Cruise Report Belgica 11/18b
Benthic Diversity and Functioning in the Gulf of Biscay

Research cruise performed within the framework of the HERMIONE project

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1. Framework and objectives

1.1 Framework

EC FP7 IP HERMIONE (2009-2012)

HERMIONE is the ecological follow-up of the EC FP6 IP HERMES project and stands 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 (Weaver *et al.*, 2009). The main aims of this project are 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). By benthic sampling of slope areas at the (understudied) Gulf of Biscay we aim at a better understanding of the biology in terms of diversity and ecosystem functioning of the benthic realm.

Part of this research cruise is dedicated to the quality development of the multibeam systems used by the FPS (Economy) – Continental Shelf Service.

1.2 Objectives

1.2.1. Benthic diversity and ecosystem functioning

In order to understand the response of margin seafloor ecosystems to a changing ocean, we will investigate the structure and functioning of the benthos associated with the soft sedimentary environments of the Gulf of Biscay by analysing field samples and on-board experiments. The benthos was sampled and characterized along several transects at the French continental margin. At fixed depths (500-1000 m) samples were collected with multicorer and/or box corer to identify nutrient profiles, biomarker composition, pigment concentration, benthic taxonomy and biomass, and molecular characterization of the associated biodiversity. Samples were also collected for onboard experiments at in-situ conditions in order to identify food specificity and organic carbon uptake/ability of the present meiofauna.

MUC/BOX sampling and onboard experiments: The initial objective was to sample 8 locations with 3 to 5 successful deployments per location. These stations are situated at 500m and 1000m depth at 4 transects spread along the French Continental Margin. These samples will be used to identify the meiofauna biodiversity in terms of morphology and state of the art ultrasequencing molecular techniques, environmental variables (Chl-a and phaeophytines, grain size, TOC, C:N, sediment porewater biogeochemistry (sulphides, nutrients), and ^{13}C, ^{15}N isotope signatures and PLFA of the bulk sediment and selected morphological groups with an ecological identity and function. Full characterization of the environment and the meiofauna taxa (including deep community analysis for the nematodes) will allow us to chart heterogeneity of biodiversity along this slope ecosystem. At these locations we also intend to retrieve sediment cores with the MUC to perform ex-situ feeding

experiments. With this we aim to investigate to what extent nematodes are able to ingest and assimilate dissolved organic matter/carbon. Live nematodes will be extracted from the sediment and incubated in sterilised environments with addition of ^{13}C labelled amino-acid solution. The results of this experiment will contribute to our understanding of nematode food-web ecology and their ability to process carbon sources and make them available to the higher trophic levels.

1.2.2. DCP-KDegrendele

In the summer of 2008 an EM3002D multibeam system was installed on board the Belgica. It is the main instrument for the monitoring of extraction activities on the Belgian Continental Shelf by the FPS Economy – Continental Shelf Service (DCP). To guarantee the quality of the results of this ongoing investigation an elaborate quality control is necessary. A comparison between the quality of measurements with the EM1002 and EM3002 on board the Belgica and the multibeam measurements executed by AZTI will provide valuable information on the quality of the systems used by both institutes. Furthermore, the comparison of the sediment classification based on the survey of a common area by both AZTI and DCP (Belgica), will provide us information on the quality and compatibility of both results

