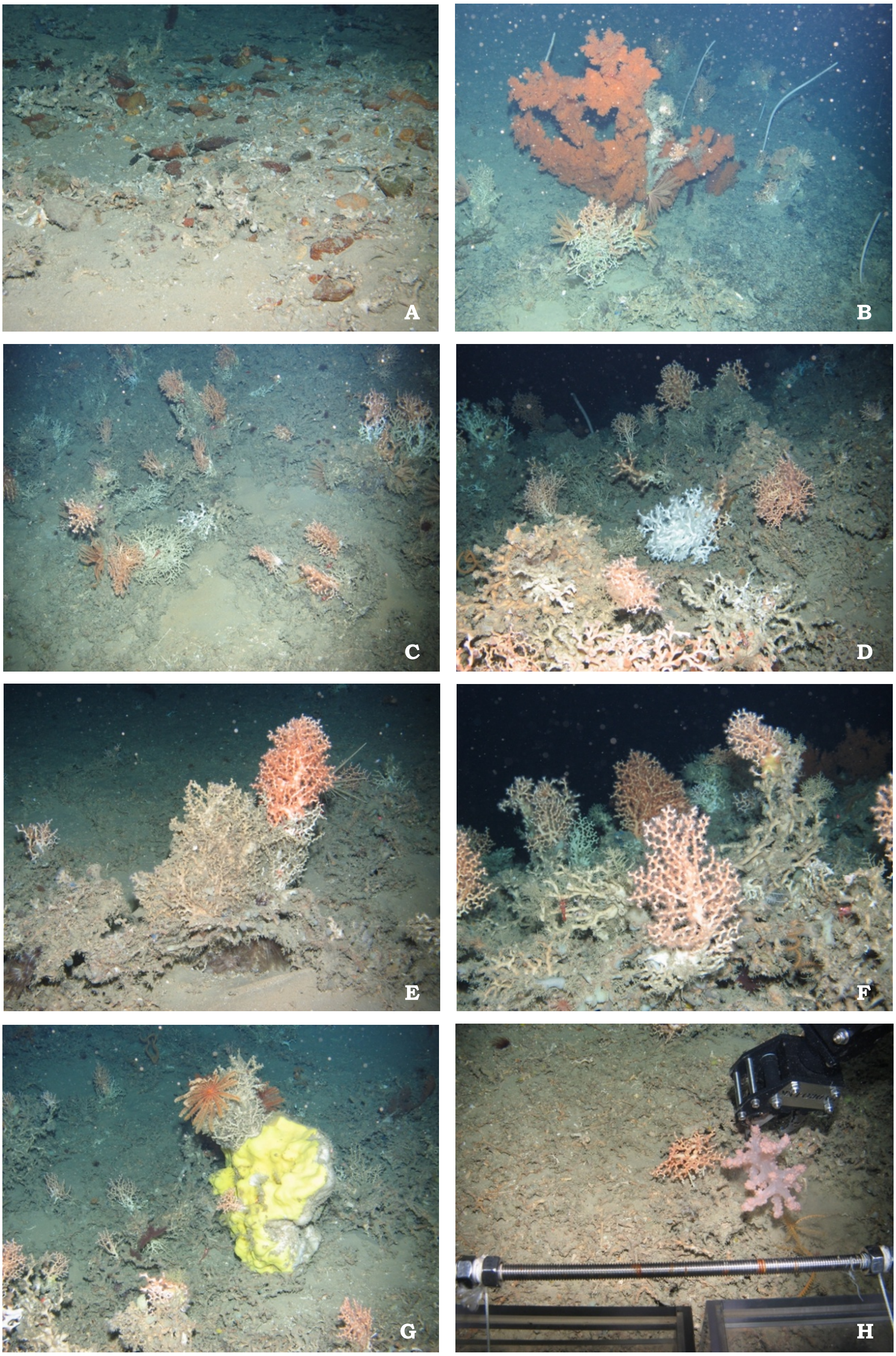

Figure 6: ***(A)*** *Small boulders with coral rubble,* ***(B)*** *Hard substrate colonized by anthipatharians, cold-water corals and crinoids,* ***(C-D)*** *Coral fields with dead and living Lophelia pertusa and Madrepora oculata,* ***(E)*** *Bush of Madrepora oculata,* ***(F)*** *Dead Lophelia pertusa with living Madrepora oculata on top,* ***(G)*** *Big sponge surrounded with dead and living corals, and* ***(H)*** *Sampling of a soft coral.*