1.3. Working area

1.3.1. Benthic diversity and ecosystem functioning

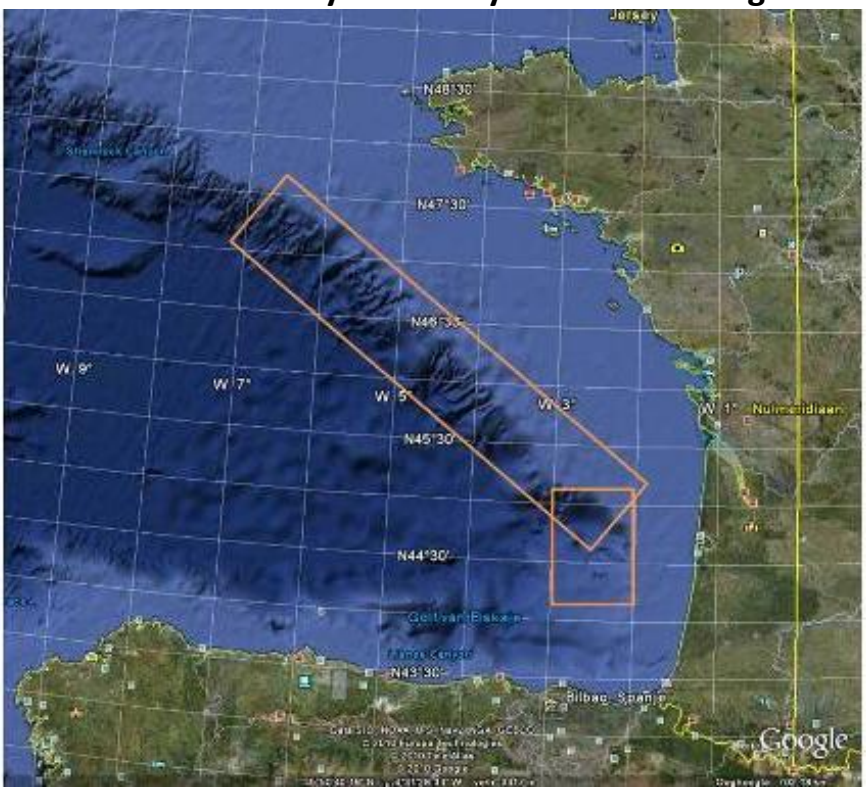


Fig. 1: Location area for benthic sampling

1.3.2. DCP-KDegrendele

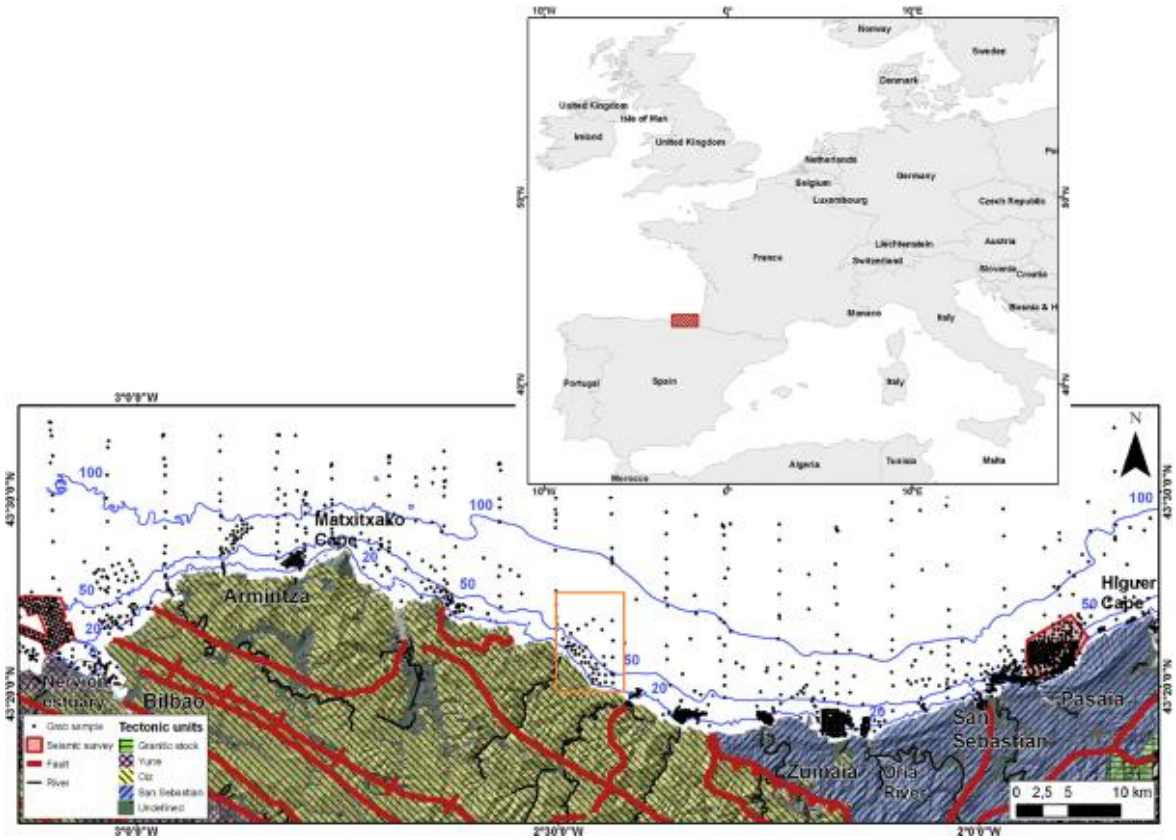


Fig. 2: The exact coordinates of the survey area and reference line will be provided on board, but will be inside the area: 2°25' – 2°30' W / 43°20' – 43°25' N

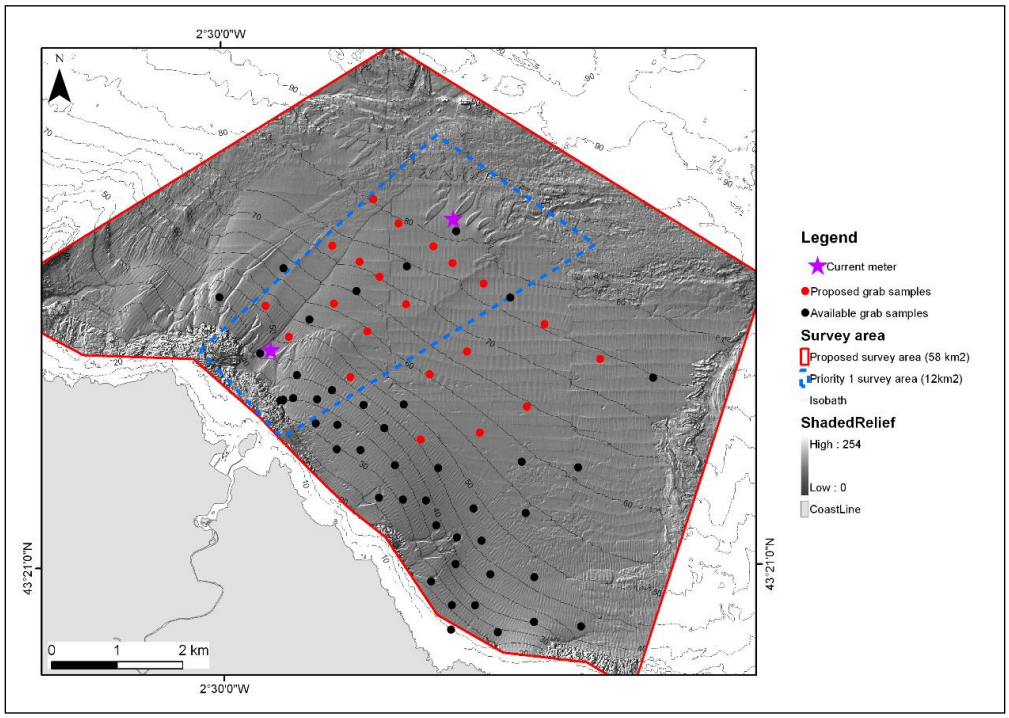


Fig. 3: Shaded relief model of the proposed survey area (blue) and existing information

2. Coordination at Sea

Chief scientist: Dr. Jeroen Ingels, Marine Biology Section, Ghent University, Krijgslaan 281 S8, 9000 Ghent
Vice chief scientist: Prof. Dr. Ann Vanreusel

3. Scientific staff

Jeroen Ingels	Ghent University
Ann Vanreusel	Ghent University
Katja Guilini	Ghent University
Lidia Lins	Ghent University
Guy De Smet	Ghent University
Dirk Van Gansbeke	Ghent University
Bart Beuselinck	Ghent University
Koen Degrendele	FOD, FPS - Economy
Marc Roche	FOD, FPS - Economy
Ibon Galparsoro	AZTI, Tecnalia

4. Operations

4.1. Multibeam

For multibeam operations, see 1.2.2.