ROV dive B10-02

Dive B10-02 is located on a small ridge southwest of the Penmarc'h Spur. An upslope transect of 3.2 km was made on the southern slope and on the top of the ridge. On the southern slope only soft sediment was observed with almost no fauna. On the top of the ridge a lot of trawl marks were observed. Going down of the ridge again dead coral rubble patches were present alternating with boulders. At some locations also living cold-water corals (*Lophelia pertusa* and *Madrepora oculata*) were observed on top of the coral rubble.

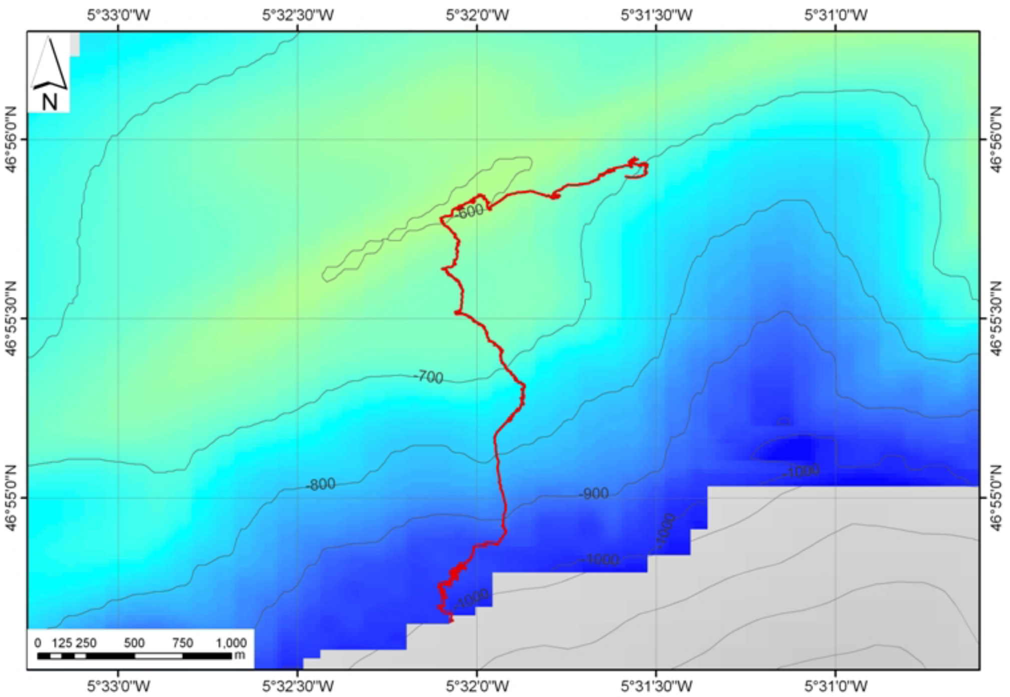

Figure 7: *Map ROV dive 02.*

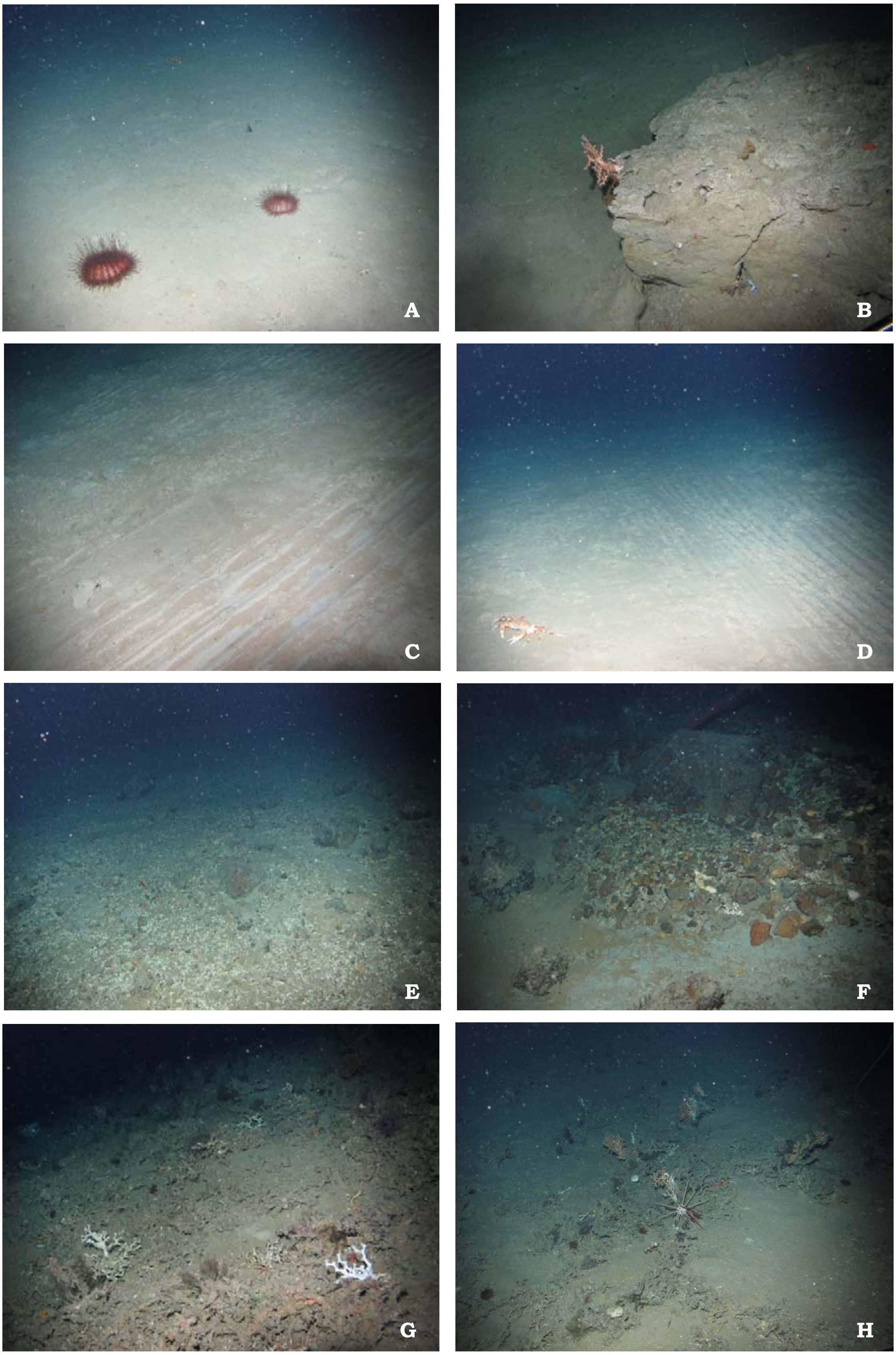

Figure 8: ***(A)*** *Soft sediment with sea urchins,* ***(B)*** *Soft sediment with outcropping hard substrate conolized by Madrepora oculata,* ***(C-D)*** *Trawl marks,* ***(E)*** *Soft sediment with a dense coral rubble coverage and a few boulders,* ***(F)*** *Boulders,* ***(G)*** *Coral rubble coverage with a few white Lophelia pertusa, and* ***(H)*** *Soft sediment with a patchy distribution of dead cold-water corals with a few living species on top (Madrepora oculata and Lophelia pertusa).*

5.2 CTD measurements

The obtained hydrographic data was acquired from the onboard CTD90M of the ROV. 2 ROV dives were performed at dive sites B10-01 and B10-02, the western and central part of the study area. At both sites water samples were collected for further investigation (Table 3). Down- and upcast measurements from site 01 are illustrated in figure 10 indicating a slight offset between the two cast. However, salinity data show a broader scatter related to problems with the pressure sensor. Therefore, these data will be more qualitatively discussed, whereas all other data present reliable values.

Station	Sample code	Sample type	Date	Time	Latitude	Longitude	Water depth
B10-01	BEL10-17a-01	$\delta^{18}O/\delta^{13}C_{DIC}$	12.06.2010	14:33	46°56.2240' N	5°21.7000' W	800 m
B10-01	BEL10-17a-01	Element/Ca	12.06.2010	14:33	46°56.2240' N	5°21.7000' W	800 m
B10-02	BEL10-17a-02a	$\delta^{18}O/\delta^{13}C_{DIC}$	13.06.2010	17:34	46°55.7827' N	5°32.0967' W	595 m
B10-02	BEL10-17a-02a	Element/Ca	13.06.2010	17:34	46°55.7827' N	5°32.0967' W	595 m

Table 3: *Water sample detail recovered during ROV dives of Leg 17a.*

The distribution of water masses can be identified using the characteristic parameters through the water column (Fig.10). Below the seasonal thermocline as inicated by the strong decrease in temperature and chlorophyll a of the surface water mass (SW, upper 50 to 100 m), temperature, salinity, and density (sigma theta) have relatively constant values between 100 and 600 m water depth. These values correspond to the Eastern North Atlantic Water (ENAW) being formed mainly during the winter months in the Bay of Biscay and carried northwards adjacent to the NE Atlantic margin (Pollard et al. 1996). A higher salinity and lower oxygen level marks Mediterranean Outflow Water (MOW), which occurs below 600 m depth at the Guilvinec Canyon.

According to Dullo et al. (2008), live cold-water coral ecosystems in the Nordic and Irish margin are located in a potential density (sigma-theta) envelope between 27.35 and 27.65 kg/m^3. ROV-CTD data at site 01 reach down to 1050 m water depth. The predicted optimal depth for cold-water coral occurrences (sigma-theta = 27.5 kg/m^3) would be about 950 m. ROV Dives at both investigated sites show maximum living coral occurrences between 850 and 750 m water depth, corresponding to sigma theta values around 27.4 kg/m^3.

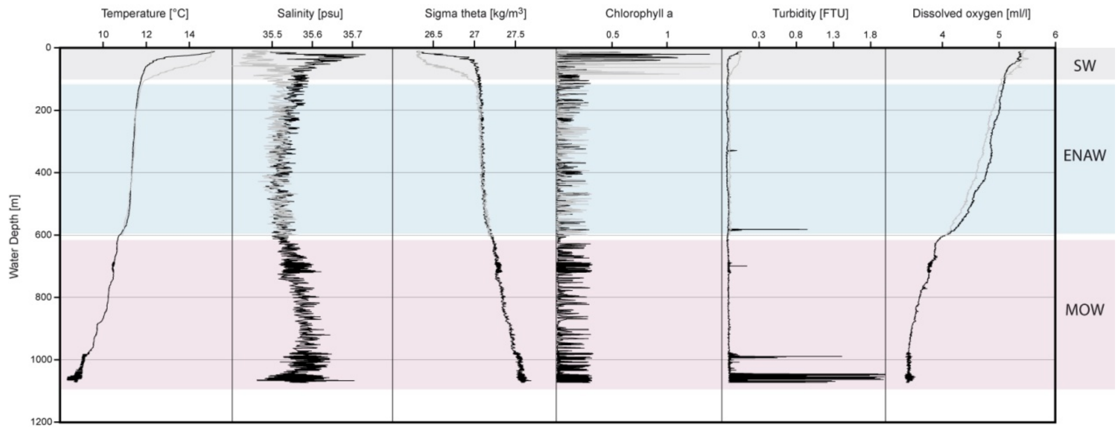

Figure 9: *CTD-depth profiles of temperature, salinity, density (sigma theta), chlorophyll a, turbidity, and dissolved oxygen during ROV Dive 02 at Site 01. SW = Surface Waters, ENAW = Eastern North Atlantic Water, MOW = Mediterranean Outflow Water. High turbidity data at depth partly due to dive procedure.*

6. Data storage

During the Belgica 10/17a campaign, 11 seismic lines were acquired over approximately 180 km. All lines were recorded in ELICS format and were converted in a SegY-Motorola format with associated navigation files (these are text files containing shot point, longitude, latitude, date and time).

A total of 2 ROV dives were performed. The ROV imagery (forward looking colour camera with/without overlay, black/white camera and rear camera) was recorded on DV tapes through Professional-DV recorders. After each dive the tapes were digitized using the Magix software and stored on an external hard drive.
All data are stored at RCMG. For more information about the seismic, video and hydrographic data, please contact

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7. References

Bryan, T.L. and Metaxas, A., 2006, Distribution of deep-water corals along the North American continental margins: relationships with environmental factors. Deep Sea Res I, 53, 1865–1879.