4.2. CTD measurements

CTD measurements during this campaign were acquired from two different sources. Initially, it was scheduled that the CTD measurements were going to be acquired using the battery-operated CTD system CTD 48M (Sea and Sun technologies, owned by VLIZ). However, do to persistent errors, this system could not be further used during this campaign. Instead, the SBE-19 deep-water CTD profiler of the MUMM was used to record sound velocity profiles needed to operate/calibrate Multibeam systems and the GAPS USBL system.

4.2. Seafloor sampling: MUC and BOX

Biological and biogeochemical sampling was performed with a Midicorer (MUC, Ocean Scientific International Ltd, kindly on loan by VLIZ) and the NIOZ-type BOX corer, property of the MUMM. The MUC is designed to take 4 undisturbed sediment cores of 100mm inner diameter. The core tubes are driven into the sediment by the weight of the corer head and its attached lead weights and the rate of descent is controlled by a hydraulic damper. The success of the MUC during several previous cruises has been variable. This cruise, a total of 21 cores were retrieved out of a maximum of 100 (21%). Unsuccessful deployments were ascribed to unsuitable seafloor conditions (coarse sediments, current activity), blockages preventing the bottom catchers to close the corer tubes upon retrieval from the seafloor, and breaks or blockages within the hydraulic damper system which prevented the cores from being lowered, precluding sediment penetration. Precise subsea positioning and navigation of MUC was aided through combination of an IXSEA GAPS transponder attached to the MUC frame. Due to persistent MUC failure, we reverted to the NIOZ-type BOX corer to obtain benthic samples.

During deployments communication was maintained between the boatswain at the winch, the scientists at the GAPS transponder system and the commander or commanding officer on the bridge, to 1) secure that the ship remained on position, 2) confirm water depth relative to paid out cable, and 3) confirm the exact position of the MUC in the water column and relative to the ship.

The deployment protocol consisted of 5 phases. 1) Deployment of the MUC at 40m/min, 2) stabilisation phase of 1-2 min at 20-50m above bottom, 3) Bottom approach at 10m/min, 4) 1-2 min penetration time on seafloor, and 5) haul back at 50m/min. During the cruise slight variations on this protocol were used in order to increase efficiency.

4.3. Operational Report

The time used in this cruise report is the Belgian Summer time (BRAVO TIME = UTC+2hours).

Saturday 18 June 2011

Meteo: Seastate 2-3, 3 ft swell, Force 3-6

7:00	Departure from Bilbao - transit to operations area near Lekeitio	
10:00	Scientific briefing	
13:10	Sound Velocity Profiler in water	
13:18	Sound Velocity Profiler on deck	
14:15	Sonar down - Start Multibeam operations near Lekeitio	
22:45	CTD in water	
22:58	CTD on deck	

Sunday 19 June 2011

Meteo: Seastate 2-3, 3 ft swell, Force 1-4

10:31	End Multibeam operations - sonar up	
11:03	Zodiac in water - disembarkment of 3 scientific crew members - touch and go in Lekeitio	
11:30	Zodiac on deck - transit to operations area A, French Margin	

Monday 20 June 2011

Meteo: Seastate 3-4, 3-4 ft swell, Force 3-5

4:10	Sonar down - Start Multibeam operations	area A
6:35	Stop Multibeam operations - Sonar up	area A
7:10	CTD in water	A1-1-CTD
7:35	CTD on deck	A1-1-CTD
7:49	GAPS in water	A1
9:17	MUC in water	A1
9:24	MUC on deck (transponder malfunction)	A1
9:29	CTD in water with transponder attached	A1
10:05	CTD on deck	A1
10:07	CTD in water	A1
10:20	CTD on deck	A1
10:37	MUC in water	A1-1-MUC
11:25	MUC on deck	A1-1-MUC
11:30	MUC in water	A1-2-MUC
12:18	MUC on deck	A1-2-MUC
12:50	MUC in water	A1-3-MUC
13:23	MUC on deck	A1-3-MUC
13:35	GAPS on deck	A1
13:36	Transit to station A2	
14:06	GAPS in water	A2
14:10	MUC in water	A2-1-MUC
15:03	MUC on deck	A2-1-MUC
15:16	MUC in water	A2-2-MUC
16:10	MUC on deck	A2-2-MUC
17:08	MUC in water	A2-3-MUC
18:03	MUC on deck	A2-3-MUC
18:40	MUC in water	A2-4-MUC
19:35	MUC on deck	A2-4-MUC

19:42	GAPS on deck	A2
19:43	Transit to operations area B	

Tuesday 21 June 2011

Meteo: Seastate 2-3, 3ft swell, Force 3-5

4:00	Reconnaissance echosounder survey	area B
8:15	CTD in water	B1-1-CTD
8:47	CTD on deck	B1-1-CTD
9:27	BOX in water	B1-1-BOX
9:50	Multibeam EM1002 down	B1
10:15	BOX on deck	B1-1-BOX
10:25	BOX in water	B1-2-BOX
11:15	BOX on deck	B1-2-BOX
11:30	Multibeam EM1002 up	B1
11:31	Transit to station B2	
12:08	BOX in water	B2-1-BOX
12:30	BOX on deck	B2-1-BOX
12:46	BOX in water	B2-2-BOX
13:12	BOX on deck	B2-2-BOX
13:13	Transit to station B1	
14:05	GAPS in water	B1
14:14	MUC in water	B1-1-MUC
15:08	MUC on deck	B1-1-MUC
16:13	MUC in water	B1-2-MUC
17:08	MUC on deck	B1-2-MUC
17:10	MUC in water	B1-3-MUC
18:05	MUC on deck	B1-3-MUC
18:18	MUC in water	B1-4-MUC
19:18	MUC on deck	B1-4-MUC
19:25	GAPS on deck	B1
19:26	Transit to operations area C	

Wednesday 22 June 2011

Meteo: Seastate 2-4, 1-5 ft swell, Force 4-6

4:00	Reconnaissance echosounder survey	
8:07	CTD in water	C1-1-CTD
8:55	CTD on deck	C1-1-CTD

no further operations because of bad weather conditions

Thursday 23 June 2011

Meteo: Seastate 2-4, 1-5 ft swell, Force 3-4

6:50	BOX in water	C1-1-BOX
7:53	BOX on deck	C1-1-BOX
8:15	GAPS in water	C1
8:25	MUC in water	C1-1-MUC
9:25	MUC on deck	C1-1-MUC
9:38	MUC in water	C1-2-MUC
10:40	MUC on deck	C1-2-MUC
11:01	MUC in water	C1-3-MUC
12:02	MUC on deck	C1-3-MUC
12:06	MUC in water	C1-4-MUC
13:05	MUC on deck	C1-4-MUC
13:12	MUC in water	C1-5-MUC
14:07	MUC on deck	C1-5-MUC
15:06	MUC in water	C1-6-MUC

16:01	MUC on deck	C1-6-MUC
16:13	MUC in water	C1-7-MUC
17:09	MUC on deck	C1-7-MUC
17:19	MUC in water	C1-8-MUC
18:17	MUC on deck	C1-8-MUC
18:30	BOX in water	C1-2-BOX
18:34	GAPS on deck	C1
19:36	BOX on deck	C1-2-BOX
19:37	Transit to C2	
19:49	BOX in water	C2-1-BOX
20:15	BOX on deck	C2-1-BOX
20:16	Transit to operations area B	