De Mol, B., Van Rensbergen, P., Pillen, S., and Van Herreweghe, K., 2002, Large deepwater coral banks in the Porcupine Basin, southwest of Ireland. Mar Geol, 188,193– 231.

Dullo, C., 2005, Coral growth and reef growth: a brief review. Facies, 51, 33–48.

Dullo, W.-C., Flögel, S., and Rüggeberg, A., 2008, Cold-water coral growth in relation to the hydrography of the Celtic and Nordic European continental margin, Marine Ecology Progress series, 371, 165-176.

Foubert, A., Beck, T., Wheeler, A.J., Opderbecke, J., Grehan, A., Klages, M., Thiede, J., Henriet, J.P., and the Polarstern ARK-XIX/3a Shipboard Party, 2005, New view of the Belgica Mounds, Porcupine Seabight, NE Atlantic: preliminary results from the Polarstern ARK-XIX/3a ROV cruise. In: Freiwald A, Roberts JM (eds) Cold-water corals and ecosystems. Springer, Heidelberg, 535–569.

Freiwald, A., Wilson, J.B., Henrich, R., 1999, Grounding Pleistocene icebergs shape recent deep-water coral reefs. Sediment Geol, 125, 1–8.

Freiwald, A., Hühnerbach, V., Lindberg, B., Wilson, J.B., and Campbell, J., 2002, The Sula Reef complex, Norwegian Shelf. Facies, 47,179–200.

Herring, P. 2002, The biology of the deep ocean. Oxford University Press, Toronto.

Huvenne, V.A.I., Beyer, A., de Haas, H., Dekindt, K., Henriet, J.P., Kozachenko, M., Olu-Le Roy, K., and Wheeler, A., The TOBI/Pelagia 197, CARACOLE Cruise Participants, 2005, The seabed appearance of different coral bank provinces in the Porcupine Seabight, NE Atlantic: results from side-scan sonar and ROV seabed mapping. In: Freiwald A, Roberts JM (eds.) Cold-water corals and ecosystems. Springer, Heidelberg, 535–569.

Montagna, P., Correa M.L., Rüggeberg, A., and Dullo, W.-Chr., 2008, Coral Li/Ca in microstructural domains as a temperature proxy, Geochimica et Cosmochimica Acta 72/12:A645-A645.

Mortensen, P.B., Hovland, M.T., Fosså, J.H., Furevik, D.M., 2001, Distribution, abundance and size of Lophelia pertusa coral-reefs in mid-Norway in relation to seabed characteristics. J Mar Biol Assoc UK, 81, 581–597.

Noé, S., Titschack, J., Freiwald, A., and Dullo, C. 2006, From sediment to rock: diagenetic processes of hardground formation in deep-water carbonate mounds of the NE Atlantic. Facies, 52,183–208.

Pollard, R.T., Griffiths, M.J., Cunningham, S.A., Read, J.F., Perez, F.F., Rios, A.F., 1996. Vivaldi 1991 - a study of the formation, circulation and ventilation of Eastern North Atlantic Water. Prog Oceanogr, 37,167–192.

Rogers, A.D., 1999, The biology of Lophelia pertusa (Linnaeus, 1758) and other deep-water reef-forming corals and impacts from human activities. Int Rev Hydrobiol, 84, 315–406.

Thiem, Ø., Ravagnan. E., Fosså, J.H., Berntsen, J., 2006, Food supply mechanisms for coldwater corals along a continental shelf edge. J Mar Syst, 60, 207–219.

Veron, J.E.N., 1993, Corals of Australia and the Indo-Pacific. University of Hawaii Press, Honolulu, HI.

Wheeler, A.J., Beck, T., Thiede, J., Klages, M., Grehan, A., Monteys, F.X., and Polarstern ARK XIX/3a Shipboard Party, 2005, Deepwater coral mounds on the Porcupine Bank, Irish Margin: preliminary results from the Polarstern ARK-XIX/3a ROV cruise. In: Freiwald A, Roberts JM (eds.) Cold-water corals and ecosystems. Springer-Verlag, Berlin, Heidelberg, 393–402.