Friday 24 June 2011

Meteo: Seastate 1-3, 1-2 ft swell, Force 1-4

4:00	Reconnaissance echosounder survey	
6:57	BOX in water	B3-1-BOX
7:25	BOX on deck	B3-1-BOX
7:30	BOX in water	B3-2-BOX
7:55	BOX on deck	B3-2-BOX
8:08	GAPS in water	B3
8:28	MUC in water	B3-1-MUC
8:55	MUC on deck	B3-1-MUC
8:58	MUC in water	B3-2-MUC
9:20	MUC on deck	B3-2-MUC
9:28	MUC in water	B3-3-MUC
9:55	MUC on deck	B3-3-MUC
10:16	BOX in water	B3-3-BOX
10:40	BOX on deck	B3-3-BOX
11:20	MUC in water	B3-4-MUC
11:50	MUC on deck	B3-4-MUC
12:01	MUC in water	B3-5-MUC
12:27	MUC on deck	B3-5-MUC
12:32	MUC in water	B3-6-MUC
12:58	MUC on deck	B3-6-MUC
13:22	BOX in water	B3-4-BOX
13:50	BOX on deck	B3-4-BOX
13:57	BOX in water	B3-5-BOX
14:04	BOX on deck	B3-5-BOX
14:21	GAPS on deck	B3
14:32	BOX in water	B3-6-BOX
14:56	BOX on deck	B3-6-BOX
15:03	BOX in water	B3-7-BOX
15:32	BOX on deck	B3-7-BOX
15:39	BOX in water	B3-8-BOX
16:06	BOX on deck	B3-8-BOX
16:07	Transit to operations area C - station C2	
17:52	BOX in water	C2-2-BOX
18:22	BOX on deck	C2-2-BOX
18:27	BOX in water	C2-3-BOX
18:56	BOX on deck	C2-3-BOX
18:57	Transit to station C1	
19:19	BOX in water	C1-3-BOX

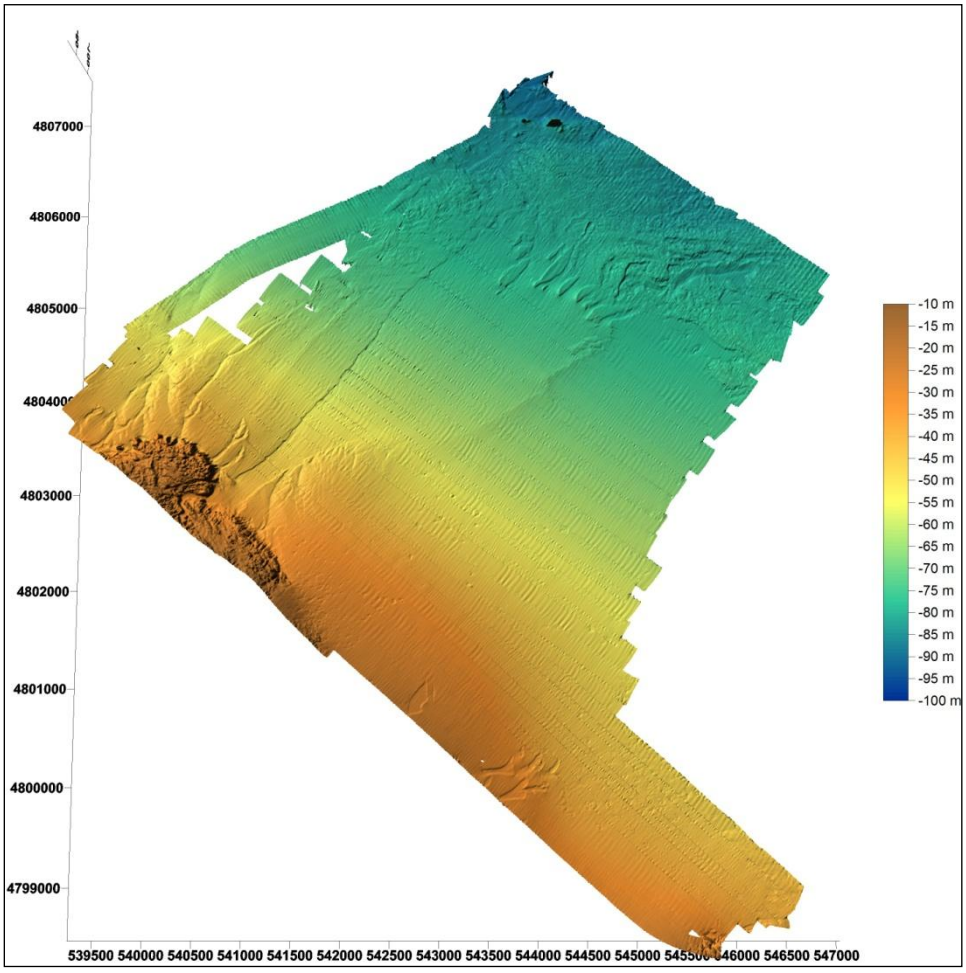
20:05 BOX on deck C1-3-BOX
20:10 End of operations – transit to Zeebrugge

4.4. Operational remarks

We want to thank the captain and crew for their excellent navigation, indispensable efforts and the excellent cooperation for this campaign. The on-board skilfulness contributed greatly to this success of this campaign. We would especially like to acknowledge their effort in repairing and fine-tuning the hydrographic winch. Other comments have been reported to the MUMM via the cruise evaluation form.

5. Preliminary results

5.1. DCP-KDegrendele



Provisional 5x5m terrain model of the Lekeitio survey (coordinates in meter - UTM zone 30).

5.2. MUC sampling

The main aim of the MUC strategy was to collect samples to identify benthic assemblages in terms of metazoan meiofauna and biogeochemistry of the sediments and interstitial water. By a multidisciplinary approach including molecular, morphological, biogeochemical approaches and in-vitro pulse-chase experiments, we aim to gain knowledge about benthic diversity and ecosystem functioning of the benthos.

Overview benthic samples

Date	Station	success	Lat (N, DM)	Long (W, DM)	Depth (m)
20/06/2011	A1-1-CTD	data ok			596
20/06/2011	A1-1-MUC	0/4	45°50.115	3°48.308	619
20/06/2011	A1-2-MUC	0/4	45°50.073	3°48.274	594
20/06/2011	A1-3-MUC	0/4	45°37.499	3°25.893	526
20/06/2011	A2-1-MUC	1/4	45°48.980	3°50.085	946
20/06/2011	A2-2-MUC	2/4	45°49.038	3°50.040	915
20/06/2011	A2-3-MUC	0/4	45°49.302	3°50.030	917
20/06/2011	A2-4-MUC	1/4	45°49.630	3°50.087	1045
21/06/2011	B1-1-CTD	data ok			ca. 1000
21/06/2011	B1-1-BOX	-	46°19.330	4°38.750	1040
21/06/2011	B1-2-BOX	+	46°19.347	4°38.759	1030
21/06/2011	B2-1-BOX	-	46°23.972	4°36.083	610
21/06/2011	B2-2-BOX	-	46°23.922	4°36.299	659
21/06/2011	B1-1-MUC	3/4	46°19.257	4°38.667	999
21/06/2011	B1-2-MUC	0/4	46°19.204	4°38.684	1001
21/06/2011	B1-3-MUC	2/4	46°19.129	4°38.765	1006
21/06/2011	B1-4-MUC	3/4	46°19.118	4°38.738	1010
22/06/2011	C1-1-CTD	data ok	46°35.240	5°00.991	1000
23/06/2011	C1-1-BOX	+	46°34.956	5°00.883	998
23/06/2011	C1-1-MUC	0/4	46°34.896	5°00.945	1036
23/06/2011	C1-2-MUC	2/4	46°35.000	5°00.800	1055
23/06/2011	C1-3-MUC	0/4	46°35.137	5°00.781	1087
23/06/2011	C1-4-MUC	0/4	46°35.394	5°00.780	1037
23/06/2011	C1-5-MUC	1/4	46°35.589	5°00.698	1135
23/06/2011	C1-6-MUC	2/4	46°35.033	5°00.898	1062
23/06/2011	C1-7-MUC	2/4	46°35.141	5°00.950	1113
23/06/2011	C1-8-MUC	0/4	46°35.230	5°00.950	1132
23/06/2011	C1-2-BOX	+	46°35.030	5°00.780	1104
23/06/2011	C2-1-BOX	+	46°35.667	4°56.920	540
24/06/2011	B3-1-BOX	+	46°24.142	4°37.218	450
24/06/2011	B3-2-BOX	+	46°24.155	4°37.212	450
24/06/2011	B3-1-MUC	0/4	46°24.449	4°37.142	442
24/06/2011	B3-2-MUC	0/4	46°24.575	4°37.165	468
24/06/2011	B3-3-MUC	0/4	46°24.629	4°37.226	446
24/06/2011	B3-3-BOX	+	46°24.124	4°37.047	450
24/06/2011	B3-4-MUC	1/4	46°24.117	4°37.165	523
24/06/2011	B3-5-MUC	1/4	46°24.165	4°37.217	521
24/06/2011	B3-6-MUC	0/4	46°24.134	4°37.282	550
24/06/2011	B3-4-BOX	+	46°24.134	4°37.282	500
24/06/2011	B3-5-BOX	+	46°24.134	4°37.282	500
24/06/2011	B3-6-BOX	+	46°24.134	4°37.282	500
24/06/2011	B3-7-BOX	+	46°24.134	4°37.282	500
24/06/2011	B3-8-BOX	+	46°24.134	4°37.282	500
24/06/2011	C2-2-BOX	+	46°35.667	4°56.920	540
24/06/2011	C2-3-BOX	-	46°35.667	4°56.920	540
24/06/2011	C1-3-BOX	+	46°34.956	5°00.883	1100

All biological and molecular samples were sliced in 0-2.5, 2.5-5 and 5-10 cm slices (when available). Faunal samples were preserved in Borax-buffered formalin (4%) lengthened with filtered (32 µm) sea

water. Molecular samples were stored in DESS. Cores for stable isotope analysis were split in half and sliced at similar sediment depths as mentioned above. Cores suitable for environmental characterization were processed with rhizons to extract interstitial water (Fig. 4) and were subsequently stored at -20°C. 1ml of the interstitial water was injected in a ZnAc solution (stored in a capped vial at -20°C) to capture the sulphide compounds whilst the left over water was stored at -20°C for nutrient analysis. Additional cores were used for experimental treatments or backup faunal characterization.

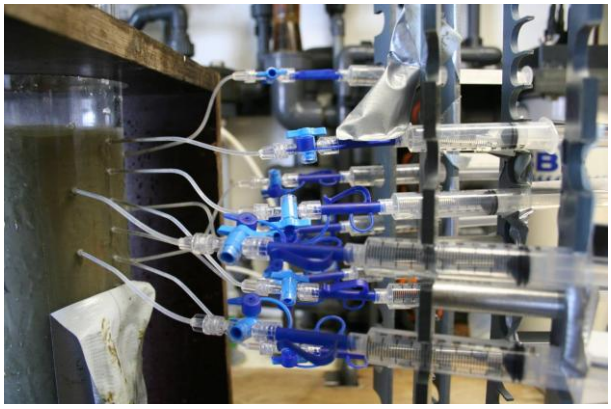


Fig. 4. Rhizon setup.

5.3. Nematode pulse-chase experiments

Bulk sediment was gently sieved over 125µm to separate the meiofauna whilst removing sediment grains. Filtered seawater (32µm) was used to rinse the sediments. Meiofauna individuals were then centrifugated using magnesiumsulphate at 1500rpm for 5 min. This process was repeated 3 times. Elutriated meiofauna was put in chilled Bogorov trays to pick out nematodes under the microscope @ 150 nematodes per experimental unit. Experimental units are glass Petri dishes with high walls and 60 mm inner diameter, covered by a lid. The units contain sterile glass beads (diameter 100-110 µm) and sterile ASW at ca. 35 psu salinity. 150 nematodes were inserted per unit and DOC (Aminoacids) was added at a predetermined concentration. Units were stored at in-situ temperature in fridge and incubated for various fixed times.

6. Sample storage

All samples have been stored at the Marine Biology Department, Ghent University. Samples still need to be processed for metazoan meiofauna (nematode assemblages) and biogeochemistry but may be available for collaborative work. For more information please contact:

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